Phase I Environmental Site Assessment

Nickel Mountain 745-Acre Area
Map and Taxlot 3006W17 TL 200 and TL 100, 3006W18 TL 400 and TL 500, and an Approximately 65-Acre Portion of 3006W16 TL 200
Riddle, Oregon 97469

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ALPINE ENVIRONMENTAL CONSULTANTS, LLC

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I declare that, to the best of my professional knowledge and belief, I meet the definition of Environmental Professional as defined in Part 312.10 of 40 Code of Federal Regulations (CFR). I have the specific qualifications based on education, training, and experience to assess a property of the nature, history, and setting of the subject property. I developed and performed the All Appropriate Inquiries (AAI) in conformance with the American Society for Testing and Materials (ASTM) standard practice for Phase I Environmental Site Assessments (ESAs), described in ASTM document E 1527-13.

The material and data in this ESA were prepared under the supervision and direction of the undersigned.

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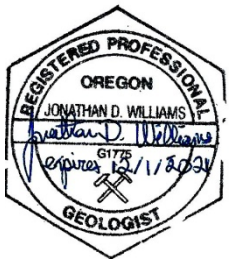

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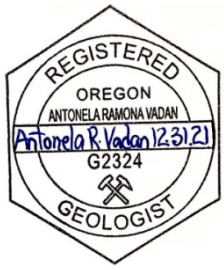

Antonela Vadan, R.G.
Project Geologist

EXECUTIVE SUMMARY

Alpine Environmental Consultants, LLC (AEC), on behalf of LTM, Incorporated dba Knife River Materials (Knife River Materials), conducted a Phase I Environmental Site Assessment (ESA) at the property identified as the approximately 745-Acre Nickel Mountain Property (the Site). The Phase I ESA was conducted consistent with the requirements of the American Society for Testing and Materials (ASTM) Standard Practice for ESAs, described in ASTM document E 1527-13 and ASTM document for Forestland or Rural Property E2247-08, which fulfills the standards and practices for the All Appropriate Inquiries (AAI) as defined in 40 CFR Part 312.

The Site is located near Riddle, Oregon and occupies four tax lots (identified as Map and Taxlot 3006W17 TL 200 and TL 100, and 3006W18 TL 400 and TL 500) and an approximately 65-acre portion of a fifth tax lot (identified as 3006W16 TL 200) for a total of approximately 745 acres. The current owner of the Site is Nickel Mountain, LLC. The first four tax lots are planned to be purchased by Knife River Materials. The fifth tax lot will be under Knife River Materials royalty.

The Site consists of relatively rugged topography which slopes steeply around Nickel Mountain. The assumed groundwater flow direction at the Site is radial outward from Nickel Mountain towards various creeks that are tributaries of Cow Creek and/or the South Umpqua River.

Historically, the Site consisted of undeveloped vegetated land until the 1950s, when a nickel surface mine started to operate at the Site and on the adjacent properties. The nickel mine was operated by Hanna Mining Corporation from 1954 through 1987 and then by Glenbrook Nickel Company into the 1990's when it was closed permanently. Subsequently, portions of the mined area that were not exempt from state requirements were reclaimed. Currently, the Site consists mostly of rugged terrain with little or no topsoil and/or vegetation and of some revegetated areas and remnant features of the historical nickel mine. These remnant features include pits, waste rock stockpiles, roads, two ore dump pockets, an ore clarifier, a shed formerly used as an explosives magazine, and the foundations of the mine office and truck/maintenance shop.

The Site is planned to be used by Knife River Materials to mine and crush at least five of the waste rock piles at the Site. The current owner of the Site applied for and received a conditional use permit from Douglas County for processing rock at the Site. The Site is currently zoned as Farm-Forest. The neighboring properties are zoned as Farm-Forest and Timberland Resource.

Relatively low concentrations of naturally occurring asbestos are likely present in waste rock piles at the Site. While it is unlikely the material in the waste rock piles would qualify as asbestos containing material as defined by the Oregon Department of Environmental Quality, Knife River Materials personnel should visually monitor for the presence of fibrous minerals and manage dust in an appropriate manner during future quarry operations. Should fibrous mineral material be identified, it should be segregated from material processing. AEC considers the likelihood of naturally occurring asbestiform minerals at very low concentrations below 1 percent asbestos by weight at the Site to be a *de minimis* condition.

A preliminary title report and/or an environmental lien search were not provided for the Site, resulting in a data failure. The environmental lien data failure is considered a data gap. AEC recommends that Knife River Materials conduct its own environmental lien search for the Site

AEC conducted a Phase II ESA at the Site on January 16, 2021. The Phase II ESA included the collection of two surface water samples and five composite rock samples representative of the five waste rock stockpiles that Knife River Materials plans to mine. The Phase II ESA was completed to evaluate potential environmental concerns associated with metals that could adversely impact human and ecological receptors at the Site and downstream of the Site, as well as to evaluate potential environmental concerns associated with metals that could adversely impact human and ecological receptors exposed to exported rock products. Based on the analytical results for the samples collected during the Phase II ESA, combined with the results of the Biotic Ligand Model (BLM), the aforementioned potential environmental issues can be eliminated from further concern.

Based on the available historical data review and on the visual observations obtained during the site reconnaissance visit, this Phase I ESA has revealed no evidence of recognized environmental conditions (RECs), historical recognized environmental conditions (HRECs), or controlled recognized environmental conditions (CRECs).

Phase I ESA Summary - Nickel Mountain 745-Acre Area, Riddle, Oregon

Section	Focus Area	No Further Action	REC	CREC	HREC	Other Environmental Considerations	Recommended Action
5.4	Current Property Use	√				√	Monitor for and segregate fibrous minerals that may contain asbestos from exported rock products, manage dust appropriately. Obtain a title report and review for potential environmental liens.
5.1 5.3 5.4	Past Property Use	√					None
5.1 5.4	Adjoining Property Use	√					None
4.0 7.0	User Provided Information	√					None
5.1	Regulatory Database Records	√					None
6.3.13	Vapor Migration	√					None
5.1	Agency Records Reviews	√					None
5.4	Historical Summary	√					None
6.0	Site Reconnaissance	√					None
7.0	Interviews	√					None

In accordance with the ASTM standard, the Phase I ESA's scope of services does not include non-scope considerations as listed in Section 13 of the ASTM 1527-13 standard, unless specifically requested by the client. Some common non-scope considerations include:

- Asbestos containing materials (ACMs);
- Mold;
- Radon;
- Lead-based paint (LBP);
- Lead in drinking water;
- Biological agents;
- Indoor air quality;
- Industrial hygiene;
- Wetlands;
- Cultural and historic resources;
- Ecological resources;
- Endangered species;
- Health and safety; and
- Regulatory compliance.

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LIST OF ACRONYMS AND ABBREVIATIONS

AAI	All Appropriate Inquiries
ACM	Asbestos Containing Material
AEC	Alpine Environmental Consultants, LLC
AML	abandoned mine land
AOC	area of concern
AQWC	Aquatic Water Quality Criteria
AST	aboveground storage tank
ASTM	American Society for Testing and Materials
AUL	Activity and Use Limitations
bgs	below ground surface
BLM	Bureau of Land Management or Biotic Ligand Model
BTEX	benzene, toluene, ethylbenzene, and total xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CREC	Controlled Recognized Environmental Condition
DEQ	Department of Environmental Quality
DOGAMI	Department of Geology and Mineral Industries
EDR	Environmental Data Resources, Inc.
EPA	Environmental Protection Agency
ESA	Environmental Site Assessment
FRDS	Federal Reporting Data System
gpm	gallons per minute
HREC	Historical Recognized Environmental Condition
MAS/MILS	Mineral Availability System/Mineral Industry Locator System
MFA	Maul Foster & Alongi, Inc.
MRDS	Mineral Resource Data System
MRL	Method Reporting Limit
MSHA	Mine Safety and Health Administration
NGVD	National Geodetic Vertical Datum

OSDW	Oregon State Database Well
OSMRE	Office of Surface Mining Reclamation and Enforcement
PADS	PCB Activity Database System
PCB	polychlorinated biphenyls
PGE	Platinum-Group Elements
PWS	Public Water Supply System Information
RBC	Risk-Based Concentration
REC	Recognized Environmental Condition
SM	Standard Method
SMRCA	Surface Mining Control and Reclamation Act of 1977
SPLP	Synthetic Precipitation Leachate Procedure
SVOCS	semivolatile organic compounds
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	underground storage tank
WRD	Water Resources Department

1 INTRODUCTION

1.1 Purpose

LTM, Incorporated dba Knife River Materials (Knife River Materials) retained Alpine Environmental Consultants, LLC (AEC) to conduct a Phase I Environmental Site Assessment (ESA) for the property identified as the approximately 745-Acre Nickel Mountain Property (the Site). The Site is located near Riddle, Oregon and occupies four tax lots (identified as Map and Taxlot 3006W17 TL 200 and TL 100 and 3006W18 TL 400 and TL 500) and an approximately 65-acre portion of a fifth tax lot (identified as 3006W16 TL 200) for a total of approximately 745 acres (see the plat map in Appendix 1). The Site consists of rugged terrain with little or no topsoil and/or vegetation, some vegetated areas, and some remnant features of a historical nickel mine. These remnant features include pits, waste rock stockpiles, roads, two ore dump pockets, an ore clarifier, a shed formerly used as an explosives magazine, and the foundations of the mine office and truck/maintenance shop. The current owner of the Site is Nickel Mountain, LLC. The first four tax lots are planned to be purchased by Knife River Materials. The fifth tax lot will be under Knife River Materials royalty.

The purpose of this Phase I ESA was to inquire into the past uses of the Site, and the practices that may have led to a recognized environmental condition (REC), a controlled recognized environmental condition (CREC), a historical recognized environmental condition (HREC), and/or a *de minimis* condition.

A REC means the presence or likely presence of any hazardous substances or petroleum products in, on, or at the Site due to any release to the environment, under conditions indicative of a release to the environment, or under conditions that pose a material threat of a future release to the environment. The term includes hazardous substances or petroleum products even under conditions in compliance with laws. The term is not intended to include *de minimis* conditions that generally do not present a material risk of harm and that generally would not be the subject of an enforcement action.

A CREC is a REC resulting from a past release of hazardous substances or petroleum products that has been addressed to the satisfaction of the applicable regulatory authority (for example, as evidenced by the issuance of a no further action letter or equivalent, or meeting risk-based criteria established by regulatory authority), with hazardous substances or petroleum products allowed to remain in place subject to the implementation of required controls (for example, property use restrictions, activity and use limitations, institutional controls, or engineering controls).

An HREC is a past release of any hazardous substances or petroleum products that has occurred in connection with the property and has been addressed to the satisfaction of the applicable

regulatory authority or meeting unrestricted use criteria established by a regulatory authority, without subjecting the property to any required controls (for example, property use restrictions, activity and use limitations, institutional controls, or engineering controls).

Any condition considered by the environmental professional to be a CREC and/or a REC is listed in the Conclusions and Recommendations section of this report.

1.2 Scope of Work

The scope of work was to conduct a Phase I ESA consistent with the requirements of the ASTM Standard Practice for ESAs, described in ASTM document E 1527-13 and ASTM document for Forestland or Rural Property E2247-08, which fulfills the standards and practices for the All Appropriate Inquiries (AAI) as defined in 40 CFR Part 312. The Phase I ESA involved the following principal tasks:

- Reviewing pertinent state and federal regulatory agency databases and available public records;
- Reviewing historical aerial photographs;
- Visiting the Site to observe current conditions, both on the Site and on the adjacent properties, and to verify information obtained from the database search, photograph review, and personal interviews;
- Reviewing published information on the Site's environmental setting; and
- Interviewing available Site owners, tenants, or persons familiar with the Site, as necessary.

1.3 Information Sources

Information was obtained from published reports, public agency lists and files, personal interviews, and a review of historical aerial photographs. AEC subcontracted Environmental Data Resources, Inc. (EDR) to review federal and state government agency lists regarding hazardous materials facilities within the prescribed ASTM minimum search distance from the Site. AEC reviewed files and pertinent maps regarding Site history, zoning, planning, and Site development available from the Douglas County online database. AEC personnel toured the Site and surrounding area to observe current land use and Site conditions, and to verify information obtained from other sources.

1.4 Significant Assumptions

Significant assumptions pertaining to the Site include:

1) Five years is an acceptable data gap when researching past uses of the Site;
2) The static groundwater depth in the vicinity of the Site is unknown; the reported static groundwater depth further from the Site is approximately 76 feet below ground surface (bgs) (according to Water Resource Department [WRD] online data); and

3) Based on professional judgment, the groundwater flow direction at the Site is assumed to be in a radial direction away from Nickel Mountain towards several creeks located around Nickel Mountain.

1.5 Data Gaps/Failures

Reasonably ascertainable standard historical sources were not consistently available at 5-year intervals back to 1940 resulting in a data failure. As sufficient historical information was available for the environmental professionals to identify RECs, the historical sources data failure is not considered a data gap.

A preliminary title report and/or an environmental lien search were not provided for the Site, resulting in a data failure. The environmental lien data failure is considered a data gap. AEC recommends that Knife River Materials conduct its own environmental lien search for the Site.

No other data gaps were identified in this Phase I ESA.

1.6 Exceptions and Deletions

There were no exceptions or deletions to the standard practice for Phase I ESAs as described in ASTM Practice E 1527-13.

1.7 User Reliance

This Phase I ESA was prepared for the exclusive use of Knife River Materials. The reason this Phase I ESA is being conducted is to qualify for the innocent landowner defense under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Knife River Materials may rely upon this report when making decisions about the environmental conditions at the Site.

2 SITE DESCRIPTION

2.1 Location and Legal Description

The Site is known as Nickel Mountain. It is located in Township 30 South, Range 6 West, Sections 16, 17, and 18 of the Willamette Meridian. The Site occupies four tax lots and a portion of a fifth tax lot for a total of approximately 745 acres. The information pertaining to these tax lots is as follows:

- Map and Taxlot 3006W17 TL 100, Property ID R37554, 160 acres;
- Map and Taxlot 3006W17 TL 200, Property ID R37570, 480 acres;
- Map and Taxlot 3006W18 TL 400, Property ID R37618, 24.17 acres;
- Map and Taxlot 3006W18 TL 500, Property ID R37610, 16.53 acres;
- Map and Taxlot 6006W16 TL 200, Property ID R37530, 320 acres, of which approximately 65 acres are included in the Site.

The Plat Maps are located in Appendix 1. The location of the Site is shown on Figures 1 through 4 located in Section 11 of this report. A legal description of the Site was not provided for the Site, but would be included in a title report if Knife River Materials obtains one.

2.2 Site and Vicinity General Characteristics

The Site consists of relatively rugged terrain with little or no topsoil and/or vegetation, some revegetated areas, and remnant features from the historical nickel mine that operated at the Site. These remnant features include pits, waste rock stockpiles, roads, two ore dump pockets, an ore clarifier, a shed formerly used as an explosives magazine, and the foundations of the mine office and truck/maintenance shop. The adjacent properties consist of vegetated and forested land with some mine land features remnant from the historical nickel mine. According to the Douglas County Planning Department's Zoning Map, the Site is zoned Farm-Forest. The adjacent properties are zoned Farm-Forest and Timberland Resource. The zoning map is located in Appendix 1.

2.3 Description of Structures

Currently, there are no structures developed at the Site with one exception. A small wood shed previously used as an explosives magazine is located in the northeast corner of the Site, on or near Site's boundary. Some concrete and steel remnants of two ore dump pockets, the former mine office and truck shop, and the clarifier (also known as an ore thickener) were identified at the Site (see Figures 2, 3, and 4).

2.4 Current Uses of the Adjoining Properties

The adjacent properties are currently occupied by vegetated and forested land with few features remnant from the historical surface mining. The neighboring property to the south is used by Nickel Mountain Rock to process rock.

3 USER PROVIDED INFORMATION

3.1 Specialized Knowledge

Mr. Rick Barnes, the owner of the Site, provided information regarding the history of the Site. The data provided by Mr. Barnes are included in the body of this report.

3.2 Title Records

No title report for the Site was provided.

3.3 Environmental Liens or Activity and Land Use Limitations

No research was conducted regarding environmental liens associated with the Site, but this information would be available in a title report if Knife River Materials obtains one. Mr. Barnes was unaware of any environmental liens associated with the Site.

3.4 Valuation Reduction for Environmental Issues

Mr. Barnes was unaware of any valuation reduction due to environmental conditions associated with the Site.

3.5 Reason for Performing the Phase I ESA

The reason this ESA is being conducted is to satisfy one of the requirements to qualify for the innocent landowner defense under CERCLA.

4 RECORDS REVIEW

4.1 Environmental Data Resources database

The environmental records databases are maintained by a variety of public agencies. The government agencies responsible for maintaining each of the state databases are listed within the EDR Radius Map Report (Appendix 3). In addition, an explanation of the information maintained in each of the searched databases and the specific ASTM minimum search distance for each of the government lists, as indicated by the EDR Radius Map Report, are included in Table 1.

Table 1 – EDR Database Summary

Database	Definition	ASTM Search Distance	Subject Property (Site) Identified	Facilities Identified Within Search Radius
STANDARD ENVIRONMENTAL RECORDS - Federal Records				
NPL	National Priority List (Superfund) – The NPL is a subset of CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund Program. NPL sites may encompass relatively large areas. As such, EDR provides polygon coverage for over 1,000 NPL site boundaries produced by EPA's Environmental Photographic Interpretation Center (EPIC) and regional EPA offices.	1 mile	No	0
Proposed NPL	Proposed National Priority List Sites - A site that has been proposed for listing on the NPL through the issuance of a proposed rule in the Federal Register. EPA then accepts public comments on the site, responds to the comments, and places on the NPL those sites that continue to meet the requirements for listing.	1 mile	No	0
NPL LIENS	Federal Superfund Liens - Under the authority granted the USEPA by CERCLA of 1980, the USEPA has the authority to file liens against real property in order to recover remedial action expenditures or when the property owner received notification of potential liability. USEPA compiles a listing of filed notices of Superfund Liens.	Site	No	0
Delisted NPL	National Priority List Deletions - The National Oil and Hazardous Substances Pollution Contingency Plan establishes the criteria that the EPA uses to delete sites from the NPL. In accordance with 40 CFR 300.425.(e), sites may be deleted from the NPL where no further response is appropriate.	1 mile	No	0
FEDERAL FACILITY	Federal facility Site Information listing - A listing of NPL and Base Realignment and Closure (BRAC) sites found in the CERCLIS Database where EPA Federal Facilities Restoration and Reuse Office is involved in cleanup activities.	½ mile	No	0
SEMS	Superfund Enterprise Management System - SEMS tracks hazardous waste sites, potentially hazardous waste sites, and remedial activities performed in support of EPA's Superfund Program across the United States. The list was formerly known as CERCLIS, renamed to SEMS by the EPA in 2015. The list contains data on potentially hazardous waste sites that have been reported to the USEPA by states, municipalities, private companies and private persons, pursuant to Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).This dataset also contains sites which are either proposed to or on the NPL and the sites which are in the screening and assessment phase for possible inclusion on the NPL.	½ mile	No	0
SEMS-ARCHIVE	Superfund Enterprise Management System Archive - SEMS tracks sites that have no further interest under the Federal Superfund Program based on available information. The list was formerly known as the CERCLIS-NFRAP, renamed to SEMS ARCHIVE by the EPA in 2015. EPA may perform a minimal level of assessment work at a site while it is archived if site conditions change and/or new information becomes available. Archived sites have been removed and archived from the inventory of SEMS sites. Archived status indicates that, to the best of EPA's knowledge, assessment at a site has been completed and that EPA has determined no further steps will be taken to list the site on the NPL, unless information indicates this decision was not appropriate or other considerations require a recommendation for listing at a later time. The decision does not necessarily mean that there is no hazard associated with a given site; it only means that. Based upon available information, the location is not judged to be potential NPL site.	½ mile	No	0

Database	Definition	ASTM Search Distance	Subject Property (Site) Identified	Facilities Identified Within Search Radius
CORRACTS	Resource Conservation and Recovery Act (RCRA) Corrective Action Report - identifies hazardous waste handlers with RCRA corrective action activity.	1 mile	No	0
RCRA TSDF	RCRA-Treatment, Storage and Disposal – The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the RCRA. Transporters are individuals or entities that move hazardous waste from the generator offsite to a facility that can recycle, treat, store, or dispose of the waste. TSDFs treat, store, or dispose of the waste.	½ mile	No	0
RCRA-LQG	RCRA Large Quantity Generator – The database includes selective information on sites, which generate, transport, store, treat, and/or dispose of hazardous waste as defined by the RCRA. LQGs generate over 1,000 kilograms (kg) of hazardous waste, or over 1 kg of acutely hazardous waste per month.	¼ mile	No	0
RCRA-VSQG	RCRA Very Small Quantity Generator – The database includes selective information on sites, which generate, transport, store, treat, and/or dispose of hazardous waste as defined by the RCRA. SQGs generate between 100 kg and 1,000 kg of hazardous waste per month.	¼ mile	No	0
RCRA-CESQG	RCRA Conditionally Exempt Small Quantity Generator - The database includes selective information on sites, which generate, transport, store, treat, and/or dispose of hazardous waste as defined by the RCRA. CESQGs generate less than 100 kg of hazardous waste, or less than 1 kg of acutely hazardous waste per month.	¼ mile	No	0
US ENG CONTROLS	Engineering Controls Sites List - A listing of sites with engineering controls in place. Engineering controls include various forms of caps, building foundations, liners, and treatment methods to create pathway elimination for regulated substances to enter environmental media or effect human health.	½ mile	No	0
US INST CONTROL	Sites with Institutional Controls - A listing of sites with institutional controls in place. Institutional controls include administrative measures, such as groundwater use restrictions, construction restrictions, property use restrictions, and post remediation care requirements intended to prevent exposure to contaminants remaining on site. Deed restrictions are generally required as part of the institutional controls.	½ mile	No	0
LUCIS	Land Use Control Information System - Contains records of land use control information pertaining to the former Navy Base Realignment and Closure properties.	½ mile	No	0
ERNS	Emergency Response Notification System – Records and stores information on reported releases of oil and hazardous substances.	Site	No	0
STANDARD ENVIRONMENTAL RECORDS - State Records				
CRL	Confirmed Release List and Inventory - All facilities with a confirmed release.	1 mile	No	0
ECSI	Environmental Cleanup Site Information System - Sites that are or may be contaminated and may require cleanup.	1 mile	**Yes**	**1**
SWF/LF	Solid Waste Facilities List - Records typically contain an inventory of solid waste disposal facilities or landfills in a particular state. Depending on the state, these may be active or inactive facilities or open dumps that failed to meet RCRA Subtitle D Section 4004 criteria for solid waste landfills or disposal sites.	½ mile	No	0
LUST	Leaking Underground Storage Tank Incident Reports - LUST records contain an inventory of reported leaking underground storage tank incidents. Not all states maintain these records, and the information stored varies by state.	½ mile	No	0
INDIAN LUST	Leaking Underground Storage Tanks on Indian Land - LUST records contain an inventory of reported leaking underground storage tank incidents. Not all states maintain these records, and the information stored varies by state. Indian LUST R10 lists LUSTs on Indian land in Alaska, Idaho, Oregon, and Washington.	½ mile	No	0
UST	Underground Storage Tank – The database contains registered USTs. UST's are regulated under Subtitle I of the RCRA and must be registered with the state department responsible for administering the UST program. Available information varies by state program.	¼ mile	No	0
AST	Aboveground Storage Tanks – The database lists ASTs locations reported to the Office of State Fire Marshal.	¼ mile	No	0
INDIAN UST	Underground Storage Tanks on Indian Land – The Indian UST R10 database provides information about underground storage tanks on Indian land in EPA Region 10 (Alaska, Idaho, Oregon, Washington, and Tribal Nations).	¼ mile	No	0
FEMA UST	Underground Storage Tank Listing - A listing of all FEMA owned underground storage tanks.	¼ mile	No	0
ENG CONTROLS	Engineering Controls Recorded at ESCI Sites - Engineering controls are physical measures selected or approved by the Director for the purpose of preventing or minimizing exposure to hazardous substances. Engineering controls may include, but are not limited to, fencing, capping, horizontal, or vertical barriers, hydraulic controls, and alternative water supplies.	½ mile	No	0
INST CONTROL	Institutional Controls Recorded at ESCI Sites - An institutional control is a legal or administrative tool or action taken to reduce the potential for exposure to hazardous substances. Institutional	½ mile	No	0

Database	Definition	ASTM Search Distance	Subject Property (Site) Identified	Facilities Identified Within Search Radius
	controls may include, but are not limited to, use restrictions, environmental monitoring requirements, and site access and security measures.			
VCP	Voluntary Cleanup Program Sites - Responsible parties have entered into an agreement with DEQ to voluntarily address contamination associated with their property.	½ mile	No	0
INDIAN VCP	Voluntary Cleanup Priority Listing - Responsible parties have entered into an agreement with DEQ to voluntarily address contamination associated with their property.	½ mile	No	0
BROWNFIELDS	Brownfields Projects - Brownfields investigations and/or cleanups that have been conducted in Oregon.	½ mile	No	0
ADDITIONAL ENVIRONMENTAL RECORDS State and Local Records				
US Brownfields	A Listing of Brownfields Sites - Brownfields are real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. Cleaning up and reinvesting in these properties takes development pressures off of undeveloped, open land and both improves and protects the environment. Assessment, Cleanup and Redevelopment Exchange System (ACRES) stores information reported by EPA Brownfields grant recipients on Brownfields properties assessed or cleaned up with grant funding as well as information on Targeted Brownfields Assessments performed by EPA Regions. A listing of ACRES Brownfield sites is obtained from Cleanups in My Community. Cleanups in My Community provide information on Brownfields properties for which information is reported back to EPA, as well as areas served by Brownfields grant programs.	½ mile	No	0
SWRCY	Recycling Facility Location Listing - A listing of recycling facility locations.	½ mile	No	0
HIST LF	Old Closed SW Disposal Sites - A list of solid waste disposal sites that have been closed for a long while.	½ mile	No	0
INDIAN ODI	Report on the Status of Open Dumps on Indian Lands - Location of open dumps on Indian land.	½ mile	No	0
ODI	Open Dump Inventory - An open dump is defined as a disposal facility that does not comply with one or more of the Part 257 or Part 258 Subtitle D Criteria.	½ mile	No	0
DEBRIS REGION 9	Torres Martinez Reservation Illegal Dump Site Locations - A listing of illegal dump sites location on the Torres Martinez Indian Reservation located in eastern Riverside County and northern Imperial County, California.	½ mile	No	0
IHS OPEN DUMPS	Open Dumps on Indian Land - A listing of all open dumps located on Indian Land in the U.S.	½ mile	No	0
AOCONCERN	Columbia Slough - Columbia Slough waterway boundaries.	1 mile	No	0
US CDL	Clandestine Drug Labs - A listing of clandestine drug lab locations. The U.S. Department of Justice ("the Department") provides this web site as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. In most cases, the source of the entries is not the Department, and the Department has not verified the entry and does not guarantee its accuracy. Members of the public must verify the accuracy of all entries by, for example, contacting local law enforcement and local health departments.	Site	No	0
CDL	Uninhabitable Drug Lab Properties - The properties listed on these county pages have been declared by a law enforcement agency to be unfit for use due to meth lab and/or storage activities. The properties are considered uninhabitable until cleaned up by a state certified decontamination contractor and a certificate of fitness is issued by the Oregon Health Division.	Site	No	0
US HIST CDL	National Clandestine Laboratory Register - A listing of clandestine drug lab locations. The U.S. Department of Justice ("the Department") provides this web site as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. In most cases, the source of the entries is not the Department, and the Department has not verified the entry and does not guarantee its accuracy. Members of the public must verify the accuracy of all entries by, for example, contacting local law enforcement and local health departments.	Site	No	0
LIENS 2	CERCLA Lien Information - A Federal CERCLA ('Superfund') lien can exist by operation of law at any site or property at which EPA has spent Superfund monies. These monies are spent to investigate and address releases and threatened releases of contamination. CERCLIS provides information as to the identity of these sites and properties.	Site	No	0
HMIRS	Hazardous Materials Information Reporting System - Contains hazardous material spill incidents reported to DOT.	Site	No	0
SPILLS	Spill Database - Oil and hazardous material spills reported to the Environmental Response Program.	Site	No	0
OR HAZMAT	Hazmat/Incidents - Hazardous material incidents reported to the State Fire Marshal by emergency responders. The hazardous material may or may not have been released.	Site	No	0
SPILLS 90	Spills 90 – The database includes those spill and release records available exclusively from First Search databases. Typically, they may include chemical, oil and/or hazardous substance spills	Site	No	0

Database	Definition	ASTM Search Distance	Subject Property (Site) Identified	Facilities Identified Within Search Radius
	recorded after 1990. Duplicate records that are already included in EDR incident and release records are not included in Spills 90.			
RCRA NonGen/NLR	RCRA - Non Generators - The database includes selective information on sites which generate, transport, store, treat, and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Non-Generators do not presently generate hazardous waste.	¼ mile	No	0
FUDS	Formerly Used Defense Sites - The listing includes locations of FUDS properties where the US Army Corps of Engineers is actively working or will take necessary cleanup actions.	1 mile	No	0
DOD	Department of Defense Sites - Consists of federally owned or administered lands, administered by the Department of Defense, that have any area equal to or greater than 640 acres of the United States, Puerto Rico, and the U.S. Virgin Islands.	1 mile	No	0
SCRD DRYCLEANERS	State Coalition for Remediation of Drycleaners Listing – It was established in 1998, with support from the U.S. EPA Office of Superfund Remediation and Technology Innovation. It is comprised of representatives of states with established drycleaner remediation programs. Currently the member states are Alabama, Connecticut, Florida, Illinois, Kansas, Minnesota, Missouri, North Carolina, Oregon, South Carolina, Tennessee, Texas, and Wisconsin.	½ mile	No	0
US FIN ASSUR	Financial Assurance Information - All owners and operators of facilities that treat, store, or dispose of hazardous waste are required to provide proof that they will have sufficient funds to pay for the cleanup, closure, and post-closure care of their facilities.	Site	No	0
EPA WATCH LIST	EPA Watch List - EPA maintains a "Watch List" to facilitate dialogue between EPA, state and local environmental agencies on enforcement matters relating to facilities with alleged violations identified as either significant or high priority. Being on the Watch List does not mean that the facility has actually violated the law only that an investigation by EPA or a state or local environmental agency has led those organizations to allege that an unproven violation has in fact occurred. Being on the Watch List does not represent a higher level of concern regarding the alleged violations that were detected, but instead indicates cases requiring additional dialogue between EPA, state and local agencies - primarily because of the length of time the alleged violation has gone unaddressed or unresolved.	Site	No	0
2020 COR ACTION	2020 Corrective Action Program List - The EPA has set ambitious goals for the RCRA Corrective Action program by creating the 2020 Corrective Action Universe. This RCRA cleanup baseline includes facilities expected to need corrective action. The 2020 universe contains a wide variety of sites. Some properties are heavily contaminated while others were contaminated but have since been cleaned up. Still others have not been fully investigated yet, and may require little or no remediation. Inclusion in the 2020 Universe does not necessarily imply failure on the part of a facility to meet its RCRA obligations.	¼ mile	No	0
TSCA	Toxic Substances Control Act - identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. It includes data on the production volume of these substances by plant site.	Site	No	0
TRIS	Toxic Chemical Release Inventory System - Identifies facilities which release toxic chemicals to the air, water, and land in reportable quantities under SARA Title III Section 313.	Site	No	0
SSTS	Section 7 Tracking Systems - Section 7 of the FIFRA, as amended (92 Stat. 829) requires all registered pesticide-producing establishments to submit a report to the EPA by March 1st each year. Each establishment must report the types and amounts of pesticides, active ingredients and devices being produced, and those having been produced and sold or distributed in the past year.	Site	No	0
ROD	Records Of Decision - ROD documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid in the cleanup.	1 mile	No	0
RMP	Risk Management Plans - When Congress passed the Clean Air Act Amendments of 1990, it required EPA to publish regulations and guidance for chemical accident prevention at facilities using extremely hazardous substances. The RMP Rule was written to implement Section 112(r) of these amendments. The rule, which was built upon existing industry codes and standards, requires companies of all sizes that use certain flammable and toxic substances to develop a RMP, which includes a(n): Hazard assessment that details the potential effects of an accidental release, an accident history of the last five years, and an evaluation of worst-case and alternative accidental releases; Prevention program that includes safety precautions and maintenance, monitoring, and employee training measures; and Emergency response program that spells out emergency health care, employee training measures and procedures for informing the public and response agencies (e.g. the fire department) should an accident occur.	Site	No	0
RAATS	RCRA Administrative Action Tracking System - Contains records based on enforcement actions issued under RCRA pertaining to major violators and includes administrative and civil actions brought by the EPA. For administration actions after September 30, 1995, data entry in the RAATS database was discontinued. EPA will retain a copy of the database for historical records. It was necessary to terminate RAATS because a decrease in agency resources made it impossible to continue to update the information contained in the database.	Site	No	0

Database	Definition	ASTM Search Distance	Subject Property (Site) Identified	Facilities Identified Within Search Radius
PRP	Potentially Responsible Parties - A listing of verified PRP.	Site	No	0
PADS	PCB Activity Database System - Identifies generators, transporters, commercial stores and/or brokers and disposers of PCB's who are required to notify the EPA of such activities.	Site	No	0
ICIS	Integrated Compliance Information System - supports the information needs of the national enforcement and compliance program as well as the unique needs of the NPDES program.	Site	No	0
FTTS	FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act)/TSCA (Toxic Substances Control Act) - Tracks administrative cases and pesticide enforcement actions and compliance activities related to FIFRA, TSCA, and EPCRA (Emergency Planning and Community Right-to-Know Act). To maintain currency, EDR contacts the Agency on a quarterly basis.	Site	No	0
MLTS	Material Licensing Tracking System – Is maintained by the Nuclear Regulatory Commission and contains a list of approximately 8,100 sites which possess or use radioactive materials and which are subject to NRC licensing requirements. To maintain currency, EDR contacts the Agency on a quarterly basis.	Site	No	0
COAL ASH DOE	Steam-Electric Plant Operation Data - A listing of power plants that store ash in surface ponds.	Site	No	0
COAL ASH EPA	Coal Combustion Residues Surface Impoundments List - A listing of coal combustion residues surface impoundments with high hazard potential ratings.	½ mile	No	0
PCB Transformer	PCB Transformer Registration Database - The database of PCB transformer registrations that includes all PCB registration submittals.	Site	No	0
RADINFO	Radiation Information Database - Contains information about facilities that are regulated by U.S. EPA regulations for radiation and radioactivity.	Site	No	0
HIST FTTS	FIFRA/TSCA Tracking System Administrative Case Listing - A complete administrative case listing for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA and TSCA. Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.	Site	No	0
DOT OPS	Department of Transportation, Office of Pipeline Safety Incident and Accident Data.	Site	No	0
CONSENT	Superfund (CERCLA) Consent Decrees - Major legal settlements that establish responsibility and standards for cleanup at NPL (Superfund) sites. Released periodically by United States District Courts after settlement by parties to litigation matters.	1 mile	No	0
INDIAN RESERV	Indian Reservations - This map layer portrays Indian administered lands of the United States that have any area equal to or greater than 640 acres.	1 mile	No	0
FUSRAP	Formerly Utilized Sites Remedial Action Program - DOE established the FUSRAP in 1974 to remediate sites where radioactive contamination remained from Manhattan Project and early U.S. Atomic Energy Commission (AEC) operations.	1 mile	No	0
UMTRA	Uranium Mill Tailings Sites - Uranium ore was mined by private companies for federal government use in national defense programs. When the mills shut down, large piles of the sand-like material (mill tailings) remain after uranium has been extracted from the ore. Levels of human exposure to radioactive materials from the piles are low; however, in some cases tailings were used as construction materials before the potential health hazards of the tailings were recognized.	½ mile	No	0
LEAD SMELTERS	Lead Smelters Sites – A listing of former lead smelters site locations, provided by EPA.	Site	No	0
US AIRS	Aerometric Information Retrieval System Facility Subsystem - contains compliance data On air pollution point sources regulated by the U.S. EPA and/or state and local air regulatory agencies. This information comes from source reports by various stationary sources of air pollution, such as electric power plants, steel mills, factories, and universities, and provides information about the air pollutants they produce. Action, air program, air program pollutant, and general level plant data. It is used to track emissions and compliance data from industrial plants.	Site	No	0
US MINES	Mines Master Index File - Contains all mine identification numbers issued for mines active or opened since 1971. The data also includes violation information.	¼ mile	**Yes**	**1**
ABANDONED MINES	Abandoned Mines - Contains an inventory of land and water impacted by past mining (primarily coal mining) is maintained by OSMRE to provide information needed to implement the Surface Mining Control and Reclamation Act of 1977 (SMCRA). The inventory contains information on the location, type, and extent of AML impacts, as well as, information on the cost associated with the reclamation of those problems. The inventory is based upon field surveys by State, Tribal, and OSMRE program officials. It is dynamic to the extent that it is modified as new problems are identified and existing problems are reclaimed.	Site	No	0
FINDS	Facility Index System/Facility Registry System - Contains both facility information and 'pointers' to other sources that contain more detail. EDR includes the following FINDS databases in this report: PCS (Permit Compliance System), AIRS (Aerometric Information Retrieval System), DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for	Site	No	0

Database	Definition	ASTM Search Distance	Subject Property (Site) Identified	Facilities Identified Within Search Radius
	all environmental statutes), FURS (Federal Underground Injection Control), C-DOCKET (Criminal Docket System used to track criminal enforcement actions for all environmental statutes), FFIS (Federal Facilities Information System), STATE (State Environmental Laws and Statutes), and PADS.			
DOCKET HWC	Hazardous Waste Compliance Docket Listing - Contains a complete list of the Federal Agency Hazardous Waste Compliance Docket Facilities.	Site	No	0
UXO	Unexploded Ordnance Sites - contains a list of unexploded ordnance site locations.	1 mile	No	0
ECHO	Enforcement and Compliance History Information - ECHO provides integrated compliance and enforcement information for about 800,000 regulated facilities nationwide.	Site	No	0
FUELS PROGRAM	EPA Fuels Program Registered Listing - This listing includes facilities that are registered under the Part 80 CFR EPA Fuels Programs. All companies now are required to submit new and updated registrations.	¼ mile	No	0
AIRS	Oregon Title V Facility Listing - A listing of Title V facility source and emissions information.	Site	No	0
COAL ASH	Coal Ash Disposal Sites Listing - A listing of coal ash disposal sites.	½ mile	No	0
DRYCLEANERS	Drycleaning Facilities - A listing of registered drycleaning facilities in Oregon.	¼ mile	No	0
ENF	Enforcement Action Listing - includes records of enforcement actions	Site	No	0
Financial Assurance	Financial Assurance Information Listing - includes financial assurance information for hazardous waste facilities.	Site	No	0
HSIS	Hazardous Substance Information Survey - Companies in Oregon submitting the Hazardous Substance Information Survey and either reporting or not reporting hazardous substances.	Site	No	0
MANIFEST	Manifest Information - Hazardous waste manifest information.	¼ mile	No	0
NPDES	Wastewater Permits Database - A listing of permitted wastewater facilities.	Site	No	0
UIC	Underground Injection Control Program Database - DEQ's Underground Injection Control Program is authorized by the Environmental Protection Agency (EPA) to regulate all underground injection in Oregon to protect groundwater resources.	Site	No	0
MINES MRDS	Mineral Resource Data System - This database contains mineral resource occurrence data covering the world. This database contains the records previously provided in the MRDS of USGS and the Mineral Availability System/Mineral Industry Locator System (MAS/MILS) originated in the U.S. Bureau of Mines, which is now part of USGS.	Site	**Yes**	**5**
EDR HIGH RISK HISTORICAL RECORDS				
EDR MGP	EDR Proprietary Manufactured Gas Plants – Includes records of coal gas plants (manufactured gas plants) compiled by EDR's researchers. Manufactured gas sites were used in the US from the 1800's to 1950'sto produce a gas that could be distributed and used as fuel. These plants used whale oil, rosin, coal, or a mixture of coal, oil, and water that also produced a significant amount of waste. Many of the byproducts of the gas production, such as coal tar (oily waste containing volatile and non-volatile chemicals), sludges, oils and other compounds are potentially hazardous to human health and the environment. The byproduct from this process was frequently disposed of directly at the plant site and can remain or spread slowly, serving as a continuous source of soil and groundwater contamination.	1 mile	No	0
EDR US Hist Auto Stat	EDR Exclusive Historic Gas Stations - EDR has searched selected national collections of business directories and has collected listings of potential gas station/filling station/service station sites that were available to EDR researchers. EDR's review was limited to those categories of sources that might, in EDR's opinion, include gas station/filling station/service station establishments. The categories reviewed included, but were not limited to gas, gas station, gasoline station, filling station, auto, automobile repair, auto service station, service station, etc. This database falls within a category of information EDR classifies as "High Risk Historical Records," or HRHR. EDR's HRHR effort presents unique and sometimes proprietary data about past sites and operations that typically create environmental concerns, but may not show up in current government records searches.	¼ mile	No	0
EDR US Hist Cleaners	EDR Exclusive Historic Dry Cleaners - EDR has searched selected national collections of business directories and has collected listings of potential dry cleaner sites that were available to EDR researchers. EDR's review was limited to those categories of sources that might, in EDR's opinion, include dry cleaning establishments. The categories reviewed included, but were not limited to dry cleaners, cleaners, laundry, laundromat, cleaning/laundry, wash and dry etc. This database falls within a category of information EDR classifies as "High Risk Historical Records," or HRHR. EDR's HRHR effort presents unique and sometimes proprietary data about past sites and operations that typically create environmental concerns, but may not show up in current government records searches.	¼ mile	No	0
EXCLUSIVE RECOVERED GOVERNMENT ARCHIVES				
RGA HWS	Recovered Government Archive State Hazardous Waste Facilities List - The EDR Recovered	Site	No	0

Database	Definition	ASTM Search Distance	Subject Property (Site) Identified	Facilities Identified Within Search Radius
	Government Archive State Hazardous Waste database provides a list of SHWS incidents derived from historical databases and includes many records that no longer appear in current government lists. Compiled from Records formerly available from the DEQ in Oregon.			
RGA LF	Recovered Government Archive Solid Waste Facilities List - The EDR Recovered Government Archive Landfill database provides a list of landfills derived from historical databases and includes many records that no longer appear in current government lists. Compiled from Records formerly available from the DEQ in Oregon.	Site	No	0
RGA LUST	Recovered Government Archive Leaking Underground Storage Tank - The EDR Recovered Government Archive Leaking Underground Storage Tank database provides a list of LUST incidents derived from historical databases and includes many records that no longer appear in current government lists. Compiled from Records formerly available from the DEQ in Oregon	Site	No	0

4.1.1 **The Site**

According to the EDR Radius Map Report, the Site was identified in the MINES Mines Mineral Resources Data System (MRDS) database and Environmental Cleanup Site Information System (ECSI) database. Information listed in these databases is summarized as follows:

- **The MINES MRDS database**. This database contains mineral resource occurrence data covering the world. This database contains the records previously provided in the Mineral Resource Data System (MRDS) of USGS and the Mineral Availability System/Mineral Industry Locator System (MAS/MILS) originated in the U.S. Bureau of Mines, which is now part of USGS. The Site was listed in the MINES MRDS database under the following names:
  - NICKEL MOUNTAIN GROUP. MRDS Identification Number: M061616. Primary Commodities: Nickel. Secondary Commodities: Not reported. Tertiary Commodities: Chromium, Rhodium, and Platinum-Group Elements (PGE). Previous Names: Upper Occurrence. First Production Year: 1954. Last Production Year: Not reported.
  - NICKEL MOUNTAIN GROUP-UPPER OCCURRENCE. MRDS Identification Number: M061616. Primary Commodities: Nickel. Secondary Commodities: Not reported. Tertiary Commodities: Not reported. Previous Names: Not reported. First Production Year: Not reported. Last Production Year: Not reported.
  - NICKEL MOUNTAIN. MRDS Identification Number: W000690. Primary Commodities: Nickel. Secondary Commodities: Cobalt, Platinum, and Palladium. Tertiary Commodities: Ruthenium, Rhodium, and Iridium. Previous Names: Hanna Nickel Mine. First Production Year: 1882. Last Production Year: Not reported.
  - HANNA NICKEL MINE. MRDS Identification Number: W000690. Primary Commodities: Nickel. Secondary Commodities: Not reported. Tertiary Commodities: Cobalt, Chromium, and Iron. Previous Names: Riddle Nickel Mine, Nickel Mountain Mine, and Riddle Nickel Laterite Deposit. First Production Year: 1954. Last Production Year: Not reported.

- RIDDLE MINE. MRDS Identification Number: ISM0232. Primary Commodities: Nickel, Iron, and Cobalt. Secondary Commodities: Not reported. Tertiary Commodities: Not Reported. Previous Names: Nickel Mountain. First Production Year: 1954. Last Production Year: Not reported.

Note that the EDR Radius Map Report lists a Colorado facility in the MINES MRDS database. This listing is incorrect and is not located in the proximity of the Site.

- **ECSI database**. This database records information about sites in Oregon that are or may be contaminated and may require cleanup. The data come from the Oregon Department of Environmental Quality (DEQ).

  - NICKEL MOUNTAIN MINE, 0S/6W/S17. ECSI State ID Number: 2666. Investigation: Suspect. Decode For Further Action: Low. The mine was added to the ECSI database in 2000 as a suspect site requiring further investigation. The ECSI file mentions, "Potential effect on sensitive surface water receptors. Mine currently undergoing reclamation efforts with BLM [U.S. Bureau of Land Management] and DOGAMI [Oregon Department of Geology and Mineral Industries]."

    AEAC reviewed the available DOGAMI files. A 2002 Report of Onsite Inspection prepared by DOGAMI mentions that, "The entire water system appears stable. Revegetation appears successful. Monitoring will continue through the winter of 2002-2003. Based on positive monitoring results of December/January 2002/2003 file closure will be requested in February 2003. If additional stabilization work is deemed necessary, renewal of the DOGAMI permit will be required in March 2003. This site is eligible for a Vegetation permit." The revegetation occurred mostly on Lower Ore Body area, in the southeastern portion of the Site. Note that most of the Site was mined prior to 1972 on owned land or prior to 1981 on leased land and therefore was exempt from the state reclamation requirements. Most of the Site consists of rocky terrain with no topsoil or vegetation and is expected to remain so for many years.

    The files obtained from DOGAMI online database and reviewed for this report are included in Appendix 5.

A smelter was located approximately 1.2 miles to the southeast of the Site. During mining operations, an aerial tramway was used to transport ore from the mine down to the smelter. AEC reviewed the documents available on DEQ online database pertaining to the smelter, identified as Glenbrook Nickel Smelter and ECSI State ID Number 2898. The available documents mention that" Hanna mining operations took place at the top of Nickel Mountain, at elevations of approximately 3,000 feet National Geodetic Vertical Datum (NGVD) on land leased from private landowners. Glenbrook's limited mining operation took place below the top of the mountain at a location known as the "Lower Ore Body" at an elevation of approximately 2,000 feet NGVD."

The available documents identified two potential areas of concern (AOCs) at the Site, specifically (1) the "underground storage tanks (USTs) at the Mine Site" and (2) the "former fueling are at the Lower Ore Body." Note that a portion of the Lower Ore Body was located in the southeastern corner of the Site. The location of the former fueling area is not known if it

was at the Site or off-site. No petroleum-like staining of soil was observed during two Site visits in December 2020 and January 2021.

According to the 2000 Report of Confirmation Sampling and the 2002 Site Summary Report, a 3,000-gallon gasoline UST and a 10,000-gallon used oil UST were located at the mine site, on top of the mountain. The area where the USTs were assumed to be present was investigated in April 2000. This area was identified as "AOC-R-15 - USTs at Mine Site." The 2000 Report of Confirmation Sampling mentions that, "Four trackhoe test pits were excavated to determine if the USTs were present, and to collect soil samples. One soil sample was collected from each test pit for laboratory analysis. No tanks were found. The samples were analyzed for TPH [total petroleum hydrocarbons] (gasoline and diesel) by DEQ Methods TPH-G and TPH-D, BTEX [benzene, toluene, ethylbenzene, and total xylenes] by Method 8021B, PAHs [polyciclic aromatic hydrocarbons] by EPA Method 8310, and PCBs [polychlorinated biphenyls] by Method 8082." The four collected soil samples, identified as TP-7 through TP-10, were collected from a depth of 12 to 15 feet bgs. The analytical data reported TPHs, BTEX, and PCBs as "non detect." There were no PAHs results included in the lab report. The Report of Confirmation Sampling prepared by August Mack Environmental Inc. for Glenbrook Nickel Company in August 2000 and the Site Summary Report prepared by DEQ in December 2002 are included in Appendix 6.

Based on AEC's experience working on mine and quarry properties, it is unlikely USTs were present at the Site because ample space was available to more cost-effectively store petroleum products in ASTs. Accordingly, it is likely that ASTs were historically used at the Site. No ASTs were identified during two Site visits.

According to the 2002 Report of Remedial Actions, "The former fueling area (one diesel aboveground storage tank [AST]) at the Lower Ore Body (located approximately one mile north of the smelter facility at an approximate elevation of 2000 feet NGVD) was identified as an additional potential AOC based on visual observations made during remedial activities at the previously identified AOCs. Minor leaks or spills through the years of operation likely resulted in the impacted soil around the former fueling area. Two rounds of excavation and sampling were conducted and a total of eight samples were collected." The confirmation samples were analyzed for TPH identification. The analytical results reported the presence of TPHs in oil-range and diesel-range in four samples. These samples were further analyzed for TPHs in diesel-range and heavy oil-range and the reported concentrations ranged between 43.5 at 616 mg/kg. (The Report of Remedial Actions, Eleven Areas of Concern prepared by Linebach Funkhouser, Inc. for Glenbrook Nickel Company in June 2002 is included in Appendix 6.)

AEC also reviewed a Site Inspection report prepared by United States Environmental Protection Agency (USEPA) in 2018. According to this report, a total of 87 samples were collected in 2017, which included surface water, sediment, and groundwater media. The sampling locations were in the vicinity of the smelter and included the retention/settling ponds, Cow Creek, and several of its tributaries, which stream from Nickel Mountain's southern slope and flow towards south, into Cow Creek. The samples were analyzed for one or more of the following analyses: PCBs, semivolatile organic compounds (SVOCs), metals, and TPHs in diesel-range. The results indicated the presence of various metals at significant concentrations in the retention ponds in

Cow Creek, and in several of nearby tributaries to Cow Creek. The Site Inspection report prepared by USEPA in April 2018 is included in Appendix 6.

4.1.2 Neighboring Properties

The EDR Radius Map Report identified no neighboring properties within the specified search distances from the Site in the searched databases

4.1.3 Orphan Sites

The state and federal record review in the EDR Radius Map Report revealed two un-mappable facilities due to poor or inadequate address information. According to the facility name, address, and/or records provided in the EDR Radius Map Report, these un-mappable properties are not located at the Site or in the immediate vicinity of the Site, but approximately 1.2 miles to the southeast at the location of the former smelter.

4.2 Physical Setting

This section describes the physical Site setting and characteristics including topography, surface drainage, and the general geologic and hydrogeologic conditions at or adjacent to the Site.

4.2.1 Topography and Drainage

The Site consists of relatively rugged topography which slopes steeply around Nickel Mountain. The neighboring properties also have a rugged topography. The Site's elevation ranges from approximately 2,400 to 3,470 feet above mean sea level. Topography in the EDR report has been determined from the United States Geological Society (USGS) 7.5' Digital Elevation Model. Several creeks are located around Nickel Mountain. The South Umpqua River is located approximately 4 miles to the east of the Site.

4.2.2 Geologic and Hydrogeologic Conditions

As listed in the 2014 Geocheck Addendum, according to the U.S. Department of the Interior USGS, the geologic units found in the vicinity of the Site are characterized as Paleozoic Plutonic and Intrusive Rocks[1]. According to the U.S Department of Agriculture's Soil Survey Geographic Database (USDA SSURGO), soils in the vicinity of the Site are mapped as Pearsoll extremely stony clay loam (see the EDR Radius Map Report for details in Appendix 3).

The Pearsoll extremely stony clay loam soils have very slow infiltration rates, and are clayey, have a high water table, or are shallow to an impervious layer. They are well drained and are not hydric.

Based on a review of the Oregon Water Resources Department (WRD) online database, one well log was identified in Section 17 of Township 30 South, Range 6 West. According to this log,

[1] Geologic Age and Rock Stratigraphic Unit Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of Conterminous U.S. at 1:2,500,000 scale-a digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS – 11 (1994).

static groundwater was reported at 76 feet bgs and well yield was approximately 50 gallons per minute (gpm).

Based on professional judgment and experience, groundwater tables in western Oregon are typically a subdued replica of land surface topography. The Site's topography slopes steeply around Nickel Mountain in all directions. The assumed groundwater flow direction at the Site is radially away from Nickel Mountain towards various creeks around the mountain, which are tributaries of Cow Creek and the South Umpqua River.

4.2.3 Water Well Search

According to ASTM E 1527-13, Section 7.2.2, "one or more additional state or local sources of environmental records may be checked, at the discretion of the environmental professional, to enhance and supplement federal and state sources." The following databases were searched in order to acquire information regarding water wells within one mile of the Site: 1) the Federal USGS Well System Information; 2) the Federal Reporting Data System Public Water Supply System Information (FRDS PWS); and 3) the Oregon State Database Well (OSDW) System Information.

The EDR Radius Map Report identified no wells within one mile of the Site in the Federal USGS Well System Information, FRDS PWS, and OSDW System Information within a 1-mile radius of the Site.

AEC also reviewed the Oregon WRD on-line database. The Site is located in Sections 16, 17, and 18 of Township 30 South, Range 6 West. AEC reviewed the well logs in these sections as well as in the adjacent northern Sections 7, 8, and 9, and the southern adjacent Sections 19, 20, and 21. One water supply well was identified in Section 17. Section 17 includes TL 100 and TL 200, both part of the Site. Based on the information provided by WRD, this well is located at the Site. The log indicates the well is a domestic well constructed in 1967. However, AEC believes the location information included on the well log may be incorrect and that no wells are present at the Site. The well search information, including the single well logs, is included in Appendix 4.

4.3 Historical Use Information on the Site and Adjoining Properties

AEC investigated the historical use of the Site and surrounding area utilizing information available from the following specific sources:

- Certified Sanborn Map Report;
- Historical Aerial Photographs;
- Historical City Directories Search; and
- Douglas County Property Ownership Records.

In accordance with Section 8.3 of ASTM document E 1527-13, AEC attempted to identify "all obvious uses of the property from the present, back to the property's first use, or back to 1940,

whichever is earlier." The reasonably obtainable data related to this Site were available back to 1954 (see below).

4.3.1 Sanborn Fire Insurance Maps

EDR was contracted to perform a search for Sanborn Fire Insurance Map coverage in the vicinity of the Site. Coverage was not available for the Site. The EDR Sanborn Map Report is included in Appendix 7.

4.3.2 Historical Aerial Photographs

AEC personnel reviewed historical aerial photographs for the years 1954, 1960, ,1971, 1982, 1994, 2004, 2014, and 2015 in order to help determine historical land use practices for the Site and the surrounding area. Historical aerial photographs between 1954 and 2014 were provided by the University of Oregon and the historical photograph from 2015 was obtained from Google Earth online database. The approximate Site boundaries, as illustrated by the plat maps, are marked by red line on the historical aerial photographs. Copies of the historical aerial photographs reviewed for this report are included in Appendix 8.

Table 2 summarizes the results of the historical aerial photograph review. The aerial photographs may not be clear; therefore, the review is limited to the quality and the visual details they provide.

Table 2 – Aerial Photographs Summary

Year	The Site	Surrounding properties
1954	The Site appears as undeveloped vacant vegetated land and partially forested with several structures and features in the southwestern portion of the Site consistent with the historical mining operations. A road runs through the southern portion of the Site.	The neighboring properties appear as undeveloped vegetated and partially forested land.
1960	Surface mining appears at the Site mostly on the western portion.	The neighboring properties continue to be undeveloped vegetated and partially forested land.
1971	Surface mining continue at the Site, on the western and northeastern portions.	Some of the neighboring properties were cleared of forest and surface mining appear to occur in few areas to the northeast and southwest of the Site.
1982	Surface mining continue on most of the Site.	Surface mining appear on the adjacent properties around the Site.
1994	Surface mining occurred on most of the Site. A clarifier, also known as an ore thickener, appears on the eastern portion of the Site. Several structures and features related to the mine appears removed from the Site.	Surface mining appear on the adjacent properties around the Site. A sediment retention pond is located to the west of the Site.

2004	All structures and features related to the mine appears removed from the Site. The Site appears as rugged land partially vegetated. Several sediment retention ponds are located in the southeastern portion of the Site.	The neighboring properties appear partially disturbed by the surface mining and partially vegetated. Several sediment retention ponds are located to the west and southeast of the Site.
2014	The Site appears as rugged land partially vegetated. Several sediment retention ponds are located in the southeastern portion of the Site.	The neighboring properties appear partially disturbed by the surface mining and partially vegetated. Several sediment retention ponds are located to the west, southwest, and southeast of the Site.
2015	The Site appears as rugged land partially vegetated. Several sediment retention ponds are located in the southeastern portion of the Site.	The neighboring properties appear partially disturbed by the surface mining and partially vegetated. Several sediment retention ponds are located to the west, southwest, and southeast of the Site.

4.3.3 Historical City Directories Review

The historical directory information is useful in helping to assess past land use practices related to the subject Site and the surrounding properties. AEC personnel reviewed historical directory information generated by EDR in order to assess past land use practices related to the Site and surrounding properties. EDR provided information for Boyer Road and Riddle Bypass Road from the EDR Digital Archive for the years 1992, 1995, 2000, 2005, 2010, 2014, and 2017.

The Site was not listed in the City Directory. The neighboring properties (farther to the south and east of the Site) are listed as residential occupants and some industrial/commercial occupants. The industrial/commercial businesses include the following:

- Tower Timber Services located at 550 Boyer Road listed in the 2017, 2014, and 2010 directories and located at 1121 Riddle Bypass Road listed in the 2010 directory;
- Herbert Lumber Co. located at 656 Riddle Bypass Road listed in the 2017, 2014, 2005, 2000, and 1995 directories;
- S A Schuyler & Son Inc. Shop located at 2168 Riddle Bypass Road listed in the 2017, 2014, and 2010 directories;
- E&L Manufacturing located at 4177 Riddle Bypass Road listed in the 2017, 2014, 2010, 2005, and 2000 directories;
- S W Transport located at 431 Boyer Road listed in the 2010 directory;
- FX Lumber located at 839 Riddle Bypass Road listed in the 2005 directory;
- Roseburg Forest Products Co. located at 3064 and 4500 Riddle Bypass Road listed in the 2005 directory; and
- Glenbrook Nickel Company located at 5093 Riddle Bypass Road listed in the 2000 directory.

Copies of EDR's City Directory abstracts reviewed for this report are provided in Appendix 9.

4.3.4 Property Ownership Records

The Site occupies four tax lots (Map and Taxlot 3006W17 TL 200 and TL 100, 3006W18 TL 400 and TL 500) and a portion of a fifth tax lot (approximately 65-Acre Portion of 3006W16 TL 200). Therefore, AEC reviewed the property ownership records for these three tax lots obtained from the Douglas County's Assessor's and Clerks Offices. The available records are included in Appendix 2.

The information provided by the available records is summarized as follows:

- Map and Taxlot 3006W17 TL 100: in January 1999, this property is listed as owned by Bruce Allen Moore and Becky Renee Moore (document 2000-010662); in January 2000, this property is listed as owned by Shadow Ranch (document 2000-010664); in September 2000, this property is listed as owned by Preston A. Willis and Gweneth E. Preston (document 2000-019994);
- Map and Taxlot 3006W17 TL 200: in September 2000, this property is listed as being conveyed by Oregon Nickel Mining Properties, Inc. unto Nickel Mountain LLC (document 2000-020274);
- Map and Taxlot 3006W18 TL 400: in January 1998, this property is listed as being conveyed by Jesse D, Beahm and Hazel J. Beahm unto Billy Ray Sanders and Helen Marie Sanders (document 1998-00142); in May 2001, this property is listed as being conveyed by Stephen Kraychy, Mary M. Kraychy, and Bank of America unto Nickel Mountain, LLC (document 2001-10664);
- Map and Taxlot 3006W18 TL 500: this property was transferred by Wells Fargo Bank, Trustee under the will of Edson F. Adams, unto Peter A. Balding and William T. Balding (document 1999-00104); in October 2000, this property is listed as being conveyed by William T. Balding unto Oregon Nickel Mining Properties, Inc. (documents 2000-22473, 2000-22135, and 2000-21874); in September 2000, this property is listed as being conveyed by Oregon Nickel Mining Properties, Inc. unto Nickel Mountain LLC (document 2000-020274); and
- An approximately 65-acre portion of Map and Taxlot 6006W16 TL 200: this property was transferred by Wells Fargo Bank, Trustee under the will of Edson F. Adams, unto Peter A. Balding and William T. Balding (document 1999-00104).

4.3.5 Past and Current Uses of the Property

Information used in this section was derived from historical aerial photographs, Josephine County property ownership records, information gathered during the Site visit, and the environmental interview.

Historically, the Site consisted of undeveloped vegetated land and partially forested. The deposits on Nickel Mountain were discovered in the 1800's and were prospected since then, with the first major mine development in the early 1950s. Reportedly, commercial surface

mining was conducted at the Site from 1954 through the 1990s. Hanna Mining Company operated the mine from 1954 through 1987 and Glenbrook Nickel Company operated from 1987 through 1990s, when the mine was closed permanently. The ore was crushed at the Site and then transported by tramway to the smelter located approximately 1.2 miles to the southeast to be processed. The smelter was located approximately one mile to the southeast of the Site near Riddle. Once the Nickel Mountain mine was closed, Glenbrook Nickel Company continued to operate the smelter until 1998 by importing ore from New Caledonia.

Subsequent to the mine closing, portions of the Site were reclaimed. The Site currently consists of rugged terrain with little or no topsoil and/or vegetation and few revegetated areas. The current owner of the Site is Nickel Mountain, LLC. AEC understands most of the Site (3006W17 TL 100, 3006W17 TL 200, 3006W18 TL 400, and 3006W18 TL 500) will be purchased by Knife River Materials and the eastern portion of the Site (specifically an approximately 65-acre portion of 6006W16 TL 200) will be under Knife River Materials royalty.

4.3.6 Past and Current Uses of the Surrounding Properties

Information used in this section was derived from historical aerial photographs, historical topographic maps, the EDR Radius Map Report, and City Directory databases. The properties adjacent to the Site consisted primarily of undeveloped vegetated and forested land, a few unpaved roads, and surface mining.

5 SITE RECONNAISSANCE

On December 17, 2020 and January 16, 2021, Mr. Jonathan Williams of AEC conducted a Site reconnaissance to observe the current condition and use of the Site and adjoining properties. The AEC environmental professional was accompanied during the first Site visit by Mr. Tom Gruszczenski, Technical Services Manager, of Knife River Materials, and Mr. Rick Barnes, the current owner of the Site. Mr. Williams was accompanied by Mr. Barnes during the second Site visit. The objective of the reconnaissance was to document the current condition of the Site with photographs and to observe conditions at the Site that may indicate the likelihood of RECs, CRECs, HRECs, and/or de minimis conditions. Copies of pertinent photographs are included in Appendix 10.

5.1 Methodology and Limiting Conditions

The Site reconnaissance included physically and visually observing the Site and structure(s) located on the Site to the extent not obstructed by bodies of water, adjacent buildings, vegetation, or other obstacles. This included walking the periphery of the Site as well as the periphery of all structures on the Site and the Site was viewed from adjacent publicly and accessible thoroughfares.

5.2 Exterior and Interior Observations

The Site is currently unoccupied. It consists of relatively rugged terrain with no or little topsoil and/or vegetation in previously mined areas. Currently, there are no structures developed at the Site with the exception of a small wood shed previously used as an explosives magazine located in the northeast corner of the Site, on or near Site's boundary. Concrete and steel remnants of two ore dump pockets and a clarifier were observed (see Figures 2, 3, and 4) were identified. Non-hazardous mining equipment debris were observed in a waste rock pile in the central portion of the Site and it is likely additional mining equipment debris is present in the waste rock stockpiles. Some foundations and floors of the previous truck shop, including steel rails on floor for tracked equipment, were identified off-site, in the vicinity of the Site's southwestern corner.

The properties adjacent to the Site currently consist of undeveloped vegetated and forested land and a few unpaved roads. Nickel Mountain Rock currently uses the adjacent southern property to process rock.

5.3 General Site Observations

5.3.1 Domestic Well

Reportedly, no water supply wells are known to exist at the Site. As discussed in Section 4.2.3, a log for a domestic well reportedly located at the Site was found. However, AEC believes the location on this well log is incorrect.

5.3.2 Septic Tank and Drain Field

There are no known septic tanks or leach fields currently present at the Site.

5.3.3 Underground Storage Tanks

No active USTs were observed at the Site.

5.3.4 Aboveground Storage Tanks

No ASTs were observed at the Site.

5.3.5 Drums and other containers

No drums or containers were identified at the Site during the Site reconnaissance.

5.3.6 Floor Drains, Sumps, and Pits

No floor drains, sumps, or pits were indentified at the Site during the Site reconnaissance.

5.3.7 Stained Areas

No stained areas were observed at the Site during the Site reconnaissance.

5.3.8 Transformers

No transformers were observed at the Site during the Site reconnaissance. The EDR Radius Map Report includes the PCB Transformer Registration Database and PCB Activity Database System (PADS) search for the Subject Site. The PCB Transformer database includes PCB transformer registrations that include all PCB registration submittals. The PADS database identifies generators, transporters, commercial stores and/or brokers and disposers of PCBs who are required to notify the EPA of such activities. The Site was not identified on the PADS database.

5.3.9 Stressed Soil or Vegetation

The Site was previously used for surface mining and most of the Site has been previously disturbed. Subsequent to the closing of the mine, some areas at the Site and on adjacent properties have been reclaimed. Currently, the Site consists of relatively rugged terrain with little or no topsoil and/or vegetation. The area across the former truck shop was covered with bark mulch as part of the terrain restoration. The DOGAMI documents mention that

"Glenbrook has a large pile of hog fuel (bark and other sawmill waste) available for mulch. After verifying via standard soil analysis that the composition of the hog fuel is acceptable, the material will be used to cover dumps and reclaimed slopes to minimize erosion." It is likely the mulch at the Site was provided by Glenbrook Mining Company.

5.3.10 Surface Water

Standing water in wetland like areas was identified in the southeast portion of the Site. This area corresponds with the sediment retention ponds created as part of the reclamation process. Ponded water was also identified in an open pit in the central portion of the Site.

5.3.11 Asbestos Containing Material/Lead Based Paint

Most asbestos containing building materials (ACBMs) were banned in the U.S. by 1989. Lead has been banned from household paint in the U.S since 1978. No structures are currently present at the Site with the exception of a small wood shed previously used as an explosive magazine; therefore, the potential presence of ACBM and/or lead-based paint (LBP) is considered low. However, evaluation of ACM and LBP was outside the scope of this Phase I ESA.

AEC's experience working on various projects located in the Klamath Mountains includes observations of fibrous asbestiform minerals, typically in mafic dikes. While no fibrous minerals were observed during the two Site visits, it is likely some asbestiform minerals are present in isolated areas of the Site, including dikes and potentially in the waste rock piles that Knife River Materials proposes to process. This supposition is supported by analytical results for two samples collected on adjacent properties and analyzed for asbestos as documented in a Phase I ESA Report for the D.R. Johnson Tracts prepared for Nickel Mountain, LLC and Nez Khan, LLC by Maul Foster & Alongi, Inc. (MFA) and dated November 6, 2015.

In support of this Phase I ESA effort, which was completed on properties adjacent to the Site, MFA collected a rock sample from waste rock/overburden and a sediment sample from a retention basin immediately adjacent to and west of the Nickel Mountain Site. The percent by weight of asbestos of the rock and sediment samples were 0.00048 percent and 0.000211 percent, respectively. DEQ defines "asbestos containing material" as material containing more than 1 percent asbestos by weight (OAR 340-248-0010). Similar asbestos results can be expected at the Site. While it is unlikely the material in the waste rock piles would qualify as asbestos containing material, Knife River Materials personnel should visually monitor for the presence of fibrous minerals and manage dust in an appropriate manner during future quarry operations. Should fibrous mineral material be identified, it should be segregated from material processing. AEC considers the likelihood of naturally occurring asbestiform minerals at very low concentrations below 1 percent asbestos by weight at the Site to be a *de minimis* condition.

5.3.12 Flood Plain and Wetland

Wetland-like areas were identified in the southeast corner of the Site. The EDR Radius Map Report indicates that the Site is not included in the National Wetland Inventory or State Wetlands. See the Overview Map in the EDR Radius Map Report in Appendix 3.

5.3.13 Vapor intrusion

According to the EPA, vapor intrusion is defined as the migration of volatile chemicals from contaminated groundwater and/or soil into overlying buildings. Based on the available historical and current information, sources for vapor migration are not known to exist at the Site.

6 INTERVIEWS

The environmental questionnaire regarding the history of the Site was completed by Mr. Rick Barnes, the current owner of the Site. The interview form is included in Appendix 11. The information provided by Mr. Barnes is included throughout of this report. Mr. Barnes was not aware of any adverse environmental conditions associated with the Site.

7 PHASE II ESA

Based on the previous environmental reports prepared for the former Glenbrook Nickel Smelter, on the site observations, and on the professional experience working on mine sites, AEC conducted a Phase II ESA at the Site.

Based on research conducted in support of the Phase I ESA, based on AEC's professional experience working on mine sites, and based on AEC's understanding about Knife River Materials' intentions to export rock products developed from the historical waste rock piles of the mine, AEC developed concerns about potential environmental issues associated with the Site. Specifically, potential environmental issues included the following:

- Historical mining operations, combined with naturally occurring conditions, could be adversely impacting surface water quality and ecological receptors at the Site and downstream of the Site. Ecological receptors of concern include wildlife drinking surface water at the Site and downstream of the Site, as well as aquatic receptors (e.g. fish) living in ponds and streams at the Site and downstream of the Site.
- Rock products developed at the Site, such as base rock and ¾-inch minus aggregate, will be exported to off-Site customers. There is the potential for metals to leach from these rock products at concentrations that could adversely impact off-Site human and ecological receptors.

The objectives of the Phase II ESA were to collect representative Site-specific surface water and rock samples and analyze them for relevant metals to determine if unacceptable risks to human and ecological receptors are present or if these potential environmental issues can be eliminated from further concern.

AEC conducted the Phase II ESA at the Site on January 16, 2021. The Phase II ESA included the collection of two surface water samples and five composite rock samples representative of the five waste rock stockpiles that Knife River Materials plans to mine. Sample locations are illustrated on Figure 4.

The two surface water samples were analyzed for the following constituents:

- Total calcium and total magnesium by U.S. Environmental Protection Agency (USEPA) Method 6020B.
- Calculated hardness by Standard Method (SM) 2340B.
- pH by SM 4500.

- Dissolved metals by USEPA Method 6020B. The 17 metals included antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, thallium, vanadium, and zinc.

The five composite rock samples were analyzed for the following constituents:

- The rock samples were first crushed by Apex Laboratories to generate a particle size distribution approximately equivalent to ¾-minus aggregate, including fines. Using the Representative Subsampling Method, approximately 100 gram samples of coarse and fine material were developed.
- The 100 gram samples were then processed by the USEPA Synthetic Precipitation Leachate Procedure (SPLP) to generate leachate approximately equivalent to that which would be generated by rain water.
- The leachate was then analyzed for metals by USEPA Method 6020B. The 17 metals included antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, thallium, vanadium, and zinc.

Based on an evaluation of the dissolved metals analytical results for the surface water samples, no reported metals concentrations exceeded risk-based concentrations (RBCs) for wildlife ingestion of surface water. However, the concentrations of copper in surface water samples SW-1 (9.51 micrograms per liter [μg/L]) and SW-2 (8.44 μg/L) did exceed the Aquatic Water Quality Criterion (AWQC) for fresh water of 5.5 μg/L. Because the bioavailability and toxicity of copper is dependent on Site-specific water chemistry, the Biotic Ligand Model (BLM) was run using both Site-specific and assumed water chemistry data input. The results of the BLM indicate Site-specific dissolved copper concentrations measured in surface water samples SW-1 and SW-2 do not present unacceptable risks to aquatic receptors at the Site.

The analytical results for the five composite rock samples representative of the five waste rock stockpiles reported only one metal in one sample at a concentration that exceeded the laboratory method reporting limits (MRLs) for the SPLP method. Specifically, nickel was reported at a concentration of 927 μg/L in composite rock sample SP-5 (i.e. collected from stockpile number 5). The reported nickel concentration of 927 μg/L in composite rock sample SP-5 exceeds the AWQC RBC for nickel of 161 of μg/L. However, it should be noted the SPLP Method involves mixing 2 liters of synthetic rain with 100 grams of sample material. During sample preparation of the composite rock samples, 15 percent of each of the rock samples consisted of very fine-grained material (i.e. 70 microns or smaller). This sample preparation method purposely generated material with a much higher surface area than will be present in ¾-minus aggregate, so the metals results are biased high relative to the rock products that will be generated during Knife River Materials' future rock processing activities. Furthermore, the amount of nickel available for dissolution can be expected to decrease significantly over time as the materials are exposed to ongoing precipitation. Accordingly, the risk associated with the leaching of nickel from exported rock products exposed to precipitation is considered acceptable.

Based on the analytical results for the samples collected during this Phase II ESA, combined with the results of the BLM, the aforementioned potential environmental issues can be

eliminated from further concern. Additional details regarding the Phase II are presented in the Phase II ESA report included as Appendix 12.

8 FINDINGS, OPINION, AND CONCLUSION

8.1 Findings and Opinion

The Findings and Opinion Section of this report summarizes known or suspected environmental conditions associated with the Site, which may include RECs, historical RECs, CRECs, and *de minimis* conditions, and discusses AEC's opinions of the impact on the Site of known or suspect environmental conditions.

Findings and Opinion are as follows:

1. The Site is identified as Nickel Mountain and is located near Riddle, Oregon. It occupies four tax lots (identified as Map and Taxlot 3006W17 TL 200 and TL 100, and 3006W18 TL 400 and TL 500) and an approximately 65-acre portion of a fifth tax lot (identified as 3006W16 TL 200) for a total of approximately 745 acres. The current owner of the Site is Nickel Mountain, LLC. AEC understands the first four tax lots are to be purchased by Knife River Materials with the fifth tax lot under Knife River Materials royalty. A nickel mine operated at the Site from the 1950s through the 1990s.
2. Most of the Site is exempt from state reclamation requirements and consists of relatively rugged terrain with little or no topsoil and/or vegetation. Portions of the Site were reclaimed and are currently vegetated. Wetland-like areas are located in the southeast portion of the Site. Remnant features of the historical nickel mine are located at the Site and include pits, waste rock stockpiles, roads, two ore dump pockets, an ore clarifier, a shed formerly used as an explosives magazine, and the foundations of the mine office and truck/maintenance shop. AEC understands Knife River Materials plans to mine and crush at least five of the waste rock piles at the Site. The current owner of the Site applied for and received a conditional use permit from Douglas County for processing rock at the Site (File Number 19-022).
3. Reasonably ascertainable standard historical sources were not consistently available at 5-year intervals back to 1940 resulting in a data failure. As sufficient historical information was available for the environmental professionals to identify RECs, the historical sources data failure is not considered a data gap. A preliminary title report and/or an environmental lien search were not provided for the Site, resulting in a data failure. The environmental lien data failure is considered a data gap.
4. The EDR Sanborn Fire Insurance Maps did not provide data coverage for the Site. See Appendix 5 for additional information.
5. According to the available deed records, the Site was owned by several entities, including several families, Oregon Nickel Mining Properties, Inc., and Nickel Mountain, LLC, the current owner of the Site. Nickel Mountain, LLC has owned the Site since

approximately 2000 and 2001. See Section 4.3.4 and Appendix 2 for additional information.

6. The EDR historical aerial photographs provided coverage for the Site since 1954. According to the aerial photographs, the Site historically consisted primarily of undeveloped vegetated land and surface mining. The neighboring properties to the Site have been consisting of vegetated and forested land and surface mining. See Section 4.3.2 and Appendix 6 for additional information.
7. The Site is not listed in the City Directory. The properties located farther from the Site are listed as residential occupants. See Section 4.3.4 and Appendix 8 for additional information.
8. According to the Oregon WRD online database, one well is listed as located in Section 17 of Township 30 South, Range 6 West. Section 17 includes TL 100 and TL 200, both part of the Site. Based on this info, this well is located at the Site, though reportedly no wells are present at the Site. Depth to groundwater in this well was reported to be 76 feet bgs and the yield was reported to be 50 gpm. However, AEC believes the location data for this well is incorrect (See Section 4.2.3 and Appendix 4 for additional information).
9. The geologic units found in the vicinity of the Site are characterized as Paleozoic Plutonic and Intrusive Rocks. The soils in the vicinity of the Site are mapped as Pearsoll extremely stony clay loam. See Appendix 3 for additional information.
10. Based on professional judgment and experience, groundwater tables in western Oregon are typically a subdued replica of land surface topography. The Site consists of relatively rugged topography which slopes steeply around Nickel Mountain. The neighboring properties also have a rugged topography. The assumed groundwater flow direction at the Site is radial in all directions away from Nickel Mountain towards various creeks around the mountain, which ultimately flow into the South Umpqua River. See Section 4.3.3. and Appendix 7 for additional information.
11. The Site was identified by the EDR database search in the Mines Mineral Resources Data System as Nickel Mountain, Hanna Nickel Mine, and Nickel Mountain Group - Upper Occurrence. Several neighboring facilities were identified by the EDR Radius Map search in several environmental databases. Due to the location of these facilities in relation to the Site, status of cleanup, and/or the expected general groundwater flow direction in the vicinity of these facilities, they are unlikely to pose an environmental threat to the Site. See Section 4.1.2 and Appendix 3 for additional information.
12. The available documents identified two potential AOCs at the Site, specifically the "USTs at the Mine Site" and the "former fueling are at the Lower Ore Body."

    According to the available documents, a 3,000-gallon gasoline UST and a 10,000-gallon used oil UST were located at the mine site, on top of the mountain. This area was investigated in 2000. Four test pits were excavated to determine if the USTs were present and to collect soil samples. One soil sample was collected from each test pit for laboratory analysis. No tanks were found. The samples were collected from a depth of 12 to 15 feet bgs and were analyzed for TPH in gasoline-range and diesel-range, BTEX, and PCBs. The analytical data reported TPHs, BTEX, and PCBs as "non detect."

Based on AEC's experience working on mine and quarry properties, it is unlikely USTs were present at the Site because ample space was available to more cost-effectively store petroleum products in ASTs. Accordingly, it is likely that ASTs were historically used at the Site. No ASTs were identified during two Site visits.

One diesel AST was located in the former fueling area at the Lower Ore Body. Potentially, "minor leaks or spills through the years of operation likely resulted in the impacted soil around the former fueling area." In 2002, two rounds of excavation were conducted and a total of eight confirmation samples were collected and analyzed for TPHs. The analytical results reported the presence of TPHs in oil-range and diesel-range in four samples. These samples were further analyzed to quantify the TPHs in diesel-range and heavy oil-range and the reported concentrations ranged between 43.5 at 616 mg/kg. A portion of the Lower Ore Body was located in the southeastern corner of the Site. The location of the former fueling area is not known if it was at the Site or off-site.

13. Most ACMs were banned in the U.S. by 1989. Lead has been banned from household paint in the U.S since 1978. No structures are currently present at the Site, with the exception of a small wood shed previously used as an explosives magazine; therefore, the potential presence of ACM and/or LBP is low. However, the evaluation of ACMs and LBPs at the Site is outside the scope of this Phase I ESA.
14. Relatively low concentrations of naturally occurring asbestos are likely present in waste rock piles at the Site. While it is unlikely the material in the waste rock piles would qualify as ACM, Knife River Materials personnel should visually monitor for the presence of fibrous minerals and manage dust in an appropriate manner during future quarry operations. Should fibrous mineral material be identified, it should be segregated from material processing. AEC considers the likelihood of naturally occurring asbestiform minerals at very low concentrations below 1 percent asbestos by weight at the Site to be a *de minimis* condition.
15. Based on readily available historical and current information, sources for vapor migration are not known to exist at the Site. See Section 5.3.13 for additional information.
16. AEC conducted a Phase II ESA at the Site on January 16, 2021. The Phase II ESA included the collection of two surface water samples and five composite rock samples representative of the five waste rock stockpiles that Knife River Materials plans to mine. The Phase II ESA was completed to evaluate potential environmental concerns associated with metals that could adversely impact human and ecological receptors at the Site and downstream of the Site, as well as to evaluate potential environmental concerns associated with metals that could adversely impact human and ecological receptors exposed to exported rock products. Based on the analytical results for the samples collected during the Phase II ESA, combined with the results of the BLM, the aforementioned potential environmental issues can be eliminated from further concern. (See Section 7 and Appendix 12 for additional information).

8.2 Conclusions and Recommendations

AEC has performed a Phase I ESA at Nickel Mountain located near Riddle, Oregon. The Site occupies four tax lots (identified as Map and Taxlot 3006W17 TL 200 and TL 100, and 3006W18 TL 400 and TL 500) and an approximately 65-acre portion of a fifth tax lot (identified as 3006W16 TL 200) for a total of approximately 745 acres. The Phase I ESA was completed in conformance with the scope and limitations of ASTM E 1527-13 and ASTM for Forestland or Rural Property E2247-08. Any exceptions to, or deletions from, this practice are described in Section 1 of this report.

Based on the available historical information and the visual observations obtained during the Site reconnaissance visit, this assessment has revealed no evidence of RECs, CRECs, and/or HRECs.

Relatively low concentrations of naturally occurring asbestos are likely present in waste rock piles at the Site. While it is unlikely the material in the waste rock piles would qualify as asbestos containing material as defined by the Oregon Department of Environmental Quality, Knife River Materials personnel should visually monitor for the presence of fibrous minerals and manage dust in an appropriate manner during future quarry operations. Should fibrous mineral material be identified, it should be segregated from material processing. AEC considers the likelihood of naturally occurring asbestiform minerals at very low concentrations below 1 percent asbestos by weight at the Site to be a *de minimis* condition

A preliminary title report and/or an environmental lien search were not provided for the Site, resulting in a data failure. The environmental lien data failure is considered a data gap. AEC recommends that Knife River Materials conduct its own environmental lien search for the Site.

9 LIMITATIONS

The purpose of an environmental assessment is to reasonably evaluate the potential for or actual impact of past practices on a given site area. In performing an environmental assessment, it is understood that a balance must be struck between a reasonable inquiry into the environmental issues and an exhaustive analysis of each conceivable issue of potential concern. This environmental assessment contains professional opinions as to the environmental issues of concern and/or additional actions, which may be addressed to the property. In rendering its professional opinion, we warrant that services provided hereunder were performed, within the limits described, consistent with current generally accepted environmental consulting principles and practices. No other warranty, express or implied, is made. The following paragraphs discuss the assumptions and parameters under which such an opinion is rendered.

No investigation is thorough enough to exclude the presence of hazardous materials at a given site. If hazardous conditions have not been identified during the assessment, such a finding should not therefore be construed as a guarantee of the absence of such materials on the site, but rather as the result of the services performed within the scope, limitations, and cost of the work performed.

Any opinions or recommendations presented apply to site conditions existing when services were performed. We are unable to report on or accurately predict events that may change the site conditions after the described services are performed, whether occurring naturally or caused by external forces. We assume no responsibility for conditions we were not authorized to investigate, or conditions not generally recognized as environmentally unacceptable when services were performed.

Environmental conditions may exist at the site that cannot be identified by visual observation. Where the scope of services was limited to observations made during site reconnaissance, interviews, review of readily available reports and literature or any combination, any conclusions or recommendations or both are necessarily based in part on information supplied by others, the accuracy or sufficiency of which we may not have independently reviewed.

Where subsurface work was performed, our professional opinions are based in part on interpretation of data from discrete sampling locations that may not represent actual conditions at unsampled locations.

Except where there is express concern of our client, or where specific environmental contaminants have been previously reported by others, naturally occurring toxic substances, potential environmental contaminants inside buildings, or contaminant concentrations that are not of current environmental concern may not be reflected in this document.

We are not responsible for any potential impact of changes in applicable environmental standards, practices, or regulations following performance of services, on the conclusions or recommendations, or both, of the study.

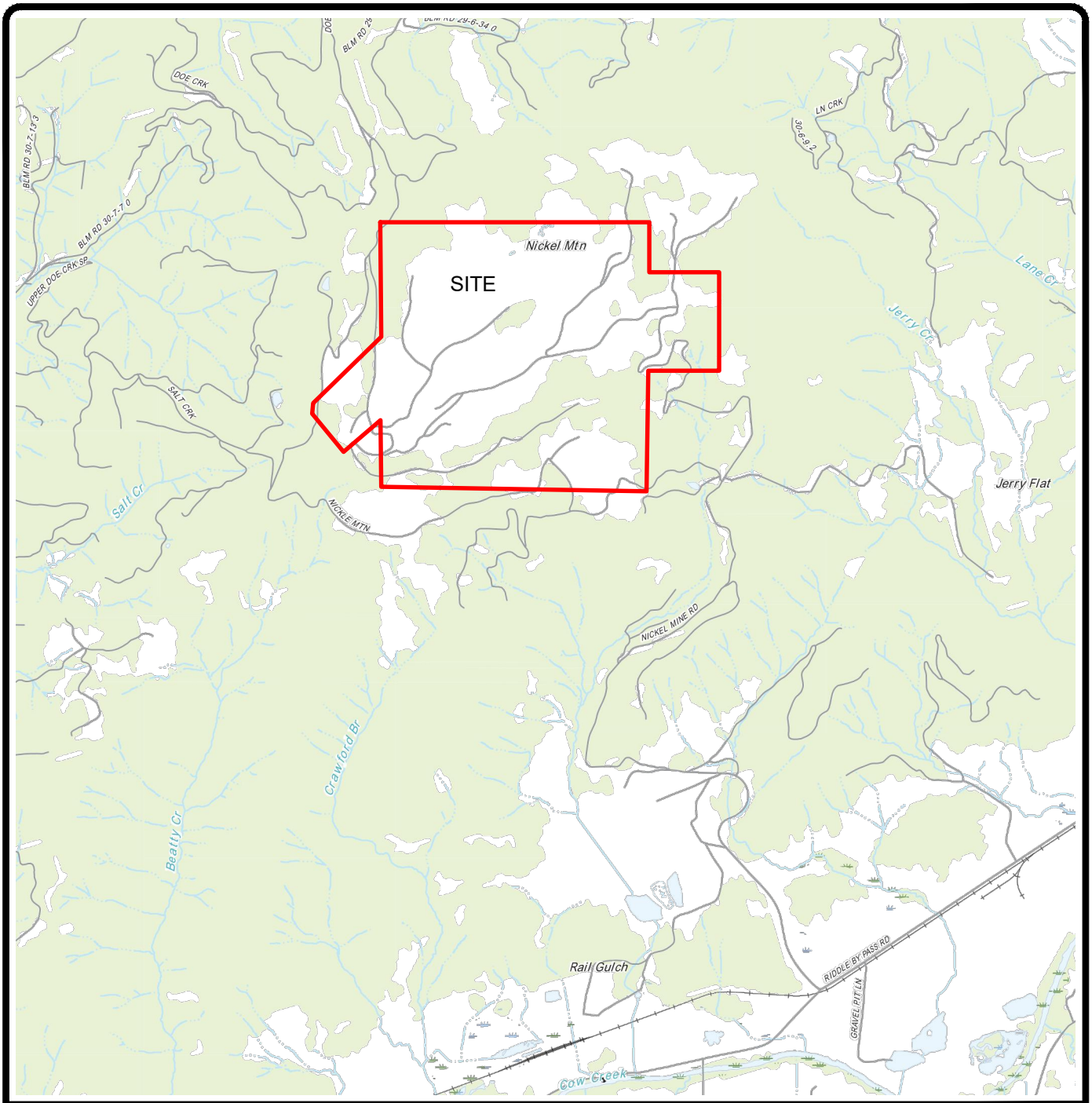
Services hereunder were performed consistent with our agreement and understanding with, and solely for the use of, our client. Opinions and recommendations are intended for the client, purpose, site, location, time frame, and project parameters indicated. We are not responsible for subsequent separation, detachment, or partial use of this document. Any reliance on this report by a third party shall be at such party's sole risk.

10 QUALIFICATIONS OF ENVIRONMENTAL PROFESSIONALS

Mr. Jonathan Williams received a Bachelor of Science degree in Geology, with honors, from Duke University in 1987. He has over 29 years experience working with geologic and environmental reports, including Phase I ESAs. Mr. Williams has been a Registered Geologist in the State of Oregon since 1996, and has 40-hour HAZWOPER training.

Ms. Antonela Vadan holds a Bachelor of Arts and Science in Earth and Environmental Sciences from the University of Illinois at Chicago. She has over 18 years of experience in both the private and public sector. Ms. Vadan has conducted multiple Phase I ESAs. Additional project activities have included risk assessments, remedial investigations/feasibility studies, soil and groundwater investigations, and indoor air quality investigations. Ms. Vadan is a Registered Geologist in the State of Oregon and has 40-hour HAZWOPER training.

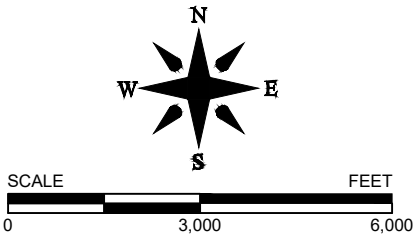
11 FIGURES



SOURCE: U.S.G.S. 7.5 MINUTE TOPOGRAPHIC QUADRANGLE
NICKEL MOUNTAIN, OR (2020)

LEGEND

APPROXIMATE SITE BOUNDARY

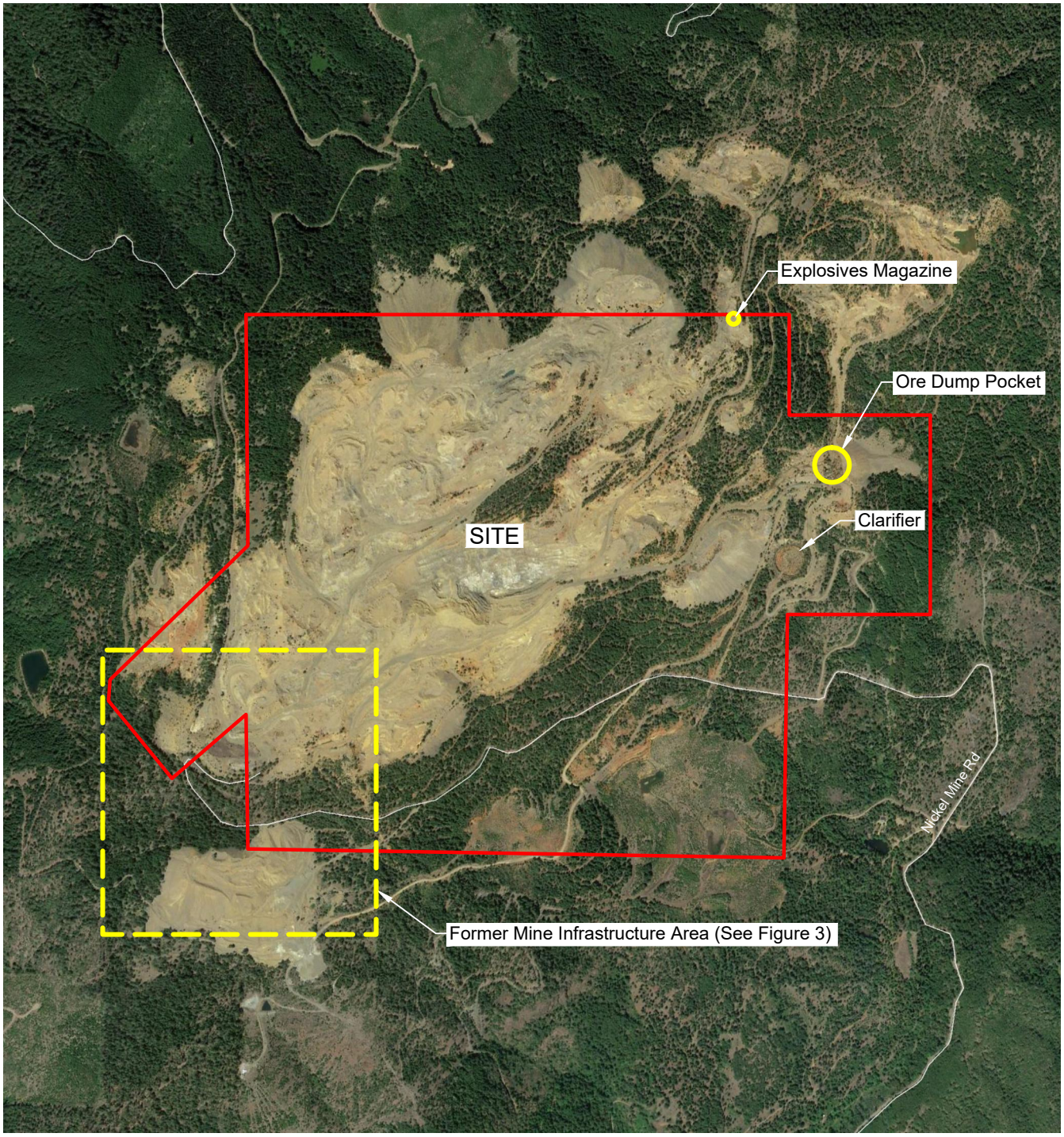


ALPINE ENVIRONMENTAL CONSULTANTS, LLC

DATE: 2/6/21

DRAWN BY: SM

Figure 1
Site Location Map
Phase I/II Environmental Site Assessments
Nickel Mine Quarry
Map and Taxlot 3006W16 TL 200; 3006W17 TL 100 and TL 200; and 3006W18 TL 400 and TL 500
Douglas County, Oregon



SOURCE: Google Earth (2019)

LEGEND

APPROXIMATE SITE BOUNDARY

N
W E
S

SCALE FEET
0 1,500 3,000

ALPINE ENVIRONMENTAL CONSULTANTS, LLC

DATE: 2/6/21 DRAWN BY: SM

Figure 2
Site Layout Map
Phase I/II Environmental Site Assessments
Nickel Mine Quarry
Map and Taxlot 3006W16 TL 200; 3006W17 TL 100 and TL 200; and 3006W18 TL 400 and TL 500
Douglas County, Oregon

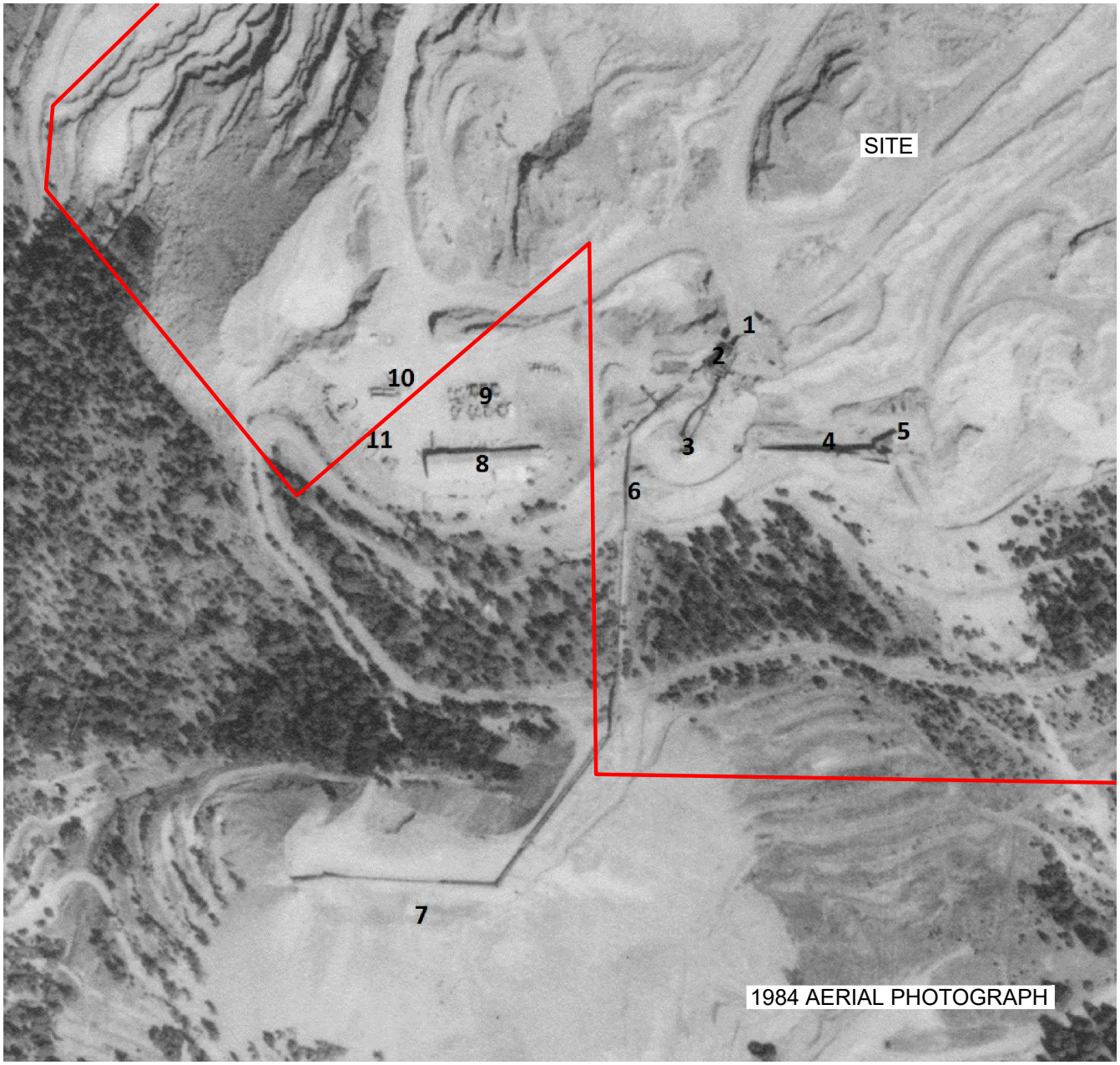


IMAGE SOURCE: University of Oregon

LEGEND

1. Ore dump pocket to the crusher
2. Ore crushing and screening plant
3. Top of crushed ore conveyor and crushed ore stockpile
4. Reclaim conveyor from bottom of crushed ore stockpile to tram station
5. Aerial tram upper loading station
6. Reject conveyor from crushing/screen plant to reject pile
7. Ore reject pile
8. Maintenance shop/warehouse/office building
9. Ready line for mine heavy equipment
10. Possible fuel tanks and dispensers
11. Possible outside warehouse storage and "boneyard"

Approximate Site Boundary

SCALE FEET

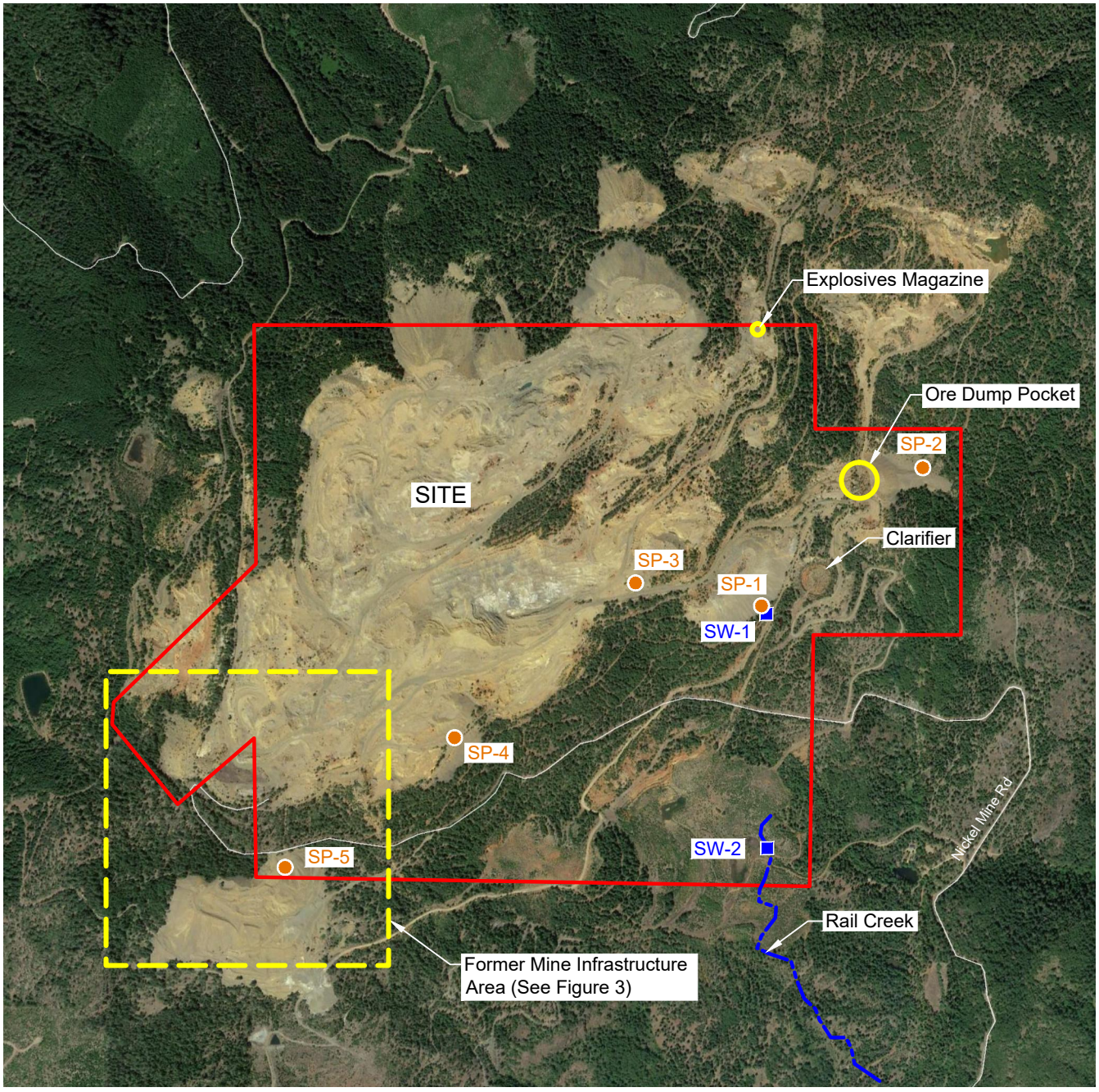
0 400 800

N W E S

ALPINE ENVIRONMENTAL CONSULTANTS, LLC

DATE: 2/6/21 DRAWN BY: SM

Figure 3
Former Mine Infrastructure Area
Phase I/II Environmental Site Assessments
Nickel Mine Quarry
Map and Taxlot 3006W16 TL 200; 3006W17 TL 100 and TL 200; and 3006W18 TL 400 and TL 500
Douglas County, Oregon



SOURCE: Google Earth (2019)

LEGEND

- Approximate Site Boundary
- SP-1 ● Stockpile Rock Sample Location, January 16, 2021, Location Approximate
- SW-1 ■ Surface Water Sample Location, January 16, 2021, Location Approximate

N
W E
S

SCALE FEET
0 1,500 3,000

ALPINE ENVIRONMENTAL CONSULTANTS, LLC

DATE: 2/6/21 DRAWN BY: SM

Figure 4
Rock and Surface Water Sample Location Map
Phase I/II Environmental Site Assessments
Nickel Mine Quarry
Map and Taxlot 3006W16 TL 200; 3006W17 TL 100 and TL 200; and 3006W18 TL 400 and TL 500
Douglas County, Oregon

APPENDIX 1

Assessors Plat Map

Site Maps

Zoning Map

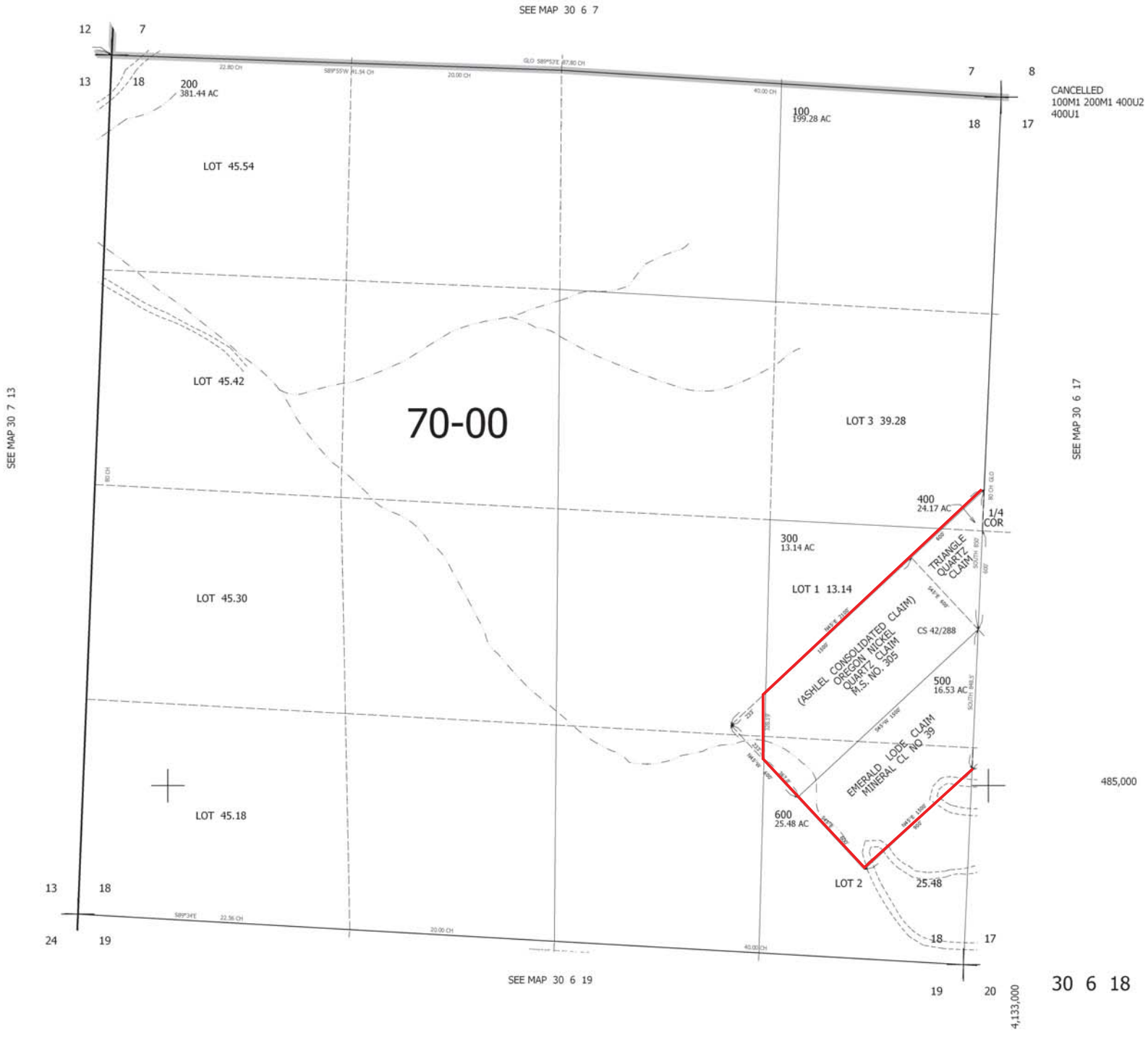
THIS MAP WAS PREPARED FOR ASSESSMENT PURPOSE ONLY.

SEC.18 T30S. R.6W. W.M.
DOUGLAS COUNTY

REVISED ON 5-18-01

30 6 18

1" = 400'



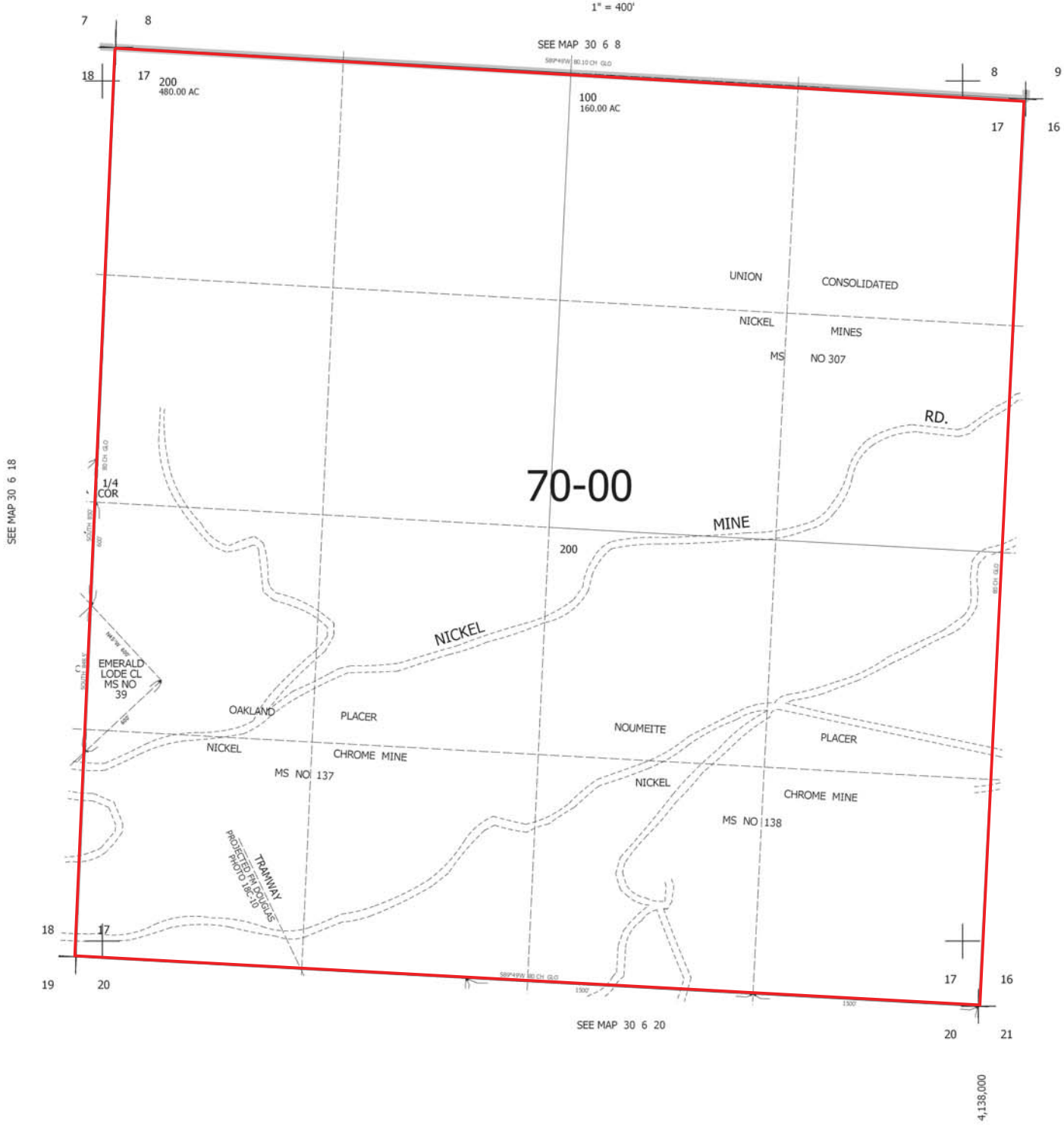
THIS MAP WAS PREPARED FOR ASSESSMENT PURPOSE ONLY.

SEC.17 T30S. R.6W. W.M.
DOUGLAS COUNTY

REVISED ON
5-18-01

30 6 17

1" = 400'



CANCELLED
200A1 100U2 100U1

484,000

4,138,000

30 6 17

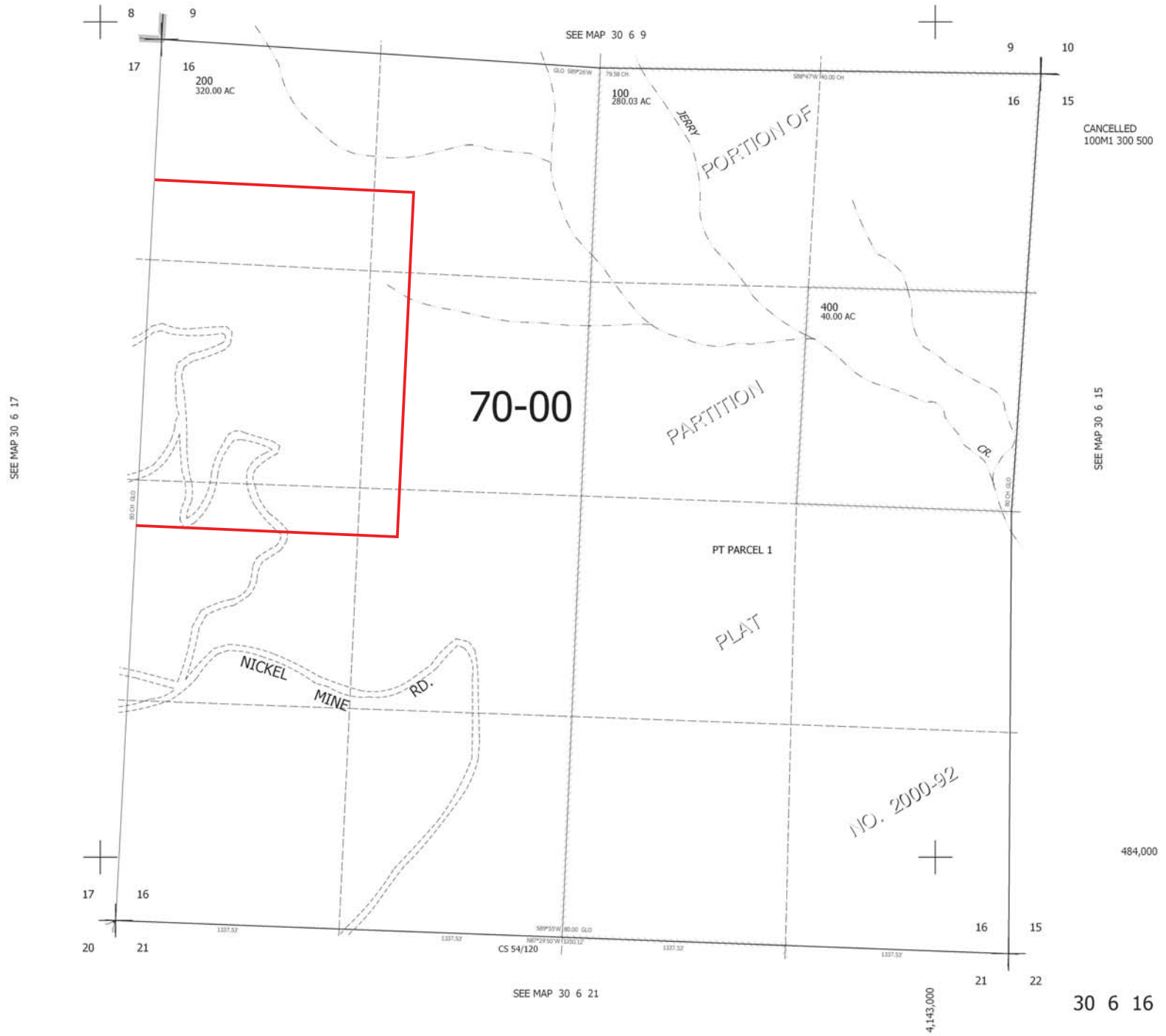
THIS MAP WAS PREPARED FOR ASSESSMENT PURPOSE ONLY.

SEC.16 T30S. R.6W. W.M.
DOUGLAS COUNTY

REVISED ON 12-28-00

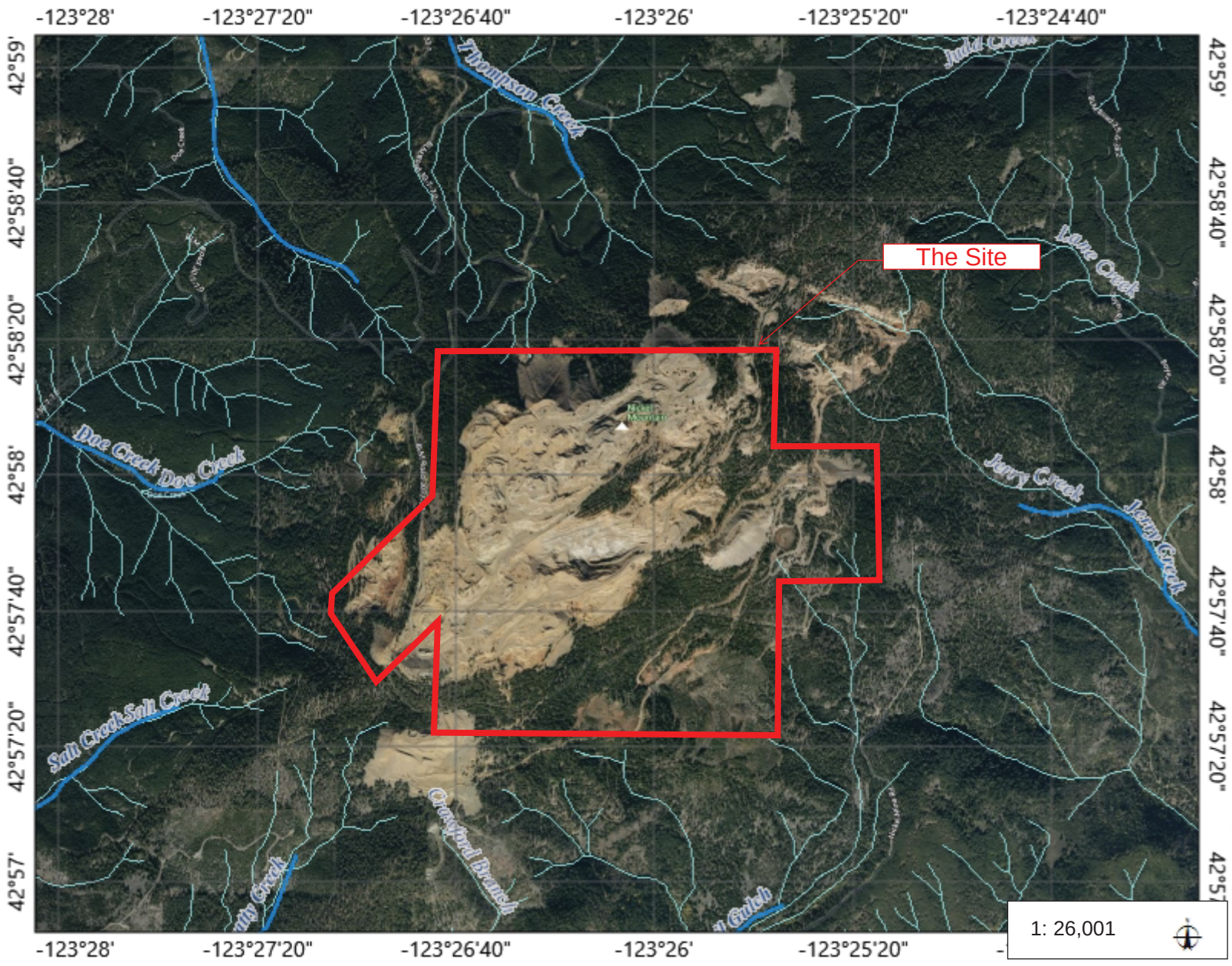
30 6 16

1" = 400'



OREGON EXPLORER

Map



Legend

- County Boundaries (2015)
- Rivers (1:100k)
- Streams
- Streams - CLAMS

Notes

Add your notes here

0.8 0 0.41 0.8 Miles

WGS_1984_Web_Mercator_Auxiliary_Sphere

© Oregon Explorer (https://oregonexplorer.info)

This map is a user generated static output for reference only from: Oregon Explorer Map Viewer

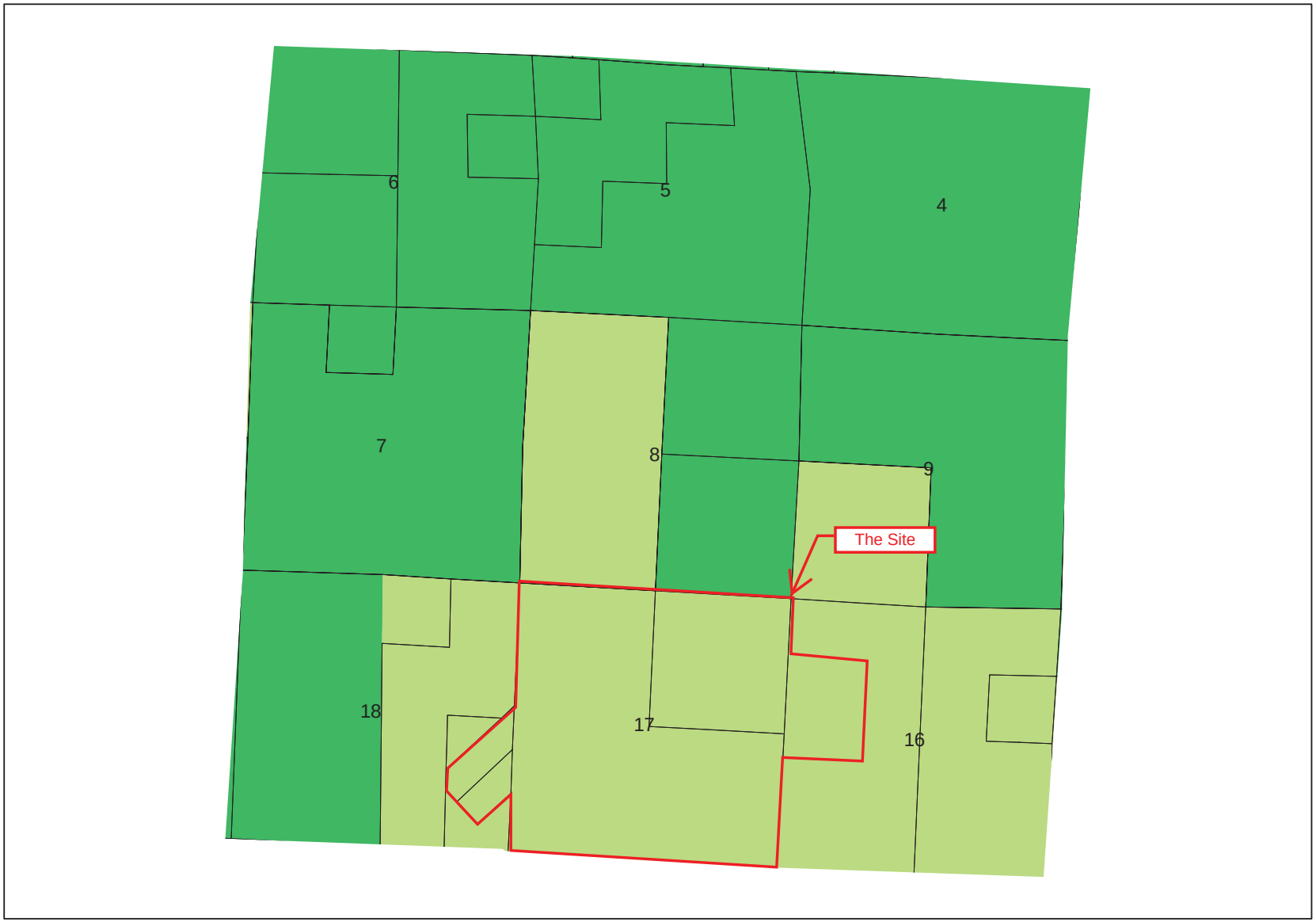
Data layers that appear on this map may or may not be accurate, current, or reliable.

THIS MAP IS NOT TO BE USED FOR NAVIGATION.

DOUGLAS COUNTY
PLANNING DEPARTMENT

ZONING MAP T30S R06W NW-1/4

April 18, 2007



T30S R06W NW-1/4

Legend

- UUA
- UGB
- RC
- TR
- FF
- AW
- FG
- F1
- F2
- F3
- 5R
- RR
- 1R
- RS
- R1
- R2
- R3
- CRS
- CRC
- CRE
- CT
- C1
- C2
- C3
- MRC
- ME
- M1
- M2
- M3
- PR
- WI
- ED
- EC
- EN
- CS
- MR
- WOCR
- WOTC
- MC
- MRI

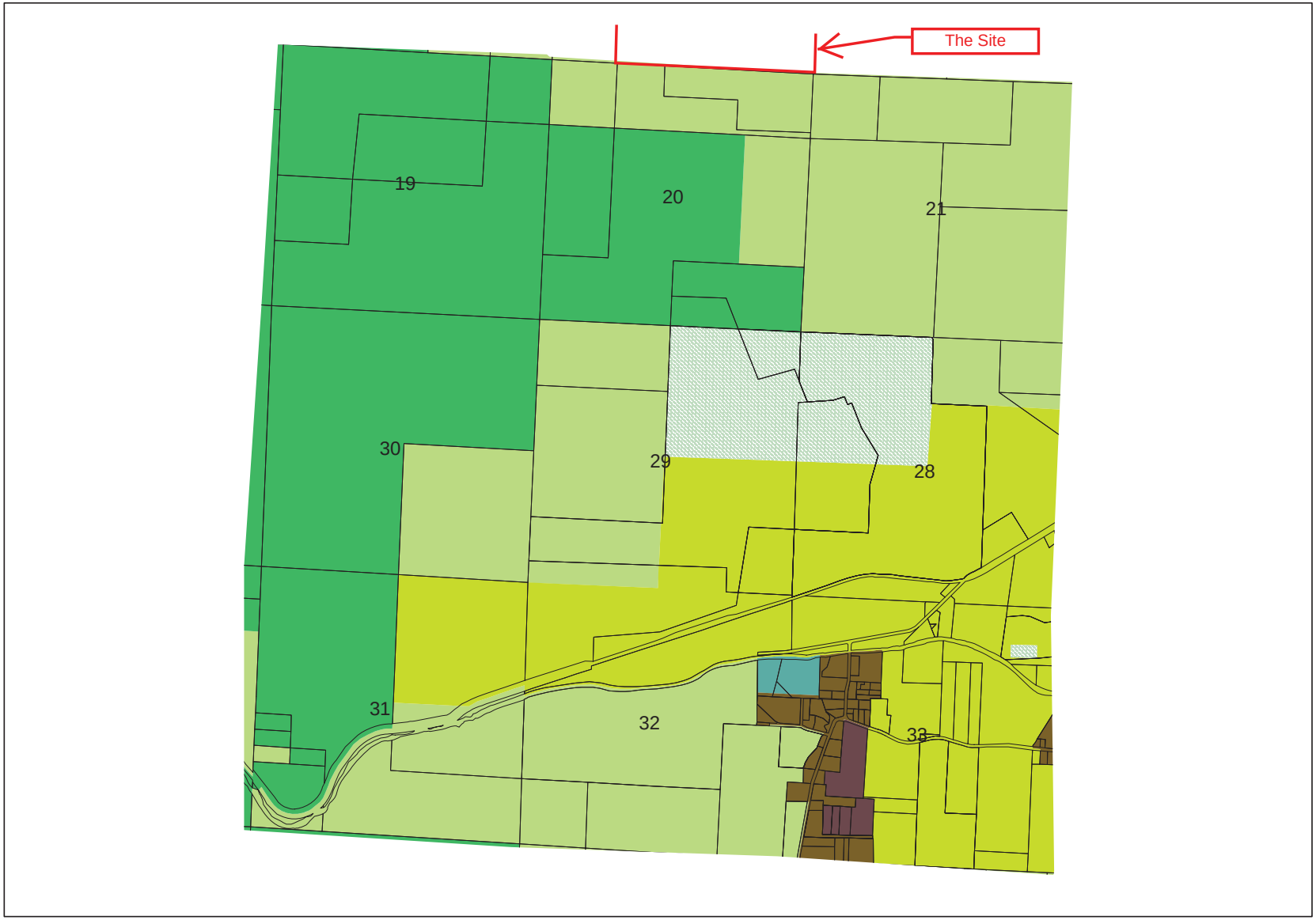
ZONING GENERALLY EXTENDS TO THE CENTERLINE OF ROADS AND RIVERS

0 0.5 1 2 3 Miles

DOUGLAS COUNTY
PLANNING DEPARTMENT

ZONING MAP T30S R06W SW-1/4

September 25, 2009



T30S R06W SW-1/4

Legend

- UGB
- UUA
- RC
- RSC
- TR
- FF
- AW
- FG
- F1
- F2
- F3
- 5R
- RR
- 1R
- RS
- R1
- R2
- R3
- CRS
- CRC
- CRE
- CT
- C1
- C2
- C3
- MRC
- ME
- M1
- M2
- M3
- PR
- WI
- ED
- EC
- EN
- CS
- MR
- WOCR
- WOTC
- MC
- MRI

ZONING GENERALLY EXTENDS TO THE CENTERLINE OF ROADS AND RIVERS

0 0.5 1 2 3 Miles

APPENDIX 2

Title Report

Deed Records

And

Other Documents

TITLE REPORT

No Title Report was Provided for the Site

PROPERTY OWNERSHIP RECORDS

b

After recording, return to:
Nickel Mountain, L.L.C.
3000 Stewart Parkway
Suite 204
Roseburg, OR 97470

2001-10667

BOOK 1761 PAGE 406

Until requested otherwise,
send all tax statements to:
Nickel Mountain, L.L.C.
3000 Stewart Parkway
Suite 204
Roseburg, OR 97470

STATUTORY QUITCLAIM DEED

The **Nickel Joint Venture**, a joint venture consisting of the **Glenbrook Nickel Company**, a dissolved Washington corporation winding up its business and affairs pursuant to RCW 23B.14.050 and **Cominco American Incorporated**, a Washington corporation, (collectively "Grantor"), releases and quitclaims to **Nickel Mountain, L.L.C.**, successor in interest to Kenneth L. Gilchrist, Nominee for Continental Bank under Agreement dated January 26, 1962 with Peter J. Mills, and Southeast Bank, Trustee of the Delores C. Mills Trust,("Grantee"), all right, title and interest in and to the real property situated in Douglas County, Oregon, more particularly described in Exhibit A attached hereto and by this reference incorporated herein.

The true consideration for this conveyance is $0.00.

THIS INSTRUMENT WILL NOT ALLOW USE OF THE PROPERTY DESCRIBED IN THIS INSTRUMENT IN VIOLATION OF APPLICABLE LAND USE LAWS AND REGULATIONS. BEFORE SIGNING OR ACCEPTING THIS INSTRUMENT, THE PERSON ACQUIRING FEE TITLE TO THE PROPERTY SHOULD CHECK WITH THE APPROPRIATE CITY OR COUNTY PLANNING DEPARTMENT TO VERIFY APPROVED USES AND TO DETERMINE ANY LIMITS ON LAWSUITS AGAINST FARMING OR FOREST PRACTICES AS DEFINED IN ORS 30.930.

Dated effective ~~April~~ May 9, 2001

COMINCO AMERICAN INCORPORATED

By: _____
C. Bruce DiLuzio
Vice President, Law and Administration

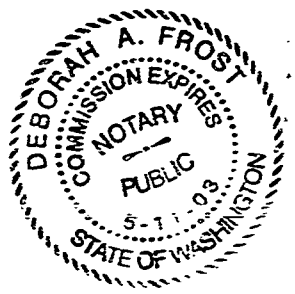
GLENBROOK NICKEL COMPANY, a Washington corporation winding up its business and affairs pursuant to RCW 23B.14.050

By: _____
C. Bruce DiLuzio, Secretary

COMMERCIAL TITLE CO.
P.O. BOX 1325
ROSEBURG, OR 97470 92468jt

STATE OF WASHINGTON)
) ss.
County of Spokane)

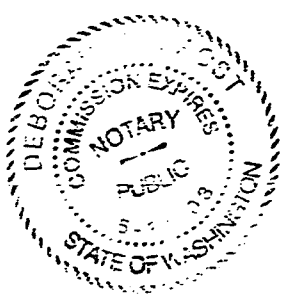
On this 30th day of March, 2001, before me personally appeared C. Bruce DiLuzio, who being duly sworn did say that he is the Secretary of Glenbrook Nickel Company, a Washington corporation, and that the foregoing instrument was signed in behalf of said Corporation, and acknowledged that said instrument is the free act and deed of said Corporation.



Deborah A. Frost
Notary Public in and for the state of
Washington residing at Spokane.
My Commission expires: 5/11/03

STATE OF WASHINGTON)
) ss.
County of Spokane)

On this 30th day of March, 2001, before me personally appeared C. Bruce DiLuzio, who being duly sworn did say that he is the Vice President, Law and Administration of Cominco American Incorporated, a Washington corporation, and that the foregoing instrument was signed in behalf of said Corporation, and acknowledged that said instrument is the free act and deed of said Corporation.



Deborah A. Frost
Notary Public in and for the state of
Washington residing at Spokane.
My Commission expires: 5/11/03

EXHIBIT A

Legal Description

BOOK 1761 PAGE 408

The following described property located in Douglas County, Oregon:

Beginning at the most easterly corner of Ashley Consolidated Mining Claim Number 395 in Section 18, Township 30 South, Range 6 West, Willamette Meridian, Douglas County, Oregon; thence south 45° west approximately 1500 feet along the southeasterly line of said mining claim to the most southerly corner of the said mining claim; thence north 45° west to the west line of the E½ of the SE¼ of said section 18; thence north along said west line to the northwesterly line of said mining claim; thence north 45° east along said northwesterly line and extension thereof to the east line of said section 18; thence south along the said east line to the place of beginning, containing 21.17 acres, more or less, and all being in section 18, said township and range.

AND ALSO the NE¼ of Section 17; the NW¼ of NW¼ of Section 21; Parmley Consolidated Mining Claim No. 306 in Section 20; all in Township 30 South, Range 6 West, Willamette Meridian, Douglas County, Oregon.

STATE OF OREGON)
COUNTY OF DOUGLAS) ss
I, DOYLE SHAVER JR., COUNTY CLERK AND RECORDER OF CONVEYANCES, DO HEREBY CERTIFY THAT THIS INSTRUMENT WAS RECORDED

01 MAY -9 PM 2:44

DOYLE SHAVER JR.
DOUGLAS COUNTY CLERK

IN THE OFFICIAL RECORDS OF DOUGLAS COUNTY

BY _____ DEPUTY

FEE $21

2001-10667

2001-10664 BOOK 1761 PAGE 385

TRUSTEE'S DEED

Bank of America, N.A., Stephen Kraychy and Mary M. Kraychy, Co-Trustees of the Peter J. Mills Trust dated January 26, 1962, Grantor, conveys the trust's undivided one-half (½) interest in the Real Property described in Exhibit A, attached, to Nickel Mountain, LLC., Grantee.

The true consideration for this conveyance is $31,250.00

By acceptance of this Deed by Grantee and recordation in the Real Property Records of Douglas County, Oregon, Grantee certifies that the Real Property is accepted on the basis of its own examination and personal knowledge of the property and opinion of the value thereof; that Grantee accepts the land and all other aspects of the property including, but not limited to, lack of access, water sources, drainage, fence lines, if any, and boundaries, including any claims for adverse possession, in their present condition, AS IS, including latent defects (including any liability associated with the provisions of ORS Chapters 465 and 466 and 42 USC §9601-9675 and USC §6901-6992 and any other state or federal statutes or regulations relating to environmental risks) without any representations or warranties, expressed or implied and that Grantee accepts the Real Property subject to that Mining Lease effective November 1, 1990 wherein the lessee is Nickel Joint Venture, a joint venture consisting of the Glenbrook Nickel Company and Cominco American Incorporated.

THIS INSTRUMENT WILL NOT ALLOW THE USE OF THE PROPERTY DESCRIBED IN THIS INSTRUMENT IN VIOLATION OF APPLICABLE LAND USE LAWS AND REGULATIONS. BEFORE SIGNING OR ACCEPTING THIS INSTRUMENT, THE PERSON ACQUIRING FEE TITLE TO THE PROPERTY SHOULD CHECK WITH THE APPROPRIATE CITY OR COUNTY PLANNING DEPARTMENT TO VERIFY APPROVED USES AND TO DETERMINE ANY LIMITS ON LAWSUITS AGAINST FARMING OR FOREST PRACTICES AS DEFINED IN ORS 30.930.

After Recording, Return to:
Nickel Mountain LLC
3000 Stewart Parkway #204
Roseburg OR 97470

Tax Statements to:
Nickel Mountain LLC
3000 Stewart Parkway #204
Roseburg OR 97470

COMMERCIAL TITLE CO.
P.O. BOX 1325
ROSEBURG, OR 97470 92468jt

DOUG DONNELL, VICE PRESIDENT
BANK OF AMERICA, N.A., CO-TRUSTEE

Dated this 25 day of April, 2001.

STATE OF Georgia]
] SS.
County of Fulton]

PERSONALLY APPEARED the above named Doug Donnell, Vice President, Bank of America, N.A., and acknowledged the foregoing instrument to be his voluntary act and deed.

Notary Public for:

JOANN MOSLEY NOTARY PUBLIC FULTON COUNTY, GEORGIA MY COMM. EXP. SEPTEMBER 23, 2003

STEPHEN KRAYCHY, CO-TRUSTEE

Dated this 1 day of MAY, 2001.

STATE OF Illinois]
] SS.
County of Cook]

PERSONALLY APPEARED the above named Stephen Kraychy, and acknowledged the foregoing instrument to be his voluntary act and deed.

Notary Public for:

"OFFICIAL SEAL"
MARY B. KONCEL
NOTARY PUBLIC, STATE OF ILLINOIS
MY COMMISSION EXPIRES MAY 15, 2004

MARY M. KRAYCHY, CO-TRUSTEE

Dated this 1 day of MAY, 2001.

STATE OF Illinois]
] SS.
County of Cook]

PERSONALLY APPEARED the above named Mary M. Kraychy, and acknowledged the foregoing instrument to be her voluntary act and deed.

Notary Public for:

"OFFICIAL SEAL"
MARY B. KONCEL
NOTARY PUBLIC, STATE OF ILLINOIS
MY COMMISSION EXPIRES MAY 15, 2004

(L & K 4-19-01)

Parcel One:

The patented ASHLEY CONSOLIDATED NICKEL QUARTZ LODE MINING CLAIM, consisting of the Triangle Nickel Quartz and Oregon Nickel Quartz Lode Mining Claims Mineral Cert. 76, designated by the Surveyor General as Lot 305, described in United States Patent recorded August 8, 1896, in Book 34 at Page 493, records of Douglas County, Oregon encompassing a portion of Section 18, Township 30 South, Range 6 West of the Willamette Meridian, County of Douglas, State of Oregon, more particularly described as follows:

Beginning for the description of the Triangle Nickel Quartz Lode Claim at a post four inches square marked No. 1 M. S. 305, with mound of stones, being also the Northwest corner of the Emerald Lode Claim, and situated on the line between Sections 17 and 18 in Township 30 South of Range 6 West Willamette Meridian, from which the quarter Section corner between said Sections bears North 600 feet distant a fir eight inches in diameter marked No. 1 M. S. 305 B. T. bears N 33°W 17 links distant and a pine twelve inches in diameter marked No. 1 M. S. 305 B. T. bears South 65°W 67 links distant.

Thence first course, N 45° W 600 feet to a post marked No. 2 M. S. 305.

Thence second course, N 45° E 600 feet to a post marked No. 3 M. S. 305.

Thence third course, South 250 feet to said quarter Section corner ; 627 feet to a point from which cut No. 6 bears West 35 feet distant; 850 feet to said post marked No. 1 M. S. 305, the place of beginning.

Beginning for the description of the Oregon Nickel Quartz Lode Claim at a post four inches square marked No. 1 M. S. 305, with mound of stones, identical with post No. 1 of said Triangle Nickel Quartz Lode Claim.

Thence first course, S 45° W 99 feet to a point from which cut No. 1 bears N 6° W 117 feet distant 228 feet to a point from which cut No. 5 bears N 28° W 46 feet distant; 1500 feet to a post marked No. 2 M. S. 305. Thence second course, N 45° W 367 feet to a post marked No. 2 + 1 M. S. 305.

Thence third course, North 329 feet to a post marked 3 + 2 M. S. 305.

Thence fourth course, N 45° E 1267 feet to a post marked No. 4 M. S. 305. Thence fifth course, S 45° E 600 feet to said post marked No. 1 M. S. 305 the place of beginning.

Parcel Two:

The patented PARMLY CONSOLIDATED NICKEL MINING CLAIM, consisting of the Riddle Nickel, the West Extension of the Riddle Nickel and the Douglas Nickel Quartz Lode Claims Mineral Cert. 77, designated by the Surveyor General as Lot 306, described in United States Patent dated April 1, 1896, recorded October 5 1950, in Book 185 at Page 23, as Recorders No. 11263[illegible], records of Douglas County, Oregon encompassing a portion of Section 20, Township 30 South, Range 6 West of the Willamette Meridian, County of Douglas, State of Oregon, more particularly described as follows:

Beginning for the description of the Riddle Nickel Quartz Lode Claim at corner No. 1, a post four inches square marked No. 1 M. S. 306, with mound of stone, being also the Southeast corner of Section 17 in Township 30 South of Range 6 West, Willamette Meridian, from which a pine 24" in diameter marked No. 1 M. S. 306 B.T. bears S 13° W 30 links distant and a pine 8" in diameter marked No. 1 M. S. 306 B. T. bears S 78° E 97 links distant.

Thence first course West 330 feet to a point from which cut No. 1 bears S 17° 30' W 179 feet and Cut No. 2 bears S 41° 30' W 231 feet, distant 1500 feet to corner No. 2.

Thence second course, South 600 feet to corner No. 3.

Thence third course, East 1500 feet to corner No. 4, situated on a line between Sections 20 and 21 said Township and Range, from which cut and tunnel No. 4 bear N 82° W 32 feet distant.

Thence fourth course, North 600 feet to Corner No. 1, the place of beginning.

Beginning for the description of the West Extension of the Riddle Nickel Quartz Lode Claim at corner No. 1, a post four inches square marked No. 1 M. S. 306, with mound of stone, identical with corner No. 2 of said Riddle Nickel Quartz Lode Claim, situated on line between Sections 20 and 17 said Township and Range, from which a fir 6" in diameter marked No. 1 M. S. 306 B. T. bears S 42° E 13 links distant and a fir 10 inches in diameter marked No. 1 M. S. 306 B. T. bears S 43° W 7 links distant.

Thence first course, West 1140 feet to the quarter Section corner between said Sections 17 and 20, 1500 feet to

corner No. 2.

Thence second course, South 600 feet to corner No. 3.

Thence third course, East 1500 feet to corner No. 4, identical with corner No. 3 of said Riddle Nickel Quartz Lode Claim.

Thence fourth course, North 600 feet to corner No. 1, the place of beginning.

Beginning for the description of the Douglas Nickel Quartz Lode Claim at corner No. 1 a post four inches square marked No. 1 M. S. 306, with mound of stone, identical with corner No. 4 of said Riddle Nickel Quartz Lode Claim from which a fir four inches in diameter marked No. 1 M. S. 306 B. T. bears S 85° E 27 links distant, and a fir five inches in diameter marked No. 1 M. S. 306 B. T. bears N 70° E 35 links distant.

Thence first course, West 1500 feet to corner No. 2, identical with corner No. 3 of said Riddle Nickel Quartz Lode Claim.

Thence second course, South 600 feet to corner No. 3.

Thence third course, East 1500 feet to corner No. 4.

Thence fourth course, North 600 feet to corner No. 1, the place of beginning.

Parcel Three:

The patented UNION CONSOLIDATED NICKEL MINING CLAIM, consisting of the Wagner Nickel Quartz, Luce Nickel Quartz, Bush Nickel Quartz, Winslow Nickel Quartz, Mammoth Nickel Quartz, Last Chance Nickel Quartz, Surghner Nickel Quartz, Parmley Nickel Quartz, Ashley Nickel Quartz and East Extension of Mammoth Nickel Quartz Lode Claim, Mineral Cert. 78, designated by the Surveyor General as Lot 307, described in United States Patent recorded May 19, 1898, in Book 37 at Page 130, encompassing a portion of Section 17 Township 30 South, Range 6 West of the Willamette Meridian, County of Douglas, State of Oregon, more particularly described as follows:

Beginning for the description of the Wagner Nickel Quartz Lode Claim at the quarter Section post between Sections 8 and 17 in Township 30 South of Range 6 West Willamette Meridian.

Thence first course, N 89° 49' E 1500 feet to corner No. 2

Thence second course, South 528 feet to corner No. 3.

Thence third course, S 89° 49' W 1500 feet to corner No. 4.

Thence fourth course, North 528 feet to said quarter Section post, the place of beginning.

Beginning for the description of the Luce Nickel Quartz Lode Claim at corner No. 1 a post four inches square marked No. 1 M. S. 307, with mound of stone, from which the quarter Section corner between said Sections 8 and 17 bears North 1056 feet distant, a pine ten inches in diameter marked No. 1 M. S. 307 B. T. bears S 28° E 26 links distant and a pine thirty inches in diameter marked No. 1 M. S. 307 B. T. bears N 51° 30' E 52 links distant. Thence first course, North 528 feet to corner No. 2.

Thence second course, N 89° 49' E 1500 feet to corner No. 3.

Thence third course, South 528 feet to corner No. 4.

Thence fourth course, S 89° 49' W 1500 feet to corner No. 1, the place of beginning.

Beginning for the description of the Bush Nickel Quartz Lode Claim at corner No. 1 a post four inches square marked No. 1 M. S. 307, with mound of stone, from which said quarter Section corner bears North 1584 feet distant a pine five inches in diameter marked No. 1 M. S. 307 B. T. bears North 73° 30' E 17 links distant and a fir 7" in diameter marked No. 1 M. S. 307 B. T. bears S 65° E 37 links distant.

Thence first course, North 528 feet to corner No. 2 identical with corner No. 1 of said Luce Nickel Quartz Lode Claim.

Thence second course, N 89° 49' E 1500 feet to corner No. 3 from which cut No. 1 bears S 74° W 396 feet distant.

Thence third course, South 528 feet to corner No. 4.

Thence fourth course, S 89° 49' W 1500 feet to corner No. 1, the place of beginning.

Beginning for the description of the Winslow Nickel Quartz Lode Claim at corner No. 1, a post four inches square marked No. 1 M. S. 307 with mound of stone, from which said quarter Section corner bears North 2112 feet distant, a fir 8 inches in diameter marked No. 1 M. S. 307 B. T. bears N 52° 30' E 9 links distant and a fir 8 inches in diameter marked No. 1 M. S.

307 B. T. bears S 82° 30' E 9 links distant and cut No. 2 bears N 60° 30' E 184 feet distant.

Thence first course, North 528 feet to corner No. 2, identical with corner No. 1 of said Bush Nickel Quartz Lode Claim.

Thence second course, N 89° 49' E 1500 feet to corner No. 3, identical with corner No. 4 of said Bush Nickel Quartz Lode Claim.

Thence third course, South 528 feet to corner No. 4.

Thence fourth course, S 89° 49' W 1500 feet to corner No. 1 the place of beginning.

Beginning for the description of the Mammoth Nickel Quartz Lode Claim at corner No. 1, a post four inches square marked No. 1 M. S. 307 from which said quarter Section corner bears North 2640 feet distant a fir twelve inches in diameter marked No. 1 M. S. 307 B. T. bears East 32 links distant and a fir fourteen inches in diameter marked No. 1 M. S. 307 B. T. bears N 49° E 59 links distant.

Thence first course, North 528 feet to corner No. 2, identical with corner No. 1 of said Winslow Nickel Quartz Lode Claim.

Thence second course, N 89° 49" E 1500 feet to corner No. 3, identical with corner No. 4 of said Winslow Nickel Quartz Lode Claim.

Thence third course, South 528 feet to corner No. 4.

Thence fourth course, S 89° 49' W 589 feet to a point from which cut No. 3 bears N 2° 30' W 315 distant, 1500 feet to corner No. 1, the place of beginning.

Beginning for the description of the Last Chance Nickel Quartz Lode Claim at corner No. 1, a post four inches square marked No. 1 M. S. 307, with mound of stone identical with the Northeast corner of said Section 17, from which a fir forty inches in diameter marked No. 1 M. S. 307 B. T. bears N 56° W 16 links distant and a fir eight inches in diameter marked No. 1 M. S. 307 B. T. bears S 27° W 44 links distant.

Thence first course S 89° 49' W 1140 feet to corner No. 2 identical with corner No. 2 of said Wagner Nickel Quartz Lode Claim.

Thence second course, South 528 feet to corner No. 3 identical with corner No. 3 of said Wagner Nickel Quartz Lode Claim.

Thence third course, N 89° 49' E 1140 feet to corner No. 4.

Thence fourth course, North 528 feet to corner No. 1 the place of beginning.

Beginning for the description of the Surghner Nickel Quartz Lode Claim at corner No. 1, a post four inches square marked No. 1 M. S. 307 with mound of stone, from which the quarter Section corner between Sections 16 and 17 said Township and Range bears South 1584 feet distant; a pine 36 inches in diameter marked No. 1 M. S. 307 B. T. bears S 59° W 60 links distant and a pine 6 inches in diameter marked No. 1 M. S. 307 B. T. bears N 57° W 51 links distant.

Thence first course North 528 feet to corner No. 2.

Thence second course, S 89° 49' W 1140 feet to corner No. 3.

Thence third course, South 528 feet to corner No. 4, identical with corner No. 4 of said Luce Nickel Quartz Lode Claim.

Thence fourth course, N 89° 49' E 1140 to corner No. 1, the place of beginning.

Beginning for the description of the Parmley Nickel Quartz Lode Claim at corner No. 1 a post four inches square marked No. 1 M. S. 307 with mound of stone, from which the quarter Section corner between said Section 16 and 17 bears South 1056 distant a pine 5 inches in diameter marked No. 1 M. S. 307 B. T. bears N 18° W 57 links distant and a pine fourteen inches in diameter marked No. 1 M. S. 307 B. T. bears S 57° W 66 links distant and cut No. 7 bears N 70° W 46 feet distant.

Thence first course, North 528 feet to corner No. 2 identical with corner No. 1 of said Surghner Nickel Quartz Claim.

Thence second course, S 89° 49' W 1140 feet to corner No. 3 identical with corner No. 4 of said Luce Nickel Quartz Lode Claim.

Thence third course, South 528 feet to corner No. 4.

Thence fourth course, N 89° 49' E 1140 feet to corner No. 1, the place of beginning.

Beginning for the description of the Ashley Nickel Quartz Lode Mining Claim at corner No. 1, a post four inches square marked No. 1 M. S. 307, with mound of stone, from which the quarter Section corner between said Sections 16 and 17 bears South 528 feet distant a cedar 36 inches in diameter marked NO. 1 M. S. 307 B. T. bears N 40° W 36 links distant, and a

cedar four inches in diameter marked No. 1 M. S. 307 B. T. bears S 73° 30 ' W 48 links distant.

Thence first course, North 528 feet to corner No. 2, identical with Corner No. 1 of said Parmley Nickel Quartz Lode Claim.

Thence second course, S 89° 49' W 1140 feet to corner No. 3.

Thence third course, South 528 feet to corner No. 4, identical with corner No. 4 of said Winslow Nickel Quartz Lode Claim.

Thence fourth course, N 89° 49' E 1140 feet to corner No. 1, the place of beginning.

Beginning for the description of the East Extension of Mammoth Nickel Quartz Lode Claim at corner No. 1, a post four inches square marked No. 1 M. S. 307, with mound of stone, identical with the quarter Section corner between said Sections 16 and 17, from which a pine twenty inches in diameter marked No. 1 M. S. 307 B. T. bears N 57° W 17 links distant and a pine thirty inches in diameter marked No. 1 M. S. 307 B. T. bears N 3° 30' W 1 chain and 18 links distant.

Thence first course, North 528 feet to corner No. 2, identical with corner No. 1 of said Ashley Nickel Quartz Lode Claim.

Thence second course, S 89° 49' W 1140 feet to corner No. 3, identical with corner No. 3 of said Mammoth Nickel Quartz Lode Claim.

Thence third course, South 528 feet to corner No. 4, identical with corner No. 4 of said Mammoth Nickel Quartz Lode Claim.

Thence fourth course, N 89° 49' E 1140 feet to corner No. 1, the place of beginning.

Parcel Four:

The Northwest quarter of the Northwest quarter (NW ¼ NW ¼) of Section Twenty-one (21), Township Thirty (30) South, Range Six (6) West of the Willamette Meridian, Douglas County Oregon.

STATE OF OREGON)
COUNTY OF DOUGLAS) ss
I, DOYLE SHAVER JR., COUNTY CLERK AND RECORDER OF CONVEYANCES, DO HEREBY CERTIFY THAT THIS INSTRUMENT WAS RECORDED

01 MAY -9 PM 2:41

DOYLE SHAVER JR.
DOUGLAS COUNTY CLERK

IN THE OFFICIAL RECORDS OF DOUGLAS COUNTY

BY _____ DEPUTY

FEE 15.00

2001-10664

BOOK 1720 PAGE 614

2000-22473

QUITCLAIM DEED

William T. Balding, Jr., aka William Thomas Balding, Jr., individually, and William T. Balding, Jr., Trustee of the William T. Balding, Jr. Revocable Living Trust, GRANTOR, releases and quitclaims to Oregon Nickel Mining Properties, Inc., an Oregon Corporation, GRANTEE, all right, title and interest in and to the real property situated in Douglas County, Oregon, described more fully in Exhibit A, attached hereto.

The true consideration for this conveyance is $10.00.

NOTICE

THIS INSTRUMENT WILL NOT ALLOW USE OF THE PROPERTY DESCRIBED IN THIS INSTRUMENT IN VIOLATION OF APPLICABLE LAND USE LAWS AND REGULATIONS. BEFORE SIGNING OR ACCEPTING THIS INSTRUMENT, THE PERSON ACQUIRING FEE TITLE TO THE PROPERTY SHOULD CHECK WITH THE APPROPRIATE CITY OR COUNTY PLANNING DEPARTMENT TO VERIFY APPROVED USES AND TO DETERMINE ANY LIMITS ON LAWSUITS AGAINST FARMING OR FOREST PRACTICES AS DEFINED IN ORS 30.930

DATED this _____ day of _____, 2000.

GRANTOR:

William T. Balding, Jr.

William T. Balding, Jr., Trustee for the William T. Balding, Jr. Revocable Living Trust

STATE OF Hawaii)
) ss.
County of Honolulu)

This instrument was acknowledged before me on October 27, 2000, by William T. Balding, Jr., individually, and as Trustee for the William T. Balding, Jr. Revocable Living Trust.

Notary Public for Hawaii
My Commission Expires: 11-6-02

NOTARY PUBLIC STATE OF HAWAII

After Recording Return to:

Ronald S. Yockim
Attorney at Law
P.O. Box 2456
Roseburg, Oregon 97470

HANDED

Until requested otherwise send all tax statements to:
Ronald S. Yockim
Attorney at Law
P.O. Box 2456
Roseburg, Oregon 97470

Exhibit A

Parcel One:
The Southeast Quarter (1/4) of Section Eight (8) Township Thirty (30) South of Range Six (6) West of Willamette Meridian, Douglas County, Oregon.

Parcel Two:
The West half (1/2) of Section Sixteen (16) in Township Thirty (30) South of Range Six (6) West of Willamette Meridian, Douglas County, Oregon.

Parcel Three:
The patented Emerald Lode Mining Claim, Mineral Cert. #57, described in United States Patent therefor recorded January 17, 1893 in Book 28, Page 308, encompassing a portion of the Southeast Quarter (1/4) of Section Eighteen (18) in Township Thirty (30) South of Range Six (6) West of the Willamette Meridian, Douglas County, Oregon, more particularly described as follows: BEGINNING at corner No. 1 a post 3 inches square Marked EMC con No. 1 a mound of stone along side situated on west boundary line of the Oakland placer claim, and also on line between Sections 17 and 18 from which the quarter section corner between said Sections 17 and 18 in Township 30 South of Range 6 West, Willamette Meridian, bears North 600 feet distant a fir 6 inches in diameter marked EMC corner No. 1 B. J. bears South 56° East 10 feet distant and a pine 4 inches in diameter marked EMC corner No. 1 B.J. bears South 30° West 12 feet distant; thence first course South 45° West 1500 feet to corner No. 2; thence second course South 45° East 600 feet to corner No. 3; thence third course North 45° East 900 feet intersect West boundary line of said Oakland placer claim and also said section line 1500 feet to corner No. 4; thence fourth course North 45° West 198 feet to a point from which corner No. 1 bears South 72° West 340 feet distant 600 feet to corner No. 1, the place of beginning. Expressly excepting and excluding from these presents all that portion of the ground hereinbefore described embraced in said Oakland placer claim, and also all that portion of said Emerald vein or lode and of all veins, lodes and ledges through their entire depth the tops or apexes of which lie inside of said excluded ground; said lot No. 39 extending 1500 feet in length along said Emerald vein or lode, the grantee's premises in said lot containing 16.53 acres of land, more or less.

Parcel Four:
The patented Noumeite Placer Nickel and Chrome Mining Claim, Mineral Cert. #45, described in United States Patent therefore recorded March 21, 1892 in Book 26, Page 631, encompassing a portion of Section Seventeen (17) in Township Thirty (30) South of Range Six (6) West of the Willamette Meridian, Douglas County, Oregon, more particularly described as follows: The Southeast Quarter of Section Seventeen (17) in Township Thirty (30) South of Range Six (6) West of the Willamette Meridian, Douglas County, Oregon.

Excepting therefrom any veins or lodes of quartz, or other rock in place bearing gold, silver, cinnabar, lead, tin, copper, or other valuable deposits within the land above described which may have been discovered or known to exist on or prior to December 21, 1886, reserved in the United States Patent referred to above.

Parcel Five:
The patented Oakland Placer Nickel and Chrome Mining Claim, Mineral Cert. #46 described in United States Patent therefore recorded March 22, 1892 in Book 26, Page 633, encompassing a portion of Section Seventeen (17) in Township Thirty (30) South of Range Six (6) West of the Willamette Meridian, Douglas County, Oregon, more particularly described as follows: The Southwest Quarter of Section Seventeen (17) in Township Thirty (30) South of Range Six (6) West of the Willamette Meridian, Douglas County, Oregon.

EXHIBIT A
PAGE 1 OF 2

Excepting therefrom any veins or lodes of quartz, or other rock in place bearing gold, silver, cinnabar, lead, tin, copper, or other valuable deposits within the land above described which may have been discovered or known to exist on or prior to December 21, 1886 , reserved in the United States Patent referred to above.

Parcel Six:
The patented Victoria Placer Mining Claim; Mineral Cert. #56, described in United States Patent therefore recorded March 22, 1892 in Book 26, Page 635, encompassing a portion of Section Seventeen (17) in Township Thirty (30) South of Range Six (6) West of the Willamette Meridian, Douglas County, Oregon, more particularly described as follows:
The Northwest Quarter of Section Seventeen (17) in Township Thirty (30) South of Range Six (6) West of the Willamette Meridian, Douglas County, Oregon.

Excepting therefrom any veins or lodes of quartz, or other rock in place bearing gold, silver, cinnabar, lead, tin, copper, or other valuable deposits within the land above described which may have been discovered or known to exist on or prior to December 11, 1888 , reserved in the United States Patent referred to above.

EXCEPTING all encumbrances of record.

INCLUDING all of Sellers rights, title and interest in unpatented mining claims known as Olivine #1, Olivine #2, Olivine #3, Olivine #4, and Olivine #5, located in Section 20; Olivine #6, Olivine #7, Olivine #8, and Olivine #9, located in Section 18; and Nickel #1, located in Sections 17 and 18; all claims located in T.30S., R.6W., W.M.

STATE OF OREGON]
COUNTY OF DOUGLAS] ss
I, DOYLE SHAVER JR., COUNTY CLERK AND RECORDER OF CONVEYANCES, DO HEREBY CERTIFY THAT THIS INSTRUMENT WAS RECORDED

00 NOV -6 PM 3:53

DOYLE SHAVER JR.
DOUGLAS COUNTY CLERK

IN THE OFFICIAL RECORDS OF DOUGLAS COUNTY

BY Nancy R Davenport
DEPUTY

FEE 26.50
31

2000-22473

EXHIBIT A
PAGE 2 OF 2

2000-22135 BOOK 1719 PAGE 699

QUITCLAIM DEED

Peter A. Balding, aka Peter Adams Balding, individually, and Peter A. Balding, Trustee for the Peter Balding Revocable Living Trust, GRANTOR, releases and quitclaims to Oregon Nickel Mining Properties, Inc., an Oregon Corporation, GRANTEE, all right, title and interest in and to the real property situated in Douglas County, Oregon, described more fully in Exhibit A, attached hereto.

The true consideration for this conveyance is $10.00.

NOTICE

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DATED this 23 day of October, 2000.

GRANTOR:

Pet. A. Balding

Peter A. Balding

Pet. A. Balding, TPEE

Peter A. Balding, Trustee for the
Peter Balding Revocable Living Trust

STATE OF Hawaii)
CITY &) ss.
County of Honolulu)

This instrument was acknowledged before me on October 23, by Peter A. Balding, individually, and as Trustee for the Peter Balding Revocable Living Trust.

CHERYL NAKAOKA NOTARY PUBLIC STATE OF HAWAII

Notary Public for State of Hawaii
My Commission Expires: 03/12/2004

After Recording Return to:

Ronald S. Yockim
Attorney at Law
P.O. Box 2456
Roseburg, Oregon 97470

Until requested otherwise send all tax statements to:
Ronald S. Yockim
Attorney at Law
P.O. Box 2456
Roseburg, Oregon 97470

Exhibit A

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Parcel Four:
The patented Noumeite Placer Nickel and Chrome Mining Claim, Mineral Cert. #45, described in United States Patent therefore recorded March 21, 1892 in Book 26, Page 631, encompassing a portion of Section Seventeen (17) in Township Thirty (30) South of Range Six (6) West of the Willamette Meridian, Douglas County, Oregon, more particularly described as follows: The Southeast Quarter of Section Seventeen (17) in Township Thirty (30) South of Range Six (6) West of the Willamette Meridian, Douglas County, Oregon.

Excepting therefrom any veins or lodes of quartz, or other rock in place bearing gold, silver, cinnabar, lead, tin, copper, or other valuable deposits within the land above described which may have been discovered or known to exist on or prior to December 21, 1886 , reserved in the United States Patent referred to above.

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EXHIBIT A
PAGE 1 OF 2

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Parcel Six:
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EXCEPTING all encumbrances of record.

INCLUDING all of Sellers rights, title and interest in unpatented mining claims known as Olivine #1, Olivine #2, Olivine #3, Olivine #4, and Olivine #5, located in Section 20; Olivine #6, Olivine #7, Olivine #8, and Olivine #9, located in Section 18; and Nickel #1, located in Sections 17 and 18; all claims located in T.30S., R.6W., W.M.

STATE OF OREGON] SS
COUNTY OF DOUGLAS]
I, DOYLE SHAVER JR., COUNTY CLERK AND RECORDER OF CONVEYANCES, DO HEREBY CERTIFY THAT THIS INSTRUMENT WAS RECORDED

00 OCT 31 PM 3:58

DOYLE SHAVER JR.
DOUGLAS COUNTY CLERK

IN THE OFFICIAL RECORDS OF DOUGLAS COUNTY

BY Nancy R. Davenport DEPUTY 2000-22135

HANDED
Yockim

FEE 26.5
31

EXHIBIT A
PAGE 2 OF 2

2000-21871 **QUITCLAIM DEED**

Albert G. Simpson, Jr., GRANTOR, releases and quitclaims to Oregon Nickel Mining Properties, Inc., an Oregon Corporation, GRANTEE, all right, title and interest in and to the real property situated in Douglas County, Oregon, described more fully in Exhibit A, attached hereto.

The true consideration for this conveyance is $10.00.

NOTICE

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DATED this 24 day of October, 2000.

GRANTOR:

Albert G. Simpson, Jr.

STATE OF California)
) ss.
County of Monterey)

This instrument was acknowledged before me on October 24, 2000, by Albert G. Simpson, Jr.

Notary Public for
My Commission Expires: 3-20-02

LORA ALBERTI
COMM. 1176842
NOTARY PUBLIC - CALIFORNIA
MERCED COUNTY
My Comm. Expires Mar. 20, 2002

After Recording Return to:

Ronald S. Yockim
Attorney at Law
P.O. Box 2456
Roseburg, Oregon 97470

Until requested otherwise send all tax statements to:
Ronald S. Yockim
Attorney at Law
P.O. Box 2456
Roseburg, Oregon 97470

HANDED

Exhibit A

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Excepting therefrom any veins or lodes of quartz, or other rock in place bearing gold, silver, cinnabar, lead, tin, copper, or other valuable deposits within the land above described which may have been discovered or known to exist on or prior to December 21, 1886, reserved in the United States Patent referred to above.

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The patented Oakland Placer Nickel and Chrome Mining Claim, Mineral Cert. #46 described in United States Patent therefore recorded March 22, 1892 in Book 26, Page 633, encompassing a portion of Section Seventeen (17) in Township Thirty (30) South of Range Six (6) West of the Willamette Meridian, Douglas County, Oregon, more particularly described as follows: The Southwest Quarter of Section Seventeen (17) in Township Thirty (30) South of Range Six (6) West of the Willamette Meridian, Douglas County, Oregon.

EXHIBIT A
PAGE 1 OF 2

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EXCEPTING all encumbrances of record.

INCLUDING all of Sellers rights, title and interest in unpatented mining claims known as Olivine #1, Olivine #2, Olivine #3, Olivine #4, and Olivine #5, located in Section 20; Olivine #6, Olivine #7, Olivine #8, and Olivine #9, located in Section 18; and Nickel #1, located in Sections 17 and 18; all claims located in T.30S., R.6W., W.M.

STATE OF OREGON] SS
COUNTY OF DOUGLAS]
I, DOYLE SHAVER JR., COUNTY CLERK AND RECORDER OF CONVEYANCES, DO HEREBY CERTIFY THAT THIS INSTRUMENT WAS RECORDED
00 OCT 27 PM 3:23
DOYLE SHAVER JR.
DOUGLAS COUNTY CLERK
IN THE OFFICIAL RECORDS OF DOUGLAS COUNTY
BY Glenaire C. Floth
DEPUTY
26.00
FEE 5.00
$31.00

2000-21871

HANDED

EXHIBIT A
PAGE 2 OF 2

FORM No. 833 – WARRANTY DEED (Individual or Corporate). COPYRIGHT 1998 STEVENS-NESS LAW PUBLISHING CO., PORTLAND, OR 97204

MB **2000-20274**

Oregon Nickel Mining Properties,
c/o John J. Macauley Inc.
10 Rockridge Road
Hillsborough, CA 94010
Grantor's Name and Address

Nickel Mountain, LLC
3000 Stewart Parkway, #204
Roseburg, OR 97470
Grantee's Name and Address

After recording, return to (Name, Address, Zip):
Ronald S. Yockim, Attorney
P.O. Box 2456
Roseburg, OR 97470

Until requested otherwise, send all tax statements to (Name, Address, Zip):
Nickel Mountain, LLC
3000 Stewart Parkway, #204
Roseburg, OR 97470

SPACE RESERVED FOR RECORDER'S USE

BOOK 1714 PAGE 895

STATE OF OREGON, County of ____ } ss.

I certify that the within instrument was received for record on the ____ day of ____, 19____, at ____ o'clock ____M., and recorded in book/reel/volume No. ____ on page ____ and/or as fee/file/instrument/microfilm/reception No. ____, Record of Deeds of said County.

Witness my hand and seal of County affixed.

NAME TITLE

By ____, Deputy.

WARRANTY DEED

KNOW ALL BY THESE PRESENTS that Oregon Nickel Mining Properties, Inc. an Oregon corporation hereinafter called grantor, for the consideration hereinafter stated, to grantor paid by Nickel Mountain, L.L.C. an Oregon Limited Liability Company hereinafter called grantee, does hereby grant, bargain, sell and convey unto the grantee and grantee's heirs, successors and assigns, that certain real property, with the tenements, hereditaments and appurtenances thereunto belonging or in any way appertaining, situated in Douglas County, State of Oregon, described as follows, to-wit:

(See Exhibit "A" attached hereto and incorporated herein)

(IF SPACE INSUFFICIENT, CONTINUE DESCRIPTION ON REVERSE SIDE)

To Have and to Hold the same unto grantee and grantee's heirs, successors and assigns forever.

And grantor hereby covenants to and with grantee and grantee's heirs, successors and assigns, that grantor is lawfully seized in fee simple of the above granted premises, free from all encumbrances except (if no exceptions, so state): None It is the intent of the Grantor to convey all after acquired title ALSO, and that grantor will warrant and forever defend the premises and every part and parcel thereof against the lawful claims and demands of all persons whomsoever, except those claiming under the above described encumbrances.

The true and actual consideration paid for this transfer, stated in terms of dollars, is $ 200,000.00 ① However, the actual consideration consists of or includes other property or value given or promised which is ☐ the whole ☐ part of the (indicate which) consideration.① (The sentence between the symbols ①, if not applicable, should be deleted. See ORS 93.030.)

In construing this deed, where the context so requires, the singular includes the plural, and all grammatical changes shall be made so that this deed shall apply equally to corporations and to individuals.

In witness whereof, the grantor has executed this instrument this 27th day of September, 19 2000; if grantor is a corporation, it has caused its name to be signed and its seal, if any, affixed by an officer or other person duly authorized to do so by order of its board of directors.

Oregon Nickel Mining Properties, Inc.

By: John J. Macauley, President

THIS INSTRUMENT WILL NOT ALLOW USE OF THE PROPERTY DESCRIBED IN THIS INSTRUMENT IN VIOLATION OF APPLICABLE LAND USE LAWS AND REGULATIONS. BEFORE SIGNING OR ACCEPTING THIS INSTRUMENT, THE PERSON ACQUIRING FEE TITLE TO THE PROPERTY SHOULD CHECK WITH THE APPROPRIATE CITY OR COUNTY PLANNING DEPARTMENT TO VERIFY APPROVED USES AND TO DETERMINE ANY LIMITS ON LAWSUITS AGAINST FARMING OR FOREST PRACTICES AS DEFINED IN ORS 30.930.

STATE OF ~~OREGON~~ California, County of ____) ss.

This instrument was acknowledged before me on ____, 2000,

by ____

This instrument was acknowledged before me on ____, 2000,

by John J. Macauley

as President

of Oregon Nickel Mining Properties, Inc.

Notary Public for Oregon

My commission expires ____

Commercial Title Co.
P.O. Box 1325
Roseburg, OR 97470
91254DH

Exhibit A

Parcel One:
The Southeast Quarter (1/4) of Section Eight (8) Township Thirty (30) South of Range Six (6) West of Willamette Meridian, Douglas County, Oregon.

Parcel Two:
The West half (1/2) of Section Sixteen (16) in Township Thirty (30) South of Range Six (6) West of Willamette Meridian, Douglas County, Oregon.

Parcel Three:
The patented Emerald Lode Mining Claim, Mineral Cert. #57, described in United States Patent therefor recorded January 17, 1893 in Book 28, Page 308, encompassing a portion of the Southeast Quarter (1/4) of Section Eighteen (18) in Township Thirty (30) South of Range Six (6) West of the Willamette Meridian, Douglas County, Oregon, more particularly described as follows: BEGINNING at corner No. 1 a post 3 inches square Marked EMC con No. 1 a mound of stone along side situated on west boundary line of the Oakland placer claim, and also on line between Sections 17 and 18 from which the quarter section corner between said Sections 17 and 18 in Township 30 South of Range 6 West, Willamette Meridian, bears North 600 feet distant a fir 6 inches in diameter marked EMC corner No. 1 B. J. bears South 56° East 10 feet distant and a pine 4 inches in diameter marked EMC corner No. 1 B.J. bears South 30° West 12 feet distant; thence first course South 45° West 1500 feet to corner No. 2; thence second course South 45° East 600 feet to corner No. 3; thence third course North 45° East 900 feet intersect West boundary line of said Oakland placer claim and also said section line 1500 feet to corner No. 4; thence fourth course North 45° West 198 feet to a point from which corner No. 1 bears South 72° West 340 feet distant 600 feet to corner No. 1, the place of beginning. Expressly excepting and excluding from these presents all that portion of the ground hereinbefore described embraced in said Oakland placer claim, and also all that portion of said Emerald vein or lode and of all veins, lodes and ledges through their entire depth the tops or apexes of which lie inside of said excluded ground; said lot No. 39 extending 1500 feet in length along said Emerald vein or lode, the grantee's premises in said lot containing 16.53 acres of land, more or less.

Parcel Four:
The patented Noumeite Placer Nickel and Chrome Mining Claim, Mineral Cert. #45, described in United States Patent therefore recorded March 21, 1892 in Book 26, Page 631, encompassing a portion of Section Seventeen (17) in Township Thirty (30) South of Range Six (6) West of the Willamette Meridian, Douglas County, Oregon, more particularly described as follows: The Southeast Quarter of Section Seventeen (17) in Township Thirty (30) South of Range Six (6) West of the Willamette Meridian, Douglas County, Oregon.

Excepting therefrom any veins or lodes of quartz, or other rock in place bearing gold, silver, cinnabar, lead, tin, copper, or other valuable deposits within the land above described which may have been discovered or known to exist on or prior to December 21, 1886, reserved in the United States Patent referred to above.

Parcel Five:
The patented Oakland Placer Nickel and Chrome Mining Claim, Mineral Cert. #46 described in United States Patent therefore recorded March 22, 1892 in Book 26, Page 633, encompassing a portion of Section Seventeen (17) in Township Thirty (30) South of Range Six (6) West of the Willamette Meridian, Douglas County, Oregon, more particularly described as follows: The Southwest Quarter of Section Seventeen (17) in Township Thirty (30) South of Range Six (6) West of the Willamette Meridian, Douglas County, Oregon.

EXHIBIT A
PAGE 1 OF 2

Excepting therefrom any veins or lodes of quartz, or other rock in place bearing gold, silver, cinnabar, lead, tin, copper, or other valuable deposits within the land above described which may have been discovered or known to exist on or prior to December 21, 1886 , reserved in the United States Patent referred to above.

Parcel Six:
The patented Victoria Placer Mining Claim, Mineral Cert. #56, described in United States Patent therefore recorded March 22, 1892 in Book 26, Page 635, encompassing a portion of Section Seventeen (17) in Township Thirty (30) South of Range Six (6) West of the Willamette Meridian, Douglas County, Oregon, more particularly described as follows:
The Northwest Quarter of Section Seventeen (17) in Township Thirty (30) South of Range Six (6) West of the Willamette Meridian, Douglas County, Oregon.

Excepting therefrom any veins or lodes of quartz, or other rock in place bearing gold, silver, cinnabar, lead, tin, copper, or other valuable deposits within the land above described which may have been discovered or known to exist on or prior to December 11, 1888 , reserved in the United States Patent referred to above.

EXCEPTING all encumbrances of record.

INCLUDING all of Sellers rights, title and interest in unpatented mining claims known as Olivine #1, Olivine #2, Olivine #3, Olivine #4, and Olivine #5, located in Section 20; Olivine #6, Olivine #7, Olivine #8, and Olivine #9, located in Section 18; and Nickel #1, located in Sections 17 and 18; all claims located in T.30S., R.6W., W.M.

EXHIBIT A
PAGE 2 OF 2

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT BOOK 1714 PAGE 898 No. 5807

State of California

County of Alameda

On 9/27/00 (DATE) before me, Jamie Vargas (NAME, TITLE OF OFFICER - E.G., "JANE DOE, NOTARY PUBLIC"),

personally appeared John Macauley (NAME(S) OF SIGNER(S)),

☒ personally known to me - **OR** - ☐ proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

JAMIE VARGAS
COMM. # 1245516
NOTARY PUBLIC - CALIFORNIA
ALAMEDA COUNTY
My Comm Exp Dec. 12 2003

WITNESS my hand and official seal.

Jamie Vargas
SIGNATURE OF NOTARY

OPTIONAL

Though the data below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent reattachment of this form.

CAPACITY CLAIMED BY SIGNER

☐ INDIVIDUAL
☐ CORPORATE OFFICER
_____ TITLE(S)
☐ PARTNER(S) ☐ LIMITED ☐ GENERAL
☐ ATTORNEY-IN-FACT
☐ TRUSTEE(S)
☐ GUARDIAN/CONSERVATOR
☐ OTHER: _____

DESCRIPTION OF ATTACHED DOCUMENT

_____ TITLE OR TYPE OF DOCUMENT

_____ NUMBER OF PAGES

_____ DATE OF DOCUMENT

_____ SIGNER(S) OTHER THAN NAMED ABOVE

SIGNER IS REPRESENTING:
NAME OF PERSON(S) OR ENTITY(IES)

_____

_____

STATE OF OREGON] SS
COUNTY OF DOUGLAS]

I, DOYLE SHAVER JR., COUNTY CLERK AND RECORDER OF CONVEYANCES, DO HEREBY CERTIFY THAT THIS INSTRUMENT WAS RECORDED

00 OCT -3 PM 2:47

DOYLE SHAVER JR.
DOUGLAS COUNTY CLERK

IN THE OFFICIAL RECORDS OF DOUGLAS COUNTY

BY Deanna Harrison DEPUTY

COM FEE 31.36

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2000-20274

5.46.

AFTER RECORDING MAIL TO:
Commercial Title Company
P O Box 1325
Roseburg, OR 97470

2000-19994

BOOK 1713 PAGE 997

LOAN NO. 2-2217806

[Space Above This Line For Recording Data]

DEED OF TRUST

THIS DEED OF TRUST ("Security Instrument") is made on September 28, 2000 . The grantor is Preston A Wills and Gweneth E Wills, Tenants by the Entirety ("Borrower"). The trustee is COMMERCIAL TITLE CO ("Trustee"). The beneficiary is SOUTH UMPQUA BANK, which is organized and existing under the laws of THE STATE OF OREGON , and whose address is 445 SE MAIN, PO BOX 1820, ROSEBURG, OR 97470 ("Lender"). Borrower owes Lender the principal sum of One Hundred Thousand Dollars and no/100 Dollars (U.S. $100,000.00). This debt is evidenced by Borrower's note dated the same date as this Security Instrument ("Note"), which provides for monthly payments, with the full debt, if not paid earlier, due and payable on October 1, 2015 . This Security Instrument secures to Lender: (a) the repayment of the debt evidenced by the Note, with interest, and all renewals, extensions and modifications of the Note; (b) the payment of all other sums, with interest, advanced under paragraph 7 to protect the security of this Security Instrument; and (c) the performance of Borrower's covenants and agreements under this Security Instrument and the Note. For this purpose, Borrower irrevocably grants and conveys to Trustee, in trust, with power of sale, the following described property located in Douglas County, Oregon:

Lot two (2) Block one (1) LOMA VISTA SUBDIVISION, PHASE I, Addition to the City of Roseburg, Douglas County, Oregon. Tax Account No. R53105

Commercial Title Co.
P.O. Box 1325
Roseburg, OR 97470
9177 jt

which has the address of 2430 NW Loma Vista Dr [Street] , Roseburg [City] ,
Oregon 97470 [Zip Code] ("Property Address");

TOGETHER WITH all the improvements now or hereafter erected on the property, and all easements, appurtenances, and fixtures now or hereafter a part of the property. All replacements and additions shall also be covered by this Security Instrument. All of the foregoing is referred to in this Security Instrument as the "Property."

BORROWER COVENANTS that Borrower is lawfully seised of the estate hereby conveyed and has the right to grant and convey the Property and that the Property is unencumbered, except for encumbrances of record. Borrower warrants and will defend generally the title to the Property against all claims and demands, subject to any encumbrances of record.

THIS SECURITY INSTRUMENT combines uniform covenants for national use and non-uniform covenants with limited variations by jurisdiction to constitute a uniform security instrument covering real property.

UNIFORM COVENANTS. Borrower and Lender covenant and agree as follows:

1. Payment of Principal and Interest; Prepayment and Late Charges. Borrower shall promptly pay when due the principal of and interest on the debt evidenced by the Note and any prepayment and late charges due under the Note.

2. Funds for Taxes and Insurance. Subject to applicable law or to a written waiver by Lender, Borrower shall pay to Lender on the day monthly payments are due under the Note, until the Note is paid in full, a sum ("Funds") for: (a) yearly taxes and assessments which may attain priority over this Security Instrument as a lien on the Property; (b) yearly leasehold payments or ground rents on the Property, if any; (c) yearly hazard or property insurance premiums; (d) yearly flood insurance premiums, if any; (e) yearly mortgage insurance premiums, if any; and (f) any sums payable by Borrower to Lender, in accordance with the provisions of paragraph 8, in lieu of the payment of mortgage insurance premiums. These items are called "Escrow Items." Lender may, at any time, collect and hold Funds in an amount not to exceed the maximum amount a lender for a federally related mortgage loan may require for Borrower's escrow account under the federal Real Estate Settlement Procedures Act of 1974 as amended from time to time, 12 U.S.C. § 2601 et seq. ("RESPA"), unless another law that applies to the Funds sets a lesser amount. If so, Lender may, at any time, collect and hold Funds in an amount not to exceed the lesser amount. Lender may estimate the amount of Funds due on the basis of current data and reasonable estimates of expenditures of future Escrow Items or otherwise in accordance with applicable law.

The Funds shall be held in an institution whose deposits are insured by a federal agency, instrumentality, or entity (including Lender, if Lender is such an institution) or in any Federal Home Loan Bank. Lender shall apply the Funds to pay the Escrow Items. Lender may not charge Borrower for holding and applying the Funds, annually analyzing the escrow account, or verifying the Escrow Items, unless Lender pays Borrower interest on the Funds and applicable law permits Lender to make such a charge. However, Lender may require Borrower to pay a one-time charge for an independent real estate tax reporting service used by Lender in connection with this loan, unless applicable law provides otherwise. Unless an agreement is made or applicable law requires interest to be paid, Lender shall not be required to pay Borrower any interest or earnings on the Funds. Borrower and Lender may agree in writing, however, that interest shall be paid on the Funds. Lender shall give to Borrower, without charge, an annual accounting of the Funds, showing credits and debits to the Funds and the purpose for which each debit to the Funds was made. The Funds are pledged as additional security for all sums secured by this Security Instrument.

If the Funds held by Lender exceed the amounts permitted to be held by applicable law, Lender shall account to Borrower for the excess Funds in accordance with the requirements of applicable law. If the amount of the Funds held by Lender at any time is not sufficient to pay the Escrow Items when due, Lender may so notify Borrower in writing, and, in such case Borrower shall pay to Lender the amount necessary to make up the deficiency. Borrower shall make up the deficiency in no more than twelve monthly payments, at Lender's sole discretion.

Upon payment in full of all sums secured by this Security Instrument, Lender shall promptly refund to Borrower any Funds held by Lender. If, under paragraph 21, Lender shall acquire or sell the Property, Lender, prior to the acquisition or sale of the Property, shall apply any Funds held by Lender at the time of acquisition or sale as a credit against the sums secured by this Security Instrument.

3. Application of Payments. Unless applicable law provides otherwise, all payments received by Lender under paragraphs 1 and 2 shall be applied: first, to any prepayment charges due under the Note; second, to amounts payable under paragraph 2; third, to interest due; fourth, to principal due; and last, to any late charges due under the Note.

4. Charges; Liens. Borrower shall pay all taxes, assessments, charges, fines and impositions attributable to the Property which may attain priority over this Security Instrument, and leasehold payments or ground rents, if any. Borrower shall pay these obligations in the manner provided in paragraph 2, or if not paid in that manner, Borrower shall pay them on time directly to the person owed payment. Borrower shall promptly furnish to Lender all notices of amounts to be paid under this paragraph. If Borrower makes these payments directly, Borrower shall promptly furnish to Lender receipts evidencing the payments.

Borrower shall promptly discharge any lien which has priority over this Security Instrument unless Borrower: (a) agrees in writing to the payment of the obligation secured by the lien in a manner acceptable to Lender; (b) contests in good faith the lien by, or defends against enforcement of the lien in, legal proceedings which in the Lender's opinion operate to prevent the enforcement of the lien; or (c) secures from the holder of the lien an agreement satisfactory to Lender subordinating the lien to this Security Instrument. If Lender determines that any part of the Property is subject to a lien which may attain priority over this Security Instrument, Lender may give Borrower a notice identifying the lien. Borrower shall satisfy the lien or take one or more of the actions set forth above within 10 days of the giving of notice.

5. Hazard or Property Insurance. Borrower shall keep the improvements now existing or hereafter erected on the Property insured against loss by fire, hazards included within the term "extended coverage" and any other hazards, including floods or flooding, for which Lender requires insurance. This insurance shall be maintained in the amounts and for the periods that Lender requires. The insurance carrier providing the insurance shall be chosen by Borrower subject to Lender's approval which shall not be unreasonably withheld. If Borrower fails to maintain coverage described above, Lender may, at Lender's option, obtain coverage to protect Lender's rights in the Property in accordance with paragraph 7.

All insurance policies and renewals shall be acceptable to Lender and shall include a standard mortgage clause. Lender shall have the right to hold the policies and renewals. If Lender requires, Borrower shall promptly give to Lender all receipts of paid premiums and renewal notices. In the event of loss, Borrower shall give prompt notice to the insurance carrier and Lender. Lender may make proof of loss if not made promptly by Borrower.

Unless Lender and Borrower otherwise agree in writing, insurance proceeds shall be applied to restoration or repair of the Property damaged, if the restoration or repair is economically feasible and Lender's security is not lessened. If the restoration or repair is not economically feasible or Lender's security would be lessened, the insurance proceeds shall be applied to the sums secured by this Security Instrument, whether or not then due, with any excess paid to Borrower. If Borrower abandons the Property, or does not answer within 30 days a notice from Lender that the insurance carrier has offered to settle a claim, then Lender may collect the insurance proceeds. Lender may use the proceeds to repair or restore the Property or to pay sums secured by this Security Instrument, whether or not then due. The 30-day period will begin when the notice is given.

Unless Lender and Borrower otherwise agree in writing, any application of proceeds to principal shall not extend or postpone the due date of the monthly payments referred to in paragraphs 1 and 2 or change the amount of the payments. If under paragraph 21 the Property is acquired by Lender, Borrower's right to any insurance policies and proceeds resulting from damage to the Property prior to the acquisition shall pass to Lender to the extent of the sums secured by this Security Instrument immediately prior to the acquisition.

6. Occupancy, Preservation, Maintenance and Protection of the Property; Borrower's Loan Application; Leaseholds. Borrower shall occupy, establish, and use the Property as Borrower's principal residence within sixty days after the execution of this Security Instrument and shall continue to occupy the Property as Borrower's principal residence for at least one year after the date of occupancy, unless Lender otherwise agrees in writing, which consent shall not be unreasonably withheld, or unless extenuating circumstances exist which are beyond Borrower's control. Borrower shall not destroy, damage or impair the Property, allow the Property to deteriorate, or commit waste on the Property. Borrower shall be in default if any forfeiture action or proceeding, whether civil or criminal, is begun that in Lender's good faith judgment could result in forfeiture of the Property or otherwise materially impair the lien created by this Security Instrument or Lender's security interest. Borrower may cure such a default and reinstate, as provided in paragraph 18, by causing the action or proceeding to be dismissed with a ruling that, in Lender's good faith determination, precludes forfeiture of the Borrower's interest in the Property or other material impairment of the lien created by this Security Instrument or Lender's security interest. Borrower shall also be in default if Borrower, during the loan application process, gave materially false or inaccurate information or statements to Lender (or failed to provide Lender with any material information) in connection with the loan evidenced by the Note, including, but not limited to, representations concerning Borrower's occupancy of the Property as a principal residence. If this Security Instrument is on a leasehold, Borrower shall comply with all the provisions of the lease. If Borrower acquires fee title to the Property, the leasehold and the fee title shall not merge unless Lender agrees to the merger in writing.

7. Protection of Lender's Rights in the Property. If Borrower fails to perform the covenants and agreements contained in this Security Instrument, or there is a legal proceeding that may significantly affect Lender's rights in the Property (such as a proceeding in bankruptcy, probate, for condemnation or forfeiture or to enforce laws or regulations), then Lender may do and pay for whatever is necessary to protect the value of the Property and Lender's rights in the Property. Lender's actions may include paying any sums secured by a lien which has priority over this Security Instrument, appearing in court, paying reasonable attorneys' fees and entering on the Property to make repairs. Although Lender may take action under this paragraph 7, Lender does not have to do so.

Any amounts disbursed by Lender under this paragraph 7 shall become additional debt of Borrower secured by this Security Instrument. Unless Borrower and Lender agree to other terms of payment, these amounts shall bear interest from the date of disbursement at the Note rate and shall be payable, with interest, upon notice from Lender to Borrower requesting payment.

8. Mortgage Insurance. If Lender required mortgage insurance as a condition of making the loan secured by this Security Instrument, Borrower shall pay the premiums required to maintain the mortgage insurance in effect. If, for any reason, the mortgage insurance coverage required by Lender lapses or ceases to be in effect, Borrower shall pay the premiums required to obtain coverage substantially equivalent to the mortgage insurance previously in effect, at a cost substantially equivalent to the cost to Borrower of the mortgage insurance previously in effect, from an alternate mortgage insurer approved by Lender. If substantially equivalent mortgage insurance coverage is not available, Borrower shall pay to Lender each month a sum equal to one-twelfth of the yearly mortgage insurance premium being paid by Borrower when the insurance coverage lapsed or ceased to be in effect. Lender will accept, use and retain these payments as a loss reserve in lieu of mortgage insurance. Loss reserve payments may no longer be required, at the option of Lender, if mortgage insurance coverage (in the amount and for the period that Lender requires) provided by an insurer approved by Lender again becomes available and is obtained. Borrower shall pay the premiums required to maintain mortgage insurance in effect, or to provide a loss reserve, until the requirement for mortgage insurance ends in accordance with any written agreement between Borrower and Lender or applicable law.

9. Inspection. Lender or its agent may make reasonable entries upon and inspections of the Property. Lender shall give Borrower notice at the time of or prior to an inspection specifying reasonable cause for the inspection.

10. Condemnation. The proceeds of any award or claim for damages, direct or consequential, in connection with any condemnation or other taking of any part of the Property, or for conveyance in lieu of condemnation, are hereby assigned and shall be paid to Lender.

In the event of a total taking of the Property, the proceeds shall be applied to the sums secured by this Security Instrument, whether or not then due, with any excess paid to Borrower. In the event of a partial taking of the Property in which the fair market value of the Property immediately before the taking is equal to or greater than the amount of the sums secured by this Security Instrument immediately before the taking, unless Borrower and Lender otherwise agree in writing, the sums secured by this Security Instrument shall be reduced by the amount of the proceeds multiplied by the following fraction: (a) the total amount of the sums secured immediately before the taking, divided by (b) the fair market value of the Property immediately before the taking. Any balance shall be paid to Borrower. In the event of a partial taking of the Property in which the fair market value of the Property immediately before the taking is less than the amount of the sums secured immediately before the taking, unless Borrower and Lender otherwise agree in writing or unless applicable law otherwise provides, the proceeds shall be applied to the sums secured by this Security Instrument whether or not the sums are then due.

If the Property is abandoned by Borrower, or if, after notice by Lender to Borrower that the condemnor offers to make an award or settle a claim for damages, Borrower fails to respond to Lender within 30 days after the date the notice is given, Lender is authorized to collect and apply the proceeds, at its option, either to restoration or repair of the Property or to the sums secured by this Security Instrument, whether or not then due.

Unless Lender and Borrower otherwise agree in writing, any application of proceeds to principal shall not extend or postpone the due date of the monthly payments referred to in paragraphs 1 and 2 or change the amount of such payments.

11. Borrower Not Released; Forbearance By Lender Not a Waiver. Extension of the time for payment or modification of amortization of the sums secured by this Security Instrument granted by Lender to any successor in interest of Borrower shall not operate to release the liability of the original Borrower or Borrrower's successors in interest. Lender shall not be required to commence proceedings against any successor in interest or refuse to extend time for payment or otherwise modify amortization of the sums secured by this Security Instrument by reason of any demand made by the original Borrower or Borrower's successors in interest. Any forbearance by Lender in exercising any right or remedy shall not be a waiver of or preclude the exercise of any right or remedy.

12. Successors and Assigns Bound; Joint and Several Liability; Co-signers. The covenants and agreements of this Security Instrument shall bind and benefit the successors and assigns of Lender and Borrower, subject to the provisions of paragraph 17. Borrower's covenants and agreements shall be joint and several. Any Borrower who co-signs this Security Instrument but does not execute the Note: (a) is co-signing this Security Instrument only to mortgage, grant and convey that Borrower's interest in the Property under the terms of this Security Instrument; (b) is not personally obligated to pay the sums secured by this Security Instrument; and (c) agrees that Lender and any other Borrower may agree to extend, modify, forbear or make any accommodations with regard to the terms of this Security Instrument or the Note without that Borrower's consent.

13. Loan Charges. If the loan secured by this Security Instrument is subject to a law which sets maximum loan charges, and that law is finally interpreted so that the interest or other loan charges collected or to be collected in connection with the loan exceed the permitted limits, then: (a) any such loan charge shall be reduced by the amount necessary to reduce the charge to the permitted limit; and (b) any sums already collected from Borrower which exceeded permitted limits will be refunded to Borrower. Lender may choose to make this refund by reducing the principal owed under the Note or by making a direct payment to Borrower. If a refund reduces principal, the reduction will be treated as a partial prepayment without any prepayment charge under the Note.

14. Notices. Any notice to Borrower provided for in this Security Instrument shall be given by delivering it or by mailing it by first class mail unless applicable law requires use of another method. The notice shall be directed to the Property Address or any other address Borrower designates by notice to Lender. Any notice to Lender shall be given by first class mail to Lender's address stated herein or any other address Lender designates by notice to Borrower. Any notice provided for in this Security Instrument shall be deemed to have been given to Borrower or Lender when given as provided in this paragraph.

15. Governing Law; Severability. This Security Instrument shall be governed by federal law and the law of the jurisdiction in which the Property is located. In the event that any provision or clause of this Security Instrument or the Note conflicts with applicable law, such conflict shall not affect other provisions of this Security Instrument or the Note which can be given effect without the conflicting provision. To this end the provisions of this Security Instrument and the Note are declared to be severable.

16. Borrower's Copy. Borrower shall be given one conformed copy of the Note and of this Security Instrument.

17. Transfer of the Property or a Beneficial Interest in Borrower. If all or any part of the Property or any interest in it is sold or transferred (or if a beneficial interest in Borrower is sold or transferred and Borrower is not a natural person) without Lender's prior written consent, Lender may, at its option, require immediate payment in full of all sums secured by this Security Instrument. However, this option shall not be exercised by Lender if exercise is prohibited by federal law as of the date of this Security Instrument.

If Lender exercises this option, Lender shall give Borrower notice of acceleration. The notice shall provide a period of not less than 30 days from the date the notice is delivered or mailed within which Borrower must pay all sums secured by this Security Instrument. If Borrower fails to pay these sums prior to the expiration of this period, Lender may invoke any remedies permitted by this Security Instrument without further notice or demand on Borrower.

18. Borrower's Right to Reinstate. If Borrower meets certain conditions, Borrower shall have the right to have enforcement of this Security Instrument discontinued at any time prior to the earlier of: (a) 5 days (or such other period as applicable law may specify for reinstatement) before sale of the Property pursuant to any power of sale contained in this Security Instrument; or (b) entry of a judgment enforcing this Security Instrument. Those conditions are that Borrower: (a) pays Lender all sums which then would be due under this Security Instrument and the Note as if no acceleration had occurred; (b) cures any default of any other covenants or agreements; (c) pays all expenses incurred in enforcing this Security Instrument, including, but not limited to, reasonable attorneys' fees; and (d) takes such action as Lender may reasonably require to assure that the lien of this Security Instrument, Lender's rights in the Property and Borrower's obligation to pay the sums secured by this Security Instrument shall continue unchanged. Upon reinstatement by Borrower, this Security Instrument and the obligations secured hereby shall remain fully effective as if no acceleration had occurred. However, this right to reinstate shall not apply in the case of acceleration under paragraph 17.

19. Sale of Note; Change of Loan Servicer.
The Note or a partial interest in the Note (together with this Security Instrument) may be sold one or more times without prior notice to Borrower. A sale may result in a change in the entity (known as the "Loan Servicer") that collects monthly payments due under the Note and this Security Instrument. There also may be one or more changes of the Loan Servicer unrelated to a sale of the Note. If there is a change of the Loan Servicer, Borrower will be given written notice of the change in accordance with paragraph 14 above and applicable law. The notice will state the name and address of the new Loan Servicer and the address to which payments should be made. The notice will also contain any other information required by applicable law.

20. Hazardous Substances. Borrower shall not cause or permit the presence, use, disposal, storage, or release of any Hazardous Substances on or in the Property. Borrower shall not do, nor allow anyone else to do, anything affecting the Property that is in violation of any Environmental Law. The preceding two sentences shall not apply to the presence, use, or storage on the Property of small quantities of Hazardous Substances that are generally recognized to be appropriate to normal residential uses and to maintenance of the Property.

Borrower shall promptly give Lender written notice of any investigation, claim, demand, lawsuit or other action by any governmental or regulatory agency or private party involving the Property and any Hazardous Substance or Environmental Law of which Borrower has actual knowledge. If Borrower learns, or is notified by any governmental or regulatory authority, that any removal or other remediation of any Hazardous Substance affecting the Property is necessary, Borrower shall promptly take all necessary remedial actions in accordance with Environmental Law.

As used in this paragraph 20, "Hazardous Substances" are those substances defined as toxic or hazardous substances by Environmental Law and the following substances: gasoline, kerosene, other flammable or toxic petroleum products, toxic pesticides and herbicides, volatile solvents, materials containing asbestos or formaldehyde, and radioactive materials. As used in this paragraph 20, "Environmental Law" means federal laws and laws of the jurisdiction where the Property is located that relate to health, safety or environmental protection.

NON-UNIFORM COVENANTS. Borrower and Lender further covenant and agree as follows:

21. Acceleration; Remedies. Lender shall give notice to Borrower prior to acceleration following Borrower's breach of any covenant or agreement in this Security Instrument (but not prior to acceleration under paragraph 17 unless applicable law provides otherwise). The notice shall specify: (a) the default; (b) the action required to cure the default; (c) a date, not less than 30 days from the date the notice is given to Borrower, by which the default must be cured; and (d) that failure to cure the default on or before the date specified in the notice may result in acceleration of the sums secured by this Security Instrument and sale of the Property. The notice shall further inform Borrower of the right to reinstate after acceleration and the right to bring a court action to assert the non-existence of a default or any other defense of Borrower to acceleration and sale. If the default is not cured on or before the date specified in the notice, Lender at its option may require immediate payment in full of all sums secured by this Security Instrument without further demand and may invoke the power of sale and any other remedies permitted by applicable law. Lender shall be entitled to collect all expenses incurred in pursuing the remedies provided in this paragraph 21, including, but not limited to, reasonable attorneys' fees and costs of title evidence.

If Lender invokes the power of sale, Lender shall execute or cause Trustee to execute a written notice of the occurrence of an event of default and of Lender's election to cause the Property to be sold and shall cause such notice to be recorded in each county in which any part of the Property is located. Lender or Trustee shall give notice of sale in the manner prescribed by applicable law to Borrower and to other persons prescribed by applicable law. After the time required by applicable law, Trustee, without demand on Borrower, shall sell the Property at public auction to the highest bidder at the time and place and under the terms designated in the notice of sale in one or more parcels and in any order Trustee determines. Trustee may postpone sale of all or any parcel of the Property by public announcement at the time and place of any previously scheduled sale. Lender or its designee may purchase the Property at any sale.

Trustee shall deliver to the purchaser Trustee's deed conveying the Property without any covenant or warranty, expressed or implied. The recitals in the Trustee's deed shall be prima facie evidence of the truth of the statements made therein. Trustee shall apply the proceeds of the sale in the following order: (a) to all expenses of the sale, including, but not limited to, reasonable Trustee's and attorneys' fees; (b) to all sums secured by this Security Instrument; and (c) any excess to the person or persons legally entitled to it.

22. Reconveyance. Upon payment of all sums secured by this Security Instrument and all notes evidencing debt secured by this Security Instrument to Trustee. Trustee shall reconvey the Property without warranty to the person or persons legally entitled to it. Such person or persons shall pay any recordation costs.

23. Substitute Trustee. Lender may from time to time remove Trustee and appoint a successor trustee to any Trustee appointed hereunder. Without conveyance of the Property, the successor trustee shall succeed to all the title, power and duties conferred upon Trustee herein and by applicable law.

24. Attorneys' Fees. As used in this Security Instrument and in the Note, "attorneys' fees" shall include any attorneys' fees awarded by an appellate court.

25. Riders to this Security Instrument.
If one or more riders are executed by Borrower and recorded together with this Security Instrument, the covenants and agreements of each such rider shall be incorporated into and shall amend and supplement the covenants and agreements of this Security Instrument as if the rider(s) were a part of this Security Instrument. [Check applicable box(es)]

- ☐ Adjustable Rate Rider
- ☐ Graduated Payment Rider
- ☐ Balloon Rider
- ☐ Other(s) [specify]
- ☐ Condominium Rider
- ☐ Planned Unit Development Rider
- ☐ Rate Improvement Rider
- ☐ 1–4 Family Rider
- ☐ Biweekly Payment Rider
- ☐ Second Home Rider

BY SIGNING BELOW, Borrower accepts and agrees to the terms and covenants contained in this Security Instrument and in any rider(s) executed by Borrower and recorded with it.

Witnesses:

STATE OF OREGON } ss
COUNTY OF DOUGLAS }
I, DOYLE SHAVER JR., COUNTY CLERK AND EX-OFFICIO RECORDER OF CONVEYANCES, DO HEREBY CERTIFY THAT THIS INSTRUMENT WAS RECORDED
00 SEP 29 AM 10:42
DOYLE SHAVER JR.
DOUGLAS COUNTY CLERK
IN THE OFFICIAL RECORDS OF DOUGLAS COUNTY
FEE $ 15.00
BY _____ Deputy

Preston A Wills _____ (Seal) -Borrower

Gweneth E Wills _____ (Seal) -Borrower

_____ (Seal) -Borrower

_____ (Seal) -Borrower

[Space Below This Line For Acknowledgment]

STATE OF OREGON, DOUGLAS County ss:

On this 28th day of September, 2000, personally appeared the above named Preston A Wills and Gweneth E Wills

and acknowledged the foregoing instrument to be their voluntary act and deed.

Before me:

OFFICIAL SEAL
CLAUDETTE S VON DERAHE
NOTARY PUBLIC - OREGON
COMMISSION NO. 059342
MY COMMISSION EXPIRES DEC. 02, 2000

Notary Public for Oregon

(Official Seal)

My Commission expires:

2000-19994

2000-02518
2000-10664

PERSONAL PROPERTY TAX WARRANT

(This is a lien demand and not an arrest warrant)

BOOK 1670 PAGE 286

State of Oregon, County of DOUGLAS Warrant Number OOW-00369

BOOK 1689 PAGE 140

Date Issued: 01-28-2000 Interest to: 02-15-2000

Directed to: SHADOW RANCH

PO BOX 1758
ROSEBURG , OR 97470

STATE OF OREGON } ss
COUNTY OF DOUGLAS }
I, DOYLE SHAVER JR., COUNTY CLERK AND RECORDER OF CONVEYANCES, DO HEREBY CERTIFY THAT THIS INSTRUMENT WAS RECORDED
00 FEB -7 AM 8:12
DOYLE SHAVER JR.
DOUGLAS COUNTY CLERK
IN THE OFFICIAL RECORDS OF DOUGLAS COUNTY
FEE

IMPS ONLY MOBILE INVEN
CHECK FOR SALE IN 99

The above named appears as owning or having possession or control of certain personal property on the accounts listed below. Taxes lawfully assessed, levied, and charged on said personal property have not been paid and are delinquent for the years and in the respective amounts specified.

This warrant is issued to enforce payment of these taxes pursuant to Oregon Revised Statute 311.610.

The description of the personal property as it appears in the latest tax roll, the year(s) for which taxes are delinquent, the principal amount for delinquent taxes for each year plus interest to the date of issuance of this warrant, and service charges, are as follows:

Description of Personal Property			Tax Year	Amount of Taxes	Amount Due	
Code Area	Account Number	Kind of Property			Interest	Total
4.01	X-4265	MFD STRUCT	99-00	100.56	1.34	101.90
		Total Amount of Taxes to be Recorded	100.56	Total Taxes and Interest		101.90
				Service Charges		25.00
				TOTAL Due		126.90

MAKE REMITTANCE PAYABLE TO:
DOUGLAS COUNTY TAX COLLECTOR
P.O. BOX 850 ROSEBURG, OR 97470

The amount due on this warrant is the sum of total taxes due, interest on all past due installments at the rate of 1.3333 percent per month until paid (ORS 311.505), and the service charges.

STATE OF OREGON } ss
COUNTY OF DOUGLAS }
I, DOYLE SHAVER JR., COUNTY CLERK AND RECORDER OF CONVEYANCES, DO HEREBY CERTIFY THAT THIS INSTRUMENT WAS RECORDED
00 MAY 17 AM 11:53
DOYLE SHAVER JR.
DOUGLAS COUNTY CLERK
IN THE OFFICIAL RECORDS OF DOUGLAS COUNTY
FEE
BY
DEPUTY

SERVICE OF WARRANT

A duplicate of this warrant was served on the person named by:

1. ☐ Personal Service (ORS 311.620) — Date of Service
2. ☐ Publication (ORS 311.615) — Date of First Publication 01-28-2000
3. ☒ Certified Mail (ORS 311.620) — Date Mailed

Warrant served on

The cost of such service, publication or postage is:

$ 25.00

RELEASE OF LIEN

This warrant has been satisfied in full, and the lien is fully released.

DOUGLAS COUNTY TAX COLLECTOR
Tax Collector

by Donna Mitchell 5/17/2000
Deputy (MUST be signed to release lien) Date

— AFTER RECORDING RETURN TO COUNTY TAX COLLECTOR 2000-02518, 2000-10664

150-310-098 (Rev. 9-93) OOW-00369 COUNTY CLERK

PERSONAL PROPERTY TAX WARRANT

BOOK 1585 PAGE 210

99-03066 (This is a lien demand and not an arrest warrant)

2000-10662

State of Oregon, County of DOUGLAS Warrant Number 99W-00459

ss.

BOOK 1689 PAGE 138

Date Issued: 01-26-1999 Interest to: 02-15-1999

STATE OF OREGON } ss
COUNTY OF DOUGLAS }
I, DOYLE SHAVER JR., COUNTY CLERK AND RECORDER OF CONVEYANCES, DO HEREBY CERTIFY THAT THIS INSTRUMENT WAS RECORDED

99 FEB -9 AM 8:38

DOYLE SHAVER JR.
DOUGLAS COUNTY CLERK
IN THE OFFICIAL RECORDS OF DOUGLAS COUNTY

10X52 BY DEPUTY FEE

Directed to: MOORE, BRUCE ALLEN
MOORE, BECKY RENEE

PO BOX 1046
WINSTON, OR 97496

The above named appears as owning or having possession or control of certain personal property on the accounts listed below. Taxes lawfully assessed, levied, and charged on said personal property have not been paid and are delinquent for the years and in the respective amounts specified.

This warrant is issued to enforce payment of these taxes pursuant to Oregon Revised Statute 311.610.

The description of the personal property as it appears in the latest tax roll, the year(s) for which taxes are delinquent, the principal amount for delinquent taxes for each year plus interest to the date of issuance of this warrant, and service charges, are as follows:

Description of Personal Property			Tax Year	Amount of Taxes	Amount Due	
Code Area	Account Number	Kind of Property			Interest	Total
19.06	X-71737	MFD STRUCT	98-99	19.51	.78	20.29
		Total Amount of Taxes to be Recorded	19.51	Total Taxes and Interest		20.29
				Service Charges		25.00
				TOTAL Due		45.29

MAKE REMITTANCE PAYABLE TO:
DOUGLAS COUNTY TAX COLLECTOR
P.O. BOX 850 ROSEBURG, OR 97470

The amount due on this warrant is the sum of total taxes due, interest on all past due installments at the rate of 1.3333 percent per month until paid (ORS 311.505), and the service charges.

STATE OF OREGON } ss
COUNTY OF DOUGLAS }
I, DOYLE SHAVER JR., COUNTY CLERK AND RECORDER OF CONVEYANCES, DO HEREBY CERTIFY THAT THIS INSTRUMENT WAS RECORDED

00 MAY 17 AM 11:53

DOYLE SHAVER JR.
DOUGLAS COUNTY CLERK
IN THE OFFICIAL RECORDS OF DOUGLAS COUNTY

BY DEPUTY FEE 10.00

SERVICE OF WARRANT

A duplicate of this warrant was served on the person named by:

1. ☐ Personal Service (ORS 311.620) Date of Service
2. ☐ Publication (ORS 311.615) Date of First Publication 01-26-1999
3. ☒ Certified Mail (ORS 311.620) Date Mailed

Warrant served on

The cost of such service, publication or postage $ 25.00

RELEASE OF LIEN

This warrant has been satisfied in full, and the lien is fully released.

DOUGLAS COUNTY TAX COLLECTOR
Tax Collector

by Donna Mitchell 5/17/2000
Deputy (MUST by signed to release lien) Date

99-03066

AFTER RECORDING RETURN TO COUNTY TAX COLLECTOR -- 2000-10662

150-310-088 (Rev. 9-93) 99W-00459 COUNTY CLERK

99-00104

BOOK 1588 PAGE 212

WHEN RECORDED RETURN TO:
Wells Fargo Bank, N. A.
P. O. Box 5825
Denver, Colorado 80217

NO CONSIDERATION
NO TAX DUE

QUITCLAIM DEED

KNOW ALL MEN BY THESE PRESENTS:

That Wells Fargo Bank, N. A., Trustee under the will of Edson F. Adams, as Transferor, does hereby transfer, release, remise and quitclaim unto the following in equal shares:

Peter A. Balding, Trustee for the Peter Balding Revocable Living Trust
1411 Laamia Place
Honolulu, HI 96821

William T. Balding, Jr., Trustee of the William T. Balding, Jr. Revocable Living Trust
dated June 3, 1988
The Moorings, #43
6370 Hawali Kai Drive
Honolulu, HI 96825

collectively as Transferee, all of Transferor's right, title and interest that it may own or claim in and to the following described real property, situated in the County of Douglas, State of Oregon, more particularly described, to-wit:

> The South Half (S1/2) and North West Quarter (1/4) of Section Number Seventeen (17) and the West Half (1/2) of Section Number Sixteen (16), and all that portion of the South East Quarter (1/4) of Section Number Eighteen (18) embracing the Emerald Lode Mining Claim and designated as Lot Number Thirty-Nine (39) all in Township Thirty (30) South of Range Six (6) West of Willamette Meridian.

To have and to hold all and singular, the above described interest subject to all conditions, restrictions and reservations of record; this conveyance being made without warranty or other assurances, express or implied. Subject to all taxes, assessments and liens thereon and to all legal encumbrances existing as of the date of this Deed.

WHEREAS this Deed is executed this the 11th day of December, 1998.

Wells Fargo Bank. N. A., Trustee under the will of Edson F. Adams

Timothy K. Davies
Assistant Vice President

Carolyn Bonde
Assistant Vice President

State of Colorado)
)
City and County of Denver)

On this the 11th day of December, 1998, before me personally appeared Timothy K. Davies, Assistant Vice President and Carolyn Bonde, Assistant Vice President, Both of Wells Fargo Bank, N. A., who are known to me to be the persons whose names are subscribed to the foregoing instrument in the capacity stated, and acknowledged before me they executed the same for the purposes and consideration therein expressed on behalf of Wells Fargo Bank, N. A. by authority of its Board of Directors.

WITNESS my hand and seal this the 11th day of December, 1998.

My commission expires: September 15, 2001

Notary Public
Address: 633 17th Street, 3rd Floor
Denver, Colorado 80202

STATE OF OREGON] ss
COUNTY OF DOUGLAS]
I, DOYLE SHAVER JR., COUNTY CLERK AND RECORDER OF CONVEYANCES, DO HEREBY CERTIFY THAT THIS INSTRUMENT WAS RECORDED

99 JAN -5 AM 9:07

DOYLE SHAVER JR.
DOUGLAS COUNTY CLERK

IN THE OFFICIAL RECORDS OF DOUGLAS COUNTY

BY _____ DEPUTY

FEE 15.00

98-00104

30

98-00142

WARRANTY DEED

BOOK 1512 PAGE 910

KNOW ALL MEN BY THESE PRESENTS, That Jesse D. Beahm and Hazel J. Beahm, husband and wife

hereinafter called the grantor, for the consideration hereinafter stated, to grantor paid by Billy Ray Sanders and Helen Marie Sanders, husband and wife

hereinafter called the grantee, does hereby grant, bargain, sell and convey unto the said grantee and grantee's heirs, successors and assigns, that certain real property, with the tenements, hereditaments and appurtenances thereunto belonging or appertaining, situated in the County of Douglas *and State of Oregon, described as follows, to-wit:*

Parcel one of Land Partition No. 1997-0132, as recorded in "Record of Partition Plats", Deed Records of Douglas County, Oregon. TOGETHER WITH access and utitility easement as more particularly set forth on said Plat filed in Land Partition No. 1997-0132

Tax account #33709.00

TO HAVE and to HOLD the same unto the said grantee and grantee's heirs, successors and assigns forever.

And said grantor hereby covenants to and with said grantee and grantee's heirs, successors and assigns, that grantor is lawfully seized in fee simple of the above granted premises, free from all encumbrances

except rights of way, reservations, and easements of record

and that grantor will warrant and forever defend the said premises and every part and parcel thereof against the lawful claims and demands of all persons whomsoever, except those claiming under the above described encumbrances.

The true and actual consideration paid for this transfer, stated in terms of dollars, is $ 42,000.00 .

In construing this deed and where the context so requires, the singular includes the plural and all grammatical changes shall be implied to make the provisions hereof apply equally to corporations and to individuals.

In Witness Whereof, the grantor has executed this instrument this 2nd *day of* January, *19* 98 *; if a corporate grantor, it has caused its name to be signed and seal affixed by its officers, duly authorized thereto by order of its board of directors.*

THIS INSTRUMENT WILL NOT ALLOW USE OF THE PROPERTY DESCRIBED IN THIS INSTRUMENT IN VIOLATION OF APPLICABLE LAND USE LAWS AND REGULATIONS. BEFORE SIGNING OR ACCEPTING THIS INSTRUMENT, THE PERSON ACQUIRING FEE TITLE TO THE PROPERTY SHOULD CHECK WITH THE APPROPRIATE CITY OR COUNTY PLANNING DEPARTMENT TO VERIFY APPROVED USES AND TO DETERMINE ANY LIMITS ON LAWSUITS AGAINST FARMING OR FOREST PRACTICES AS DEFINED IN ORS 30.930.

Jesse D Beahm

Jesse D. Beahm

Hazel J. Beahm

Hazel J. Beahm

STATE OF OREGON
County of Multnomah) ss.

BE IT REMEMBERED, That on this 2nd day of ~~December~~ January, ~~1997~~ 1998, before me, the undersigned, a Notary Public in and for the said State, personally appeared the within named Jesse D. Beahm, Hazel J. Beahm

known to me to be the identical individual s described in and who executed the within instrument and acknowledged to me that they executed the same freely and voluntarily.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my official seal the day and year last above written.

Debra L Johnson

Notary Public for Oregon

OFFICIAL SEAL
DEBRA L JOHNSON
NOTARY PUBLIC-OREGON
COMMISSION NO. 034846
MY COMMISSION EXPIRES MAY 19, 1998

My Commission Expires 5/19/98

Jesse D. Beahm
1517 SE Kelly
Gresham, OR 97080
Grantor's Name and Address

Billy Ray Sanders
359 Hawthorne
Sutherlin, OR. 97479
Grantee's Name and Address

After recording return to:
Billy Ray Sanders
359 Hawthorne
Sutherlin, OR. 97479
Name, Address, Zip

Until a change is requested all tax statements shall be sent to the following address.
Billy Ray Sanders
359 Hawthorne
Sutherlin, OR. 97479
Name, Address, Zip

STATE OF OREGON] SS
COUNTY OF DOUGLAS]

I, DOYLE SHAVER JR., COUNTY CLERK AND RECORDER OF CONVEYANCES, DO HEREBY CERTIFY THAT THIS INSTRUMENT WAS RECORDED

'98 JAN -5 PM 2:46

Space Reserved For Recorder's Use

DOYLE SHAVER JR.
DOUGLAS COUNTY CLERK

IN THE OFFICIAL RECORDS OF DOUGLAS COUNTY

BY Deana Adair DEPUTY

25-
FEE 5-
30-

STATE OF OREGON, County of
I certify that the within instrument received for record on the - day of _____, _____ *o'clock* ___ *M., and recorded in book/reel/volume No.* _____ *on page* _____ *or as fee/file/instrument/microfilm/reception No.* _____ *Records of Deeds of said County*
Witness my hand and seal of affixed.

Name Title

By _____ *Deputy*

Commercial Title Co.
P.O. Box 1325
Roseburg, OR 97470
84693 CV

98-00142

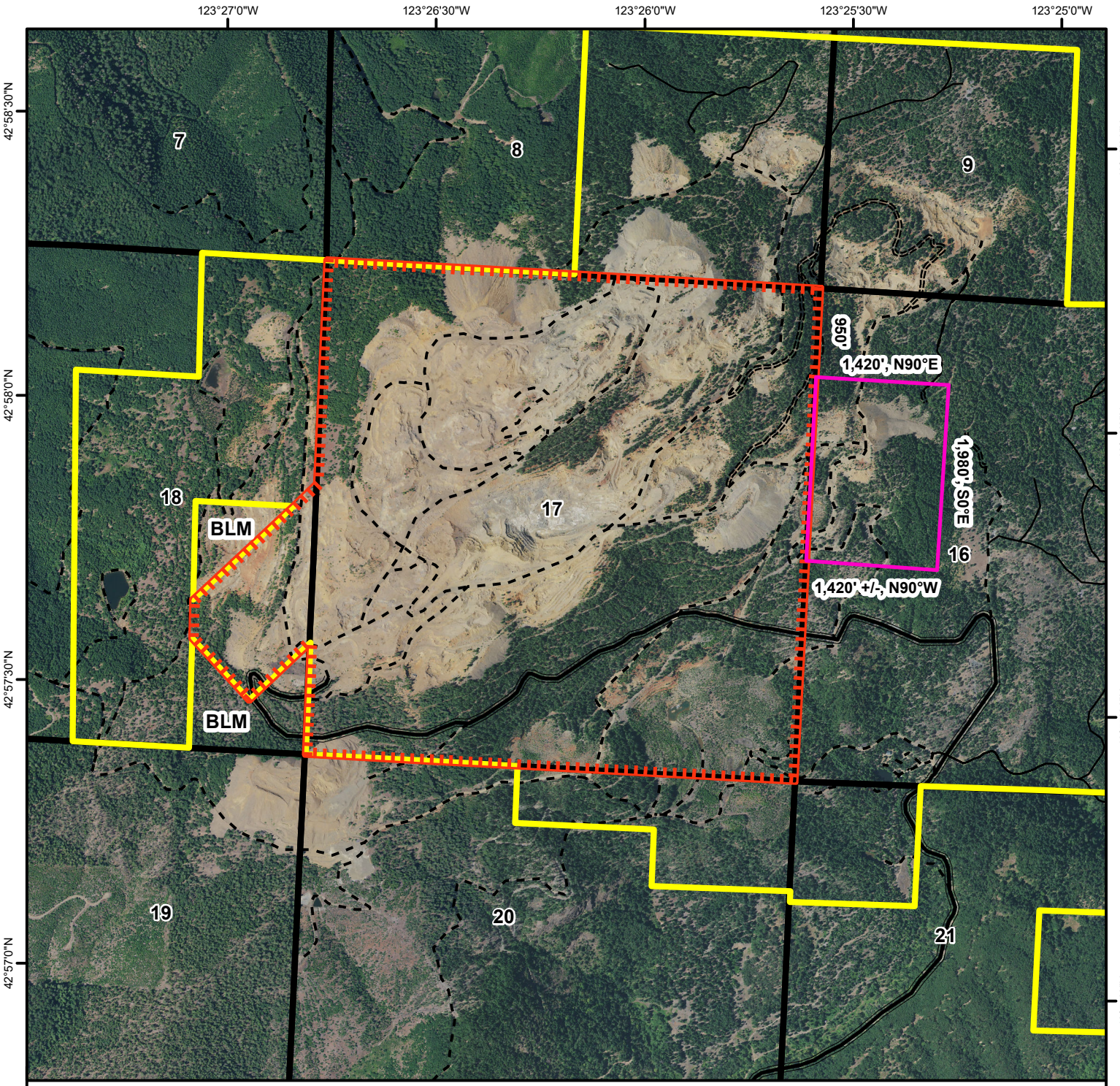
OTHER DOCUMENTS

Barnes & Associates, Inc.
3000 NW Stewart Parkway, Suite 204
Roseburg, OR 97471
541-673-1208

Nickel Mountain, LLC
Knife River Phase 1 Map

T. 30S., R. 6W. Sec. 16, 17, & 18, W.M.
Douglas County, Oregon

N



KnifeRiverAreaUnderRoyalty
KnifeRiverPurchaseArea
Nickel Mountain, LLC Ownership
Paved
Rock
Native
ATV
BrushedOver

1 inch = 1,500 feet
2020 Imagery
Date: 1/5/2021

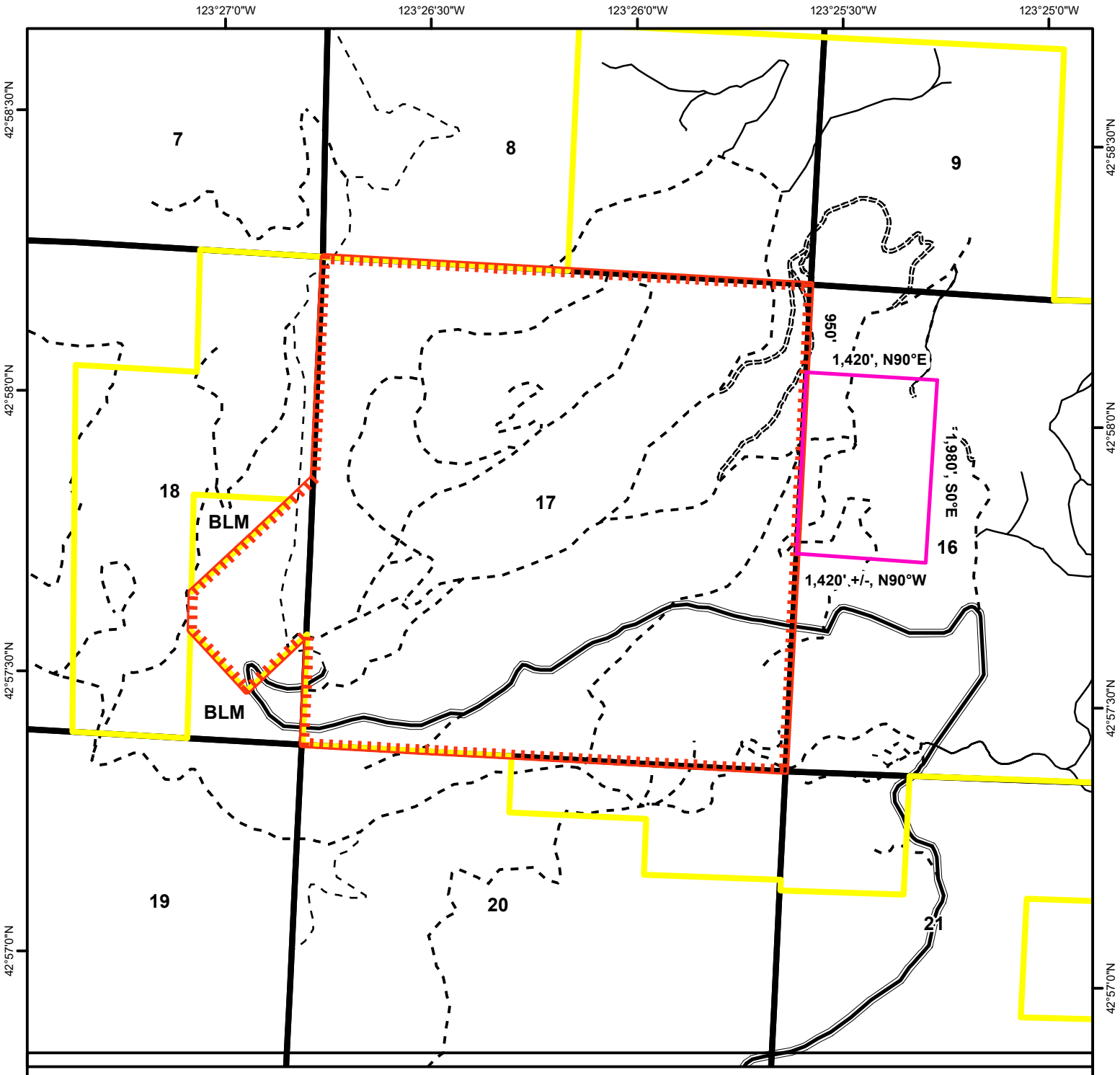
This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or suveling purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information.

Barnes & Associates, Inc.
3000 NW Stewart Parkway, Suite 204
Roseburg, OR 97471
541-673-1208

Nickel Mountain, LLC
Knife River Phase 1 Map

T. 30S., R. 6W. Sec. 16, 17, & 18, W.M.
Douglas County, Oregon

N



KnifeRiverAreaUnderRoyalty
KnifeRiverPurchaseArea
Nickel Mountain, LLC Ownership
Paved
Rock
Native
==== ATV
×××× BrushedOver

1 inch = 1,500 feet
2016 Imagery
Date: 1/5/2021

This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or suveling purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information.

FINAL DOGAMI PERMIT BOUNDARY

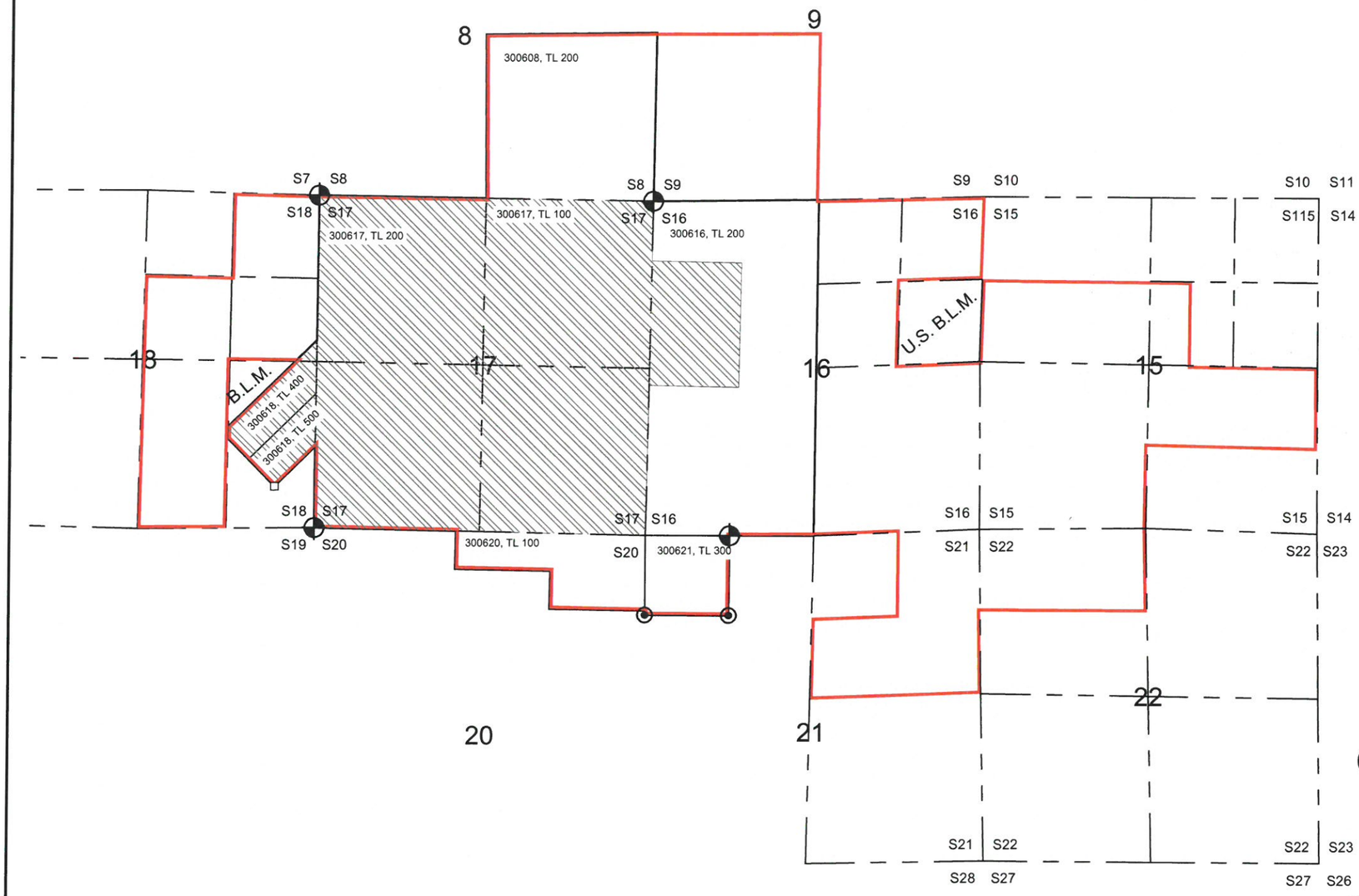
Nickel Mountain Quarry

DOGAMI Permit Number: _____

Permittee: Knife River Materials, Inc.,
3959 Hamrick Rd.
Central Point, OR 97502

Situated in Lot 200,Sec. 8, Tax Lot 200, Sec. 16, Tax Lots 100 & 200, Sec. 17, Tax Lots 400 & 500, Sec. 18, Tax Lot 100, Sec. 20 & Tax Lot 300, Sec. 21, T. 30 S., R. 6 W., W.M., Douglas County, Oregon

JULY 28 , 2020



LEGEND

- FD 5/8" IRON ROD
- FD BRASS CAP
- COMPUTED CORNER FROM FD BEARING TREES
- CALCULATED POINT
- NICKEL MTN. LLC. PROPERTY BOUNDARY
- CONDITIONAL USE PERMIT BOUNDARY
- PERMIT BOUNDARY (748± AC.)

BASIS OF BEARINGS PER OREGON COORDINATE REFERENCE SYSTEM, COTTAGE GROVE - CANYONVILLE ZONE PER OREGON REAL TIME GNSS NETWORK - (CORRECTORS FROM RSBG, RDL2 & GTPS)

N

0 2000 4000 8000 Feet

SCALE: 1" = 2000'

REGISTERED
PROFESSIONAL
LAND SURVEYOR

OREGON
JULY 16, 1987
MARK A. HEIMBURGER
2287

RENEWS JUNE 30, 2021

Land Mark
Surveying, Inc.
3317 N.E. Stephens St. •Roseburg, Oregon 97470
Office (541) 677-9400 •Fax (541) 677-9401

LM Proj. No.2020-0057

PERMIT BOUNDARY SURVEY

Nickel Mountain Quarry

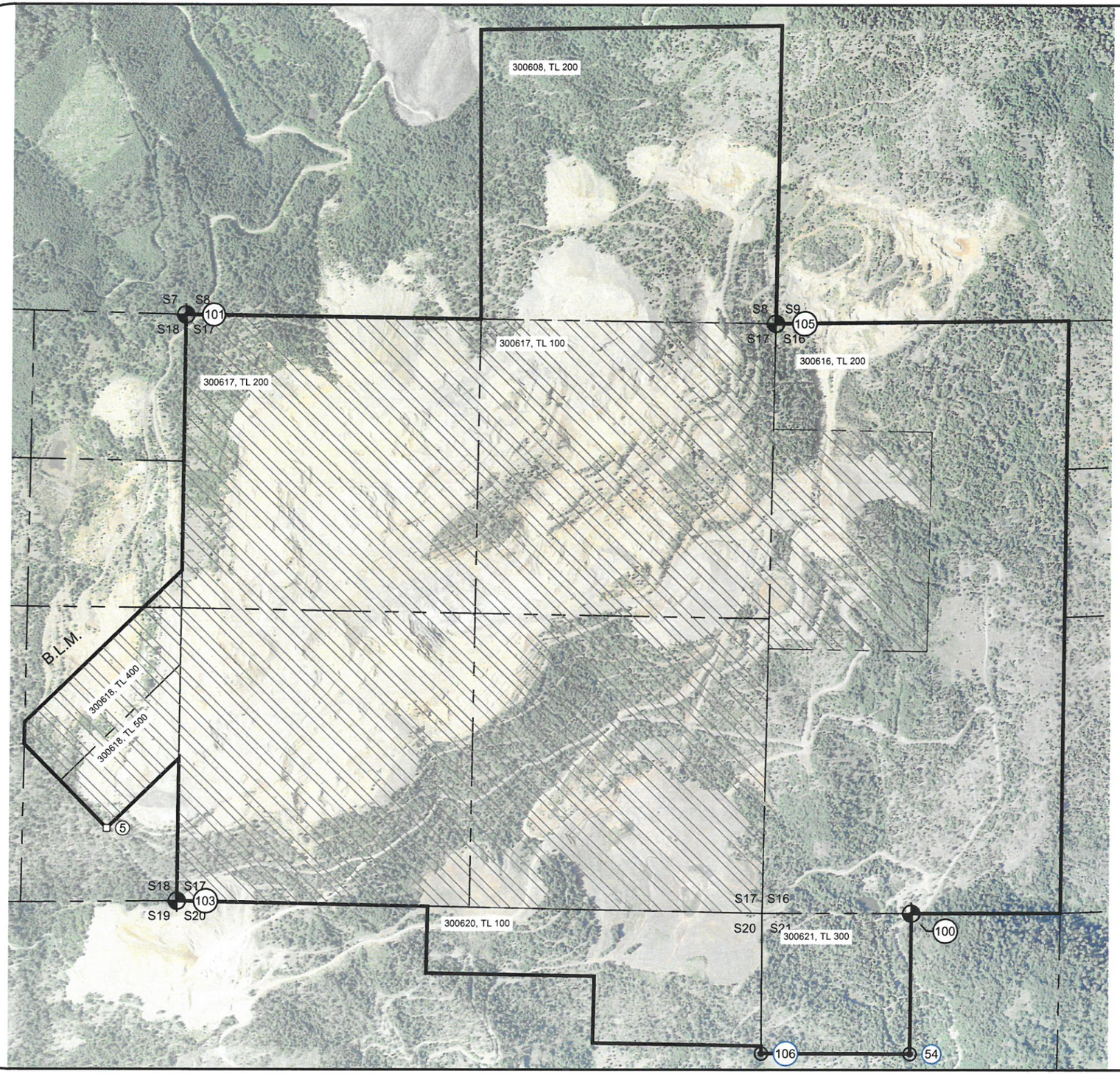
DOGAMI Permit Number: _____

Permittee: Knife River Materials, Inc.,
3959 Hamrick Rd.
Central Point, OR 97502

Situated in Lot 200,Sec. 8, Tax Lot 200, Sec. 16, Tax Lots 100 & 200, Sec. 17, Tax Lots 400 & 500, Sec. 18, Tax Lot 100, Sec. 20 & Tax Lot 300, Sec. 21, T. 30 S., R. 6 W., W.M., Douglas County, Oregon

SURVEYED JULY 21 - 25, 2020

DRAFTED JULY 28 , 2020



LEGEND

- FD 5/8" IRON ROD
- FD BRASS CAP
- COMPUTED CORNER FROM FD BEARING TREES
- CALCULATED POINT
- CONDITIONAL USE PERMIT BOUNDARY (1262± AC. PER ASSESSOR, 1271± PER MAP)
- PERMIT BOUNDARY (748± AC. PER MAP)

BASIS OF BEARINGS PER OREGON COORDINATE REFERENCE SYSTEM, COTTAGE GROVE - CANYONVILLE ZONE PER OREGON REAL TIME GNSS NETWORK - CORRECTORS FROM RSBG, RDL2 & CRES)

N

0 1000 2000

1:12000

REGISTERED
PROFESSIONAL
LAND SURVEYOR

OREGON
JULY 16, 1987
MARK A. HEIMBURGER
2287

RENEWS JUNE 30, 2021

Land Mark
Surveying, Inc.
3317 N.E. Stephens St. •Roseburg, Oregon 97470
Office (541) 677-9400 •Fax (541) 677-9401

LM Proj. No.2020-0057

PERMIT BOUNDARY SURVEY
Nickel Mountain Quarry

NARRATIVE

KNIFE RIVER CORPORATION REQUESTED LAND MARK SURVEYING INC. TO IDENTIFY EACH CORNER OF THE PROPERTY KNOWN AS NICKEL MOUNTAIN WITH A VALUE BASED UPON OREGON COORDINATE REFERENCE SYSTEM, COTTAGE GROVE - CANYONVILLE ZONE.. A PORTION OF THE PROPERTY CORNERS WERE LOCATED AND MEASURED IN A SURVEY ON JULY 20 THRU JULY 23. THE REMAINING CORNERS WERE SEARCH FOR BUT NOT FOUND. MISSING CORNERS WERE CALCULATED AS FOLLOWS:

- *THE SE 1/4, SECTION 8 PER RECORD SURVEY M148-10*
- *1/4 CORNER COMMON TO SECTIONS 9 & 16 PER BLM 1965 DEPENDENT RESURVEY*
- *1/4 CORNER COMMON TO SECTIONS 16 & 21, WEST 1/16 COMMON TO SECTIONS 16 & 21, N.W. 1/16, SECTION 21 AND NORTH 1/16, SECTIONS 20 & 21 PER RECORD OF SURVEY M129-23.*
- *PARMLEY CONSOLIDATED NICKEL MINES (TAX LOT 100, SEC. 20) BY HOLDING SEC. COR. COMMON TO SEC. 16, 17, 20 & 21 AND RECORD INFORMATION PER ORIGINAL PLAT OF THE CLAIM.*
- *THE BOUNDARIES OF EMERALD LODE CLAIM BOUNDARY AND OREGON NICKEL QUARTZ CLAIM (TAX LOTS 400 & 500, SEC. 18),WERE DETERMINED BY COMPUTING EMERALD LOODE CLAIM CORNER #3 FROM FOUND BEARING TREES AND USING RECORD INFORMATION PER THE PLATS OF CLAIM TO RECONSTRUCT THE BOUNDARY.*

BASIS OF SURVEY

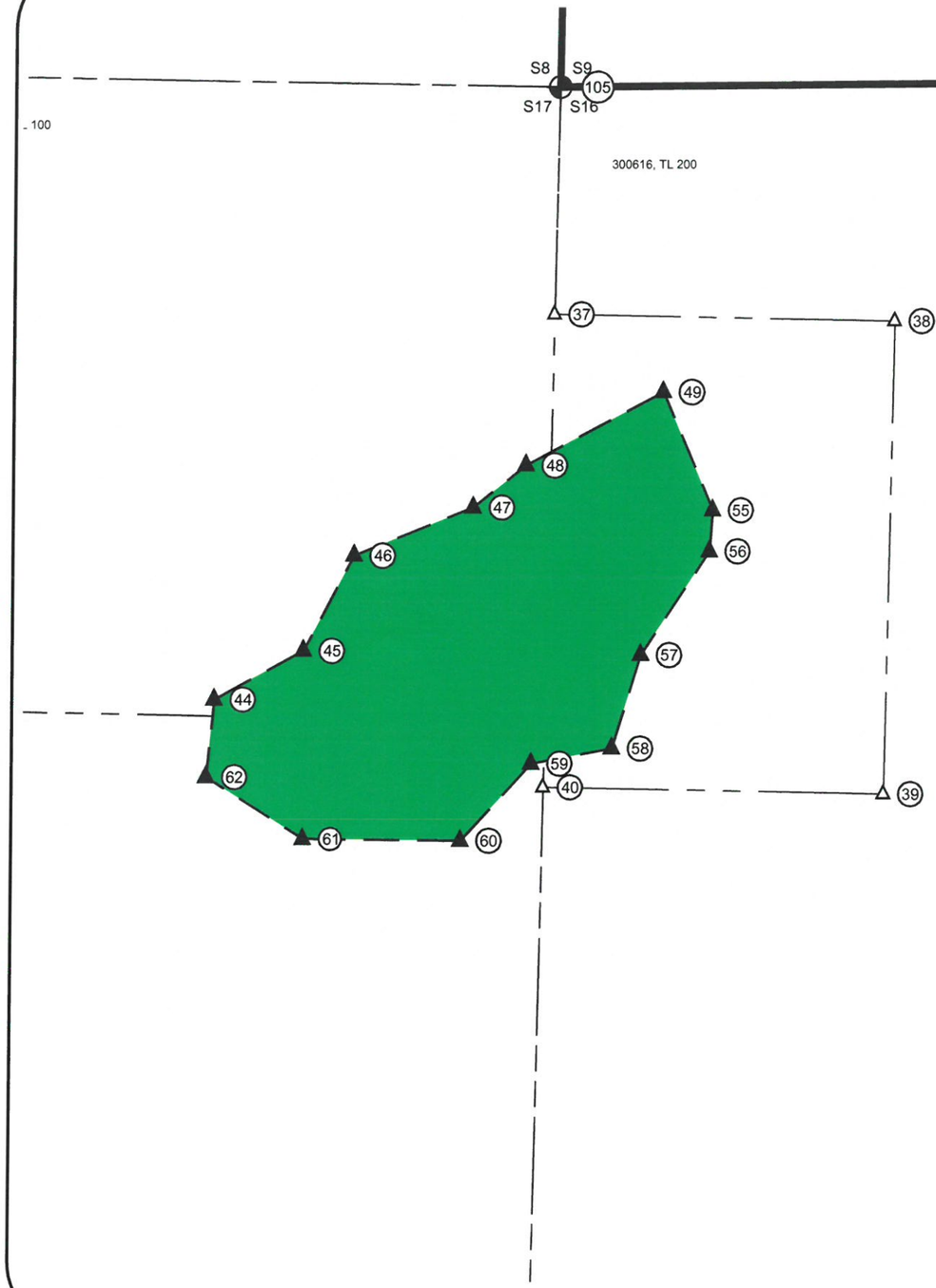
Oregon Coordinate Reference System
Cottage Grove-Canyonville Zone
Transverse Mercator projection
International foot (1 foot = 0.3048 meters)
North American Datum of 1983
Latitude of grid origin: 42° 50' 00" N
Central meridian: 123° 20' 00" W
False northing: 0.000 m
False easting: 50,000.000 m
Central meridian scale: 1.000023 (exact)

Point Table			
Point #	Northing	Easting	Description
4	46174.40	133912.33	SP
5	45545.50	133268.53	CALC #918030
6	46304.69	132526.92	SP #910050
7	46501.83	132530.24	SP #910030
19	47871.34	133932.21	SP #910010
23	44840.70	136155.07	SP #909030
25	43576.94	139152.63	SP #909070
26	44236.73	136143.91	SP #909040
27	44208.82	137653.85	SP #909050
28	43604.85	137642.69	SP #909060
29	44776.25	141828.37	SP #340400
32	50120.60	141879.82	SP #340500
33	50136.03	136604.42	SP #240500
34	52740.88	136589.66	SP #240540
35	52774.75	139294.72	SP #300540
37	49144.79	139236.05	SP
38	49118.25	140655.80	SP
39	47138.59	140618.79	SP
40	47165.14	139199.04	SP
41	44776.94	139154.39	SP
54	43504.69	140481.07	Fd. 5/8" Iron Rod 5/8 YPC NYGREN LS 1085
100	44775.27	140490.73	DCSO" Brass Cap W1/16
101	50177.44	133955.04	DCSO" Brass Cap SEC
103	44888.59	133902.68	DCSO" Brass Cap S17-18-19-20
105	50094.62	139253.81	S8-9-16-17" Brass Cap T30S
106	43509.59	139152.53	Fd. 5/8" Iron Rod 5/8 NYGREN LS1035 N1/16

REGISTERED
PROFESSIONAL
LAND SURVEYOR
Mark A. Heimburger
OREGON
JULY 16, 1987
MARK A. HEIMBURGER
2287
RENEWS JUNE 30, 2021

Land Mark
Surveying, Inc.
3317 N.E. Stephens St. •Roseburg, Oregon 97470
Office (541) 677-9400 •Fax (541) 677-9401

LM Proj. No.2020-0057



Point Table		
Point #	Northing	Easting
37	49144.79	139236.05
38	49118.25	140655.80
39	47138.59	140618.79
40	47165.14	139199.04
44	47530.69	137826.60
45	47735.78	138195.63
46	48134.43	138405.76
47	48336.35	138901.91
48	48513.28	139121.44
49	48820.42	139690.55
55	48326.15	139898.20
56	48154.05	139885.37
57	47720.04	139601.62
58	47328.37	139483.72
59	47263.94	139149.05
60	46940.30	138856.48
61	46947.12	138196.95
62	47205.75	137793.50
105	50094.62	139253.81

INTERIM PERMIT BOUNDARY 1

Nickel Mountain Quarry

DOGAMI Permit Number: _____

Permittee: Knife River Materials, Inc.,
3959 Hamrick Rd.
Central Point, OR 97502

Situated in Tax Lot 200, Sec. 16, Tax Lots 100 & 200, Sec. 17, Township 30 South., Range 6 West., W.M., Douglas County, Oregon

DRAFTED AUGUST 18 , 2020

LEGEND

- FD 5/8" IRON ROD
- FD BRASS CAP
- CALCULATED CORNER
- INTERIM PERMIT CALCULATED POINTS
- CONDITIONAL USE PERMIT BOUNDARY (1262± AC. PER ASSESSOR, 1271± PER MAP)
- PERMIT BOUNDARY (748± AC. PER MAP)
- INTERIM PERMIT BOUNDARY 1(50± AC.)

N

BASIS OF BEARINGS PER OREGON COORDINATE REFERENCE SYSTEM, COTTAGE GROVE - CANYONVILLE ZONE PER OREGON REAL TIME GNSS NETWORK - (CORRECTORS FROM RSBG, RDL2 & GTPS)

0 600 1200 2400 Feet

1:7200

REGISTERED
PROFESSIONAL
LAND SURVEYOR

OREGON
JULY 16, 1987
MARK A. HEIMBURGER
2287

RENEWS JUNE 30, 2021

Land Mark
Surveying, Inc.
3317 N.E. Stephens St. •Roseburg, Oregon 97470
Office (541) 677-9400 •Fax (541) 677-9401

LM Proj. No.2020-0057

Property Details for Property ID: R37530

Owner Information :

Owner Name:	NICKEL MOUNTAIN LLC
Owner Address #1:	3000 STEWART PARKWAY #204
Owner Address #2:	
Owner Address # 3:	
Owner City/State/Zip:	ROSEBURG, OR 97470
Alternate Account #:	1
Account Status:	A

Property Information :

Township:	30	Situs Address:	5115 RIDDLE BY-PASS RD RIDDLE, OR 97469
Range:	06W	Map ID:	30061600200
Section:	16	County Property Class:	541
Quarter:		Legal Acreage:	320.00
Sixteenth:		Code Area:	07000
Maintenance Area:	4	Neighborhood Code:	BD
Year Built:	2007	Living Area:	
Bedrooms:		Baths:	BATH1
Exemption Code:		Exemption Desc.:	
MFD Home ID:			

Value Information : 2020-2021 Certified Values and Tax Information

Improvement Appr. Value:	$7,952.00	Total Appr. Value:	$99,993.00
Land Appr. Value:	$92,041.00	Exemption Value:	$0.00
Land Market Value:	$150,493.00	Total Assessed Value:	$71,877.00
Total Real Market Value:	$158,445.00	Taxes Imposed:	$493.21

Sales Information :

Deed No:	00CV3595CC		
Sale Price:	$0.00	Sale Date:	3/28/2001

DISCLAIMER

The information provided here is for convenience ONLY. For All Commercial, Industrial, and Multi-Family Properties visit the Douglas County Assessor's Office. The records located at the Douglas County Assessor's office are the one and only legal instruments for Assessment purposes. Although reasonable attempts are made to maintain this information as accurate as possible, these documents are being provided as an informational convenience ONLY. Douglas County in no way will be liable for any inaccuracies, inconsistencies, errors, omissions, or other deviations in these documents from the original copies maintained and filed at the Douglas County Assessor's Office.

Property Details for Property ID: R37554

Owner Information :

Owner Name:	NICKEL MOUNTAIN LLC
Owner Address #1:	3000 STEWART PARKWAY #204
Owner Address #2:	
Owner Address # 3:	
Owner City/State/Zip:	ROSEBURG, OR 97470
Alternate Account #:	13757.00
Account Status:	A

Property Information :

Township:	30	Situs Address:	0 RIDDLE BY-PASS RD RIDDLE, OR 97469
Range:	06W	Map ID:	30061700100
Section:	17	County Property Class:	500
Quarter:		Legal Acreage:	160.00
Sixteenth:		Code Area:	07000
Maintenance Area:	4	Neighborhood Code:	B
Year Built:		Living Area:	
Bedrooms:		Baths:	
Exemption Code:		Exemption Desc.:	
MFD Home ID:			

Value Information : 2020-2021 Certified Values and Tax Information

Improvement Appr. Value:	$0.00	Total Appr. Value:	$12,000.00
Land Appr. Value:	$12,000.00	Exemption Value:	$0.00
Land Market Value:	$12,000.00	Total Assessed Value:	$12,000.00
Total Real Market Value:	$12,000.00	Taxes Imposed:	$74.56

Sales Information :

Deed No:	2001-10667		
Sale Price:	$0.00	Sale Date:	5/9/2001

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Property Details for Property ID: R37570

Owner Information :

Owner Name:	NICKEL MOUNTAIN LLC
Owner Address #1:	3000 STEWART PARKWAY #204
Owner Address #2:	
Owner Address # 3:	
Owner City/State/Zip:	ROSEBURG, OR 97470
Alternate Account #:	13758.00
Account Status:	A

Property Information :

Township:	30	Situs Address:	0 RIDDLE BY-PASS RD RIDDLE, OR 97469
Range:	06W	Map ID:	30061700200
Section:	17	County Property Class:	640
Quarter:		Legal Acreage:	480.00
Sixteenth:		Code Area:	07000
Maintenance Area:	4	Neighborhood Code:	B
Year Built:		Living Area:	
Bedrooms:		Baths:	
Exemption Code:		Exemption Desc.:	
MFD Home ID:			

Value Information : 2020-2021 Certified Values and Tax Information

Improvement Appr. Value:	$0.00	Total Appr. Value:	$103,680.00
Land Appr. Value:	$103,680.00	Exemption Value:	$0.00
Land Market Value:	$110,148.00	Total Assessed Value:	$80,811.00
Total Real Market Value:	$110,148.00	Taxes Imposed:	$554.51

Sales Information :

Deed No:	00CV3595CC		
Sale Price:	$0.00	Sale Date:	3/28/2001

DISCLAIMER

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Property Details for Property ID: R37618

Owner Information :

Owner Name:	NICKEL MOUNTAIN LLC		
Owner Address #1:	3000 STEWART PARKWAY #204		
Owner Address #2:			
Owner Address # 3:		Alternate Account #:	13762.00
Owner City/State/Zip:	ROSEBURG, OR 97470	Account Status:	A

Property Information :

Township:	30	Situs Address:	0 RIDDLE BY-PASS RD RIDDLE, OR 97469
Range:	06W	Map ID:	30061800400
Section:	18	County Property Class:	500
Quarter:		Legal Acreage:	24.17
Sixteenth:		Code Area:	07000
Maintenance Area:	4	Neighborhood Code:	B
Year Built:		Living Area:	
Bedrooms:		Baths:	
Exemption Code:		Exemption Desc.:	
MFD Home ID:			

Value Information : 2020-2021 Certified Values and Tax Information

Improvement Appr. Value:	$0.00	Total Appr. Value:	$1,813.00
Land Appr. Value:	$1,813.00	Exemption Value:	$0.00
Land Market Value:	$1,813.00	Total Assessed Value:	$1,813.00
Total Real Market Value:	$1,813.00	Taxes Imposed:	$11.27

Sales Information :

Deed No:	2001-10667		
Sale Price:	$0.00	Sale Date:	5/9/2001

DISCLAIMER

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Property Details for Property ID: R37610

Owner Information :

Owner Name:	NICKEL MOUNTAIN LLC
Owner Address #1:	3000 STEWART PARKWAY #204
Owner Address #2:	
Owner Address # 3:	
Owner City/State/Zip:	ROSEBURG, OR 97470

Alternate Account #:	13761.00
Account Status:	A

Property Information :

Township:	30	Situs Address:	0 RIDDLE BY-PASS RD RIDDLE, OR 97469
Range:	06W	Map ID:	30061800500
Section:	18	County Property Class:	500
Quarter:		Legal Acreage:	16.53
Sixteenth:		Code Area:	07000
Maintenance Area:	4	Neighborhood Code:	B
Year Built:		Living Area:	
Bedrooms:		Baths:	
Exemption Code:		Exemption Desc.:	
MFD Home ID:			

Value Information : 2020-2021 Certified Values and Tax Information

Improvement Appr. Value:	$0.00	Total Appr. Value:	$1,240.00
Land Appr. Value:	$1,240.00	Exemption Value:	$0.00
Land Market Value:	$1,240.00	Total Assessed Value:	$1,240.00
Total Real Market Value:	$1,240.00	Taxes Imposed:	$7.70

Sales Information :

Deed No:	00CV3595CC		
Sale Price:	$0.00	Sale Date:	3/28/2001

DISCLAIMER

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APPENDIX 3

Radius Map Report

Nickel Mountain
Nickel Mountain Quarry
Winston, OR 97496

Inquiry Number: 6390900.1s
March 03, 2021

EDR Summary Radius Map Report

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

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SECTION	PAGE
Executive Summary	ES1
Overview Map	2
Detail Map	3
Map Findings Summary	4
Map Findings	8
Orphan Summary	16
Government Records Searched/Data Currency Tracking	GR-1

GEOCHECK ADDENDUM

GeoCheck - Not Requested

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

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EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc (EDR). The report was designed to assist parties seeking to meet the search requirements of EPA's Standards and Practices for All Appropriate Inquiries (40 CFR Part 312), the ASTM Standard Practice for Environmental Site Assessments (E 1527-13), the ASTM Standard Practice for Environmental Site Assessments for Forestland or Rural Property (E 2247-16), the ASTM Standard Practice for Limited Environmental Due Diligence: Transaction Screen Process (E 1528-14) or custom requirements developed for the evaluation of environmental risk associated with a parcel of real estate.

TARGET PROPERTY INFORMATION

ADDRESS

NICKEL MOUNTAIN QUARRY
WINSTON, OR 97496

COORDINATES

Latitude (North):	42.9636300 - 42° 57' 49.06''
Longitude (West):	123.4359180 - 123° 26' 9.30''
Universal Tranverse Mercator:	Zone 10
UTM X (Meters):	464447.1
UTM Y (Meters):	4756653.0
Elevation:	2969 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property:	TP
Source:	U.S. Geological Survey

AERIAL PHOTOGRAPHY IN THIS REPORT

Portions of Photo from:	20140610
Source:	USDA

MAPPED SITES SUMMARY

Target Property Address:
NICKEL MOUNTAIN QUARRY
WINSTON, OR 97469

Click on Map ID to see full detail.

MAP ID	SITE NAME	ADDRESS	DATABASE ACRONYMS	RELATIVE ELEVATION	DIST (ft. & mi.) DIRECTION
A1	NICKEL MOUNTAIN GROU		MINES MRDS	Higher	1 ft.
A2	NICKEL MOUNTAIN MINE	30S/6W/S17	ECSI	Higher	1 ft.
3	NICKEL MOUNTAIN GROU		MINES MRDS	Higher	1 ft.
A4	NICKEL MOUNTAIN		MINES MRDS	Higher	1 ft.
B5	HANNA NICKEL MINE		MINES MRDS	Higher	1 ft.
B6	RIDDLE MINE		MINES MRDS	Higher	1 ft.
7	COLORADO DEPARTMENT		US MINES	Higher	1 ft.

EXECUTIVE SUMMARY

TARGET PROPERTY SEARCH RESULTS

The target property was not listed in any of the databases searched by EDR.

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were identified in the following databases.

Elevations have been determined from the USGS Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified. Sites with an elevation equal to or higher than the target property have been differentiated below from sites with an elevation lower than the target property.
Page numbers and map identification numbers refer to the EDR Radius Map report where detailed data on individual sites can be reviewed.

Sites listed in ***bold italics*** are in multiple databases.

Unmappable (orphan) sites are not considered in the foregoing analysis.

STANDARD ENVIRONMENTAL RECORDS

State- and tribal - equivalent CERCLIS

ECSI: A review of the ECSI list, as provided by EDR, and dated 09/01/2020 has revealed that there is 1 ECSI site within approximately 1 mile of the target property.

Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
NICKEL MOUNTAIN MINE Investigation: Suspect State ID Number: 2666 Decode For Further Action: Low	30S/6W/S17	0 - 1/8 (0.000 mi.)	A2	8

ADDITIONAL ENVIRONMENTAL RECORDS

Other Ascertainable Records

US MINES: A review of the US MINES list, as provided by EDR, has revealed that there is 1 US MINES site within approximately 0.25 miles of the target property.

Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
COLORADO DEPARTMENT Database: US MINES, Date of Government Version: 11/03/2020 Mine ID:: 0503409		0 - 1/8 (0.000 mi.)	7	9

EXECUTIVE SUMMARY

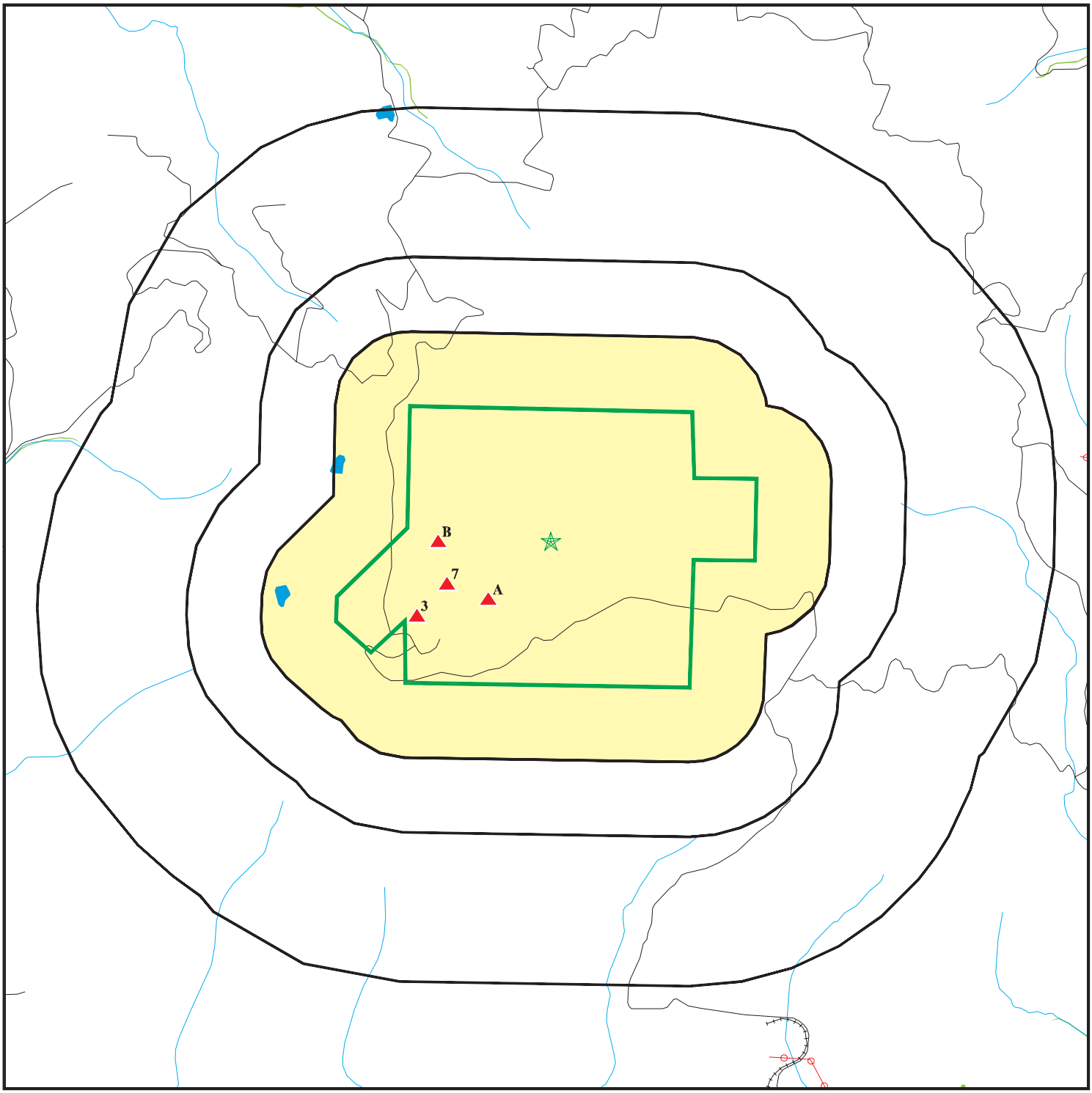
MINES MRDS: A review of the MINES MRDS list, as provided by EDR, and dated 04/06/2018 has revealed that there are 5 MINES MRDS sites within approximately 0.001 miles of the target property.

Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
NICKEL MOUNTAIN GROU		0 - 1/8 (0.000 mi.)	A1	8
NICKEL MOUNTAIN GROU		0 - 1/8 (0.000 mi.)	3	8
NICKEL MOUNTAIN		0 - 1/8 (0.000 mi.)	A4	8
HANNA NICKEL MINE		0 - 1/8 (0.000 mi.)	B5	8
RIDDLE MINE		0 - 1/8 (0.000 mi.)	B6	9

Count: 2 records. ORPHAN SUMMARY

City	EDR ID	Site Name	Site Address	Zip	Database(s)
RIDDLE	S115334019	HANNA NICKEL SMELTING CO.	NICKEL MINE RD.		RGA HWS
RIDDLE	S115334017	HANNA NICKEL SMELTING CO. (SEE ECS	NICKEL MINE RD.		RGA HWS

OVERVIEW MAP - 6390900.1S



Target Property

Sites at elevations higher than or equal to the target property

Sites at elevations lower than the target property

Manufactured Gas Plants

National Priority List Sites

Dept. Defense Sites

0 1/4 1/2 1 Miles

Indian Reservations BIA

Power transmission lines

Special Flood Hazard Area (1%)

0.2% Annual Chance Flood Hazard

National Wetland Inventory

State Wetlands

Areas of Concern

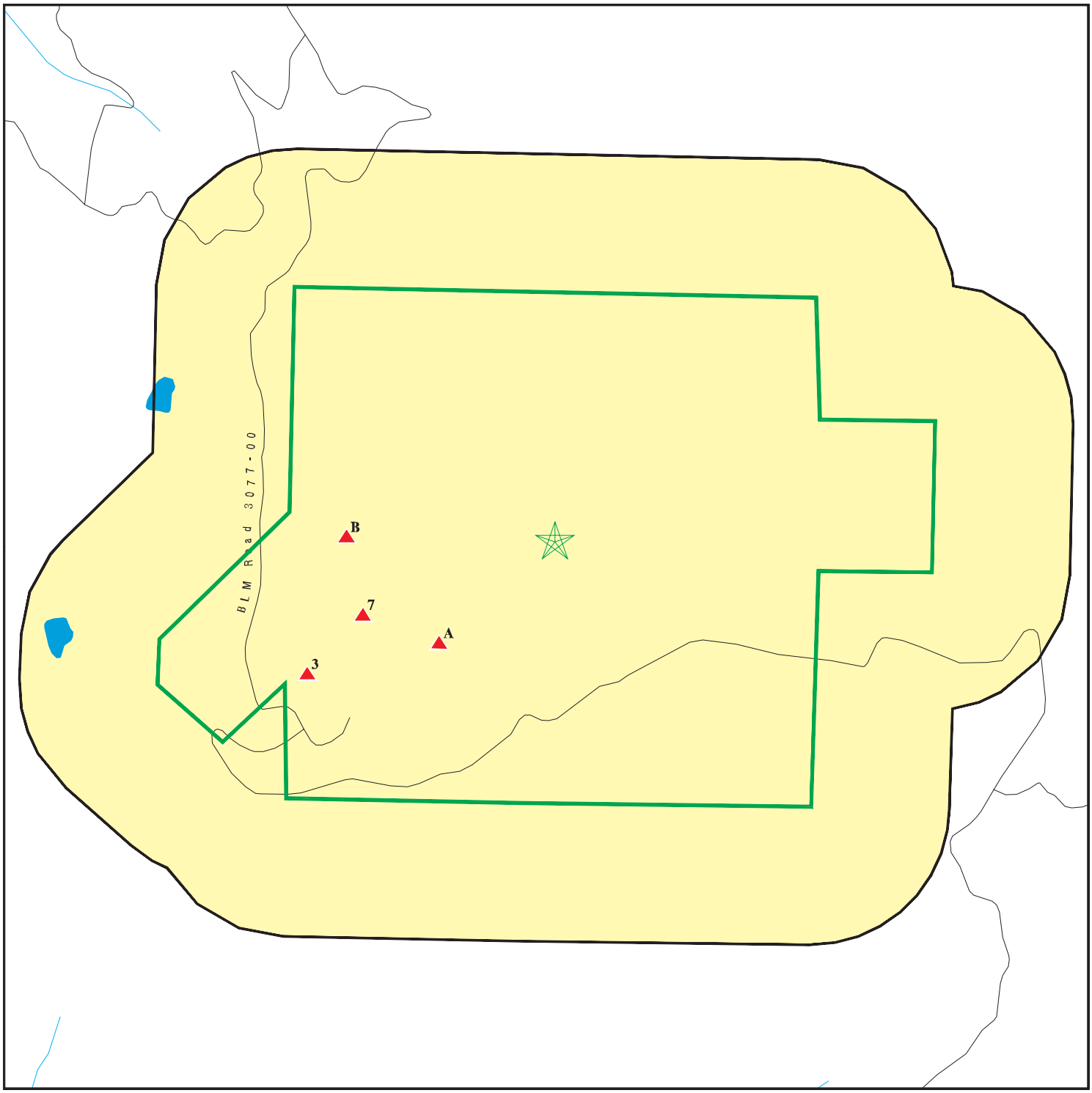
N

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME:	Nickel Mountain	CLIENT:	Alpine Environmental Consultants, LLC
ADDRESS:	Nickel Mountain Quarry Winston OR 97496	CONTACT:	Antonela Vadan
LAT/LONG:	42.96363 / 123.435918	INQUIRY #:	6390900.1s
		DATE:	March 03, 2021 8:30 pm

Copyright © 2021 EDR, Inc. © 2015 TomTom Rel. 2015.

DETAIL MAP - 6390900.1S



Target Property

Sites at elevations higher than or equal to the target property

Sites at elevations lower than the target property

Manufactured Gas Plants

Sensitive Receptors

National Priority List Sites

Dept. Defense Sites

0 1/4 1/2 1 Miles

Indian Reservations BIA

Special Flood Hazard Area (1%)

0.2% Annual Chance Flood Hazard

Areas of Concern

N

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME:	Nickel Mountain	CLIENT:	Alpine Environmental Consultants, LLC
ADDRESS:	Nickel Mountain Quarry Winston OR 97496	CONTACT:	Antonela Vadan
		INQUIRY #:	6390900.1s
LAT/LONG:	42.96363 / 123.435918	DATE:	March 03, 2021 8:31 pm

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MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
STANDARD ENVIRONMENTAL RECORDS								
Federal NPL site list								
NPL	1.000		0	0	0	0	NR	0
Proposed NPL	1.000		0	0	0	0	NR	0
NPL LIENS	1.000		0	0	0	0	NR	0
Federal Delisted NPL site list								
Delisted NPL	1.000		0	0	0	0	NR	0
Federal CERCLIS list								
FEDERAL FACILITY	0.500		0	0	0	NR	NR	0
SEMS	0.500		0	0	0	NR	NR	0
Federal CERCLIS NFRAP site list								
SEMS-ARCHIVE	0.500		0	0	0	NR	NR	0
Federal RCRA CORRACTS facilities list								
CORRACTS	1.000		0	0	0	0	NR	0
Federal RCRA non-CORRACTS TSD facilities list								
RCRA-TSDF	0.500		0	0	0	NR	NR	0
Federal RCRA generators list								
RCRA-LQG	0.250		0	0	NR	NR	NR	0
RCRA-SQG	0.250		0	0	NR	NR	NR	0
RCRA-VSQG	0.250		0	0	NR	NR	NR	0
Federal institutional controls / engineering controls registries								
LUCIS	0.500		0	0	0	NR	NR	0
US ENG CONTROLS	0.500		0	0	0	NR	NR	0
US INST CONTROLS	0.500		0	0	0	NR	NR	0
Federal ERNS list								
ERNS	0.001		0	NR	NR	NR	NR	0
State- and tribal - equivalent CERCLIS								
CRL	1.000		0	0	0	0	NR	0
ECSI	1.000		1	0	0	0	NR	1
State and tribal landfill and/or solid waste disposal site lists								
SWF/LF	0.500		0	0	0	NR	NR	0
State and tribal leaking storage tank lists								
LUST	0.500		0	0	0	NR	NR	0
INDIAN LUST	0.500		0	0	0	NR	NR	0
State and tribal registered storage tank lists								
FEMA UST	0.250		0	0	NR	NR	NR	0

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
UST	0.250		0	0	NR	NR	NR	0
AST	0.250		0	0	NR	NR	NR	0
INDIAN UST	0.250		0	0	NR	NR	NR	0
State and tribal institutional control / engineering control registries								
ENG CONTROLS	0.500		0	0	0	NR	NR	0
INST CONTROL	0.500		0	0	0	NR	NR	0
State and tribal voluntary cleanup sites								
VCP	0.500		0	0	0	NR	NR	0
INDIAN VCP	0.500		0	0	0	NR	NR	0
State and tribal Brownfields sites								
BROWNFIELDS	0.500		0	0	0	NR	NR	0
ADDITIONAL ENVIRONMENTAL RECORDS								
Local Brownfield lists								
US BROWNFIELDS	0.500		0	0	0	NR	NR	0
Local Lists of Landfill / Solid Waste Disposal Sites								
HIST LF	0.500		0	0	0	NR	NR	0
SWRCY	0.500		0	0	0	NR	NR	0
INDIAN ODI	0.500		0	0	0	NR	NR	0
ODI	0.500		0	0	0	NR	NR	0
DEBRIS REGION 9	0.500		0	0	0	NR	NR	0
IHS OPEN DUMPS	0.500		0	0	0	NR	NR	0
Local Lists of Hazardous waste / Contaminated Sites								
AOCONCERN	1.000		0	0	0	0	NR	0
US HIST CDL	0.001		0	NR	NR	NR	NR	0
CDL	0.001		0	NR	NR	NR	NR	0
US CDL	0.001		0	NR	NR	NR	NR	0
Local Land Records								
LIENS 2	0.001		0	NR	NR	NR	NR	0
Records of Emergency Release Reports								
HMIRS	0.001		0	NR	NR	NR	NR	0
SPILLS	0.001		0	NR	NR	NR	NR	0
OR HAZMAT	0.001		0	NR	NR	NR	NR	0
SPILLS 90	0.001		0	NR	NR	NR	NR	0
Other Ascertainable Records								
RCRA NonGen / NLR	0.250		0	0	NR	NR	NR	0
FUDS	1.000		0	0	0	0	NR	0
DOD	1.000		0	0	0	0	NR	0

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
SCRD DRYCLEANERS	0.500		0	0	0	NR	NR	0
US FIN ASSUR	0.001		0	NR	NR	NR	NR	0
EPA WATCH LIST	0.001		0	NR	NR	NR	NR	0
2020 COR ACTION	0.250		0	0	NR	NR	NR	0
TSCA	0.001		0	NR	NR	NR	NR	0
TRIS	0.001		0	NR	NR	NR	NR	0
SSTS	0.001		0	NR	NR	NR	NR	0
ROD	1.000		0	0	0	0	NR	0
RMP	0.001		0	NR	NR	NR	NR	0
RAATS	0.001		0	NR	NR	NR	NR	0
PRP	0.001		0	NR	NR	NR	NR	0
PADS	0.001		0	NR	NR	NR	NR	0
ICIS	0.001		0	NR	NR	NR	NR	0
FTTS	0.001		0	NR	NR	NR	NR	0
MLTS	0.001		0	NR	NR	NR	NR	0
COAL ASH DOE	0.001		0	NR	NR	NR	NR	0
COAL ASH EPA	0.500		0	0	0	NR	NR	0
PCB TRANSFORMER	0.001		0	NR	NR	NR	NR	0
RADINFO	0.001		0	NR	NR	NR	NR	0
HIST FTTS	0.001		0	NR	NR	NR	NR	0
DOT OPS	0.001		0	NR	NR	NR	NR	0
CONSENT	1.000		0	0	0	0	NR	0
INDIAN RESERV	1.000		0	0	0	0	NR	0
FUSRAP	1.000		0	0	0	0	NR	0
UMTRA	0.500		0	0	0	NR	NR	0
LEAD SMELTERS	0.001		0	NR	NR	NR	NR	0
US AIRS	0.001		0	NR	NR	NR	NR	0
US MINES	0.250		1	0	NR	NR	NR	1
ABANDONED MINES	0.250		0	0	NR	NR	NR	0
FINDS	0.001		0	NR	NR	NR	NR	0
DOCKET HWC	0.001		0	NR	NR	NR	NR	0
ECHO	0.001		0	NR	NR	NR	NR	0
UXO	1.000		0	0	0	0	NR	0
FUELS PROGRAM	0.250		0	0	NR	NR	NR	0
AIRS	0.001		0	NR	NR	NR	NR	0
COAL ASH	0.500		0	0	0	NR	NR	0
DRYCLEANERS	0.250		0	0	NR	NR	NR	0
Enforcement	0.001		0	NR	NR	NR	NR	0
Financial Assurance	0.001		0	NR	NR	NR	NR	0
HSIS	0.001		0	NR	NR	NR	NR	0
MANIFEST	0.250		0	0	NR	NR	NR	0
NPDES	0.001		0	NR	NR	NR	NR	0
UIC	0.001		0	NR	NR	NR	NR	0
MINES MRDS	0.001		5	NR	NR	NR	NR	5
EDR HIGH RISK HISTORICAL RECORDS								
EDR Exclusive Records								
EDR MGP	1.000		0	0	0	0	NR	0
EDR Hist Auto	0.125		0	NR	NR	NR	NR	0

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
EDR Hist Cleaner	0.125		0	NR	NR	NR	NR	0
EDR RECOVERED GOVERNMENT ARCHIVES								
Exclusive Recovered Govt. Archives								
RGA HWS	0.001		0	NR	NR	NR	NR	0
RGA LF	0.001		0	NR	NR	NR	NR	0
RGA LUST	0.001		0	NR	NR	NR	NR	0
- Totals --		0	7	0	0	0	0	7

NOTES:

TP = Target Property

NR = Not Requested at this Search Distance

Sites may be listed in more than one database

A1 **NICKEL MOUNTAIN GROUP** **MINES MRDS** **1025548103**
N/A

< 1/8 **WINSTON, OR 97496**
1 ft.

Relative: **Higher**

Click here for full text details

A2 **NICKEL MOUNTAIN MINE** **ECSI** **S109346088**
30S/6W/S17 **N/A**

< 1/8 **, OR**
1 ft.

Relative: **Higher**

Click here for full text details

ECSI
State ID Number 2666
Investigation Suspect
Decode For Further Action Low

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3 **NICKEL MOUNTAIN GROUP-UPPER OCCUR.** **MINES MRDS** **1025613384**
N/A

< 1/8 **WINSTON, OR 97496**
1 ft.

Relative: **Higher**

Click here for full text details

A4 **NICKEL MOUNTAIN** **MINES MRDS** **1025561901**
N/A

< 1/8 **WINSTON, OR 97496**
1 ft.

Relative: **Higher**

Click here for full text details

B5 **HANNA NICKEL MINE** **MINES MRDS** **1025680157**
N/A

< 1/8 **WINSTON, OR 97496**
1 ft.

Relative: **Higher**

Click here for full text details

Map ID Direction Distance Elevation	Site	Database(s)	EDR ID Number EPA ID Number
B6 **< 1/8** **1 ft.** **Relative:** **Higher**	**RIDDLE MINE** **WINSTON, OR 97496** **Click here for full text details**	**MINES MRDS**	**1025531554** **N/A**
7 **< 1/8** **1 ft.** **Relative:** **Higher**	**COLORADO DEPARTMENT OF HIGHWAYS** **CHAFFEE (County), CO** **Click here for full text details** **US MINES** Mine ID: 0503409	**US MINES**	**1016470709** **N/A**

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

St	Acronym	Full Name	Government Agency	Gov Date	Arvl. Date	Active Date
OR	AIRS	Oregon Title V Facility Listing	Department of Environmental Quality	09/24/2020	10/06/2020	12/22/2020
OR	AOC COL	Columbia Slough	City of Portland Environmental Services	08/10/2005	05/17/2006	06/16/2006
OR	AOC MU	East Multnomah County Area	City of Portland Environmental Services	01/01/2002	10/07/2002	10/22/2002
OR	AST	Aboveground Storage Tanks	Office of State Fire Marshal	02/26/2020	02/27/2020	05/05/2020
OR	BROWNFIELDS	Brownfields Projects	Department of Environmental Quality	11/01/2020	11/11/2020	01/28/2021
OR	CDL	Uninhabitable Drug Lab Properties	Department of Consumer & Business Services	06/29/2020	06/30/2020	09/16/2020
OR	CDL 2	Clandestine Drug Lab Site Listing	Oregon State Police	10/08/2020	10/27/2020	01/14/2021
OR	COAL ASH	Coal Ash Disposal Sites Listing	Department of Environmental Quality	12/31/2019	03/06/2020	05/14/2020
OR	CRL	Confirmed Release List and Inventory	Department of Environmental Quality	11/01/2020	11/11/2020	01/28/2021
OR	DRYCLEANERS	Drycleaning Facilities	Department of Environmental Quality	10/23/2020	10/26/2020	10/26/2020
OR	ECSI	Environmental Cleanup Site Information System	Department of Environmental Quality	09/01/2020	09/29/2020	12/17/2020
OR	ENF	Enforcement Action Listing	Department of Environmental Quality	09/14/2020	09/16/2020	12/10/2020
OR	ENG CONTROLS	Engineering Controls Recorded at ESCI Sites	Department of Environmental Quality	09/01/2020	09/29/2020	12/17/2020
OR	Financial Assurance 1	Financial Assurance Information Listing	Department of Environmental Quality	06/24/2019	06/27/2019	09/11/2019
OR	Financial Assurance 2	Financial Assurance Information Listing	Department of Environmental Quality	11/30/2020	12/02/2020	12/10/2020
OR	HAZMAT	Hazmat/Incidents	State Fire Marshal's Office	10/08/2020	10/27/2020	01/14/2021
OR	HIST LF	Old Closed SW Disposal Sites	Department of Environmental Quality	04/01/2000	07/08/2003	07/18/2003
OR	HSIS	Hazardous Substance Information Survey	State Fire Marshal's Office	10/26/2020	10/27/2020	01/14/2021
OR	INST CONTROL	Institutional Controls Recorded at ESCI Sites	Department of Environmental Quality	09/01/2020	09/29/2020	12/17/2020
OR	LUST	Leaking Underground Storage Tank Database	Department of Environmental Quality	10/07/2020	11/11/2020	01/28/2021
OR	NPDES	Wastewater Permits Database	Department of Environmental Quality	11/02/2020	11/12/2020	01/28/2021
OR	OR MANIFEST	Manifest Information	Department of Environmental Quality	12/31/2019	07/30/2020	10/15/2020
OR	PFAS	PFAS Site Contamination Listing	Department of Environmental Quality	10/07/2020	10/09/2020	12/31/2020
OR	RGA HWS	Recovered Government Archive State Hazardous Waste Facilitie	Department of Environmental Quality		07/01/2013	01/03/2014
OR	RGA LF	Recovered Government Archive Solid Waste Facilities List	Department of Environmental Quality		07/01/2013	01/13/2014
OR	RGA LUST	Recovered Government Archive Leaking Underground Storage Tan	Department of Environmental Quality		07/01/2013	12/27/2013
OR	SPILLS	Spill Data	Department of Environmental Quality	09/24/2020	09/25/2020	12/16/2020
OR	SPILLS 90	SPILLS90 data from FirstSearch	FirstSearch	05/01/2006	01/03/2013	02/22/2013
OR	SWF/LF	Solid Waste Facilities List	Department of Environmental Quality	09/29/2020	09/30/2020	12/18/2020
OR	SWRCY	Recycling Facility Location Listing	Department of Environmental Quality	11/19/2020	11/23/2020	02/09/2021
OR	UIC	Underground Injection Control Program Database	Department of Environmental Quality	09/28/2020	10/02/2020	12/22/2020
OR	UST	Underground Storage Tank Database	Department of Environmental Quality	10/07/2020	11/11/2020	01/28/2021
OR	VCS	Voluntary Cleanup Program Sites	DEQ	09/24/2020	09/30/2020	12/17/2020
US	2020 COR ACTION	2020 Corrective Action Program List	Environmental Protection Agency	09/30/2017	05/08/2018	07/20/2018
US	ABANDONED MINES	Abandoned Mines	Department of Interior	12/11/2020	12/11/2020	03/02/2021
US	BRS	Biennial Reporting System	EPA/NTIS	12/31/2017	06/22/2020	11/20/2020
US	COAL ASH DOE	Steam-Electric Plant Operation Data	Department of Energy	12/31/2019	12/01/2020	02/09/2021
US	COAL ASH EPA	Coal Combustion Residues Surface Impoundments List	Environmental Protection Agency	01/12/2017	03/05/2019	11/11/2019
US	CONSENT	Superfund (CERCLA) Consent Decrees	Department of Justice, Consent Decree Library	09/30/2020	10/08/2020	01/04/2021
US	CORRACTS	Corrective Action Report	EPA	12/14/2020	12/17/2020	12/22/2020
US	DEBRIS REGION 9	Torres Martinez Reservation Illegal Dump Site Locations	EPA, Region 9	01/12/2009	05/07/2009	09/21/2009
US	DOCKET HWC	Hazardous Waste Compliance Docket Listing	Environmental Protection Agency	11/03/2020	11/17/2020	02/09/2021
US	DOD	Department of Defense Sites	USGS	12/31/2005	11/10/2006	01/11/2007
US	DOT OPS	Incident and Accident Data	Department of Transporation, Office of Pipeli	01/02/2020	01/28/2020	04/17/2020
US	Delisted NPL	National Priority List Deletions	EPA	12/30/2020	01/14/2021	02/09/2021
US	ECHO	Enforcement & Compliance History Information	Environmental Protection Agency	10/03/2020	10/06/2020	01/04/2021
US	EDR Hist Auto	EDR Exclusive Historical Auto Stations	EDR, Inc.			

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

St	Acronym	Full Name	Government Agency	Gov Date	Arvl. Date	Active Date
US	EDR Hist Cleaner	EDR Exclusive Historical Cleaners	EDR, Inc.			
US	EDR MGP	EDR Proprietary Manufactured Gas Plants	EDR, Inc.			
US	EPA WATCH LIST	EPA WATCH LIST	Environmental Protection Agency	08/30/2013	03/21/2014	06/17/2014
US	ERNS	Emergency Response Notification System	National Response Center, United States Coast	12/14/2020	12/15/2020	12/22/2020
US	FEDERAL FACILITY	Federal Facility Site Information listing	Environmental Protection Agency	04/03/2019	04/05/2019	05/14/2019
US	FEDLAND	Federal and Indian Lands	U.S. Geological Survey	04/02/2018	04/11/2018	11/06/2019
US	FEMA UST	Underground Storage Tank Listing	FEMA	07/21/2020	09/03/2020	11/25/2020
US	FINDS	Facility Index System/Facility Registry System	EPA	11/04/2020	12/01/2020	01/25/2021
US	FTTS	FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fu	EPA/Office of Prevention, Pesticides and Toxi	04/09/2009	04/16/2009	05/11/2009
US	FTTS INSP	FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fu	EPA	04/09/2009	04/16/2009	05/11/2009
US	FUDS	Formerly Used Defense Sites	U.S. Army Corps of Engineers	09/29/2020	11/17/2020	01/25/2021
US	FUELS PROGRAM	EPA Fuels Program Registered Listing	EPA	11/13/2020	11/13/2020	01/25/2021
US	FUSRAP	Formerly Utilized Sites Remedial Action Program	Department of Energy	08/08/2017	09/11/2018	09/14/2018
US	HIST FTTS	FIFRA/TSCA Tracking System Administrative Case Listing	Environmental Protection Agency	10/19/2006	03/01/2007	04/10/2007
US	HIST FTTS INSP	FIFRA/TSCA Tracking System Inspection & Enforcement Case Lis	Environmental Protection Agency	10/19/2006	03/01/2007	04/10/2007
US	HMIRS	Hazardous Materials Information Reporting System	U.S. Department of Transportation	09/20/2020	09/22/2020	12/14/2020
US	ICIS	Integrated Compliance Information System	Environmental Protection Agency	11/18/2016	11/23/2016	02/10/2017
US	IHS OPEN DUMPS	Open Dumps on Indian Land	Department of Health & Human Serivces, Indian	04/01/2014	08/06/2014	01/29/2015
US	INDIAN LUST R1	Leaking Underground Storage Tanks on Indian Land	EPA Region 1	04/29/2020	05/20/2020	08/12/2020
US	INDIAN LUST R10	Leaking Underground Storage Tanks on Indian Land	EPA Region 10	04/14/2020	05/20/2020	08/12/2020
US	INDIAN LUST R4	Leaking Underground Storage Tanks on Indian Land	EPA Region 4	04/14/2020	05/26/2020	08/12/2020
US	INDIAN LUST R5	Leaking Underground Storage Tanks on Indian Land	EPA, Region 5	04/14/2020	05/20/2020	08/12/2020
US	INDIAN LUST R6	Leaking Underground Storage Tanks on Indian Land	EPA Region 6	04/08/2020	05/20/2020	08/12/2020
US	INDIAN LUST R7	Leaking Underground Storage Tanks on Indian Land	EPA Region 7	04/15/2020	05/20/2020	08/12/2020
US	INDIAN LUST R8	Leaking Underground Storage Tanks on Indian Land	EPA Region 8	04/14/2020	05/20/2020	08/12/2020
US	INDIAN LUST R9	Leaking Underground Storage Tanks on Indian Land	Environmental Protection Agency	04/08/2020	05/20/2020	08/12/2020
US	INDIAN ODI	Report on the Status of Open Dumps on Indian Lands	Environmental Protection Agency	12/31/1998	12/03/2007	01/24/2008
US	INDIAN RESERV	Indian Reservations	USGS	12/31/2014	07/14/2015	01/10/2017
US	INDIAN UST R1	Underground Storage Tanks on Indian Land	EPA, Region 1	04/29/2020	05/20/2020	08/12/2020
US	INDIAN UST R10	Underground Storage Tanks on Indian Land	EPA Region 10	04/14/2020	05/20/2020	08/12/2020
US	INDIAN UST R4	Underground Storage Tanks on Indian Land	EPA Region 4	04/14/2020	05/26/2020	08/12/2020
US	INDIAN UST R5	Underground Storage Tanks on Indian Land	EPA Region 5	04/14/2020	05/20/2020	08/12/2020
US	INDIAN UST R6	Underground Storage Tanks on Indian Land	EPA Region 6	04/08/2020	05/20/2020	08/12/2020
US	INDIAN UST R7	Underground Storage Tanks on Indian Land	EPA Region 7	04/03/2020	05/20/2020	08/12/2020
US	INDIAN UST R8	Underground Storage Tanks on Indian Land	EPA Region 8	04/14/2020	05/20/2020	08/13/2020
US	INDIAN UST R9	Underground Storage Tanks on Indian Land	EPA Region 9	04/08/2020	05/20/2020	08/12/2020
US	INDIAN VCP R1	Voluntary Cleanup Priority Listing	EPA, Region 1	07/27/2015	09/29/2015	02/18/2016
US	INDIAN VCP R7	Voluntary Cleanup Priority Lisitng	EPA, Region 7	03/20/2008	04/22/2008	05/19/2008
US	LEAD SMELTER 1	Lead Smelter Sites	Environmental Protection Agency	12/30/2020	01/14/2021	02/09/2021
US	LEAD SMELTER 2	Lead Smelter Sites	American Journal of Public Health	04/05/2001	10/27/2010	12/02/2010
US	LIENS 2	CERCLA Lien Information	Environmental Protection Agency	12/30/2020	01/14/2021	02/18/2021
US	LUCIS	Land Use Control Information System	Department of the Navy	11/11/2020	11/17/2020	02/09/2021
US	MINES MRDS	Mineral Resources Data System	USGS	04/06/2018	10/21/2019	10/24/2019
US	MINES VIOLATIONS	MSHA Violation Assessment Data	DOL, Mine Safety & Health Admi	11/24/2020	11/30/2020	01/25/2021
US	MLTS	Material Licensing Tracking System	Nuclear Regulatory Commission	08/05/2020	08/10/2020	10/08/2020
US	NPL	National Priority List	EPA	12/30/2020	01/14/2021	02/09/2021
US	NPL LIENS	Federal Superfund Liens	EPA	10/15/1991	02/02/1994	03/30/1994

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

St	Acronym	Full Name	Government Agency	Gov Date	Arvl. Date	Active Date
US	ODI	Open Dump Inventory	Environmental Protection Agency	06/30/1985	08/09/2004	09/17/2004
US	PADS	PCB Activity Database System	EPA	10/09/2019	10/11/2019	12/20/2019
US	PCB TRANSFORMER	PCB Transformer Registration Database	Environmental Protection Agency	09/13/2019	11/06/2019	02/10/2020
US	PCS	Permit Compliance System	EPA, Office of Water	07/14/2011	08/05/2011	09/29/2011
US	PCS ENF	Enforcement data	EPA	12/31/2014	02/05/2015	03/06/2015
US	PCS INACTIVE	Listing of Inactive PCS Permits	EPA	11/05/2014	01/06/2015	05/06/2015
US	PRP	Potentially Responsible Parties	EPA	04/27/2020	05/06/2020	06/09/2020
US	Proposed NPL	Proposed National Priority List Sites	EPA	12/30/2020	01/14/2021	02/09/2021
US	RAATS	RCRA Administrative Action Tracking System	EPA	04/17/1995	07/03/1995	08/07/1995
US	RADINFO	Radiation Information Database	Environmental Protection Agency	07/01/2019	07/01/2019	09/23/2019
US	RCRA NonGen / NLR	RCRA - Non Generators / No Longer Regulated	Environmental Protection Agency	12/14/2020	12/17/2020	12/22/2020
US	RCRA-LQG	RCRA - Large Quantity Generators	Environmental Protection Agency	12/14/2020	12/17/2020	12/22/2020
US	RCRA-SQG	RCRA - Small Quantity Generators	Environmental Protection Agency	12/14/2020	12/17/2020	12/22/2020
US	RCRA-TSDF	RCRA - Treatment, Storage and Disposal	Environmental Protection Agency	12/14/2020	12/17/2020	12/22/2020
US	RCRA-VSQG	RCRA - Very Small Quantity Generators (Formerly Conditionall	Environmental Protection Agency	12/14/2020	12/17/2020	12/22/2020
US	RMP	Risk Management Plans	Environmental Protection Agency	11/02/2020	11/12/2020	01/25/2021
US	ROD	Records Of Decision	EPA	12/30/2020	01/14/2021	02/18/2021
US	SCRD DRYCLEANERS	State Coalition for Remediation of Drycleaners Listing	Environmental Protection Agency	01/01/2017	02/03/2017	04/07/2017
US	SEMS	Superfund Enterprise Management System	EPA	12/30/2020	01/14/2021	02/18/2021
US	SEMS-ARCHIVE	Superfund Enterprise Management System Archive	EPA	12/30/2020	01/14/2021	02/18/2021
US	SSTS	Section 7 Tracking Systems	EPA	10/19/2020	10/19/2020	01/04/2021
US	TRIS	Toxic Chemical Release Inventory System	EPA	12/31/2018	08/14/2020	11/04/2020
US	TSCA	Toxic Substances Control Act	EPA	12/31/2016	06/17/2020	09/10/2020
US	UMTRA	Uranium Mill Tailings Sites	Department of Energy	08/30/2019	11/15/2019	01/28/2020
US	US AIRS (AFS)	Aerometric Information Retrieval System Facility Subsystem (	EPA	10/12/2016	10/26/2016	02/03/2017
US	US AIRS MINOR	Air Facility System Data	EPA	10/12/2016	10/26/2016	02/03/2017
US	US BROWNFIELDS	A Listing of Brownfields Sites	Environmental Protection Agency	12/11/2020	12/11/2020	03/02/2021
US	US CDL	Clandestine Drug Labs	Drug Enforcement Administration	12/07/2020	12/09/2020	03/02/2021
US	US ENG CONTROLS	Engineering Controls Sites List	Environmental Protection Agency	10/28/2020	11/05/2020	11/18/2020
US	US FIN ASSUR	Financial Assurance Information	Environmental Protection Agency	09/21/2020	09/22/2020	12/14/2020
US	US HIST CDL	National Clandestine Laboratory Register	Drug Enforcement Administration	12/07/2020	12/09/2020	03/02/2021
US	US INST CONTROLS	Institutional Controls Sites List	Environmental Protection Agency	10/28/2020	11/05/2020	11/18/2020
US	US MINES	Mines Master Index File	Department of Labor, Mine Safety and Health A	11/03/2020	11/23/2020	01/25/2021
US	US MINES 2	Ferrous and Nonferrous Metal Mines Database Listing	USGS	05/06/2020	05/27/2020	08/13/2020
US	US MINES 3	Active Mines & Mineral Plants Database Listing	USGS	04/14/2011	06/08/2011	09/13/2011
US	UXO	Unexploded Ordnance Sites	Department of Defense	12/31/2018	07/02/2020	09/17/2020

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

St	Acronym	Full Name	Government Agency	Gov Date	Arvl. Date	Active Date
NY	NY MANIFEST	Facility and Manifest Data	Department of Environmental Conservation	01/01/2019	04/29/2020	07/10/2020
WI	WI MANIFEST	Manifest Information	Department of Natural Resources	05/31/2018	06/19/2019	09/03/2019
US	AHA Hospitals	Sensitive Receptor: AHA Hospitals	American Hospital Association, Inc.			
US	Medical Centers	Sensitive Receptor: Medical Centers	Centers for Medicare & Medicaid Services			
US	Nursing Homes	Sensitive Receptor: Nursing Homes	National Institutes of Health			
US	Public Schools	Sensitive Receptor: Public Schools	National Center for Education Statistics			
US	Private Schools	Sensitive Receptor: Private Schools	National Center for Education Statistics			
OR	Daycare Centers	Sensitive Receptor: Child Care Listings	Employment Department			
US	Flood Zones	100-year and 500-year flood zones	Emergency Management Agency (FEMA)			
US	NWI	National Wetlands Inventory	U.S. Fish and Wildlife Service			
OR	State Wetlands	Wetlands Inventory Data	Oregon Geospatial Enterprise Office			
US	Topographic Map		U.S. Geological Survey			
US	Oil/Gas Pipelines		Endeavor Business Media			
US	Electric Power Transmission Line Data		Endeavor Business Media			

STREET AND ADDRESS INFORMATION

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Nickel Mountain
Nickel Mountain Quarry
Winston, OR 97496

Inquiry Number: 6175862.2s
September 01, 2020

The EDR Radius Map™ Report with GeoCheck®

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

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Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

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EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc (EDR). The report was designed to assist parties seeking to meet the search requirements of EPA's Standards and Practices for All Appropriate Inquiries (40 CFR Part 312), the ASTM Standard Practice for Environmental Site Assessments (E 1527-13), the ASTM Standard Practice for Environmental Site Assessments for Forestland or Rural Property (E 2247-16), the ASTM Standard Practice for Limited Environmental Due Diligence: Transaction Screen Process (E 1528-14) or custom requirements developed for the evaluation of environmental risk associated with a parcel of real estate.

TARGET PROPERTY INFORMATION

ADDRESS

NICKEL MOUNTAIN QUARRY
WINSTON, OR 97496

COORDINATES

Latitude (North):	42.9636300 - 42° 57' 49.06''
Longitude (West):	123.4359180 - 123° 26' 9.30''
Universal Tranverse Mercator:	Zone 10
UTM X (Meters):	464447.1
UTM Y (Meters):	4756653.0
Elevation:	2969 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property Map:	6070939 NICKEL MOUNTAIN, OR
Version Date:	2014

AERIAL PHOTOGRAPHY IN THIS REPORT

Portions of Photo from:	20140610
Source:	USDA

MAPPED SITES SUMMARY

Target Property Address:
NICKEL MOUNTAIN QUARRY
WINSTON, OR 97469

Click on Map ID to see full detail.

MAP ID	SITE NAME	ADDRESS	DATABASE ACRONYMS	RELATIVE ELEVATION	DIST (ft. & mi.) DIRECTION
A1	NICKEL MOUNTAIN GROU		MINES MRDS	Higher	1 ft.
A2	NICKEL MOUNTAIN MINE	30S/6W/S17	ECSI	Higher	1 ft.
3	NICKEL MOUNTAIN GROU		MINES MRDS	Higher	1 ft.
A4	NICKEL MOUNTAIN		MINES MRDS	Higher	1 ft.
B5	HANNA NICKEL MINE		MINES MRDS	Higher	1 ft.
B6	RIDDLE MINE		MINES MRDS	Higher	1 ft.
7	COLORADO DEPARTMENT		US MINES	Higher	1 ft.

EXECUTIVE SUMMARY

TARGET PROPERTY SEARCH RESULTS

The target property was not listed in any of the databases searched by EDR.

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records either on the target property or within the search radius around the target property for the following databases:

STANDARD ENVIRONMENTAL RECORDS

Federal NPL site list

NPL ---------- National Priority List
Proposed NPL ---------- Proposed National Priority List Sites
NPL LIENS ---------- Federal Superfund Liens

Federal Delisted NPL site list

Delisted NPL ---------- National Priority List Deletions

Federal CERCLIS list

FEDERAL FACILITY ---------- Federal Facility Site Information listing
SEMS ---------- Superfund Enterprise Management System

Federal CERCLIS NFRAP site list

SEMS-ARCHIVE ---------- Superfund Enterprise Management System Archive

Federal RCRA CORRACTS facilities list

CORRACTS ---------- Corrective Action Report

Federal RCRA non-CORRACTS TSD facilities list

RCRA-TSDF ---------- RCRA - Treatment, Storage and Disposal

Federal RCRA generators list

RCRA-LQG ---------- RCRA - Large Quantity Generators
RCRA-SQG ---------- RCRA - Small Quantity Generators
RCRA-VSQG ---------- RCRA - Very Small Quantity Generators (Formerly Conditionally Exempt Small Quantity Generators)

Federal institutional controls / engineering controls registries

LUCIS ---------- Land Use Control Information System

US ENG CONTROLS---- Engineering Controls Sites List
US INST CONTROLS---- Institutional Controls Sites List

Federal ERNS list

ERNS---- Emergency Response Notification System

State- and tribal - equivalent CERCLIS

CRL---- Confirmed Release List and Inventory

State and tribal landfill and/or solid waste disposal site lists

SWF/LF---- Solid Waste Facilities List

State and tribal leaking storage tank lists

LUST---- Leaking Underground Storage Tank Database
INDIAN LUST---- Leaking Underground Storage Tanks on Indian Land

State and tribal registered storage tank lists

FEMA UST---- Underground Storage Tank Listing
UST---- Underground Storage Tank Database
AST---- Aboveground Storage Tanks
INDIAN UST---- Underground Storage Tanks on Indian Land

State and tribal institutional control / engineering control registries

ENG CONTROLS---- Engineering Controls Recorded at ESCI Sites
INST CONTROL---- Institutional Controls Recorded at ESCI Sites

State and tribal voluntary cleanup sites

VCP---- Voluntary Cleanup Program Sites
INDIAN VCP---- Voluntary Cleanup Priority Listing

State and tribal Brownfields sites

BROWNFIELDS---- Brownfields Projects

ADDITIONAL ENVIRONMENTAL RECORDS

Local Brownfield lists

US BROWNFIELDS---- A Listing of Brownfields Sites

Local Lists of Landfill / Solid Waste Disposal Sites

HIST LF---- Old Closed SW Disposal Sites
SWRCY---- Recycling Facility Location Listing
INDIAN ODI---- Report on the Status of Open Dumps on Indian Lands
DEBRIS REGION 9---- Torres Martinez Reservation Illegal Dump Site Locations
ODI---- Open Dump Inventory

IHS OPEN DUMPS ---------- Open Dumps on Indian Land

Local Lists of Hazardous waste / Contaminated Sites

AOCONCERN ---------- Columbia Slough
US HIST CDL ---------- Delisted National Clandestine Laboratory Register
CDL ---------- Uninhabitable Drug Lab Properties
US CDL ---------- National Clandestine Laboratory Register

Local Land Records

LIENS 2 ---------- CERCLA Lien Information

Records of Emergency Release Reports

HMIRS ---------- Hazardous Materials Information Reporting System
SPILLS ---------- Spill Database
OR HAZMAT ---------- Hazmat/Incidents
SPILLS 90 ---------- SPILLS 90 data from FirstSearch

Other Ascertainable Records

RCRA NonGen / NLR ---------- RCRA - Non Generators / No Longer Regulated
FUDS ---------- Formerly Used Defense Sites
DOD ---------- Department of Defense Sites
SCRD DRYCLEANERS ---------- State Coalition for Remediation of Drycleaners Listing
US FIN ASSUR ---------- Financial Assurance Information
EPA WATCH LIST ---------- EPA WATCH LIST
2020 COR ACTION ---------- 2020 Corrective Action Program List
TSCA ---------- Toxic Substances Control Act
TRIS ---------- Toxic Chemical Release Inventory System
SSTS ---------- Section 7 Tracking Systems
ROD ---------- Records Of Decision
RMP ---------- Risk Management Plans
RAATS ---------- RCRA Administrative Action Tracking System
PRP ---------- Potentially Responsible Parties
PADS ---------- PCB Activity Database System
ICIS ---------- Integrated Compliance Information System
FTTS ---------- FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
MLTS ---------- Material Licensing Tracking System
COAL ASH DOE ---------- Steam-Electric Plant Operation Data
COAL ASH EPA ---------- Coal Combustion Residues Surface Impoundments List
PCB TRANSFORMER ---------- PCB Transformer Registration Database
RADINFO ---------- Radiation Information Database
HIST FTTS ---------- FIFRA/TSCA Tracking System Administrative Case Listing
DOT OPS ---------- Incident and Accident Data
CONSENT ---------- Superfund (CERCLA) Consent Decrees
INDIAN RESERV ---------- Indian Reservations
FUSRAP ---------- Formerly Utilized Sites Remedial Action Program
UMTRA ---------- Uranium Mill Tailings Sites
LEAD SMELTERS ---------- Lead Smelter Sites
US AIRS ---------- Aerometric Information Retrieval System Facility Subsystem
ABANDONED MINES ---------- Abandoned Mines
FINDS ---------- Facility Index System/Facility Registry System

EXECUTIVE SUMMARY

DOCKET HWC - Hazardous Waste Compliance Docket Listing
UXO - Unexploded Ordnance Sites
ECHO - Enforcement & Compliance History Information
FUELS PROGRAM - EPA Fuels Program Registered Listing
AIRS - Oregon Title V Facility Listing
COAL ASH - Coal Ash Disposal Sites Listing
DRYCLEANERS - Drycleaning Facilities
Enforcement - Enforcement Action Listing
Financial Assurance - Financial Assurance Information Listing
HSIS - Hazardous Substance Information Survey
MANIFEST - Manifest Information
NPDES - Wastewater Permits Database
UIC - Underground Injection Control Program Database

EDR HIGH RISK HISTORICAL RECORDS

EDR Exclusive Records

EDR MGP - EDR Proprietary Manufactured Gas Plants
EDR Hist Auto - EDR Exclusive Historical Auto Stations
EDR Hist Cleaner - EDR Exclusive Historical Cleaners

EDR RECOVERED GOVERNMENT ARCHIVES

Exclusive Recovered Govt. Archives

RGA HWS - Recovered Government Archive State Hazardous Waste Facilities List
RGA LF - Recovered Government Archive Solid Waste Facilities List
RGA LUST - Recovered Government Archive Leaking Underground Storage Tank

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were identified in the following databases.

Elevations have been determined from the USGS Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified. Sites with an elevation equal to or higher than the target property have been differentiated below from sites with an elevation lower than the target property.
Page numbers and map identification numbers refer to the EDR Radius Map report where detailed data on individual sites can be reviewed.

Sites listed in ***bold italics*** are in multiple databases.

Unmappable (orphan) sites are not considered in the foregoing analysis.

STANDARD ENVIRONMENTAL RECORDS

State- and tribal - equivalent CERCLIS

ECSI: The Environmental Cleanup Site Information System records information about sites in Oregon that may be of environmental interest. The data come from the Department of Environmental Quality.

A review of the ECSI list, as provided by EDR, and dated 03/01/2020 has revealed that there is 1 ECSI

site within approximately 1 mile of the target property.

Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
NICKEL MOUNTAIN MINE Investigation: Suspect State ID Number: 2666 Decode For Further Action: Low	30S/6W/S17	0 - 1/8 (0.000 mi.)	A2	9

ADDITIONAL ENVIRONMENTAL RECORDS

Other Ascertainable Records

US MINES: Mines Master Index File. The source of this database is the Dept. of Labor, Mine Safety and Health Administration.

A review of the US MINES list, as provided by EDR, has revealed that there is 1 US MINES site within approximately 0.25 miles of the target property.

Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
COLORADO DEPARTMENT Database: US MINES, Date of Government Version: 05/01/2020 Mine ID:: 0503409		0 - 1/8 (0.000 mi.)	7	14

MINES MRDS: Mineral Resources Data System

A review of the MINES MRDS list, as provided by EDR, and dated 04/06/2018 has revealed that there are 5 MINES MRDS sites within approximately 0.001 miles of the target property.

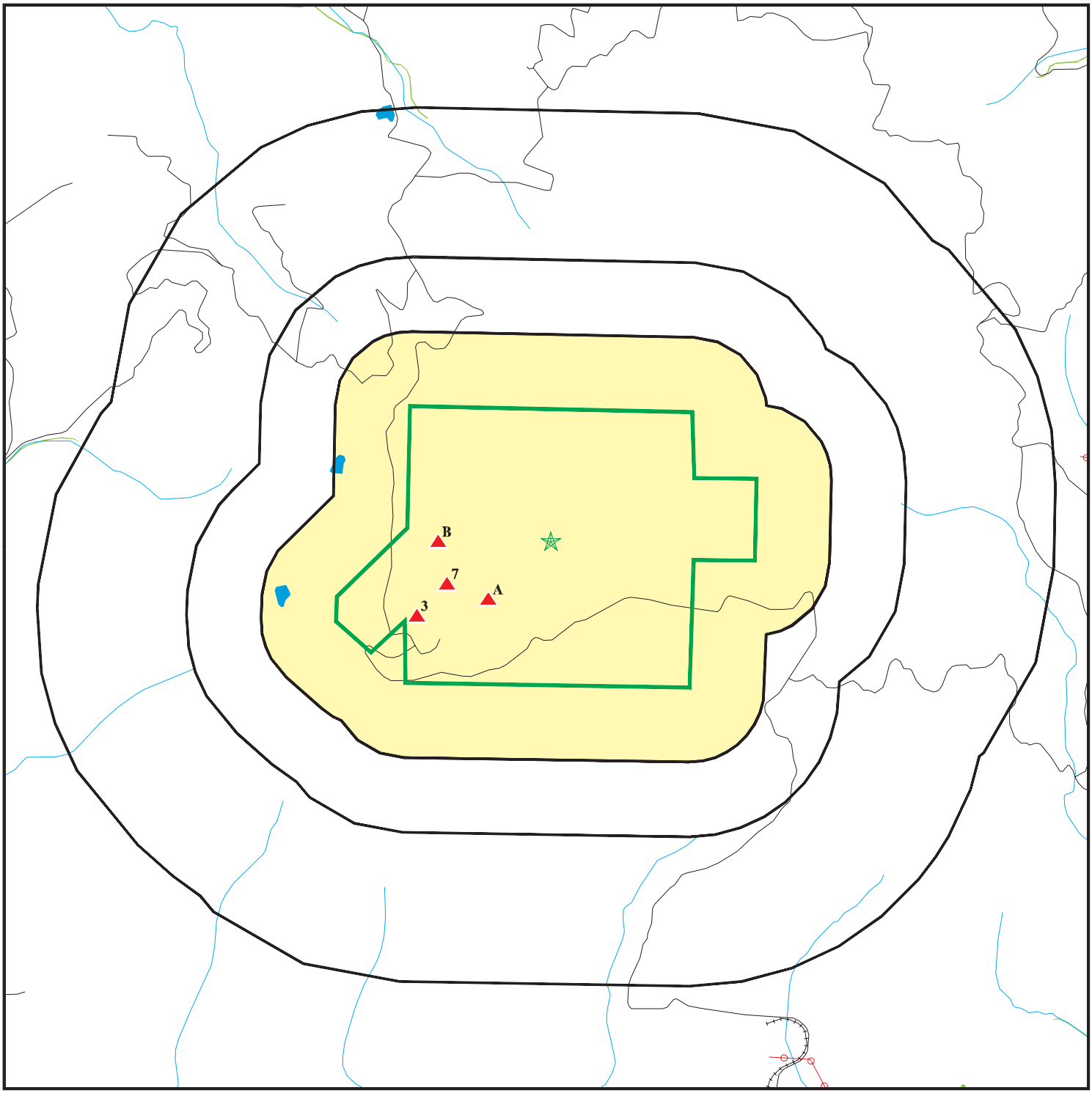
Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
NICKEL MOUNTAIN GROU		0 - 1/8 (0.000 mi.)	A1	8
NICKEL MOUNTAIN GROU		0 - 1/8 (0.000 mi.)	3	10
NICKEL MOUNTAIN		0 - 1/8 (0.000 mi.)	A4	11
HANNA NICKEL MINE		0 - 1/8 (0.000 mi.)	B5	12
RIDDLE MINE		0 - 1/8 (0.000 mi.)	B6	13

EXECUTIVE SUMMARY

Due to poor or inadequate address information, the following sites were not mapped. Count: 2 records.

Site Name	Database(s)
HANNA NICKEL SMELTING CO.	RGA HWS
HANNA NICKEL SMELTING CO. (SEE ECS	RGA HWS

OVERVIEW MAP - 6175862.2S



Target Property

Sites at elevations higher than or equal to the target property

Sites at elevations lower than the target property

Manufactured Gas Plants

National Priority List Sites

Dept. Defense Sites

0 1/4 1/2 1 Miles

Indian Reservations BIA

Power transmission lines

Special Flood Hazard Area (1%)

0.2% Annual Chance Flood Hazard

National Wetland Inventory

State Wetlands

Areas of Concern

N

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME:	Nickel Mountain	CLIENT:	Alpine Environmental Consultants, LLC
ADDRESS:	Nickel Mountain Quarry Winston OR 97496	CONTACT:	Jonathan Williams
LAT/LONG:	42.96363 / 123.435918	INQUIRY #:	6175862.2s
		DATE:	September 01, 2020 1:11 pm

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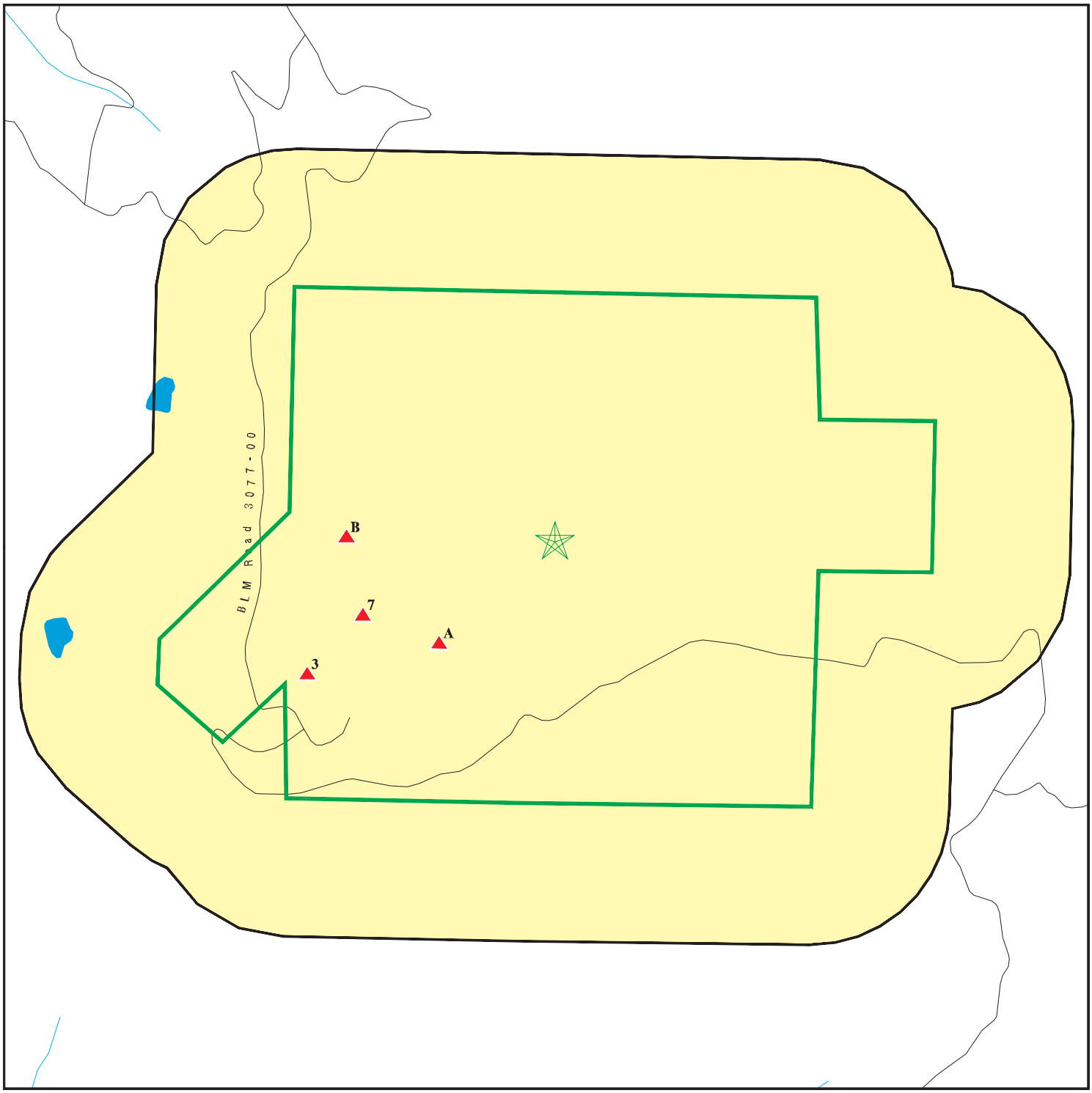
DETAIL MAP - 6175862.2S



Target Property

Sites at elevations higher than or equal to the target property

Sites at elevations lower than the target property

Manufactured Gas Plants

Sensitive Receptors

National Priority List Sites

Dept. Defense Sites

0 1/4 1/2 1 Miles

Indian Reservations BIA

Special Flood Hazard Area (1%)

0.2% Annual Chance Flood Hazard

Areas of Concern

N

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME:	Nickel Mountain	CLIENT:	Alpine Environmental Consultants, LLC
ADDRESS:	Nickel Mountain Quarry Winston OR 97496	CONTACT:	Jonathan Williams
LAT/LONG:	42.96363 / 123.435918	INQUIRY #:	6175862.2s
		DATE:	September 01, 2020 1:12 pm

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MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
STANDARD ENVIRONMENTAL RECORDS								
Federal NPL site list								
NPL	1.000		0	0	0	0	NR	0
Proposed NPL	1.000		0	0	0	0	NR	0
NPL LIENS	1.000		0	0	0	0	NR	0
Federal Delisted NPL site list								
Delisted NPL	1.000		0	0	0	0	NR	0
Federal CERCLIS list								
FEDERAL FACILITY	0.500		0	0	0	NR	NR	0
SEMS	0.500		0	0	0	NR	NR	0
Federal CERCLIS NFRAP site list								
SEMS-ARCHIVE	0.500		0	0	0	NR	NR	0
Federal RCRA CORRACTS facilities list								
CORRACTS	1.000		0	0	0	0	NR	0
Federal RCRA non-CORRACTS TSD facilities list								
RCRA-TSDF	0.500		0	0	0	NR	NR	0
Federal RCRA generators list								
RCRA-LQG	0.250		0	0	NR	NR	NR	0
RCRA-SQG	0.250		0	0	NR	NR	NR	0
RCRA-VSQG	0.250		0	0	NR	NR	NR	0
Federal institutional controls / engineering controls registries								
LUCIS	0.500		0	0	0	NR	NR	0
US ENG CONTROLS	0.500		0	0	0	NR	NR	0
US INST CONTROLS	0.500		0	0	0	NR	NR	0
Federal ERNS list								
ERNS	0.001		0	NR	NR	NR	NR	0
State- and tribal - equivalent CERCLIS								
ECSI	1.000		1	0	0	0	NR	1
CRL	1.000		0	0	0	0	NR	0
State and tribal landfill and/or solid waste disposal site lists								
SWF/LF	0.500		0	0	0	NR	NR	0
State and tribal leaking storage tank lists								
LUST	0.500		0	0	0	NR	NR	0
INDIAN LUST	0.500		0	0	0	NR	NR	0
State and tribal registered storage tank lists								
FEMA UST	0.250		0	0	NR	NR	NR	0

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
UST	0.250		0	0	NR	NR	NR	0
AST	0.250		0	0	NR	NR	NR	0
INDIAN UST	0.250		0	0	NR	NR	NR	0
State and tribal institutional control / engineering control registries								
ENG CONTROLS	0.500		0	0	0	NR	NR	0
INST CONTROL	0.500		0	0	0	NR	NR	0
State and tribal voluntary cleanup sites								
VCP	0.500		0	0	0	NR	NR	0
INDIAN VCP	0.500		0	0	0	NR	NR	0
State and tribal Brownfields sites								
BROWNFIELDS	0.500		0	0	0	NR	NR	0
ADDITIONAL ENVIRONMENTAL RECORDS								
Local Brownfield lists								
US BROWNFIELDS	0.500		0	0	0	NR	NR	0
Local Lists of Landfill / Solid Waste Disposal Sites								
HIST LF	0.500		0	0	0	NR	NR	0
SWRCY	0.500		0	0	0	NR	NR	0
INDIAN ODI	0.500		0	0	0	NR	NR	0
DEBRIS REGION 9	0.500		0	0	0	NR	NR	0
ODI	0.500		0	0	0	NR	NR	0
IHS OPEN DUMPS	0.500		0	0	0	NR	NR	0
Local Lists of Hazardous waste / Contaminated Sites								
AOCONCERN	1.000		0	0	0	0	NR	0
US HIST CDL	0.001		0	NR	NR	NR	NR	0
CDL	0.001		0	NR	NR	NR	NR	0
US CDL	0.001		0	NR	NR	NR	NR	0
Local Land Records								
LIENS 2	0.001		0	NR	NR	NR	NR	0
Records of Emergency Release Reports								
HMIRS	0.001		0	NR	NR	NR	NR	0
SPILLS	0.001		0	NR	NR	NR	NR	0
OR HAZMAT	0.001		0	NR	NR	NR	NR	0
SPILLS 90	0.001		0	NR	NR	NR	NR	0
Other Ascertainable Records								
RCRA NonGen / NLR	0.250		0	0	NR	NR	NR	0
FUDS	1.000		0	0	0	0	NR	0
DOD	1.000		0	0	0	0	NR	0

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
SCRD DRYCLEANERS	0.500		0	0	0	NR	NR	0
US FIN ASSUR	0.001		0	NR	NR	NR	NR	0
EPA WATCH LIST	0.001		0	NR	NR	NR	NR	0
2020 COR ACTION	0.250		0	0	NR	NR	NR	0
TSCA	0.001		0	NR	NR	NR	NR	0
TRIS	0.001		0	NR	NR	NR	NR	0
SSTS	0.001		0	NR	NR	NR	NR	0
ROD	1.000		0	0	0	0	NR	0
RMP	0.001		0	NR	NR	NR	NR	0
RAATS	0.001		0	NR	NR	NR	NR	0
PRP	0.001		0	NR	NR	NR	NR	0
PADS	0.001		0	NR	NR	NR	NR	0
ICIS	0.001		0	NR	NR	NR	NR	0
FTTS	0.001		0	NR	NR	NR	NR	0
MLTS	0.001		0	NR	NR	NR	NR	0
COAL ASH DOE	0.001		0	NR	NR	NR	NR	0
COAL ASH EPA	0.500		0	0	0	NR	NR	0
PCB TRANSFORMER	0.001		0	NR	NR	NR	NR	0
RADINFO	0.001		0	NR	NR	NR	NR	0
HIST FTTS	0.001		0	NR	NR	NR	NR	0
DOT OPS	0.001		0	NR	NR	NR	NR	0
CONSENT	1.000		0	0	0	0	NR	0
INDIAN RESERV	1.000		0	0	0	0	NR	0
FUSRAP	1.000		0	0	0	0	NR	0
UMTRA	0.500		0	0	0	NR	NR	0
LEAD SMELTERS	0.001		0	NR	NR	NR	NR	0
US AIRS	0.001		0	NR	NR	NR	NR	0
US MINES	0.250		1	0	NR	NR	NR	1
ABANDONED MINES	0.250		0	0	NR	NR	NR	0
FINDS	0.001		0	NR	NR	NR	NR	0
DOCKET HWC	0.001		0	NR	NR	NR	NR	0
UXO	1.000		0	0	0	0	NR	0
ECHO	0.001		0	NR	NR	NR	NR	0
FUELS PROGRAM	0.250		0	0	NR	NR	NR	0
AIRS	0.001		0	NR	NR	NR	NR	0
COAL ASH	0.500		0	0	0	NR	NR	0
DRYCLEANERS	0.250		0	0	NR	NR	NR	0
Enforcement	0.001		0	NR	NR	NR	NR	0
Financial Assurance	0.001		0	NR	NR	NR	NR	0
HSIS	0.001		0	NR	NR	NR	NR	0
MANIFEST	0.250		0	0	NR	NR	NR	0
NPDES	0.001		0	NR	NR	NR	NR	0
UIC	0.001		0	NR	NR	NR	NR	0
MINES MRDS	0.001		5	NR	NR	NR	NR	5

EDR HIGH RISK HISTORICAL RECORDS

EDR Exclusive Records

EDR MGP	1.000		0	0	0	0	NR	0
EDR Hist Auto	0.125		0	NR	NR	NR	NR	0

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
EDR Hist Cleaner	0.125		0	NR	NR	NR	NR	0
EDR RECOVERED GOVERNMENT ARCHIVES								
Exclusive Recovered Govt. Archives								
RGA HWS	0.001		0	NR	NR	NR	NR	0
RGA LF	0.001		0	NR	NR	NR	NR	0
RGA LUST	0.001		0	NR	NR	NR	NR	0
- Totals --		0	7	0	0	0	0	7

NOTES:

TP = Target Property

NR = Not Requested at this Search Distance

Sites may be listed in more than one database

A1 **NICKEL MOUNTAIN GROUP** **MINES MRDS** **1025548103**
N/A

< 1/8
1 ft. **WINSTON, OR 97496**

Site 1 of 3 in cluster A

Relative:
Higher

Actual:
3126 ft.

MINES MRDS:

Name:	NICKEL MOUNTAIN GROUP
Address:	Not reported
Deposit identification Number:	10043117
City,State,Zip:	WINSTON, OREGON 97496
URL:	https://mrdata.usgs.gov/mrds/show-mrds.php?dep_id=10043117
MRDS Identification Number:	M061616
MAS/MILS Identification Number:	Not reported
Region:	NA
Country:	United States
Primary Commodities:	Nickel
Secondary Commodities:	Not reported
Tertiary Commodities:	Chromium, Rhodium, PGE
Operation Type:	Unknown
Deposit Type:	Residual
Production Size:	Y - Yes, production has occurred
Development Status:	Producer
Ore Minerals or Materials:	Not reported
Gangue Minerals or Materials:	Quartz
Other Minerals or Materials:	Not reported
Ore Body Form:	IRREGULAR
Workings Type:	Not reported
Mineral Deposit Model:	110: Lateritic Ni
Alteration Processes:	Not reported
Concentration Processes:	Supergene Enrichment. Weathering To Saprolite Probably Took Place In Late Tertiary.
Previous Names:	Upper Occurrence
Ore Controls:	Subparallel Diagonal Cross Faults At Right Angles To The Main Rock Fault.
Reporter:	Johnson, Maureen G., Ferns, Mark L. (Brooks, Howard C.), Peterson, Jocelyn A.
Host Rock Unit Name:	Not reported
Host Rock Type:	Not reported
Associated Rock Unit Name:	Riddle Mountain Peridotite;Dothan Formation;Riddle Formation;Riddle Formation;Riddle Formation
Associated Rock Type Code:	Sandstone
Structural Characteristics:	Tertiary Klamath Peneplain (Upper Body), Sherwood Peneplain (Lower Body), Klamath Peneplain, Rock Fault And Associated Faults, Fractures And Joints.
Tectonic Setting:	Klamath Mountains Accreted Terrane
References:	Not reported
First Production Year:	1954
Began Before/After FPY:	Not reported
Last Production Year:	Not reported
Ended Before/After LPY:	Not reported
Year Discovered:	1864
Found Before/After YD:	Not reported
Production History:	Not reported
Discovery Information:	Sheepherders
Latitude:	42.96093
Longitude:	-123.44005

A2 **NICKEL MOUNTAIN MINE** **ECSI** **S109346088**
30S/6W/S17 **N/A**
< 1/8 **, OR**
1 ft.

Site 2 of 3 in cluster A

Relative: Higher

Actual: 3112 ft.

ECSI:

Name:	NICKEL MOUNTAIN MINE
Address:	30S/6W/S17
City,State,Zip:	OR
State ID Number:	2666
Brown ID:	0
Study Area:	False
Region ID:	3
Legislatve ID:	0
Investigation:	Suspect
FACA ID:	40976
Further Action:	260
Lat/Long (dms):	42 57 38.16 / -123 26 26.16
County Code:	10.00
Score Value:	Not reported
Cerclis ID:	Not reported
Township Coord.:	30.00
Township Zone:	S
Range Coord:	6.00
Range Zone:	W
Section Coord:	17
Qtr Section:	Not reported
Tax Lots:	Not reported
Size:	Not reported
NPL:	False
Orphan:	False
Updated By:	GWISTAR
Update Date:	10/27/2008
Created Date:	08/22/2000
Decode For RegionID:	Western Region
Decode For BrownID:	Not reported
Decode For Furtheract:	Low
Decode For Investstat:	Suspect
Decode For Legislative:	Not reported

Narrative:

NARR ID:	5740007
NARR Code:	Pathways Other Hazards
Created By:	Not reported
Created Date:	12/17/2002
Updated By:	Not reported
Updated Date:	12/17/2002
Decode for NarcdID:	Pathways & Other Hazards
NARR Comments:	Potential effect on sensitive surface water receptors. Mine currently undergoing reclamation efforts with BLM and DOGAMI.

NARR ID:	5742920
NARR Code:	Site History
Created By:	GWISTAR
Created Date:	01/24/2003
Updated By:	GWISTAR
Updated Date:	01/24/2003
Decode for NarcdID:	Site History
NARR Comments:	The early history of Nickel Mountain Mine was not reported. The

NICKEL MOUNTAIN MINE (Continued) **S109346088**

surface mine was first discovered in 1864. There is a smelter on-site. Nickel Mountain Mine is considered a large producer of nickel ore.

Administrative Action:
Action ID: 9424
Region: Western Region
Complete Date: Not reported
Rank Value: 0
Cleanup Flag: False
Created Date: 12/17/2002
Decode for AgencyID: Department of Environmental Quality
Decode for RegionID: Western Region
Category: Administrative Action
Action Code Flag: False
Action: Site added to database
Further Action: Not reported
Comments: Not reported

Action ID: 9508
Region: Western Region
Complete Date: 08/22/2000
Rank Value: 0
Cleanup Flag: False
Created Date: 12/17/2002
Decode for AgencyID: Department of Environmental Quality
Decode for RegionID: Western Region
Category: Remedial Action
Action Code Flag: False
Action: Site Screening recommended (EV)
Further Action: Low
Comments: Not reported

Action ID: 9454
Region: 0
Complete Date: Not reported
Rank Value: Not reported
Cleanup Flag: False
Created Date: 10/15/2003
Decode for AgencyID: Department of Environmental Quality
Decode for RegionID: Not reported
Category: Administrative Action
Action Code Flag: False
Action: Other
Further Action: 0
Comments: Not reported

---

3 **NICKEL MOUNTAIN GROUP-UPPER OCCUR.** **MINES MRDS** **1025613384**
N/A

< 1/8 **WINSTON, OR 97496**
1 ft.

MINES MRDS:
Relative: Name: NICKEL MOUNTAIN GROUP-UPPER OCCUR.
Higher Address: Not reported
Actual: Deposit identification Number: 10128671
3176 ft. City,State,Zip: WINSTON, OREGON 97496
URL: https://mrdata.usgs.gov/mrds/show-mrds.php?dep_id=10128671

NICKEL MOUNTAIN GROUP-UPPER OCCUR. (Continued) **1025613384**

MRDS Identification Number:	M061616
MAS/MILS Identification Number:	0410190356
Region:	NA
Country:	United States
Primary Commodities:	Nickel
Secondary Commodities:	Not reported
Tertiary Commodities:	Not reported
Operation Type:	Surface
Deposit Type:	Not reported
Production Size:	Not reported
Development Status:	Past Producer
Ore Minerals or Materials:	Not reported
Gangue Minerals or Materials:	Not reported
Other Minerals or Materials:	Not reported
Ore Body Form:	Not reported
Workings Type:	Not reported
Mineral Deposit Model:	Not reported
Alteration Processes:	Not reported
Concentration Processes:	Not reported
Previous Names:	Not reported
Ore Controls:	Not reported
Reporter:	Ridenour, James
Host Rock Unit Name:	Not reported
Host Rock Type:	Not reported
Associated Rock Unit Name:	Not reported
Associated Rock Type Code:	Not reported
Structural Characteristics:	Not reported
Tectonic Setting:	Not reported
References:	Not reported
First Production Year:	Not reported
Began Before/After FPY:	Not reported
Last Production Year:	Not reported
Ended Before/After LPY:	Not reported
Year Discovered:	Not reported
Found Before/After YD:	Not reported
Production History:	Not reported
Discovery Information:	Not reported
Latitude:	42.96012
Longitude:	-123.44476

A4 **NICKEL MOUNTAIN** **MINES MRDS** **1025561901**
N/A

< 1/8
1 ft.

WINSTON, OR 97496

Site 3 of 3 in cluster A

Relative:
Higher

Actual:
3126 ft.

MINES MRDS:

Name:	NICKEL MOUNTAIN
Address:	Not reported
Deposit identification Number:	10067833
City,State,Zip:	WINSTON, OREGON 97496
URL:	https://mrdata.usgs.gov/mrds/show-mrds.php?dep_id=10067833
MRDS Identification Number:	W000690
MAS/MILS Identification Number:	Not reported
Region:	NA
Country:	United States
Primary Commodities:	Nickel
Secondary Commodities:	Cobalt, Platinum, Palladium

NICKEL MOUNTAIN (Continued) **1025561901**

Tertiary Commodities:	Ruthenium, Rhodium, Iridium
Operation Type:	Unknown
Deposit Type:	Not reported
Production Size:	L - Large amount of material produced (we do not know what criteria are used to make this determination)
Development Status:	Producer
Ore Minerals or Materials:	Chlorite, Chromite, Garnierite, Ilmenite, Magnetite, Sepiolite, Spinel
Gangue Minerals or Materials:	Chalcedony
Other Minerals or Materials:	Not reported
Ore Body Form:	STRATIFIED BLANKET
Workings Type:	Surface
Mineral Deposit Model:	110: Lateritic Ni
Alteration Processes:	Not reported
Concentration Processes:	Weathering Processes
Previous Names:	Hanna Nickel Mine
Ore Controls:	Laterite Occurs In Two Areas, The First And Largest Coverstop Of Mountain And Has Been Mined; A Second Deposit, Considerably Smaller, Occurs In A Bench On Southeast Slope Of Mountain. Both Deposits Overlie Fresh Peridotite And Have A Well Developed Quartz-Garnierite Boxwork Zone.
Reporter:	Bradley, Robin (Walker, George W.), Peterson, Jocelyn A., Coury, Anny B.
Host Rock Unit Name:	Not reported
Host Rock Type:	Not reported
Associated Rock Unit Name:	Riddle Formation;Riddle Formation;Riddle Formation;Dothan Formation;Dothan Formation;Dothan Formation;Dothan Formation;;;
Associated Rock Type Code:	Sandstone
Structural Characteristics:	See Comments, Rock Fault And Sring Fault Related To Saprolite Formation; Joints Related To Depth Of Saprolite; Former Water Table Related To Boxwork Ore.
Tectonic Setting:	Klamath Mountains Accreted Terrane
References:	Not reported
First Production Year:	1882
Began Before/After FPY:	Not reported
Last Production Year:	Not reported
Ended Before/After LPY:	Not reported
Year Discovered:	1864
Found Before/After YD:	Not reported
Production History:	Not reported
Discovery Information:	Sheepherders
Latitude:	42.96093
Longitude:	-123.44005

B5 **HANNA NICKEL MINE** **MINES MRDS** **1025680157**
N/A

< 1/8
1 ft.

WINSTON, OR 97496

Site 1 of 2 in cluster B

Relative:
Higher

Actual:
3333 ft.

MINES MRDS:

Name:	HANNA NICKEL MINE
Address:	Not reported
Deposit identification Number:	10201067
City,State,Zip:	WINSTON, OREGON 97496
URL:	https://mrdata.usgs.gov/mrds/show-mrds.php?dep_id=10201067
MRDS Identification Number:	W000690
MAS/MILS Identification Number:	0410190001
Region:	NA

HANNA NICKEL MINE (Continued) **1025680157**

Country:	United States
Primary Commodities:	Nickel
Secondary Commodities:	Not reported
Tertiary Commodities:	Cobalt, Chromium, Iron
Operation Type:	Surface
Deposit Type:	Not reported
Production Size:	Not reported
Development Status:	Past Producer
Ore Minerals or Materials:	Garnierite
Gangue Minerals or Materials:	Montmorillonite, Sepiolite
Other Minerals or Materials:	Chromite, Chrysoprase
Ore Body Form:	Not reported
Workings Type:	Surface
Mineral Deposit Model:	110: Lateritic Ni
Alteration Processes:	Not reported
Concentration Processes:	Not reported
Previous Names:	Riddle Nickel Mine, Nickel Mountain Mine, Riddle Nickel Laterite Deposit
Ore Controls:	Not reported
Reporter:	Ritchey, Joseph L.
Host Rock Unit Name:	Not reported
Host Rock Type:	Not reported
Associated Rock Unit Name:	Not reported
Associated Rock Type Code:	Not reported
Structural Characteristics:	Not reported
Tectonic Setting:	Not reported
References:	Not reported
First Production Year:	1954
Began Before/After FPY:	Not reported
Last Production Year:	Not reported
Ended Before/After LPY:	Not reported
Year Discovered:	1865
Found Before/After YD:	Not reported
Production History:	Not reported
Discovery Information:	Not reported
Latitude:	42.96372
Longitude:	-123.44336

B6 **RIDDLE MINE** **MINES MRDS** **1025531554**
N/A

< 1/8
1 ft.

WINSTON, OR 97496

Site 2 of 2 in cluster B

Relative:
Higher

Actual:
3330 ft.

MINES MRDS:

Name:	RIDDLE MINE
Address:	Not reported
Deposit identification Number:	10024510
City,State,Zip:	WINSTON, OREGON 97496
URL:	https://mrdata.usgs.gov/mrds/show-mrds.php?dep_id=10024510
MRDS Identification Number:	ISM0232
MAS/MILS Identification Number:	Not reported
Region:	NA
Country:	United States
Primary Commodities:	Nickel, Iron, Cobalt
Secondary Commodities:	Not reported
Tertiary Commodities:	Not reported
Operation Type:	Unknown

RIDDLE MINE (Continued) **1025531554**

Deposit Type:	Not reported
Production Size:	Y - Yes, production has occurred
Development Status:	Producer
Ore Minerals or Materials:	Not reported
Gangue Minerals or Materials:	Not reported
Other Minerals or Materials:	Not reported
Ore Body Form:	Not reported
Workings Type:	Not reported
Mineral Deposit Model:	Not reported
Alteration Processes:	Not reported
Concentration Processes:	Leaching And Oxidation
Previous Names:	Nickel Mountain
Ore Controls:	Laterite, Fractures
Reporter:	Foose, Michael P.
Host Rock Unit Name:	Not reported
Host Rock Type:	Peridotite,Serpentinite
Associated Rock Unit Name:	Not reported
Associated Rock Type Code:	Not reported
Structural Characteristics:	Tropical Weathering Of Ultramafic Rocks
Tectonic Setting:	Orogenic Belt
References:	Not reported
First Production Year:	1954
Began Before/After FPY:	Not reported
Last Production Year:	1983
Ended Before/After LPY:	>
Year Discovered:	1864
Found Before/After YD:	Not reported
Production History:	Not reported
Discovery Information:	Not reported
Latitude:	42.96371
Longitude:	-123.44338

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7 **COLORADO DEPARTMENT OF HIGHWAYS** **US MINES** **1016470709**
N/A

< 1/8
1 ft.

CHAFFEE (County), CO

Relative:
Higher

Actual:
3214 ft.

US MINES:

Sic Code(s):	144200
Sic Code(s):	000000
Sic Code(s):	000000
Sic Code(s):	000000
Sic Code(s):	000000
Sic Code(s):	000000
Mine ID:	0503409
Entity Name:	STATE LAND BOARD
Company:	COLORADO DEPARTMENT OF HIGHWAYS
Status:	4
Status Date:	19820812
Operation Class:	2
Number of Shops:	0
Number of Plants:	0
Latitude Degree:	00
Longitude Degree:	000
Latitude Minute:	00
Latitude Seconds:	00
Longitude Minutes:	00
Longitude Seconds:	00

COLORADO DEPARTMENT OF HIGHWAYS (Continued) **1016470709**

Number of Pits: 000

Count: 2 records. ORPHAN SUMMARY

City	EDR ID	Site Name	Site Address	Zip	Database(s)
RIDDLE	S115334019	HANNA NICKEL SMELTING CO.	NICKEL MINE RD.		RGA HWS
RIDDLE	S115334017	HANNA NICKEL SMELTING CO. (SEE ECS	NICKEL MINE RD.		RGA HWS

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

To maintain currency of the following federal and state databases, EDR contacts the appropriate governmental agency on a monthly or quarterly basis, as required.

Number of Days to Update: Provides confirmation that EDR is reporting records that have been updated within 90 days from the date the government agency made the information available to the public.

STANDARD ENVIRONMENTAL RECORDS

Federal NPL site list

NPL: National Priority List

National Priorities List (Superfund). The NPL is a subset of CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund Program. NPL sites may encompass relatively large areas. As such, EDR provides polygon coverage for over 1,000 NPL site boundaries produced by EPA's Environmental Photographic Interpretation Center (EPIC) and regional EPA offices.

Date of Government Version: 07/29/2020
Date Data Arrived at EDR: 08/03/2020
Date Made Active in Reports: 08/25/2020
Number of Days to Update: 22

Source: EPA
Telephone: N/A
Last EDR Contact: 08/03/2020
Next Scheduled EDR Contact: 10/12/2020
Data Release Frequency: Quarterly

NPL Site Boundaries

Sources:

EPA's Environmental Photographic Interpretation Center (EPIC)
Telephone: 202-564-7333

EPA Region 1
Telephone 617-918-1143

EPA Region 6
Telephone: 214-655-6659

EPA Region 3
Telephone 215-814-5418

EPA Region 7
Telephone: 913-551-7247

EPA Region 4
Telephone 404-562-8033

EPA Region 8
Telephone: 303-312-6774

EPA Region 5
Telephone 312-886-6686

EPA Region 9
Telephone: 415-947-4246

EPA Region 10
Telephone 206-553-8665

Proposed NPL: Proposed National Priority List Sites

A site that has been proposed for listing on the National Priorities List through the issuance of a proposed rule in the Federal Register. EPA then accepts public comments on the site, responds to the comments, and places on the NPL those sites that continue to meet the requirements for listing.

Date of Government Version: 07/29/2020
Date Data Arrived at EDR: 08/03/2020
Date Made Active in Reports: 08/25/2020
Number of Days to Update: 22

Source: EPA
Telephone: N/A
Last EDR Contact: 08/03/2020
Next Scheduled EDR Contact: 10/12/2020
Data Release Frequency: Quarterly

NPL LIENS: Federal Superfund Liens

Federal Superfund Liens. Under the authority granted the USEPA by CERCLA of 1980, the USEPA has the authority to file liens against real property in order to recover remedial action expenditures or when the property owner received notification of potential liability. USEPA compiles a listing of filed notices of Superfund Liens.

Date of Government Version: 10/15/1991
Date Data Arrived at EDR: 02/02/1994
Date Made Active in Reports: 03/30/1994
Number of Days to Update: 56

Source: EPA
Telephone: 202-564-4267
Last EDR Contact: 08/15/2011
Next Scheduled EDR Contact: 11/28/2011
Data Release Frequency: No Update Planned

Federal Delisted NPL site list

Delisted NPL: National Priority List Deletions

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes the criteria that the EPA uses to delete sites from the NPL. In accordance with 40 CFR 300.425.(e), sites may be deleted from the NPL where no further response is appropriate.

Date of Government Version: 07/29/2020
Date Data Arrived at EDR: 08/03/2020
Date Made Active in Reports: 08/25/2020
Number of Days to Update: 22

Source: EPA
Telephone: N/A
Last EDR Contact: 08/03/2020
Next Scheduled EDR Contact: 10/12/2020
Data Release Frequency: Quarterly

Federal CERCLIS list

FEDERAL FACILITY: Federal Facility Site Information listing

A listing of National Priority List (NPL) and Base Realignment and Closure (BRAC) sites found in the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) Database where EPA Federal Facilities Restoration and Reuse Office is involved in cleanup activities.

Date of Government Version: 04/03/2019
Date Data Arrived at EDR: 04/05/2019
Date Made Active in Reports: 05/14/2019
Number of Days to Update: 39

Source: Environmental Protection Agency
Telephone: 703-603-8704
Last EDR Contact: 07/02/2020
Next Scheduled EDR Contact: 10/12/2020
Data Release Frequency: Varies

SEMS: Superfund Enterprise Management System

SEMS (Superfund Enterprise Management System) tracks hazardous waste sites, potentially hazardous waste sites, and remedial activities performed in support of EPA's Superfund Program across the United States. The list was formerly know as CERCLIS, renamed to SEMS by the EPA in 2015. The list contains data on potentially hazardous waste sites that have been reported to the USEPA by states, municipalities, private companies and private persons, pursuant to Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This dataset also contains sites which are either proposed to or on the National Priorities List (NPL) and the sites which are in the screening and assessment phase for possible inclusion on the NPL.

Date of Government Version: 07/29/2020
Date Data Arrived at EDR: 08/03/2020
Date Made Active in Reports: 08/25/2020
Number of Days to Update: 22

Source: EPA
Telephone: 800-424-9346
Last EDR Contact: 08/03/2020
Next Scheduled EDR Contact: 10/26/2020
Data Release Frequency: Quarterly

Federal CERCLIS NFRAP site list

SEMS-ARCHIVE: Superfund Enterprise Management System Archive

SEMS-ARCHIVE (Superfund Enterprise Management System Archive) tracks sites that have no further interest under the Federal Superfund Program based on available information. The list was formerly known as the CERCLIS-NFRAP, renamed to SEMS ARCHIVE by the EPA in 2015. EPA may perform a minimal level of assessment work at a site while it is archived if site conditions change and/or new information becomes available. Archived sites have been removed and archived from the inventory of SEMS sites. Archived status indicates that, to the best of EPA's knowledge, assessment at a site has been completed and that EPA has determined no further steps will be taken to list the site on the National Priorities List (NPL), unless information indicates this decision was not appropriate or other considerations require a recommendation for listing at a later time. The decision does not necessarily mean that there is no hazard associated with a given site; it only means that. based upon available information, the location is not judged to be potential NPL site.

Date of Government Version: 07/29/2020
Date Data Arrived at EDR: 08/03/2020
Date Made Active in Reports: 08/25/2020
Number of Days to Update: 22

Source: EPA
Telephone: 800-424-9346
Last EDR Contact: 08/03/2020
Next Scheduled EDR Contact: 10/26/2020
Data Release Frequency: Quarterly

Federal RCRA CORRACTS facilities list

CORRACTS: Corrective Action Report

CORRACTS identifies hazardous waste handlers with RCRA corrective action activity.

Date of Government Version: 03/23/2020
Date Data Arrived at EDR: 03/25/2020
Date Made Active in Reports: 05/21/2020
Number of Days to Update: 57

Source: EPA
Telephone: 800-424-9346
Last EDR Contact: 06/22/2020
Next Scheduled EDR Contact: 10/05/2020
Data Release Frequency: Quarterly

Federal RCRA non-CORRACTS TSD facilities list

RCRA-TSDF: RCRA - Treatment, Storage and Disposal

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Transporters are individuals or entities that move hazardous waste from the generator offsite to a facility that can recycle, treat, store, or dispose of the waste. TSDFs treat, store, or dispose of the waste.

Date of Government Version: 03/23/2020
Date Data Arrived at EDR: 03/25/2020
Date Made Active in Reports: 05/21/2020
Number of Days to Update: 57

Source: Environmental Protection Agency
Telephone: (206) 553-1200
Last EDR Contact: 06/22/2020
Next Scheduled EDR Contact: 10/05/2020
Data Release Frequency: Quarterly

Federal RCRA generators list

RCRA-LQG: RCRA - Large Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Large quantity generators (LQGs) generate over 1,000 kilograms (kg) of hazardous waste, or over 1 kg of acutely hazardous waste per month.

Date of Government Version: 03/23/2020
Date Data Arrived at EDR: 03/25/2020
Date Made Active in Reports: 05/21/2020
Number of Days to Update: 57

Source: Environmental Protection Agency
Telephone: (206) 553-1200
Last EDR Contact: 06/22/2020
Next Scheduled EDR Contact: 10/05/2020
Data Release Frequency: Quarterly

RCRA-SQG: RCRA - Small Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Small quantity generators (SQGs) generate between 100 kg and 1,000 kg of hazardous waste per month.

Date of Government Version: 03/23/2020
Date Data Arrived at EDR: 03/25/2020
Date Made Active in Reports: 05/21/2020
Number of Days to Update: 57

Source: Environmental Protection Agency
Telephone: (206) 553-1200
Last EDR Contact: 06/22/2020
Next Scheduled EDR Contact: 10/05/2020
Data Release Frequency: Quarterly

RCRA-VSQG: RCRA - Very Small Quantity Generators (Formerly Conditionally Exempt Small Quantity Generators)

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Very small quantity generators (VSQGs) generate less than 100 kg of hazardous waste, or less than 1 kg of acutely hazardous waste per month.

Date of Government Version: 03/23/2020
Date Data Arrived at EDR: 03/25/2020
Date Made Active in Reports: 05/21/2020
Number of Days to Update: 57

Source: Environmental Protection Agency
Telephone: (206) 553-1200
Last EDR Contact: 06/22/2020
Next Scheduled EDR Contact: 10/05/2020
Data Release Frequency: Quarterly

Federal institutional controls / engineering controls registries

LUCIS: Land Use Control Information System

LUCIS contains records of land use control information pertaining to the former Navy Base Realignment and Closure properties.

Date of Government Version: 05/15/2020
Date Data Arrived at EDR: 05/19/2020
Date Made Active in Reports: 06/18/2020
Number of Days to Update: 30

Source: Department of the Navy
Telephone: 843-820-7326
Last EDR Contact: 08/04/2020
Next Scheduled EDR Contact: 11/23/2020
Data Release Frequency: Varies

US ENG CONTROLS: Engineering Controls Sites List

A listing of sites with engineering controls in place. Engineering controls include various forms of caps, building foundations, liners, and treatment methods to create pathway elimination for regulated substances to enter environmental media or effect human health.

Date of Government Version: 02/13/2020
Date Data Arrived at EDR: 02/20/2020
Date Made Active in Reports: 05/15/2020
Number of Days to Update: 85

Source: Environmental Protection Agency
Telephone: 703-603-0695
Last EDR Contact: 08/24/2020
Next Scheduled EDR Contact: 09/07/2020
Data Release Frequency: Varies

US INST CONTROLS: Institutional Controls Sites List

A listing of sites with institutional controls in place. Institutional controls include administrative measures, such as groundwater use restrictions, construction restrictions, property use restrictions, and post remediation care requirements intended to prevent exposure to contaminants remaining on site. Deed restrictions are generally required as part of the institutional controls.

Date of Government Version: 02/13/2020
Date Data Arrived at EDR: 02/20/2020
Date Made Active in Reports: 05/15/2020
Number of Days to Update: 85

Source: Environmental Protection Agency
Telephone: 703-603-0695
Last EDR Contact: 08/24/2020
Next Scheduled EDR Contact: 12/07/2020
Data Release Frequency: Varies

Federal ERNS list

ERNS: Emergency Response Notification System

Emergency Response Notification System. ERNS records and stores information on reported releases of oil and hazardous substances.

Date of Government Version: 03/22/2020
Date Data Arrived at EDR: 03/24/2020
Date Made Active in Reports: 06/18/2020
Number of Days to Update: 86

Source: National Response Center, United States Coast Guard
Telephone: 202-267-2180
Last EDR Contact: 06/22/2020
Next Scheduled EDR Contact: 10/05/2020
Data Release Frequency: Quarterly

State- and tribal - equivalent CERCLIS

CRL: Confirmed Release List and Inventory

All facilities with a confirmed release.

Date of Government Version: 05/12/2020
Date Data Arrived at EDR: 05/13/2020
Date Made Active in Reports: 07/29/2020
Number of Days to Update: 77

Source: Department of Environmental Quality
Telephone: 503-229-6170
Last EDR Contact: 08/11/2020
Next Scheduled EDR Contact: 11/23/2020
Data Release Frequency: Quarterly

ECSI: Environmental Cleanup Site Information System

Sites that are or may be contaminated and may require cleanup.

Date of Government Version: 03/01/2020
Date Data Arrived at EDR: 03/31/2020
Date Made Active in Reports: 06/11/2020
Number of Days to Update: 72

Source: Department of Environmental Quality
Telephone: 503-229-6629
Last EDR Contact: 06/30/2020
Next Scheduled EDR Contact: 10/12/2020
Data Release Frequency: Quarterly

State and tribal landfill and/or solid waste disposal site lists

SWF/LF: Solid Waste Facilities List

Solid Waste Facilities/Landfill Sites. SWF/LF type records typically contain an inventory of solid waste disposal facilities or landfills in a particular state. Depending on the state, these may be active or inactive facilities or open dumps that failed to meet RCRA Subtitle D Section 4004 criteria for solid waste landfills or disposal sites.

Date of Government Version: 01/31/2020
Date Data Arrived at EDR: 01/31/2020
Date Made Active in Reports: 04/13/2020
Number of Days to Update: 73

Source: Department of Environmental Quality
Telephone: 503-229-6299
Last EDR Contact: 07/09/2020
Next Scheduled EDR Contact: 10/26/2020
Data Release Frequency: Semi-Annually

State and tribal leaking storage tank lists

LUST: Leaking Underground Storage Tank Database

Leaking Underground Storage Tank Incident Reports. LUST records contain an inventory of reported leaking underground storage tank incidents. Not all states maintain these records, and the information stored varies by state.

Date of Government Version: 04/03/2020
Date Data Arrived at EDR: 05/13/2020
Date Made Active in Reports: 07/29/2020
Number of Days to Update: 77

Source: Department of Environmental Quality
Telephone: 503-229-5790
Last EDR Contact: 08/11/2020
Next Scheduled EDR Contact: 11/23/2020
Data Release Frequency: Quarterly

INDIAN LUST R6: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in New Mexico and Oklahoma.

Date of Government Version: 04/08/2020
Date Data Arrived at EDR: 05/20/2020
Date Made Active in Reports: 08/12/2020
Number of Days to Update: 84

Source: EPA Region 6
Telephone: 214-665-6597
Last EDR Contact: 07/24/2020
Next Scheduled EDR Contact: 11/02/2020
Data Release Frequency: Varies

INDIAN LUST R9: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Arizona, California, New Mexico and Nevada

Date of Government Version: 04/08/2020
Date Data Arrived at EDR: 05/20/2020
Date Made Active in Reports: 08/12/2020
Number of Days to Update: 84

Source: Environmental Protection Agency
Telephone: 415-972-3372
Last EDR Contact: 07/24/2020
Next Scheduled EDR Contact: 11/02/2020
Data Release Frequency: Varies

INDIAN LUST R4: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Florida, Mississippi and North Carolina.

Date of Government Version: 04/14/2020
Date Data Arrived at EDR: 05/26/2020
Date Made Active in Reports: 08/12/2020
Number of Days to Update: 78

Source: EPA Region 4
Telephone: 404-562-8677
Last EDR Contact: 07/24/2020
Next Scheduled EDR Contact: 11/02/2020
Data Release Frequency: Varies

INDIAN LUST R8: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming.

Date of Government Version: 04/14/2020
Date Data Arrived at EDR: 05/20/2020
Date Made Active in Reports: 08/12/2020
Number of Days to Update: 84

Source: EPA Region 8
Telephone: 303-312-6271
Last EDR Contact: 07/24/2020
Next Scheduled EDR Contact: 11/02/2020
Data Release Frequency: Varies

INDIAN LUST R5: Leaking Underground Storage Tanks on Indian Land
Leaking underground storage tanks located on Indian Land in Michigan, Minnesota and Wisconsin.

Date of Government Version: 04/14/2020
Date Data Arrived at EDR: 05/20/2020
Date Made Active in Reports: 08/12/2020
Number of Days to Update: 84

Source: EPA, Region 5
Telephone: 312-886-7439
Last EDR Contact: 07/24/2020
Next Scheduled EDR Contact: 11/02/2020
Data Release Frequency: Varies

INDIAN LUST R10: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Alaska, Idaho, Oregon and Washington.

Date of Government Version: 04/14/2020
Date Data Arrived at EDR: 05/20/2020
Date Made Active in Reports: 08/12/2020
Number of Days to Update: 84

Source: EPA Region 10
Telephone: 206-553-2857
Last EDR Contact: 07/24/2020
Next Scheduled EDR Contact: 11/02/2020
Data Release Frequency: Varies

INDIAN LUST R1: Leaking Underground Storage Tanks on Indian Land
A listing of leaking underground storage tank locations on Indian Land.

Date of Government Version: 04/29/2020
Date Data Arrived at EDR: 05/20/2020
Date Made Active in Reports: 08/12/2020
Number of Days to Update: 84

Source: EPA Region 1
Telephone: 617-918-1313
Last EDR Contact: 07/24/2020
Next Scheduled EDR Contact: 11/02/2020
Data Release Frequency: Varies

INDIAN LUST R7: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Iowa, Kansas, and Nebraska

Date of Government Version: 04/15/2020
Date Data Arrived at EDR: 05/20/2020
Date Made Active in Reports: 08/12/2020
Number of Days to Update: 84
Source: EPA Region 7
Telephone: 913-551-7003
Last EDR Contact: 07/24/2020
Next Scheduled EDR Contact: 11/02/2020
Data Release Frequency: Varies

State and tribal registered storage tank lists

FEMA UST: Underground Storage Tank Listing
A listing of all FEMA owned underground storage tanks.

Date of Government Version: 02/01/2020
Date Data Arrived at EDR: 03/19/2020
Date Made Active in Reports: 06/09/2020
Number of Days to Update: 82
Source: FEMA
Telephone: 202-646-5797
Last EDR Contact: 07/06/2020
Next Scheduled EDR Contact: 10/19/2020
Data Release Frequency: Varies

UST: Underground Storage Tank Database
Registered Underground Storage Tanks. UST's are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA) and must be registered with the state department responsible for administering the UST program. Available information varies by state program.

Date of Government Version: 04/03/2020
Date Data Arrived at EDR: 05/13/2020
Date Made Active in Reports: 07/29/2020
Number of Days to Update: 77
Source: Department of Environmental Quality
Telephone: 503-229-5815
Last EDR Contact: 08/11/2020
Next Scheduled EDR Contact: 11/23/2020
Data Release Frequency: Quarterly

AST: Aboveground Storage Tanks
Aboveground storage tank locations reported to the Office of State Fire Marshal.

Date of Government Version: 02/26/2020
Date Data Arrived at EDR: 02/27/2020
Date Made Active in Reports: 05/05/2020
Number of Days to Update: 68
Source: Office of State Fire Marshal
Telephone: 503-378-3473
Last EDR Contact: 08/19/2020
Next Scheduled EDR Contact: 11/09/2020
Data Release Frequency: Semi-Annually

INDIAN UST R9: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 9 (Arizona, California, Hawaii, Nevada, the Pacific Islands, and Tribal Nations).

Date of Government Version: 04/08/2020
Date Data Arrived at EDR: 05/20/2020
Date Made Active in Reports: 08/12/2020
Number of Days to Update: 84
Source: EPA Region 9
Telephone: 415-972-3368
Last EDR Contact: 07/23/2020
Next Scheduled EDR Contact: 11/01/2020
Data Release Frequency: Varies

INDIAN UST R5: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 5 (Michigan, Minnesota and Wisconsin and Tribal Nations).

Date of Government Version: 04/14/2020
Date Data Arrived at EDR: 05/20/2020
Date Made Active in Reports: 08/12/2020
Number of Days to Update: 84
Source: EPA Region 5
Telephone: 312-886-6136
Last EDR Contact: 07/24/2020
Next Scheduled EDR Contact: 11/02/2020
Data Release Frequency: Varies

INDIAN UST R10: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 10 (Alaska, Idaho, Oregon, Washington, and Tribal Nations).

Date of Government Version: 04/14/2020
Date Data Arrived at EDR: 05/20/2020
Date Made Active in Reports: 08/12/2020
Number of Days to Update: 84

Source: EPA Region 10
Telephone: 206-553-2857
Last EDR Contact: 07/24/2020
Next Scheduled EDR Contact: 11/02/2020
Data Release Frequency: Varies

INDIAN UST R6: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 6 (Louisiana, Arkansas, Oklahoma, New Mexico, Texas and 65 Tribes).

Date of Government Version: 04/08/2020
Date Data Arrived at EDR: 05/20/2020
Date Made Active in Reports: 08/12/2020
Number of Days to Update: 84

Source: EPA Region 6
Telephone: 214-665-7591
Last EDR Contact: 07/24/2020
Next Scheduled EDR Contact: 11/02/2020
Data Release Frequency: Varies

INDIAN UST R8: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 8 (Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming and 27 Tribal Nations).

Date of Government Version: 04/14/2020
Date Data Arrived at EDR: 05/20/2020
Date Made Active in Reports: 08/13/2020
Number of Days to Update: 85

Source: EPA Region 8
Telephone: 303-312-6137
Last EDR Contact: 07/24/2020
Next Scheduled EDR Contact: 11/02/2020
Data Release Frequency: Varies

INDIAN UST R1: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 1 (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont and ten Tribal Nations).

Date of Government Version: 04/29/2020
Date Data Arrived at EDR: 05/20/2020
Date Made Active in Reports: 08/12/2020
Number of Days to Update: 84

Source: EPA, Region 1
Telephone: 617-918-1313
Last EDR Contact: 07/24/2020
Next Scheduled EDR Contact: 11/02/2020
Data Release Frequency: Varies

INDIAN UST R4: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 4 (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee and Tribal Nations)

Date of Government Version: 04/14/2020
Date Data Arrived at EDR: 05/26/2020
Date Made Active in Reports: 08/12/2020
Number of Days to Update: 78

Source: EPA Region 4
Telephone: 404-562-9424
Last EDR Contact: 07/24/2020
Next Scheduled EDR Contact: 11/02/2020
Data Release Frequency: Varies

INDIAN UST R7: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 7 (Iowa, Kansas, Missouri, Nebraska, and 9 Tribal Nations).

Date of Government Version: 04/03/2020
Date Data Arrived at EDR: 05/20/2020
Date Made Active in Reports: 08/12/2020
Number of Days to Update: 84

Source: EPA Region 7
Telephone: 913-551-7003
Last EDR Contact: 07/24/2020
Next Scheduled EDR Contact: 11/02/2020
Data Release Frequency: Varies

State and tribal institutional control / engineering control registries

ENG CONTROLS: Engineering Controls Recorded at ESCI Sites

Engineering controls are physical measures selected or approved by the Director for the purpose of preventing or minimizing exposure to hazardous substances. Engineering controls may include, but are not limited to, fencing, capping, horizontal or vertical barriers, hydraulic controls, and alternative water supplies.

Date of Government Version: 03/01/2020
Date Data Arrived at EDR: 03/31/2020
Date Made Active in Reports: 06/11/2020
Number of Days to Update: 72

Source: Department of Environmental Quality
Telephone: 503-229-5193
Last EDR Contact: 06/30/2020
Next Scheduled EDR Contact: 10/12/2020
Data Release Frequency: Quarterly

INST CONTROL: Institutional Controls Recorded at ESCI Sites

An institutional control is a legal or administrative tool or action taken to reduce the potential for exposure to hazardous substances. Institutional controls may include, but are not limited to, use restrictions, environmental monitoring requirements, and site access and security measures.

Date of Government Version: 03/01/2020
Date Data Arrived at EDR: 03/31/2020
Date Made Active in Reports: 06/11/2020
Number of Days to Update: 72

Source: Department of Environmental Quality
Telephone: 503-229-5193
Last EDR Contact: 06/30/2020
Next Scheduled EDR Contact: 10/12/2020
Data Release Frequency: Quarterly

State and tribal voluntary cleanup sites

INDIAN VCP R7: Voluntary Cleanup Priority Lisitng

A listing of voluntary cleanup priority sites located on Indian Land located in Region 7.

Date of Government Version: 03/20/2008
Date Data Arrived at EDR: 04/22/2008
Date Made Active in Reports: 05/19/2008
Number of Days to Update: 27

Source: EPA, Region 7
Telephone: 913-551-7365
Last EDR Contact: 04/20/2009
Next Scheduled EDR Contact: 07/20/2009
Data Release Frequency: Varies

INDIAN VCP R1: Voluntary Cleanup Priority Listing

A listing of voluntary cleanup priority sites located on Indian Land located in Region 1.

Date of Government Version: 07/27/2015
Date Data Arrived at EDR: 09/29/2015
Date Made Active in Reports: 02/18/2016
Number of Days to Update: 142

Source: EPA, Region 1
Telephone: 617-918-1102
Last EDR Contact: 06/17/2020
Next Scheduled EDR Contact: 10/05/2020
Data Release Frequency: Varies

VCS: Voluntary Cleanup Program Sites

Responsible parties have entered into an agreement with DEQ to voluntarily address contamination associated with their property.

Date of Government Version: 03/25/2020
Date Data Arrived at EDR: 03/26/2020
Date Made Active in Reports: 06/10/2020
Number of Days to Update: 76

Source: DEQ
Telephone: 503-229-5256
Last EDR Contact: 06/24/2020
Next Scheduled EDR Contact: 10/12/2020
Data Release Frequency: Quarterly

State and tribal Brownfields sites

BROWNFIELDS: Brownfields Projects

Brownfields investigations and/or cleanups that have been conducted in Oregon.

Date of Government Version: 05/12/2020
Date Data Arrived at EDR: 05/13/2020
Date Made Active in Reports: 07/29/2020
Number of Days to Update: 77

Source: Department of Environmental Quality
Telephone: 503-229-6801
Last EDR Contact: 08/11/2020
Next Scheduled EDR Contact: 11/23/2020
Data Release Frequency: Annually

ADDITIONAL ENVIRONMENTAL RECORDS

Local Brownfield lists

US BROWNFIELDS: A Listing of Brownfields Sites

Brownfields are real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. Cleaning up and reinvesting in these properties takes development pressures off of undeveloped, open land, and both improves and protects the environment. Assessment, Cleanup and Redevelopment Exchange System (ACRES) stores information reported by EPA Brownfields grant recipients on brownfields properties assessed or cleaned up with grant funding as well as information on Targeted Brownfields Assessments performed by EPA Regions. A listing of ACRES Brownfield sites is obtained from Cleanups in My Community. Cleanups in My Community provides information on Brownfields properties for which information is reported back to EPA, as well as areas served by Brownfields grant programs.

Date of Government Version: 06/01/2020
Date Data Arrived at EDR: 06/02/2020
Date Made Active in Reports: 06/09/2020
Number of Days to Update: 7

Source: Environmental Protection Agency
Telephone: 202-566-2777
Last EDR Contact: 06/02/2020
Next Scheduled EDR Contact: 09/28/2020
Data Release Frequency: Semi-Annually

Local Lists of Landfill / Solid Waste Disposal Sites

HIST LF: Old Closed SW Disposal Sites

A list of solid waste disposal sites that have been closed for a long while.

Date of Government Version: 04/01/2000
Date Data Arrived at EDR: 07/08/2003
Date Made Active in Reports: 07/18/2003
Number of Days to Update: 10

Source: Department of Environmental Quality
Telephone: 503-229-5409
Last EDR Contact: 07/08/2003
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

SWRCY: Recycling Facility Location Listing

A listing of recycling facility locations.

Date of Government Version: 05/26/2020
Date Data Arrived at EDR: 05/27/2020
Date Made Active in Reports: 08/11/2020
Number of Days to Update: 76

Source: Department of Environmental Quality
Telephone: 503-229-5353
Last EDR Contact: 08/25/2020
Next Scheduled EDR Contact: 12/07/2020
Data Release Frequency: Quarterly

INDIAN ODI: Report on the Status of Open Dumps on Indian Lands

Location of open dumps on Indian land.

Date of Government Version: 12/31/1998
Date Data Arrived at EDR: 12/03/2007
Date Made Active in Reports: 01/24/2008
Number of Days to Update: 52

Source: Environmental Protection Agency
Telephone: 703-308-8245
Last EDR Contact: 07/21/2020
Next Scheduled EDR Contact: 11/09/2020
Data Release Frequency: Varies

DEBRIS REGION 9: Torres Martinez Reservation Illegal Dump Site Locations

A listing of illegal dump sites location on the Torres Martinez Indian Reservation located in eastern Riverside County and northern Imperial County, California.

Date of Government Version: 01/12/2009
Date Data Arrived at EDR: 05/07/2009
Date Made Active in Reports: 09/21/2009
Number of Days to Update: 137

Source: EPA, Region 9
Telephone: 415-947-4219
Last EDR Contact: 07/14/2020
Next Scheduled EDR Contact: 11/02/2020
Data Release Frequency: No Update Planned

ODI: Open Dump Inventory
An open dump is defined as a disposal facility that does not comply with one or more of the Part 257 or Part 258 Subtitle D Criteria.

Date of Government Version: 06/30/1985
Date Data Arrived at EDR: 08/09/2004
Date Made Active in Reports: 09/17/2004
Number of Days to Update: 39
Source: Environmental Protection Agency
Telephone: 800-424-9346
Last EDR Contact: 06/09/2004
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

IHS OPEN DUMPS: Open Dumps on Indian Land
A listing of all open dumps located on Indian Land in the United States.

Date of Government Version: 04/01/2014
Date Data Arrived at EDR: 08/06/2014
Date Made Active in Reports: 01/29/2015
Number of Days to Update: 176
Source: Department of Health & Human Serivces, Indian Health Service
Telephone: 301-443-1452
Last EDR Contact: 07/31/2020
Next Scheduled EDR Contact: 11/09/2020
Data Release Frequency: Varies

Local Lists of Hazardous waste / Contaminated Sites

AOC COL: Columbia Slough
Columbia Slough waterway boundaries.

Date of Government Version: 08/10/2005
Date Data Arrived at EDR: 05/17/2006
Date Made Active in Reports: 06/16/2006
Number of Days to Update: 30
Source: City of Portland Environmental Services
Telephone: 503-823-5310
Last EDR Contact: 03/13/2007
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

AOC MU: East Multnomah County Area
Approximate extent of TSA VOC plume February , 2002

Date of Government Version: N/A
Date Data Arrived at EDR: 10/07/2002
Date Made Active in Reports: 10/22/2002
Number of Days to Update: 15
Source: City of Portland Environmental Services
Telephone: 503-823-5310
Last EDR Contact: 03/13/2007
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

US HIST CDL: National Clandestine Laboratory Register
A listing of clandestine drug lab locations that have been removed from the DEAs National Clandestine Laboratory Register.

Date of Government Version: 03/18/2020
Date Data Arrived at EDR: 03/19/2020
Date Made Active in Reports: 06/09/2020
Number of Days to Update: 82
Source: Drug Enforcement Administration
Telephone: 202-307-1000
Last EDR Contact: 08/19/2020
Next Scheduled EDR Contact: 12/07/2020
Data Release Frequency: No Update Planned

CDL: Uninhabitable Drug Lab Properties
The properties listed on these county pages have been declared by a law enforcement agency to be unfit for use due to meth lab and/or storage activities. The properties are considered uninhabitable until cleaned up by a state certified decontamination contractor and a certificate of fitness is issued by the Oregon Health Division.

Date of Government Version: 02/04/2020
Date Data Arrived at EDR: 02/05/2020
Date Made Active in Reports: 02/14/2020
Number of Days to Update: 9
Source: Department of Consumer & Business Services
Telephone: 503-378-4133
Last EDR Contact: 07/28/2020
Next Scheduled EDR Contact: 11/16/2020
Data Release Frequency: Quarterly

CDL 2: Clandestine Drug Lab Site Listing
A listing of clandestine drug lab site locations included in the Incident database.

Date of Government Version: 04/01/2020
Date Data Arrived at EDR: 04/29/2020
Date Made Active in Reports: 07/09/2020
Number of Days to Update: 71
Source: Oregon State Police
Telephone: 503-373-1540
Last EDR Contact: 07/22/2020
Next Scheduled EDR Contact: 11/09/2020
Data Release Frequency: Varies

US CDL: Clandestine Drug Labs
A listing of clandestine drug lab locations. The U.S. Department of Justice ("the Department") provides this web site as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. In most cases, the source of the entries is not the Department, and the Department has not verified the entry and does not guarantee its accuracy. Members of the public must verify the accuracy of all entries by, for example, contacting local law enforcement and local health departments.

Date of Government Version: 03/18/2020
Date Data Arrived at EDR: 03/19/2020
Date Made Active in Reports: 06/09/2020
Number of Days to Update: 82
Source: Drug Enforcement Administration
Telephone: 202-307-1000
Last EDR Contact: 08/19/2020
Next Scheduled EDR Contact: 12/07/2020
Data Release Frequency: Quarterly

PFAS: PFAS Site Contamination Listing
Site locations where pfas contamination has been detected.

Date of Government Version: 02/06/2020
Date Data Arrived at EDR: 02/07/2020
Date Made Active in Reports: 03/12/2020
Number of Days to Update: 34
Source: Department of Environmental Quality
Telephone: 503-229-6783
Last EDR Contact: 07/09/2020
Next Scheduled EDR Contact: 10/26/2020
Data Release Frequency: Varies

Local Land Records

LIENS 2: CERCLA Lien Information
A Federal CERCLA ('Superfund') lien can exist by operation of law at any site or property at which EPA has spent Superfund monies. These monies are spent to investigate and address releases and threatened releases of contamination. CERCLIS provides information as to the identity of these sites and properties.

Date of Government Version: 07/29/2020
Date Data Arrived at EDR: 08/03/2020
Date Made Active in Reports: 08/25/2020
Number of Days to Update: 22
Source: Environmental Protection Agency
Telephone: 202-564-6023
Last EDR Contact: 08/03/2020
Next Scheduled EDR Contact: 10/12/2020
Data Release Frequency: Semi-Annually

Records of Emergency Release Reports

HMIRS: Hazardous Materials Information Reporting System
Hazardous Materials Incident Report System. HMIRS contains hazardous material spill incidents reported to DOT.

Date of Government Version: 02/27/2020
Date Data Arrived at EDR: 03/24/2020
Date Made Active in Reports: 06/18/2020
Number of Days to Update: 86
Source: U.S. Department of Transportation
Telephone: 202-366-4555
Last EDR Contact: 06/23/2020
Next Scheduled EDR Contact: 10/05/2020
Data Release Frequency: Quarterly

SPILLS: Spill Data
Oil and hazardous material spills reported to the Environmental Response Program.

Date of Government Version: 03/23/2020
Date Data Arrived at EDR: 03/24/2020
Date Made Active in Reports: 06/10/2020
Number of Days to Update: 78

Source: Department of Environmental Quality
Telephone: 503-229-5815
Last EDR Contact: 07/01/2020
Next Scheduled EDR Contact: 10/12/2020
Data Release Frequency: Semi-Annually

HAZMAT: Hazmat/Incidents

Hazardous material incidents reported to the State Fire Marshal by emergency responders. The hazardous material may or may not have been released.

Date of Government Version: 04/01/2020
Date Data Arrived at EDR: 04/29/2020
Date Made Active in Reports: 07/10/2020
Number of Days to Update: 72

Source: State Fire Marshal's Office
Telephone: 503-373-1540
Last EDR Contact: 07/27/2020
Next Scheduled EDR Contact: 11/09/2020
Data Release Frequency: Semi-Annually

SPILLS 90: SPILLS90 data from FirstSearch

Spills 90 includes those spill and release records available exclusively from FirstSearch databases. Typically, they may include chemical, oil and/or hazardous substance spills recorded after 1990. Duplicate records that are already included in EDR incident and release records are not included in Spills 90.

Date of Government Version: 05/01/2006
Date Data Arrived at EDR: 01/03/2013
Date Made Active in Reports: 02/22/2013
Number of Days to Update: 50

Source: FirstSearch
Telephone: N/A
Last EDR Contact: 01/03/2013
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

Other Ascertainable Records

RCRA NonGen / NLR: RCRA - Non Generators / No Longer Regulated

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Non-Generators do not presently generate hazardous waste.

Date of Government Version: 03/23/2020
Date Data Arrived at EDR: 03/25/2020
Date Made Active in Reports: 05/21/2020
Number of Days to Update: 57

Source: Environmental Protection Agency
Telephone: (206) 553-1200
Last EDR Contact: 06/22/2020
Next Scheduled EDR Contact: 10/05/2020
Data Release Frequency: Quarterly

FUDS: Formerly Used Defense Sites

The listing includes locations of Formerly Used Defense Sites properties where the US Army Corps of Engineers is actively working or will take necessary cleanup actions.

Date of Government Version: 05/13/2020
Date Data Arrived at EDR: 05/18/2020
Date Made Active in Reports: 08/12/2020
Number of Days to Update: 86

Source: U.S. Army Corps of Engineers
Telephone: 202-528-4285
Last EDR Contact: 08/13/2020
Next Scheduled EDR Contact: 11/30/2020
Data Release Frequency: Varies

DOD: Department of Defense Sites

This data set consists of federally owned or administered lands, administered by the Department of Defense, that have any area equal to or greater than 640 acres of the United States, Puerto Rico, and the U.S. Virgin Islands.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 11/10/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 62

Source: USGS
Telephone: 888-275-8747
Last EDR Contact: 07/09/2020
Next Scheduled EDR Contact: 10/19/2020
Data Release Frequency: Semi-Annually

FEDLAND: Federal and Indian Lands

Federally and Indian administrated lands of the United States. Lands included are administrated by: Army Corps of Engineers, Bureau of Reclamation, National Wild and Scenic River, National Wildlife Refuge, Public Domain Land, Wilderness, Wilderness Study Area, Wildlife Management Area, Bureau of Indian Affairs, Bureau of Land Management, Department of Justice, Forest Service, Fish and Wildlife Service, National Park Service.

Date of Government Version: 04/02/2018
Date Data Arrived at EDR: 04/11/2018
Date Made Active in Reports: 11/06/2019
Number of Days to Update: 574

Source: U.S. Geological Survey
Telephone: 888-275-8747
Last EDR Contact: 07/06/2020
Next Scheduled EDR Contact: 10/19/2020
Data Release Frequency: N/A

SCRD DRYCLEANERS: State Coalition for Remediation of Drycleaners Listing

The State Coalition for Remediation of Drycleaners was established in 1998, with support from the U.S. EPA Office of Superfund Remediation and Technology Innovation. It is comprised of representatives of states with established drycleaner remediation programs. Currently the member states are Alabama, Connecticut, Florida, Illinois, Kansas, Minnesota, Missouri, North Carolina, Oregon, South Carolina, Tennessee, Texas, and Wisconsin.

Date of Government Version: 01/01/2017
Date Data Arrived at EDR: 02/03/2017
Date Made Active in Reports: 04/07/2017
Number of Days to Update: 63

Source: Environmental Protection Agency
Telephone: 615-532-8599
Last EDR Contact: 08/05/2020
Next Scheduled EDR Contact: 11/23/2020
Data Release Frequency: Varies

US FIN ASSUR: Financial Assurance Information

All owners and operators of facilities that treat, store, or dispose of hazardous waste are required to provide proof that they will have sufficient funds to pay for the clean up, closure, and post-closure care of their facilities.

Date of Government Version: 03/23/2020
Date Data Arrived at EDR: 03/24/2020
Date Made Active in Reports: 06/18/2020
Number of Days to Update: 86

Source: Environmental Protection Agency
Telephone: 202-566-1917
Last EDR Contact: 06/22/2020
Next Scheduled EDR Contact: 10/05/2020
Data Release Frequency: Quarterly

EPA WATCH LIST: EPA WATCH LIST

EPA maintains a "Watch List" to facilitate dialogue between EPA, state and local environmental agencies on enforcement matters relating to facilities with alleged violations identified as either significant or high priority. Being on the Watch List does not mean that the facility has actually violated the law only that an investigation by EPA or a state or local environmental agency has led those organizations to allege that an unproven violation has in fact occurred. Being on the Watch List does not represent a higher level of concern regarding the alleged violations that were detected, but instead indicates cases requiring additional dialogue between EPA, state and local agencies - primarily because of the length of time the alleged violation has gone unaddressed or unresolved.

Date of Government Version: 08/30/2013
Date Data Arrived at EDR: 03/21/2014
Date Made Active in Reports: 06/17/2014
Number of Days to Update: 88

Source: Environmental Protection Agency
Telephone: 617-520-3000
Last EDR Contact: 07/31/2020
Next Scheduled EDR Contact: 11/16/2020
Data Release Frequency: Quarterly

2020 COR ACTION: 2020 Corrective Action Program List

The EPA has set ambitious goals for the RCRA Corrective Action program by creating the 2020 Corrective Action Universe. This RCRA cleanup baseline includes facilities expected to need corrective action. The 2020 universe contains a wide variety of sites. Some properties are heavily contaminated while others were contaminated but have since been cleaned up. Still others have not been fully investigated yet, and may require little or no remediation. Inclusion in the 2020 Universe does not necessarily imply failure on the part of a facility to meet its RCRA obligations.

Date of Government Version: 09/30/2017
Date Data Arrived at EDR: 05/08/2018
Date Made Active in Reports: 07/20/2018
Number of Days to Update: 73

Source: Environmental Protection Agency
Telephone: 703-308-4044
Last EDR Contact: 08/06/2020
Next Scheduled EDR Contact: 11/16/2020
Data Release Frequency: Varies

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

TSCA: Toxic Substances Control Act

Toxic Substances Control Act. TSCA identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. It includes data on the production volume of these substances by plant site.

Date of Government Version: 12/31/2016
Date Data Arrived at EDR: 06/21/2017
Date Made Active in Reports: 01/05/2018
Number of Days to Update: 198

Source: EPA
Telephone: 202-260-5521
Last EDR Contact: 06/17/2020
Next Scheduled EDR Contact: 09/28/2020
Data Release Frequency: Every 4 Years

TRIS: Toxic Chemical Release Inventory System

Toxic Release Inventory System. TRIS identifies facilities which release toxic chemicals to the air, water and land in reportable quantities under SARA Title III Section 313.

Date of Government Version: 12/31/2018
Date Data Arrived at EDR: 02/05/2020
Date Made Active in Reports: 04/24/2020
Number of Days to Update: 79

Source: EPA
Telephone: 202-566-0250
Last EDR Contact: 08/14/2020
Next Scheduled EDR Contact: 11/30/2020
Data Release Frequency: Annually

SSTS: Section 7 Tracking Systems

Section 7 of the Federal Insecticide, Fungicide and Rodenticide Act, as amended (92 Stat. 829) requires all registered pesticide-producing establishments to submit a report to the Environmental Protection Agency by March 1st each year. Each establishment must report the types and amounts of pesticides, active ingredients and devices being produced, and those having been produced and sold or distributed in the past year.

Date of Government Version: 03/01/2020
Date Data Arrived at EDR: 04/21/2020
Date Made Active in Reports: 07/15/2020
Number of Days to Update: 85

Source: EPA
Telephone: 202-564-4203
Last EDR Contact: 07/21/2020
Next Scheduled EDR Contact: 11/02/2020
Data Release Frequency: Annually

ROD: Records Of Decision

Record of Decision. ROD documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid in the cleanup.

Date of Government Version: 07/29/2020
Date Data Arrived at EDR: 08/03/2020
Date Made Active in Reports: 08/25/2020
Number of Days to Update: 22

Source: EPA
Telephone: 703-416-0223
Last EDR Contact: 08/03/2020
Next Scheduled EDR Contact: 09/14/2020
Data Release Frequency: Annually

RMP: Risk Management Plans

When Congress passed the Clean Air Act Amendments of 1990, it required EPA to publish regulations and guidance for chemical accident prevention at facilities using extremely hazardous substances. The Risk Management Program Rule (RMP Rule) was written to implement Section 112(r) of these amendments. The rule, which built upon existing industry codes and standards, requires companies of all sizes that use certain flammable and toxic substances to develop a Risk Management Program, which includes a(n): Hazard assessment that details the potential effects of an accidental release, an accident history of the last five years, and an evaluation of worst-case and alternative accidental releases; Prevention program that includes safety precautions and maintenance, monitoring, and employee training measures; and Emergency response program that spells out emergency health care, employee training measures and procedures for informing the public and response agencies (e.g the fire department) should an accident occur.

Date of Government Version: 01/31/2020
Date Data Arrived at EDR: 05/13/2020
Date Made Active in Reports: 08/03/2020
Number of Days to Update: 82

Source: Environmental Protection Agency
Telephone: 202-564-8600
Last EDR Contact: 07/15/2020
Next Scheduled EDR Contact: 11/02/2020
Data Release Frequency: Varies

RAATS: RCRA Administrative Action Tracking System

RCRA Administration Action Tracking System. RAATS contains records based on enforcement actions issued under RCRA pertaining to major violators and includes administrative and civil actions brought by the EPA. For administration actions after September 30, 1995, data entry in the RAATS database was discontinued. EPA will retain a copy of the database for historical records. It was necessary to terminate RAATS because a decrease in agency resources made it impossible to continue to update the information contained in the database.

Date of Government Version: 04/17/1995
Date Data Arrived at EDR: 07/03/1995
Date Made Active in Reports: 08/07/1995
Number of Days to Update: 35

Source: EPA
Telephone: 202-564-4104
Last EDR Contact: 06/02/2008
Next Scheduled EDR Contact: 09/01/2008
Data Release Frequency: No Update Planned

PRP: Potentially Responsible Parties

A listing of verified Potentially Responsible Parties

Date of Government Version: 04/27/2020
Date Data Arrived at EDR: 05/06/2020
Date Made Active in Reports: 06/09/2020
Number of Days to Update: 34

Source: EPA
Telephone: 202-564-6023
Last EDR Contact: 08/03/2020
Next Scheduled EDR Contact: 11/16/2020
Data Release Frequency: Quarterly

PADS: PCB Activity Database System

PCB Activity Database. PADS Identifies generators, transporters, commercial storers and/or brokers and disposers of PCB's who are required to notify the EPA of such activities.

Date of Government Version: 10/09/2019
Date Data Arrived at EDR: 10/11/2019
Date Made Active in Reports: 12/20/2019
Number of Days to Update: 70

Source: EPA
Telephone: 202-566-0500
Last EDR Contact: 07/13/2020
Next Scheduled EDR Contact: 10/19/2020
Data Release Frequency: Annually

ICIS: Integrated Compliance Information System

The Integrated Compliance Information System (ICIS) supports the information needs of the national enforcement and compliance program as well as the unique needs of the National Pollutant Discharge Elimination System (NPDES) program.

Date of Government Version: 11/18/2016
Date Data Arrived at EDR: 11/23/2016
Date Made Active in Reports: 02/10/2017
Number of Days to Update: 79

Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 06/30/2020
Next Scheduled EDR Contact: 10/19/2020
Data Release Frequency: Quarterly

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

FTTS: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
FTTS tracks administrative cases and pesticide enforcement actions and compliance activities related to FIFRA, TSCA and EPCRA (Emergency Planning and Community Right-to-Know Act). To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 04/09/2009
Date Data Arrived at EDR: 04/16/2009
Date Made Active in Reports: 05/11/2009
Number of Days to Update: 25
Source: EPA/Office of Prevention, Pesticides and Toxic Substances
Telephone: 202-566-1667
Last EDR Contact: 08/18/2017
Next Scheduled EDR Contact: 12/04/2017
Data Release Frequency: No Update Planned

FTTS INSP: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
A listing of FIFRA/TSCA Tracking System (FTTS) inspections and enforcements.

Date of Government Version: 04/09/2009
Date Data Arrived at EDR: 04/16/2009
Date Made Active in Reports: 05/11/2009
Number of Days to Update: 25
Source: EPA
Telephone: 202-566-1667
Last EDR Contact: 08/18/2017
Next Scheduled EDR Contact: 12/04/2017
Data Release Frequency: No Update Planned

MLTS: Material Licensing Tracking System
MLTS is maintained by the Nuclear Regulatory Commission and contains a list of approximately 8,100 sites which possess or use radioactive materials and which are subject to NRC licensing requirements. To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 10/25/2019
Date Data Arrived at EDR: 10/25/2019
Date Made Active in Reports: 01/15/2020
Number of Days to Update: 82
Source: Nuclear Regulatory Commission
Telephone: 301-415-7169
Last EDR Contact: 07/20/2020
Next Scheduled EDR Contact: 11/02/2020
Data Release Frequency: Quarterly

COAL ASH DOE: Steam-Electric Plant Operation Data
A listing of power plants that store ash in surface ponds.

Date of Government Version: 12/31/2018
Date Data Arrived at EDR: 12/04/2019
Date Made Active in Reports: 01/15/2020
Number of Days to Update: 42
Source: Department of Energy
Telephone: 202-586-8719
Last EDR Contact: 06/05/2020
Next Scheduled EDR Contact: 09/14/2020
Data Release Frequency: Varies

COAL ASH EPA: Coal Combustion Residues Surface Impoundments List
A listing of coal combustion residues surface impoundments with high hazard potential ratings.

Date of Government Version: 01/12/2017
Date Data Arrived at EDR: 03/05/2019
Date Made Active in Reports: 11/11/2019
Number of Days to Update: 251
Source: Environmental Protection Agency
Telephone: N/A
Last EDR Contact: 08/31/2020
Next Scheduled EDR Contact: 12/14/2020
Data Release Frequency: Varies

PCB TRANSFORMER: PCB Transformer Registration Database
The database of PCB transformer registrations that includes all PCB registration submittals.

Date of Government Version: 09/13/2019
Date Data Arrived at EDR: 11/06/2019
Date Made Active in Reports: 02/10/2020
Number of Days to Update: 96
Source: Environmental Protection Agency
Telephone: 202-566-0517
Last EDR Contact: 08/06/2020
Next Scheduled EDR Contact: 11/16/2020
Data Release Frequency: Varies

RADINFO: Radiation Information Database
The Radiation Information Database (RADINFO) contains information about facilities that are regulated by U.S. Environmental Protection Agency (EPA) regulations for radiation and radioactivity.

Date of Government Version: 07/01/2019
Date Data Arrived at EDR: 07/01/2019
Date Made Active in Reports: 09/23/2019
Number of Days to Update: 84

Source: Environmental Protection Agency
Telephone: 202-343-9775
Last EDR Contact: 06/24/2020
Next Scheduled EDR Contact: 10/12/2020
Data Release Frequency: Quarterly

HIST FTTS: FIFRA/TSCA Tracking System Administrative Case Listing

A complete administrative case listing from the FIFRA/TSCA Tracking System (FTTS) for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) and TSCA (Toxic Substances Control Act). Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.

Date of Government Version: 10/19/2006
Date Data Arrived at EDR: 03/01/2007
Date Made Active in Reports: 04/10/2007
Number of Days to Update: 40

Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 12/17/2007
Next Scheduled EDR Contact: 03/17/2008
Data Release Frequency: No Update Planned

HIST FTTS INSP: FIFRA/TSCA Tracking System Inspection & Enforcement Case Listing

A complete inspection and enforcement case listing from the FIFRA/TSCA Tracking System (FTTS) for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) and TSCA (Toxic Substances Control Act). Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.

Date of Government Version: 10/19/2006
Date Data Arrived at EDR: 03/01/2007
Date Made Active in Reports: 04/10/2007
Number of Days to Update: 40

Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 12/17/2008
Next Scheduled EDR Contact: 03/17/2008
Data Release Frequency: No Update Planned

DOT OPS: Incident and Accident Data

Department of Transporation, Office of Pipeline Safety Incident and Accident data.

Date of Government Version: 01/02/2020
Date Data Arrived at EDR: 01/28/2020
Date Made Active in Reports: 04/17/2020
Number of Days to Update: 80

Source: Department of Transporation, Office of Pipeline Safety
Telephone: 202-366-4595
Last EDR Contact: 07/27/2020
Next Scheduled EDR Contact: 11/09/2020
Data Release Frequency: Quarterly

CONSENT: Superfund (CERCLA) Consent Decrees

Major legal settlements that establish responsibility and standards for cleanup at NPL (Superfund) sites. Released periodically by United States District Courts after settlement by parties to litigation matters.

Date of Government Version: 06/30/2020
Date Data Arrived at EDR: 07/15/2020
Date Made Active in Reports: 07/21/2020
Number of Days to Update: 6

Source: Department of Justice, Consent Decree Library
Telephone: Varies
Last EDR Contact: 07/06/2020
Next Scheduled EDR Contact: 10/19/2020
Data Release Frequency: Varies

BRS: Biennial Reporting System

The Biennial Reporting System is a national system administered by the EPA that collects data on the generation and management of hazardous waste. BRS captures detailed data from two groups: Large Quantity Generators (LQG) and Treatment, Storage, and Disposal Facilities.

Date of Government Version: 12/31/2015
Date Data Arrived at EDR: 02/22/2017
Date Made Active in Reports: 09/28/2017
Number of Days to Update: 218

Source: EPA/NTIS
Telephone: 800-424-9346
Last EDR Contact: 06/22/2020
Next Scheduled EDR Contact: 10/05/2020
Data Release Frequency: Biennially

INDIAN RESERV: Indian Reservations

This map layer portrays Indian administered lands of the United States that have any area equal to or greater than 640 acres.

Date of Government Version: 12/31/2014
Date Data Arrived at EDR: 07/14/2015
Date Made Active in Reports: 01/10/2017
Number of Days to Update: 546

Source: USGS
Telephone: 202-208-3710
Last EDR Contact: 07/07/2020
Next Scheduled EDR Contact: 10/19/2020
Data Release Frequency: Semi-Annually

FUSRAP: Formerly Utilized Sites Remedial Action Program

DOE established the Formerly Utilized Sites Remedial Action Program (FUSRAP) in 1974 to remediate sites where radioactive contamination remained from Manhattan Project and early U.S. Atomic Energy Commission (AEC) operations.

Date of Government Version: 08/08/2017
Date Data Arrived at EDR: 09/11/2018
Date Made Active in Reports: 09/14/2018
Number of Days to Update: 3

Source: Department of Energy
Telephone: 202-586-3559
Last EDR Contact: 07/28/2020
Next Scheduled EDR Contact: 11/16/2020
Data Release Frequency: Varies

UMTRA: Uranium Mill Tailings Sites

Uranium ore was mined by private companies for federal government use in national defense programs. When the mills shut down, large piles of the sand-like material (mill tailings) remain after uranium has been extracted from the ore. Levels of human exposure to radioactive materials from the piles are low; however, in some cases tailings were used as construction materials before the potential health hazards of the tailings were recognized.

Date of Government Version: 08/30/2019
Date Data Arrived at EDR: 11/15/2019
Date Made Active in Reports: 01/28/2020
Number of Days to Update: 74

Source: Department of Energy
Telephone: 505-845-0011
Last EDR Contact: 08/21/2020
Next Scheduled EDR Contact: 11/30/2020
Data Release Frequency: Varies

LEAD SMELTER 1: Lead Smelter Sites

A listing of former lead smelter site locations.

Date of Government Version: 07/29/2020
Date Data Arrived at EDR: 08/03/2020
Date Made Active in Reports: 08/25/2020
Number of Days to Update: 22

Source: Environmental Protection Agency
Telephone: 703-603-8787
Last EDR Contact: 08/03/2020
Next Scheduled EDR Contact: 10/12/2020
Data Release Frequency: Varies

LEAD SMELTER 2: Lead Smelter Sites

A list of several hundred sites in the U.S. where secondary lead smelting was done from 1931and 1964. These sites may pose a threat to public health through ingestion or inhalation of contaminated soil or dust

Date of Government Version: 04/05/2001
Date Data Arrived at EDR: 10/27/2010
Date Made Active in Reports: 12/02/2010
Number of Days to Update: 36

Source: American Journal of Public Health
Telephone: 703-305-6451
Last EDR Contact: 12/02/2009
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

US AIRS (AFS): Aerometric Information Retrieval System Facility Subsystem (AFS)

The database is a sub-system of Aerometric Information Retrieval System (AIRS). AFS contains compliance data on air pollution point sources regulated by the U.S. EPA and/or state and local air regulatory agencies. This information comes from source reports by various stationary sources of air pollution, such as electric power plants, steel mills, factories, and universities, and provides information about the air pollutants they produce. Action, air program, air program pollutant, and general level plant data. It is used to track emissions and compliance data from industrial plants.

Date of Government Version: 10/12/2016
Date Data Arrived at EDR: 10/26/2016
Date Made Active in Reports: 02/03/2017
Number of Days to Update: 100

Source: EPA
Telephone: 202-564-2496
Last EDR Contact: 09/26/2017
Next Scheduled EDR Contact: 01/08/2018
Data Release Frequency: Annually

US AIRS MINOR: Air Facility System Data

A listing of minor source facilities.

Date of Government Version: 10/12/2016
Date Data Arrived at EDR: 10/26/2016
Date Made Active in Reports: 02/03/2017
Number of Days to Update: 100

Source: EPA
Telephone: 202-564-2496
Last EDR Contact: 09/26/2017
Next Scheduled EDR Contact: 01/08/2018
Data Release Frequency: Annually

US MINES: Mines Master Index File

Contains all mine identification numbers issued for mines active or opened since 1971. The data also includes violation information.

Date of Government Version: 05/01/2020
Date Data Arrived at EDR: 05/21/2020
Date Made Active in Reports: 08/13/2020
Number of Days to Update: 84

Source: Department of Labor, Mine Safety and Health Administration
Telephone: 303-231-5959
Last EDR Contact: 08/25/2020
Next Scheduled EDR Contact: 12/07/2020
Data Release Frequency: Semi-Annually

MINES VIOLATIONS: MSHA Violation Assessment Data

Mines violation and assessment information. Department of Labor, Mine Safety & Health Administration.

Date of Government Version: 05/28/2020
Date Data Arrived at EDR: 05/28/2020
Date Made Active in Reports: 08/13/2020
Number of Days to Update: 77

Source: DOL, Mine Safety & Health Admi
Telephone: 202-693-9424
Last EDR Contact: 08/26/2020
Next Scheduled EDR Contact: 12/14/2020
Data Release Frequency: Quarterly

US MINES 2: Ferrous and Nonferrous Metal Mines Database Listing

This map layer includes ferrous (ferrous metal mines are facilities that extract ferrous metals, such as iron ore or molybdenum) and nonferrous (Nonferrous metal mines are facilities that extract nonferrous metals, such as gold, silver, copper, zinc, and lead) metal mines in the United States.

Date of Government Version: 05/06/2020
Date Data Arrived at EDR: 05/27/2020
Date Made Active in Reports: 08/13/2020
Number of Days to Update: 78

Source: USGS
Telephone: 703-648-7709
Last EDR Contact: 08/28/2020
Next Scheduled EDR Contact: 12/07/2020
Data Release Frequency: Varies

US MINES 3: Active Mines & Mineral Plants Database Listing

Active Mines and Mineral Processing Plant operations for commodities monitored by the Minerals Information Team of the USGS.

Date of Government Version: 04/14/2011
Date Data Arrived at EDR: 06/08/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 97

Source: USGS
Telephone: 703-648-7709
Last EDR Contact: 08/28/2020
Next Scheduled EDR Contact: 12/07/2020
Data Release Frequency: Varies

ABANDONED MINES: Abandoned Mines

An inventory of land and water impacted by past mining (primarily coal mining) is maintained by OSMRE to provide information needed to implement the Surface Mining Control and Reclamation Act of 1977 (SMCRA). The inventory contains information on the location, type, and extent of AML impacts, as well as, information on the cost associated with the reclamation of those problems. The inventory is based upon field surveys by State, Tribal, and OSMRE program officials. It is dynamic to the extent that it is modified as new problems are identified and existing problems are reclaimed.

Date of Government Version: 03/05/2020
Date Data Arrived at EDR: 03/06/2020
Date Made Active in Reports: 05/29/2020
Number of Days to Update: 84

Source: Department of Interior
Telephone: 202-208-2609
Last EDR Contact: 06/19/2020
Next Scheduled EDR Contact: 09/21/2020
Data Release Frequency: Quarterly

FINDS: Facility Index System/Facility Registry System

Facility Index System. FINDS contains both facility information and 'pointers' to other sources that contain more detail. EDR includes the following FINDS databases in this report: PCS (Permit Compliance System), AIRS (Aerometric Information Retrieval System), DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes), FURS (Federal Underground Injection Control), C-DOCKET (Criminal Docket System used to track criminal enforcement actions for all environmental statutes), FFIS (Federal Facilities Information System), STATE (State Environmental Laws and Statutes), and PADS (PCB Activity Data System).

Date of Government Version: 02/03/2020
Date Data Arrived at EDR: 03/03/2020
Date Made Active in Reports: 05/28/2020
Number of Days to Update: 86

Source: EPA
Telephone: (206) 553-1200
Last EDR Contact: 08/26/2020
Next Scheduled EDR Contact: 12/14/2020
Data Release Frequency: Quarterly

DOCKET HWC: Hazardous Waste Compliance Docket Listing

A complete list of the Federal Agency Hazardous Waste Compliance Docket Facilities.

Date of Government Version: 05/31/2018
Date Data Arrived at EDR: 07/26/2018
Date Made Active in Reports: 10/05/2018
Number of Days to Update: 71

Source: Environmental Protection Agency
Telephone: 202-564-0527
Last EDR Contact: 08/19/2020
Next Scheduled EDR Contact: 12/07/2020
Data Release Frequency: Varies

ECHO: Enforcement & Compliance History Information

ECHO provides integrated compliance and enforcement information for about 800,000 regulated facilities nationwide.

Date of Government Version: 04/04/2020
Date Data Arrived at EDR: 04/07/2020
Date Made Active in Reports: 06/26/2020
Number of Days to Update: 80

Source: Environmental Protection Agency
Telephone: 202-564-2280
Last EDR Contact: 07/02/2020
Next Scheduled EDR Contact: 10/19/2020
Data Release Frequency: Quarterly

UXO: Unexploded Ordnance Sites

A listing of unexploded ordnance site locations

Date of Government Version: 12/31/2017
Date Data Arrived at EDR: 01/17/2019
Date Made Active in Reports: 04/01/2019
Number of Days to Update: 74

Source: Department of Defense
Telephone: 703-704-1564
Last EDR Contact: 07/09/2020
Next Scheduled EDR Contact: 10/26/2020
Data Release Frequency: Varies

FUELS PROGRAM: EPA Fuels Program Registered Listing

This listing includes facilities that are registered under the Part 80 (Code of Federal Regulations) EPA Fuels Programs. All companies now are required to submit new and updated registrations.

Date of Government Version: 05/18/2020
Date Data Arrived at EDR: 05/19/2020
Date Made Active in Reports: 08/03/2020
Number of Days to Update: 76

Source: EPA
Telephone: 800-385-6164
Last EDR Contact: 08/17/2020
Next Scheduled EDR Contact: 11/30/2020
Data Release Frequency: Quarterly

AIRS: Oregon Title V Facility Listing

A listing of Title V facility source and emissions information.

Date of Government Version: 03/24/2020
Date Data Arrived at EDR: 03/25/2020
Date Made Active in Reports: 06/10/2020
Number of Days to Update: 77

Source: Department of Environmental Quality
Telephone: 503-229-6459
Last EDR Contact: 06/24/2020
Next Scheduled EDR Contact: 10/12/2020
Data Release Frequency: Annually

COAL ASH: Coal Ash Disposal Sites Listing
A listing of coal ash disposal sites.

Date of Government Version: 12/31/2019
Date Data Arrived at EDR: 03/06/2020
Date Made Active in Reports: 05/14/2020
Number of Days to Update: 69

Source: Department of Environmental Quality
Telephone: 541-298-7255
Last EDR Contact: 08/26/2020
Next Scheduled EDR Contact: 12/14/2020
Data Release Frequency: Varies

DRYCLEANERS: Drycleaning Facilities
A listing of registered drycleaning facilities in Oregon.

Date of Government Version: 04/17/2020
Date Data Arrived at EDR: 04/22/2020
Date Made Active in Reports: 07/09/2020
Number of Days to Update: 78

Source: Department of Environmental Quality
Telephone: 503-229-6783
Last EDR Contact: 07/22/2020
Next Scheduled EDR Contact: 11/09/2020
Data Release Frequency: Annually

ENF: Enforcement Action Listing
Enforcement actions

Date of Government Version: 09/16/2019
Date Data Arrived at EDR: 09/18/2019
Date Made Active in Reports: 11/20/2019
Number of Days to Update: 63

Source: Department of Environmental Quality
Telephone: 503-229-5696
Last EDR Contact: 06/12/2020
Next Scheduled EDR Contact: 09/28/2020
Data Release Frequency: Quarterly

Financial Assurance 1: Financial Assurance Information Listing
Financial assurance information for hazardous waste facilities.

Date of Government Version: 06/24/2019
Date Data Arrived at EDR: 06/27/2019
Date Made Active in Reports: 09/11/2019
Number of Days to Update: 76

Source: Department of Environmental Quality
Telephone: 541-633-2011
Last EDR Contact: 08/26/2020
Next Scheduled EDR Contact: 12/14/2020
Data Release Frequency: Semi-Annually

Financial Assurance 2: Financial Assurance Information Listing
Financial assurance information for solid waste facilities. Financial assurance is intended to ensure that resources are available to pay for the cost of closure, post-closure care, and corrective measures if the owner or operator of a regulated facility is unable or unwilling to pay.

Date of Government Version: 06/02/2020
Date Data Arrived at EDR: 06/03/2020
Date Made Active in Reports: 08/13/2020
Number of Days to Update: 71

Source: Department of Environmental Quality
Telephone: 503-229-5521
Last EDR Contact: 08/21/2020
Next Scheduled EDR Contact: 11/30/2020
Data Release Frequency: Semi-Annually

HSIS: Hazardous Substance Information Survey
Companies in Oregon submitting the Hazardous Substance Information Survey and either reporting or not reporting hazardous substances.

Date of Government Version: 04/30/2020
Date Data Arrived at EDR: 05/01/2020
Date Made Active in Reports: 07/10/2020
Number of Days to Update: 70

Source: State Fire Marshal's Office
Telephone: 503-373-1540
Last EDR Contact: 07/27/2020
Next Scheduled EDR Contact: 11/09/2020
Data Release Frequency: Semi-Annually

OR MANIFEST: Manifest Information
Hazardous waste manifest information.

Date of Government Version: 12/31/2018
Date Data Arrived at EDR: 11/06/2019
Date Made Active in Reports: 01/15/2020
Number of Days to Update: 70

Source: Department of Environmental Quality
Telephone: N/A
Last EDR Contact: 07/28/2020
Next Scheduled EDR Contact: 11/16/2020
Data Release Frequency: Annually

NPDES: Wastewater Permits Database
A listing of permitted wastewater facilities.

Date of Government Version: 04/30/2020
Date Data Arrived at EDR: 05/01/2020
Date Made Active in Reports: 07/10/2020
Number of Days to Update: 70

Source: Department of Environmental Quality
Telephone: 503-229-5657
Last EDR Contact: 07/28/2020
Next Scheduled EDR Contact: 11/16/2020
Data Release Frequency: Varies

UIC: Underground Injection Control Program Database
DEQ's Underground Injection Control Program is authorized by the Environmental Protection Agency (EPA) to regulate all underground injection in Oregon to protect groundwater resources.

Date of Government Version: 04/03/2020
Date Data Arrived at EDR: 04/09/2020
Date Made Active in Reports: 06/30/2020
Number of Days to Update: 82

Source: Department of Environmental Quality
Telephone: 503-229-5945
Last EDR Contact: 06/22/2020
Next Scheduled EDR Contact: 10/05/2020
Data Release Frequency: Quarterly

PCS INACTIVE: Listing of Inactive PCS Permits
An inactive permit is a facility that has shut down or is no longer discharging.

Date of Government Version: 11/05/2014
Date Data Arrived at EDR: 01/06/2015
Date Made Active in Reports: 05/06/2015
Number of Days to Update: 120

Source: EPA
Telephone: 202-564-2496
Last EDR Contact: 07/09/2020
Next Scheduled EDR Contact: 10/19/2020
Data Release Frequency: Semi-Annually

PCS ENF: Enforcement data
No description is available for this data

Date of Government Version: 12/31/2014
Date Data Arrived at EDR: 02/05/2015
Date Made Active in Reports: 03/06/2015
Number of Days to Update: 29

Source: EPA
Telephone: 202-564-2497
Last EDR Contact: 07/01/2020
Next Scheduled EDR Contact: 10/19/2020
Data Release Frequency: Varies

PCS: Permit Compliance System
PCS is a computerized management information system that contains data on National Pollutant Discharge Elimination System (NPDES) permit holding facilities. PCS tracks the permit, compliance, and enforcement status of NPDES facilities.

Date of Government Version: 07/14/2011
Date Data Arrived at EDR: 08/05/2011
Date Made Active in Reports: 09/29/2011
Number of Days to Update: 55

Source: EPA, Office of Water
Telephone: 202-564-2496
Last EDR Contact: 06/08/2020
Next Scheduled EDR Contact: 09/21/2020
Data Release Frequency: Semi-Annually

MINES MRDS: Mineral Resources Data System
Mineral Resources Data System

Date of Government Version: 04/06/2018
Date Data Arrived at EDR: 10/21/2019
Date Made Active in Reports: 10/24/2019
Number of Days to Update: 3

Source: USGS
Telephone: 703-648-6533
Last EDR Contact: 08/28/2020
Next Scheduled EDR Contact: 12/07/2020
Data Release Frequency: Varies

EDR HIGH RISK HISTORICAL RECORDS

EDR Exclusive Records

EDR MGP: EDR Proprietary Manufactured Gas Plants

The EDR Proprietary Manufactured Gas Plant Database includes records of coal gas plants (manufactured gas plants) compiled by EDR's researchers. Manufactured gas sites were used in the United States from the 1800's to 1950's to produce a gas that could be distributed and used as fuel. These plants used whale oil, rosin, coal, or a mixture of coal, oil, and water that also produced a significant amount of waste. Many of the byproducts of the gas production, such as coal tar (oily waste containing volatile and non-volatile chemicals), sludges, oils and other compounds are potentially hazardous to human health and the environment. The byproduct from this process was frequently disposed of directly at the plant site and can remain or spread slowly, serving as a continuous source of soil and groundwater contamination.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

EDR Hist Auto: EDR Exclusive Historical Auto Stations

EDR has searched selected national collections of business directories and has collected listings of potential gas station/filling station/service station sites that were available to EDR researchers. EDR's review was limited to those categories of sources that might, in EDR's opinion, include gas station/filling station/service station establishments. The categories reviewed included, but were not limited to gas, gas station, gasoline station, filling station, auto, automobile repair, auto service station, service station, etc. This database falls within a category of information EDR classifies as "High Risk Historical Records", or HRHR. EDR's HRHR effort presents unique and sometimes proprietary data about past sites and operations that typically create environmental concerns, but may not show up in current government records searches.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

EDR Hist Cleaner: EDR Exclusive Historical Cleaners

EDR has searched selected national collections of business directories and has collected listings of potential dry cleaner sites that were available to EDR researchers. EDR's review was limited to those categories of sources that might, in EDR's opinion, include dry cleaning establishments. The categories reviewed included, but were not limited to dry cleaners, cleaners, laundry, laundromat, cleaning/laundry, wash & dry etc. This database falls within a category of information EDR classifies as "High Risk Historical Records", or HRHR. EDR's HRHR effort presents unique and sometimes proprietary data about past sites and operations that typically create environmental concerns, but may not show up in current government records searches.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

EDR RECOVERED GOVERNMENT ARCHIVES

Exclusive Recovered Govt. Archives

RGA HWS: Recovered Government Archive State Hazardous Waste Facilities List

The EDR Recovered Government Archive State Hazardous Waste database provides a list of SHWS incidents derived from historical databases and includes many records that no longer appear in current government lists. Compiled from Records formerly available from the Department of Environmental Quality in Oregon.

Date of Government Version: N/A
Date Data Arrived at EDR: 07/01/2013
Date Made Active in Reports: 01/03/2014
Number of Days to Update: 186

Source: Department of Environmental Quality
Telephone: N/A
Last EDR Contact: 06/01/2012
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

RGA LF: Recovered Government Archive Solid Waste Facilities List

The EDR Recovered Government Archive Landfill database provides a list of landfills derived from historical databases and includes many records that no longer appear in current government lists. Compiled from Records formerly available from the Department of Environmental Quality in Oregon.

Date of Government Version: N/A
Date Data Arrived at EDR: 07/01/2013
Date Made Active in Reports: 01/13/2014
Number of Days to Update: 196

Source: Department of Environmental Quality
Telephone: N/A
Last EDR Contact: 06/01/2012
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

RGA LUST: Recovered Government Archive Leaking Underground Storage Tank

The EDR Recovered Government Archive Leaking Underground Storage Tank database provides a list of LUST incidents derived from historical databases and includes many records that no longer appear in current government lists. Compiled from Records formerly available from the Department of Environmental Quality in Oregon.

Date of Government Version: N/A
Date Data Arrived at EDR: 07/01/2013
Date Made Active in Reports: 12/27/2013
Number of Days to Update: 179

Source: Department of Environmental Quality
Telephone: N/A
Last EDR Contact: 06/01/2012
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

OTHER DATABASE(S)

Depending on the geographic area covered by this report, the data provided in these specialty databases may or may not be complete. For example, the existence of wetlands information data in a specific report does not mean that all wetlands in the area covered by the report are included. Moreover, the absence of any reported wetlands information does not necessarily mean that wetlands do not exist in the area covered by the report.

NY MANIFEST: Facility and Manifest Data

Manifest is a document that lists and tracks hazardous waste from the generator through transporters to a TSD facility.

Date of Government Version: 01/01/2019
Date Data Arrived at EDR: 04/29/2020
Date Made Active in Reports: 07/10/2020
Number of Days to Update: 72

Source: Department of Environmental Conservation
Telephone: 518-402-8651
Last EDR Contact: 07/31/2020
Next Scheduled EDR Contact: 11/09/2020
Data Release Frequency: Quarterly

WI MANIFEST: Manifest Information

Hazardous waste manifest information.

Date of Government Version: 05/31/2018
Date Data Arrived at EDR: 06/19/2019
Date Made Active in Reports: 09/03/2019
Number of Days to Update: 76

Source: Department of Natural Resources
Telephone: N/A
Last EDR Contact: 06/04/2020
Next Scheduled EDR Contact: 09/21/2020
Data Release Frequency: Annually

Oil/Gas Pipelines
Source: Endeavor Business Media
Petroleum Bundle (Crude Oil, Refined Products, Petrochemicals, Gas Liquids (LPG/NGL), and Specialty Gases (Miscellaneous)) N = Natural Gas Bundle (Natural Gas, Gas Liquids (LPG/NGL), and Specialty Gases (Miscellaneous)). This map includes information copyrighted by Endeavor Business Media. This information is provided on a best effort basis and Endeavor Business Media does not guarantee its accuracy nor warrant its fitness for any particular purpose. Such information has been reprinted with the permission of Endeavor Business Media.

Electric Power Transmission Line Data
Source: Endeavor Business Media
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Sensitive Receptors: There are individuals deemed sensitive receptors due to their fragile immune systems and special sensitivity to environmental discharges. These sensitive receptors typically include the elderly, the sick, and children. While the location of all sensitive receptors cannot be determined, EDR indicates those buildings and facilities - schools, daycares, hospitals, medical centers, and nursing homes - where individuals who are sensitive receptors are likely to be located.

AHA Hospitals:
Source: American Hospital Association, Inc.
Telephone: 312-280-5991
The database includes a listing of hospitals based on the American Hospital Association's annual survey of hospitals.

Medical Centers: Provider of Services Listing
Source: Centers for Medicare & Medicaid Services
Telephone: 410-786-3000
A listing of hospitals with Medicare provider number, produced by Centers of Medicare & Medicaid Services, a federal agency within the U.S. Department of Health and Human Services.

Nursing Homes
Source: National Institutes of Health
Telephone: 301-594-6248
Information on Medicare and Medicaid certified nursing homes in the United States.

Public Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on elementary and secondary public education in the United States. It is a comprehensive, annual, national statistical database of all public elementary and secondary schools and school districts, which contains data that are comparable across all states.

Private Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on private school locations in the United States.

Daycare Centers: Child Care Listings
Source: Employment Department
Telephone: 503-947-1420

Flood Zone Data: This data was obtained from the Federal Emergency Management Agency (FEMA). It depicts 100-year and 500-year flood zones as defined by FEMA. It includes the National Flood Hazard Layer (NFHL) which incorporates Flood Insurance Rate Map (FIRM) data and Q3 data from FEMA in areas not covered by NFHL.
Source: FEMA
Telephone: 877-336-2627
Date of Government Version: 2003, 2015

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002, 2005 and 2010 from the U.S. Fish and Wildlife Service.

State Wetlands Data: Wetlands Inventory Data
Source: Oregon Geospatial Enterprise Office
Telephone: 503-378-2166

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Current USGS 7.5 Minute Topographic Map
Source: U.S. Geological Survey

STREET AND ADDRESS INFORMATION

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GEOCHECK ®- PHYSICAL SETTING SOURCE ADDENDUM

TARGET PROPERTY ADDRESS

NICKEL MOUNTAIN
NICKEL MOUNTAIN QUARRY
WINSTON, OR 97496

TARGET PROPERTY COORDINATES

Latitude (North):	42.96363 - 42° 57' 49.07''
Longitude (West):	123.435918 - 123° 26' 9.30''
Universal Tranverse Mercator:	Zone 10
UTM X (Meters):	464447.1
UTM Y (Meters):	4756653.0
Elevation:	2969 ft. above sea level

USGS TOPOGRAPHIC MAP

Target Property Map:	6070939 NICKEL MOUNTAIN, OR
Version Date:	2014

EDR's GeoCheck Physical Setting Source Addendum is provided to assist the environmental professional in forming an opinion about the impact of potential contaminant migration.

Assessment of the impact of contaminant migration generally has two principle investigative components:

1. Groundwater flow direction, and
2. Groundwater flow velocity.

Groundwater flow direction may be impacted by surface topography, hydrology, hydrogeology, characteristics of the soil, and nearby wells. Groundwater flow velocity is generally impacted by the nature of the geologic strata.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW DIRECTION INFORMATION

Groundwater flow direction for a particular site is best determined by a qualified environmental professional using site-specific well data. If such data is not reasonably ascertainable, it may be necessary to rely on other sources of information, such as surface topographic information, hydrologic information, hydrogeologic data collected on nearby properties, and regional groundwater flow information (from deep aquifers).

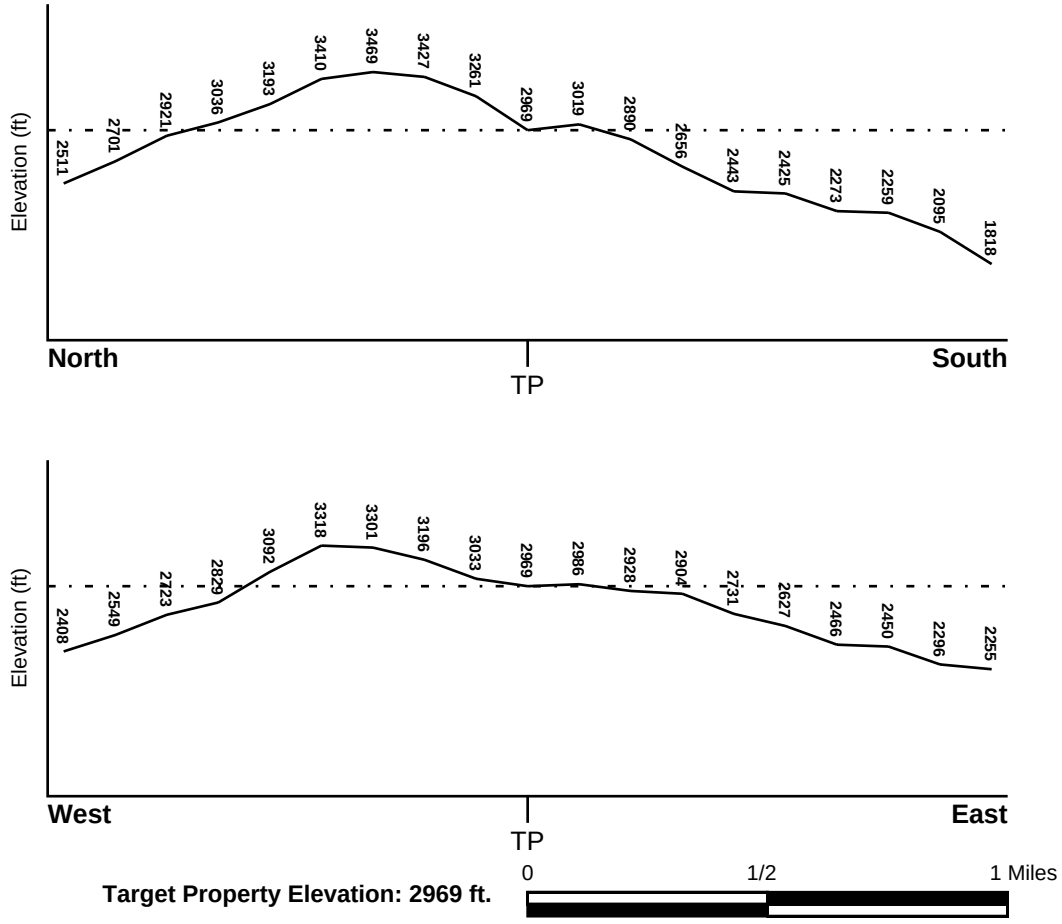
TOPOGRAPHIC INFORMATION

Surface topography may be indicative of the direction of surficial groundwater flow. This information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

TARGET PROPERTY TOPOGRAPHY

General Topographic Gradient: General SSE

SURROUNDING TOPOGRAPHY: ELEVATION PROFILES



Target Property Elevation: 2969 ft.

Source: Topography has been determined from the USGS 7.5' Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

HYDROLOGIC INFORMATION

Surface water can act as a hydrologic barrier to groundwater flow. Such hydrologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

Refer to the Physical Setting Source Map following this summary for hydrologic information (major waterways and bodies of water).

FEMA FLOOD ZONE

Flood Plain Panel at Target Property	FEMA Source Type
41019C2485F	FEMA FIRM Flood data

Additional Panels in search area:	FEMA Source Type
4100591125A	FEMA Q3 Flood data
4100591140A	FEMA Q3 Flood data

NATIONAL WETLAND INVENTORY

NWI Quad at Target Property	NWI Electronic Data Coverage
NOT AVAILABLE	YES - refer to the Overview Map and Detail Map

HYDROGEOLOGIC INFORMATION

Hydrogeologic information obtained by installation of wells on a specific site can often be an indicator of groundwater flow direction in the immediate area. Such hydrogeologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

AQUIFLOW®

Search Radius: 1.000 Mile.

EDR has developed the AQUIFLOW Information System to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted by environmental professionals to regulatory authorities at select sites and has extracted the date of the report, groundwater flow direction as determined hydrogeologically, and the depth to water table.

MAP ID	LOCATION FROM TP	GENERAL DIRECTION GROUNDWATER FLOW
Not Reported		

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW VELOCITY INFORMATION

Groundwater flow velocity information for a particular site is best determined by a qualified environmental professional using site specific geologic and soil strata data. If such data are not reasonably ascertainable, it may be necessary to rely on other sources of information, including geologic age identification, rock stratigraphic unit and soil characteristics data collected on nearby properties and regional soil information. In general, contaminant plumes move more quickly through sandy-gravelly types of soils than silty-clayey types of soils.

GEOLOGIC INFORMATION IN GENERAL AREA OF TARGET PROPERTY

Geologic information can be used by the environmental professional in forming an opinion about the relative speed at which contaminant migration may be occurring.

ROCK STRATIGRAPHIC UNIT

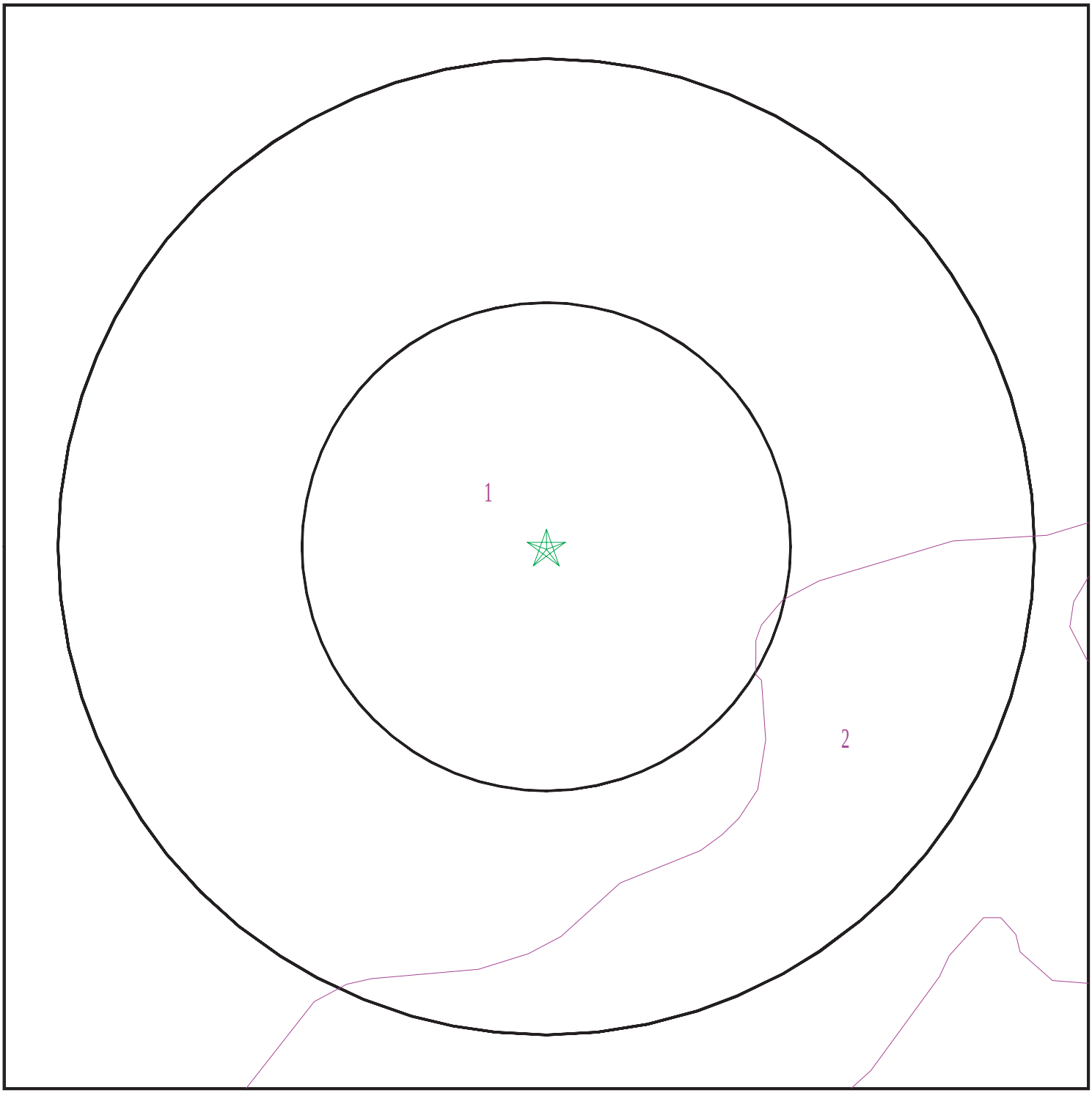
Era:	Paleozoic
System:	Permian
Series:	Ultramafic rocks
Code:	uM *(decoded above as Era, System & Series)*

GEOLOGIC AGE IDENTIFICATION

Category: Plutonic and Intrusive Rocks

Geologic Age and Rock Stratigraphic Unit Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - a digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

SSURGO SOIL MAP - 6175862.2s



Target Property
SSURGO Soil
Water

0 1/16 1/8 1/4 Miles

N

SITE NAME:	Nickel Mountain	CLIENT:	Alpine Environmental Consultants, LLC
ADDRESS:	Nickel Mountain Quarry Winston OR 97496	CONTACT:	Jonathan Williams
LAT/LONG:	42.96363 / 123.435918	INQUIRY #:	6175862.2s
		DATE:	September 01, 2020 1:12 pm

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GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

DOMINANT SOIL COMPOSITION IN GENERAL AREA OF TARGET PROPERTY

The U.S. Department of Agriculture's (USDA) Soil Conservation Service (SCS) leads the National Cooperative Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. The following information is based on Soil Conservation Service SSURGO data.

Soil Map ID: 1

Soil Component Name:	Pits
Soil Surface Texture:	
Hydrologic Group:	Not reported
Soil Drainage Class:	
Hydric Status: Not hydric	
Corrosion Potential - Uncoated Steel:	Not Reported
Depth to Bedrock Min:	> 0 inches
Depth to Watertable Min:	> 0 inches

No Layer Information available.

Soil Map ID: 2

Soil Component Name:	Pearsoll
Soil Surface Texture:	extremely stony clay loam
Hydrologic Group:	Class D - Very slow infiltration rates. Soils are clayey, have a high water table, or are shallow to an impervious layer.
Soil Drainage Class:	Well drained
Hydric Status: Not hydric	
Corrosion Potential - Uncoated Steel:	Moderate
Depth to Bedrock Min:	> 36 inches
Depth to Watertable Min:	> 0 inches

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

Soil Layer Information							
	Boundary			Classification		Saturated hydraulic conductivity micro m/sec	Soil Reaction (pH)
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil		
1	0 inches	5 inches	extremely stony clay loam	Silt-Clay Materials (more than 35 pct. passing No. 200), Clayey Soils.	Not reported	Max: Min:	Max: Min:
2	5 inches	14 inches	extremely cobbly clay	Silt-Clay Materials (more than 35 pct. passing No. 200), Clayey Soils.	Not reported	Max: Min:	Max: Min:
3	14 inches	24 inches	unweathered bedrock	Silt-Clay Materials (more than 35 pct. passing No. 200), Clayey Soils.	Not reported	Max: Min:	Max: Min:

LOCAL / REGIONAL WATER AGENCY RECORDS

EDR Local/Regional Water Agency records provide water well information to assist the environmental professional in assessing sources that may impact ground water flow direction, and in forming an opinion about the impact of contaminant migration on nearby drinking water wells.

WELL SEARCH DISTANCE INFORMATION

DATABASE	SEARCH DISTANCE (miles)
Federal USGS	1.000
Federal FRDS PWS	Nearest PWS within 1 mile
State Database	1.000

FEDERAL USGS WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
No Wells Found		

FEDERAL FRDS PUBLIC WATER SUPPLY SYSTEM INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
No PWS System Found		

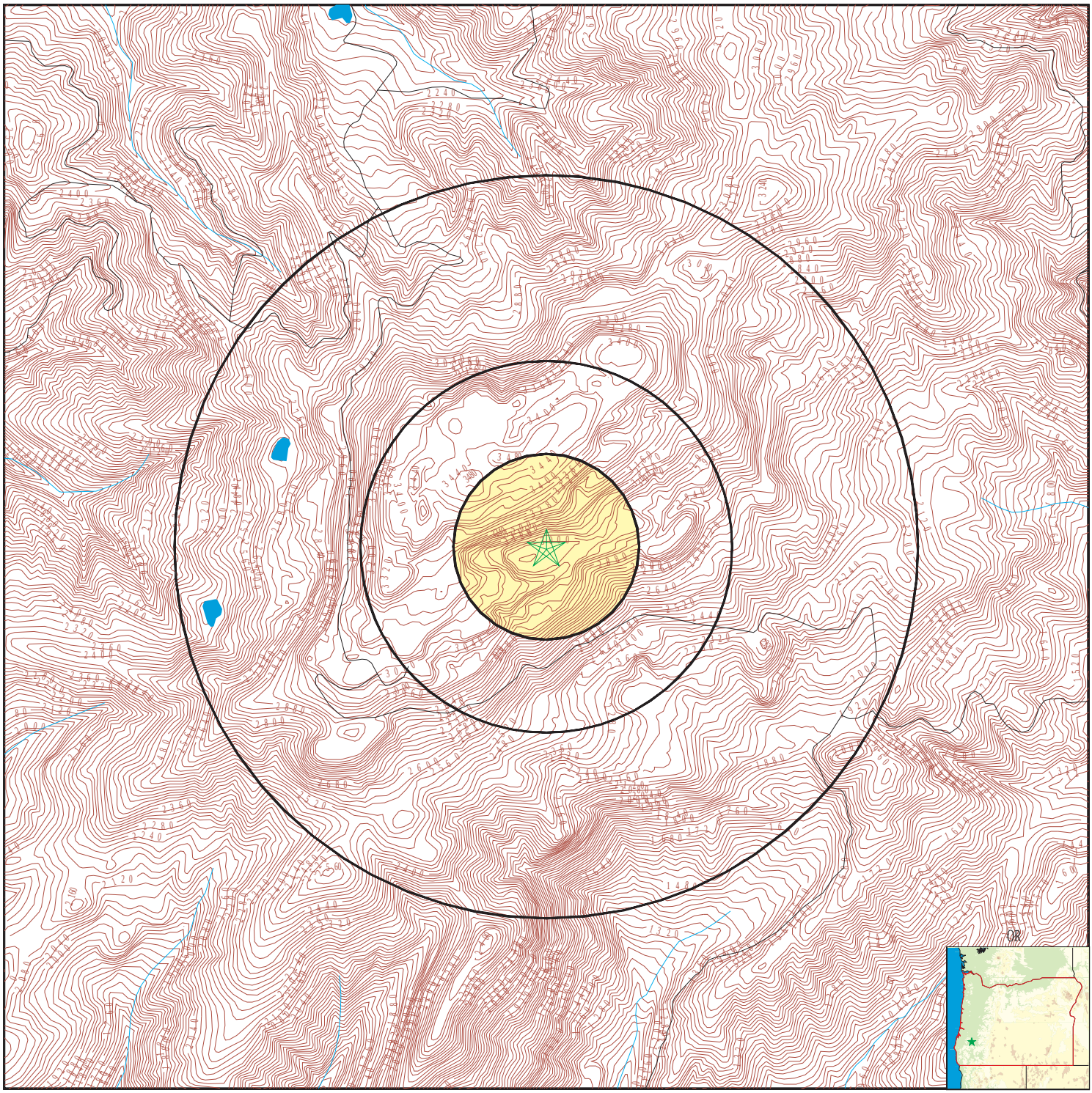
Note: PWS System location is not always the same as well location.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

STATE DATABASE WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
No Wells Found		

PHYSICAL SETTING SOURCE MAP - 6175862.2s



- County Boundary
- Major Roads
- Contour Lines
- Earthquake epicenter, Richter 5 or greater
- Water Wells
- Public Water Supply Wells
- Cluster of Multiple Icons
- Groundwater Flow Direction
- GI Indeterminate Groundwater Flow at Location
- GV Groundwater Flow Varies at Location
- Oil, gas or related wells

SITE NAME:	Nickel Mountain	CLIENT:	Alpine Environmental Consultants, LLC
ADDRESS:	Nickel Mountain Quarry Winston OR 97496	CONTACT:	Jonathan Williams
		INQUIRY #:	6175862.2s
LAT/LONG:	42.96363 / 123.435918	DATE:	September 01, 2020 1:12 pm

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GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS
RADON

AREA RADON INFORMATION

State Database: OR Radon

Radon Test Results

Zipcode	Num Tests	Maximum	Minimum	Average	# > 4 pCi/L
97469	1	0.1	0.1	0.1	0

Federal EPA Radon Zone for DOUGLAS County: 3

Note: Zone 1 indoor average level > 4 pCi/L.
: Zone 2 indoor average level >= 2 pCi/L and <= 4 pCi/L.
: Zone 3 indoor average level < 2 pCi/L.

Not Reported

PHYSICAL SETTING SOURCE RECORDS SEARCHED

TOPOGRAPHIC INFORMATION

USGS 7.5' Digital Elevation Model (DEM)
Source: United States Geologic Survey
EDR acquired the USGS 7.5' Digital Elevation Model in 2002 and updated it in 2006. The 7.5 minute DEM corresponds to the USGS 1:24,000- and 1:25,000-scale topographic quadrangle maps. The DEM provides elevation data with consistent elevation units and projection.

Current USGS 7.5 Minute Topographic Map
Source: U.S. Geological Survey

HYDROLOGIC INFORMATION

Flood Zone Data: This data was obtained from the Federal Emergency Management Agency (FEMA). It depicts 100-year and 500-year flood zones as defined by FEMA. It includes the National Flood Hazard Layer (NFHL) which incorporates Flood Insurance Rate Map (FIRM) data and Q3 data from FEMA in areas not covered by NFHL.
Source: FEMA
Telephone: 877-336-2627
Date of Government Version: 2003, 2015

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002, 2005 and 2010 from the U.S. Fish and Wildlife Service.

State Wetlands Data: Wetlands Inventory Data
Source: Oregon Geospatial Enterprise Office
Telephone: 503-378-2166

HYDROGEOLOGIC INFORMATION

AQUIFLOW^{R} Information System
Source: EDR proprietary database of groundwater flow information
EDR has developed the AQUIFLOW Information System (AIS) to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted to regulatory authorities at select sites and has extracted the date of the report, hydrogeologically determined groundwater flow direction and depth to water table information.

GEOLOGIC INFORMATION

Geologic Age and Rock Stratigraphic Unit
Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - A digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

STATSGO: State Soil Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Service (NRCS)
The U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) leads the national Conservation Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps.

SSURGO: Soil Survey Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Service (NRCS)
Telephone: 800-672-5559
SSURGO is the most detailed level of mapping done by the Natural Resources Conservation Service, mapping scales generally range from 1:12,000 to 1:63,360. Field mapping methods using national standards are used to construct the soil maps in the Soil Survey Geographic (SSURGO) database. SSURGO digitizing duplicates the original soil survey maps. This level of mapping is designed for use by landowners, townships and county natural resource planning and management.

PHYSICAL SETTING SOURCE RECORDS SEARCHED

LOCAL / REGIONAL WATER AGENCY RECORDS

FEDERAL WATER WELLS

PWS: Public Water Systems
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Public Water System data from the Federal Reporting Data System. A PWS is any water system which provides water to at least 25 people for at least 60 days annually. PWSs provide water from wells, rivers and other sources.

PWS ENF: Public Water Systems Violation and Enforcement Data
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Violation and Enforcement data for Public Water Systems from the Safe Drinking Water Information System (SDWIS) after August 1995. Prior to August 1995, the data came from the Federal Reporting Data System (FRDS).

USGS Water Wells: USGS National Water Inventory System (NWIS)
This database contains descriptive information on sites where the USGS collects or has collected data on surface water and/or groundwater. The groundwater data includes information on wells, springs, and other sources of groundwater.

STATE RECORDS

Water Well Data
Source: Department of Water Resources
Telephone: 503-986-0843

OTHER STATE DATABASE INFORMATION

Oil and Gas Well Locations
Source: Department of Geology and Mineral Industries
Telephone: 971-673-1540
A listing of oil and gas well locations in the state.

RADON

State Database: OR Radon
Source: Oregon Health Services
Telephone: 503-731-4272
Radon Levels in Orgeon

Area Radon Information
Source: USGS
Telephone: 703-356-4020
The National Radon Database has been developed by the U.S. Environmental Protection Agency (USEPA) and is a compilation of the EPA/State Residential Radon Survey and the National Residential Radon Survey. The study covers the years 1986 - 1992. Where necessary data has been supplemented by information collected at private sources such as universities and research institutions.

EPA Radon Zones
Source: EPA
Telephone: 703-356-4020
Sections 307 & 309 of IRAA directed EPA to list and identify areas of U.S. with the potential for elevated indoor radon levels.

OTHER

Airport Landing Facilities: Private and public use landing facilities
Source: Federal Aviation Administration, 800-457-6656

Epicenters: World earthquake epicenters, Richter 5 or greater
Source: Department of Commerce, National Oceanic and Atmospheric Administration

Earthquake Fault Lines: The fault lines displayed on EDR's Topographic map are digitized quaternary faultlines, prepared in 1975 by the United State Geological Survey

PHYSICAL SETTING SOURCE RECORDS SEARCHED

STREET AND ADDRESS INFORMATION

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APPENDIX 4

Well Search

Oregon Water Resources Department
Well Report Query

Well Report Query Results

GPS points, where available are at the far right of the table. Click link to view on map

Township: 30 S, Range: 06 W, Sections: 7,8,9,16,17,18,19,20,21

Well Log	Details	T-R-S/ QQ-Q	Taxlot	Street of Well	Owner	Company	Special Standards	Well Type	First Water	Completed Depth	Static Water Level	Yield	Completed Date	Received Date	Bonded Constructor	Startcard	Well Id #	New	Abandon	Deepen	Alteration	Conversion	Domestic	Irrigation	Community	Livestock	Industrial	Injection	Thermal	Dewatering	Piezometer	Latitude/ Longitude
DOUG 9405	Details	30.00S-6.00W-17 -			MAURETT, DON GENERAL DELIVERY CANYONVILLE OR 97417			W		85.00	76.0	50.0	11/07/1967	11/14/1967	MOHR, STANLEY F MOHR WELL DRILLING			✓					✓										

Download Data

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the STATE ENGINEER, SALEM, OREGON 97310 within 30 days from the date of well completion.

DOUG 9405

WATER WELL REPORT

STATE OF OREGON (Please type or print) (Do not write above this line)

NOV 14 1967

DOUG 009405

State Well No. 30/6w-17

State Permit No.

(1) OWNER:

Name Don Maurett

Address Ben Del Canyonville Oregon

(2) TYPE OF WORK (check):

New Well ☑ Deepening ☐ Reconditioning ☐ Abandon ☐

If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:

Rotary ☑ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):

Domestic ☑ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

CASING INSTALLED:

Threaded ☐ Welded ☑

2" Diam. from 0 ft. to 80 ft. Gage 250

..." Diam. from ... ft. to ... ft. Gage ...

..." Diam. from ... ft. to ... ft. Gage ...

PERFORATIONS:

Perforated? ☐ Yes ☒ No

Type of perforator used

Size of perforations in. by in.

... perforations from ... ft. to ... ft.

... perforations from ... ft. to ... ft.

... perforations from ... ft. to ... ft.

... perforations from ... ft. to ... ft.

... perforations from ... ft. to ... ft.

(7) SCREENS:

Well screen installed? ☐ Yes ☒ No

Manufacturer's Name

Type Model No.

Diam. Slot size Set from ft. to ft.

Diam. Slot size Set from ft. to ft.

(8) WATER LEVEL: Completed well.

ic level 76 ft. below land surface Date 11/7/67

sian pressure lbs. per square inch Date

(9) WELL TESTS:

Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes, by whom?

d: gal./min. with ft. drawdown after hrs.

" " " "

" " " "

Bailer test 50 gal./min. with 8 ft. drawdown after 1 hrs.

Artesian flow g.p.m. Date

Temperature of water 53 Was a chemical analysis made? ☐ Yes ☐ No

(10) CONSTRUCTION:

Well seal—Material used Bentinite

Depth of seal 40 ft.

Diameter of well bore to bottom of seal 9 in.

Were any loose strata cemented off? ☐ Yes ☒ No Depth

Was a drive shoe used? ☐ Yes ☒ No

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? depth of strata

Method of sealing strata off

Was well gravel packed? ☐ Yes ☒ No Size of gravel:

Gravel placed from ft. to ft.

(11) LOCATION OF WELL:

County Douglas Driller's well number

¼ ¼ Section 17 T. 30 R. 6 W W.M.

Bearing and distance from section or subdivision corner

(12) WELL LOG:

Diameter of well below casing 6

Depth drilled 85 ft. Depth of completed well 85 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level as drilling proceeds. Note drilling rates.

MATERIAL	From	To	SWL
Dirt	0	3	
Yellow Clay	3	31	
Blue Clay	31	65	
Forge Rudren	65	85	176

Work started 11/7/67 19 Completed 11/7/67 19

Date well drilling machine moved off of well 11/7/67 19

Drilling Machine Operator's Certification:

This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.

[Signed] (Drilling Machine Operator) Date 11/12/67 19

Drilling Machine Operator's License No. 168

Water Well Contractor's Certification:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME (Person, firm or corporation) (Type or print)

Address RT 2 Box 1169 Roseburg Ore

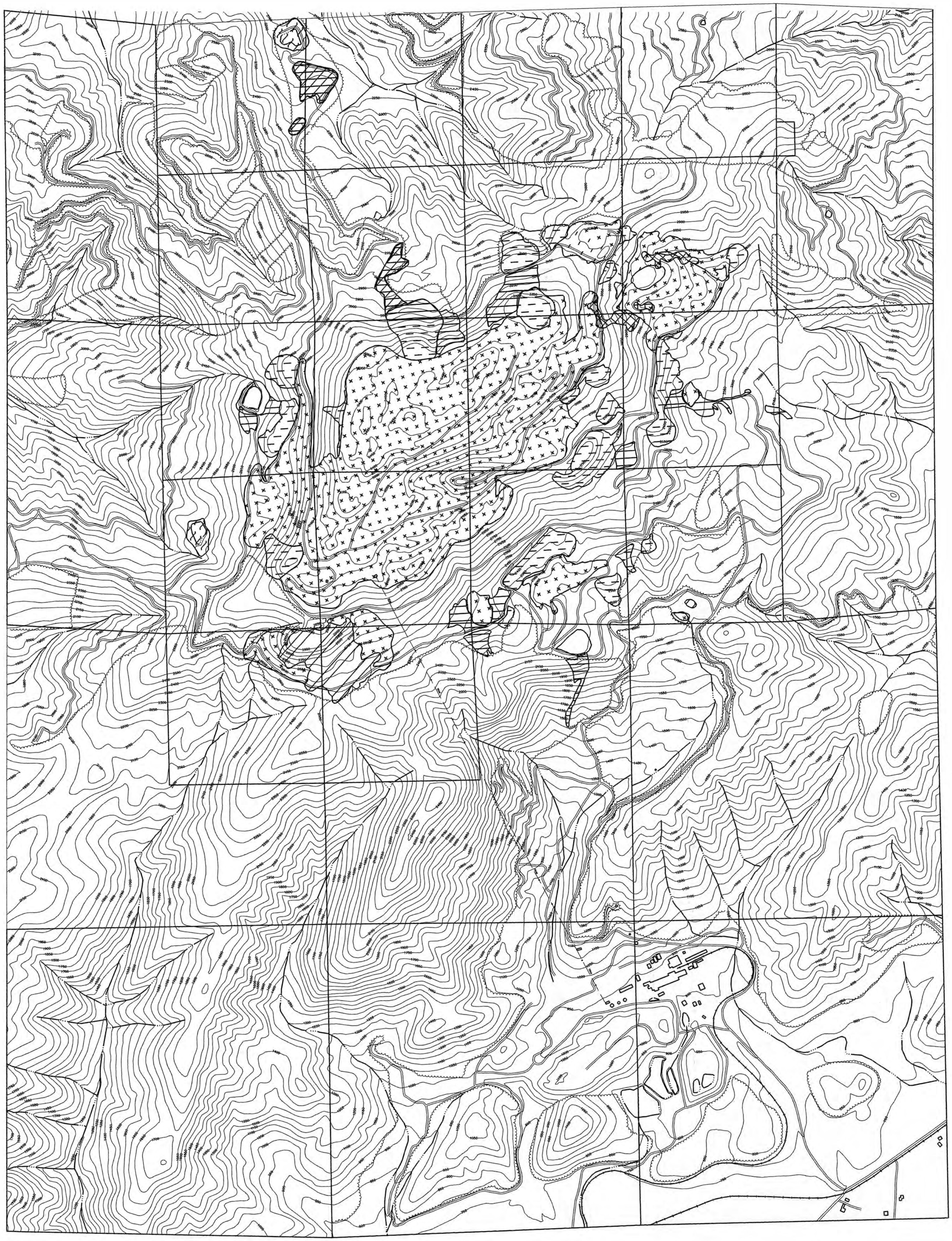
[Signed] (Water Well Contractor)

Contractor's License No. 60 Date 11/12/67 19

(USE ADDITIONAL SHEETS IF NECESSARY)

APPENDIX 5

Previous Environmental Documents for the Site



GLENBROOK MINING CO.

DISTURBED GROUND BEFORE 1989
MINED AREA

NICKEL MOUNTAIN MINE

SCALE 1" = 1000'

MINED AREA

DISTURBED GROUND 1981

DUMP AREA

DISTURBED 1-1-1981

GRASS 1980

GRASS 1981

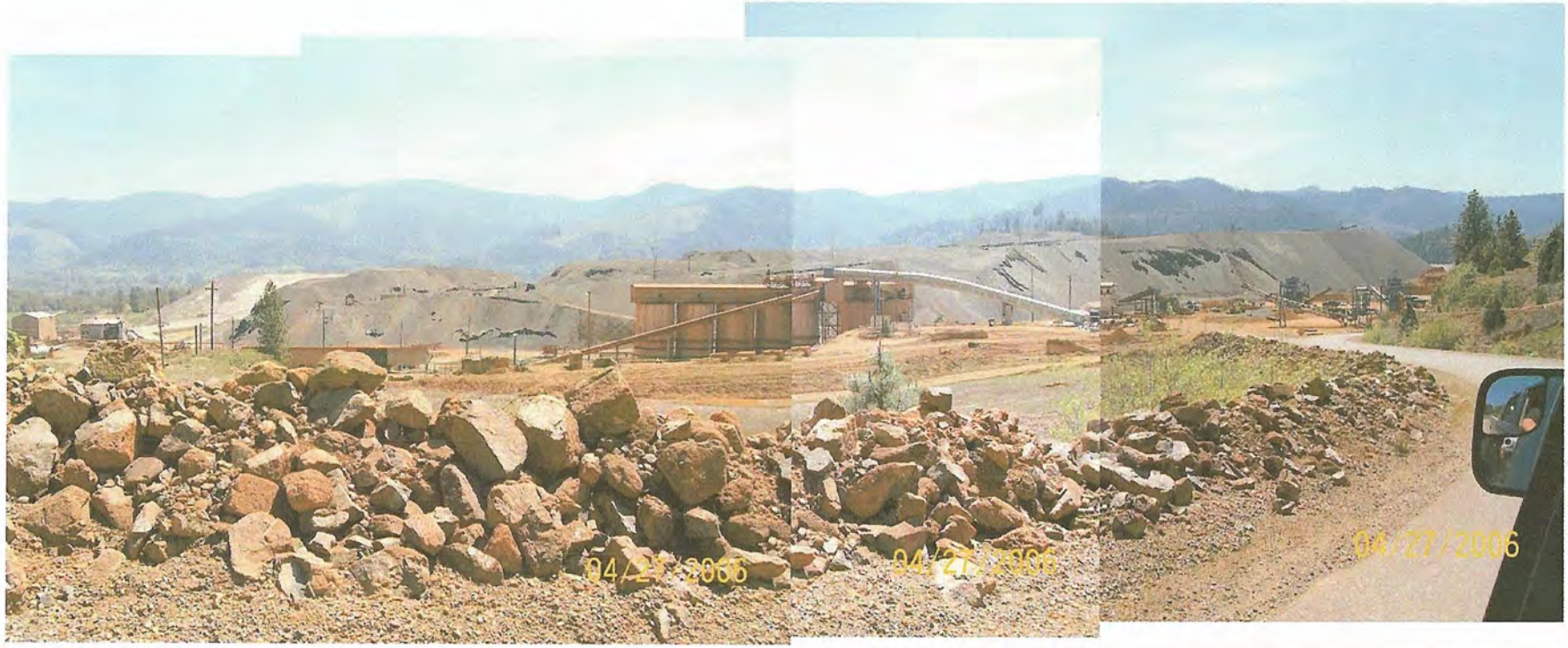
SETTELING POND

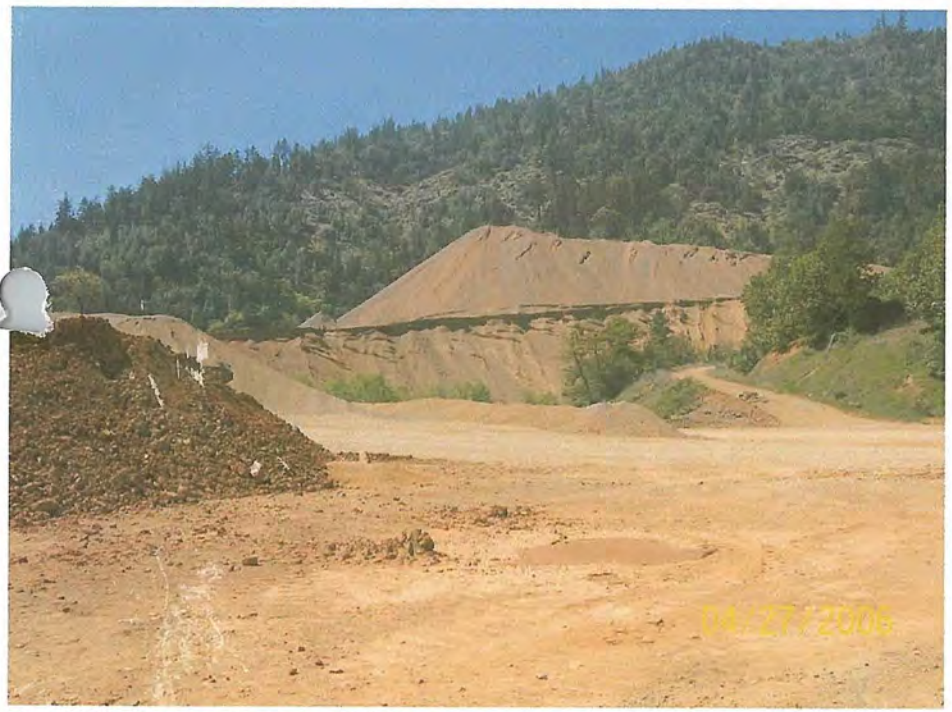
REJECT AREA

DRAFT

map file

10-0026





10-0026 Green Diamond (pics a-e page 1 of 1)
4/27/2006 - VGB

Oregon
John A. Kitzhaber, M.D., Governor

Department of Geology & Mineral Industries
Mined Land Reclamation
229 Broadalbin Street SW
Albany OR 97321-2246
(541) 967-2039
FAX (541) 967-2075

June 20, 2002

Report of Onsite Inspection
Conducted June 5, 2002

Tech Cominco American Incorporated
PO Box 3087
Spokane WA 99220-3087

MLR ID: 10-0026
Nickel Mountain
DEQ Permit: Individual NPDES 105366
Reclaimed Acres: Interim 0, Concurrent 0

I was accompanied on this inspection by Greg Schoen of Teck Cominco American Inc., Ron Thomas and Kiersten Fuchs of Redwing Ecological Services Inc., Roy Arnoldt of Arnoldt Engineering, and Douglas Warren of Westland Resources Inc. This inspection was scheduled to review reclamation work completed at the lower ore body permitted area. Redwing personnel were on site for quarterly monitoring.

Mining began to slow down at Nickel mountain in 1994 when nickel prices were depressed. The last mining reported by Glenbrook was in 1996.

Reclamation of the lower ore body began in 1999. The reclamation plan called for establishing areas of upland forest, open meadows, wetlands, and wooded riverine corridors. All grading was completed by the end of 2000.

The number of cubic yards graded during this project is not known, but it is substantial. The final monitoring report from Redwing will estimate this figure.

The lower ore body area is an ancestral landslide feature. As the open pit was developed in the early 1990's, subsurface springs began draining into the mine. This drainage was routed around the mine operations and into an existing channel. Since the end of mining this drainage has remained fairly constant at 20 gpm and typically flows year round.

Dealing with this water source was an integral part of the reclamation plan.

A series of shallow ponds was created to provide wetland habitat and route the water through the quarry floor. The lower two ponds were sealed with bentonite to increase the water holding capacity. Wetland herbaceous plant species were planted in the ponds, and willow stakes have established along the channels connecting the ponds.

The pond inlets and outlets as well as the connecting channels are armored with oversized rock. Drop pools have formed in the channels along the steeper reaches. No movement of rock or erosion features are evident after the first two winter seasons the system has been in place.

Inspected by:

Ben Mundie
Reclamationist
Mined Land Reclamation

c: Douglas County Planning Department
DEQ Roseburg
Awards 2002

BAM/CC:06/20/02, 10-0026 06-05-02IR

Tree survival rates top 90%. A local timber contractor, Barnes and Associates has purchased a parcel of this property that includes the entire lower ore body area. Barnes & Assoc. planted approximately 400 trees/acre over 50 acres in the spring of 2001. Spot planting of additional trees was completed by Barnes & Assoc. in spring of 2002.

Pond #2 was determined to have insufficient freeboard for a major storm event. The outlet was widened by 30% spring of 2002 to provide the additional conveyance. The water level in pond #2 dropped by about one foot after this work was completed. Willow stakes have already established in the outlet channel of pond #2.

Based on visual estimates the outflow of the water system appears to be within 90% of the inflow. It is anticipated self-sealing of the lower two ponds with sediment will decrease the loss through the system over the next several years.

The entire water system appears stable. Revegetation appears successful. Monitoring will continue through the winter of 2002-2003. Based on positive monitoring results of December/January 2002/2003 file closure will be requested in February 2003. If additional stabilization work is deemed necessary, renewal of the DOGAMI permit will be required in March 2003. This site is eligible for a Vegetation permit.

An excellent job has been accomplished to stabilize this site. Teck Cominco will be nominated for outstanding reclamation for 2002. It must be recognized that many parties had a hand in making this reclamation project a success, but the corporate philosophy and the talent of equipment operators at Glenbrook/Teck Cominco ultimately produced the final product.

Oregon Dept. of Geology & Mineral Industries
Mineral Land Regulation & Reclamation Program
229 Broadalbin St. SW
Albany OR 97321-2246
(541) 967-2039

OPERATING PERMIT -- Renewal
ISSUED SUBJECT TO ANY LISTED CONDITIONS

Tech Cominco American Incorporated
PO Box 3087
Spokane WA 99220-3087

ID No.: 10-0026
County: Douglas
Site: Nickel Mountain
Section: 16 17
Twp: 30S
Range: 6W

This permit shall be in effect, unless revoked or suspended for cause, from the date of issuance and shall remain in effect so long thereafter as the Permittee pays the annual fee to renew the permit, complies with the provisions of ORS 517.750 through 517.955 as applicable, the Rules as promulgated to administer the Oregon Mined Land Reclamation Act, the approved reclamation plan, and any conditions attached to this permit, and maintains a performance bond as required by the Act.

Issuance of this permit is not a finding of compliance with state-wide planning goals or the acknowledged comprehensive plan. The applicant must receive land-use approval from local government before using this permit.

NOTE: Reclamation plans may be modified per ORS 517.830(4) and OAR 632-(30) and (35)-035.

CONDITIONS: (Conditions may be appealed per OAR 632-30-030. If an appeal is made, this permit is invalid until the condition(s) appealed is/are resolved and the permit reissued.)

The Permittee shall:

1. mulch all topsoil stockpiles constructed between October 31 and April 1 as soon as constructed.
2. reconstruct rock-lined drainages with a similar gradient and width to the pre-mine condition.
3. seed and mulch outslopes of new haul roads.
4. restore new haul roads to pre-mine condition upon completion of mining.
5. reclaim all exploration work to the standards contained in OAR 632.33.

Issued 7-22, 2002

Gary W. Lynch
Assistant Director

RENEWAL IS REQUIRED BY MARCH 31, 2003

c: Douglas County Planning Department
DEQ Roseburg

Oregon Dept. of Geology & Mineral Industries
Mined Land Reclamation Program
1536 Queen Avenue SE
Albany OR 97321
(541) 967-2039

OPERATING PERMIT -- Renewal
ISSUED SUBJECT TO ANY LISTED CONDITIONS

Glenbrook Nickel Company Attention: Greg Schoen
PO Box 85
Riddle OR 97469

ID No.: 10-0026
County: Douglas
Site: Nickel Mountain
Section: 16 17
Twp: 30S
Range: 6W

This permit shall be in effect, unless revoked or suspended for cause, from the date of issuance and shall remain in effect so long thereafter as the Permittee pays the annual fee to renew the permit, complies with the provisions of ORS 517.750 through 517.955 as applicable, the Rules as promulgated to administer the Oregon Mined Land Reclamation Act, the approved reclamation plan, and any conditions attached to this permit, and maintains a performance bond as required by the Act.

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3. seed and mulch outslopes of new haul roads.
4. restore new haul roads to pre-mine condition upon completion of mining.
5. reclaim all exploration work to the standards contained in OAR 632.33.

Issued 4-10, 2001

Gary W. Lynch
Supervisor

RENEWAL IS REQUIRED BY MARCH 31, 2002

c: Douglas County
DEQ Roseburg

Oregon Dept. of Geology & Mineral Industries
Mined Land Reclamation Program
1536 Queen Avenue SE
Albany OR 97321
(541) 967-2039

OPERATING PERMIT -- Renewal
ISSUED SUBJECT TO ANY LISTED CONDITIONS

Glenbrook Nickel Company Attn: Greg Schoen
PO Box 85
Riddle OR 97469

ID No.: 10-0026
County: Douglas
Site: Nickel Mountain
Section: 16 17
Twp: 30S
Range: 6W

This permit shall be in effect, unless revoked or suspended for cause, from the date of issuance and shall remain in effect so long thereafter as the Permittee pays the annual fee to renew the permit, complies with the provisions of ORS 517.750 through 517.955 as applicable, the Rules as promulgated to administer the Oregon Mined Land Reclamation Act, the approved reclamation plan, and any conditions attached to this permit, and maintains a performance bond as required by the Act.

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2. reconstruct rock-lined drainages with a similar gradient and width to the pre-mine condition.
3. seed and mulch outslopes of new haul roads.
4. restore new haul roads to pre-mine condition upon completion of mining.
5. reclaim all exploration work to the standards contained in OAR 632.33.

Issued 4-18, 2000

Gary W. Lynch
Supervisor

RENEWAL IS REQUIRED BY MARCH 31, 2001

c: Douglas County
DEQ Roseburg

Oregon Dept. of Geology & Mineral Industries
Mined Land Reclamation
1536 Queen Avenue SE
Albany OR 97321
(541) 967-2039

OPERATING PERMIT -- Renewal
ISSUED SUBJECT TO ANY LISTED CONDITIONS

Glenbrook Nickel Company
PO Box 85; Attention Greg Schoen
Riddle OR 97469

ID No.: 10-0026
County: Douglas
Site: Nickel Mountain
Section: 16,17
Twp: 30S
Range: 6W

This permit shall be in effect, unless revoked or suspended for cause, from the date of issuance and shall remain in effect so long thereafter as the Permittee pays the annual fee to renew the permit, complies with the provisions of ORS 517.750 through 517.955 as applicable, the Rules as promulgated to administer the Oregon Mined Land Reclamation Act, the approved reclamation plan, and any conditions attached to this permit, and maintains a performance bond as required by the Act.

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NOTE: Reclamation plans may be modified per ORS 517.830(4) and OAR 632-(30) and (35)-035.

CONDITIONS:

Conditions may be appealed per OAR 632-30-030. If an appeal is made, this permit is invalid until the condition(s) appealed is/are resolved and the permit reissued.

The Permittee shall:

1. mulch all topsoil stockpiles constructed between October 31 and April 1 as soon as constructed.
2. reconstruct rock-lined drainages with a similar gradient and width to the pre-mine condition.
3. seed and mulch outslopes of new haul roads.
4. restore new haul roads to pre-mine condition upon completion of mining.
5. reclaim all exploration work to the standards contained in OAR 632.33.

Issued 4-6, 1999

Gary W. Lynch
Supervisor

RENEWAL IS REQUIRED BY MARCH 31, 2000

c: Douglas County
DEQ - Roseburg

10-0026
Glenbrook
11/5/98

Loyi N. Collins

10-0026
11/5/98

10-0026
11/5/98

10-0026
11/5/98

10-0026
Glenbrook
11/5/98

by: N. Collins

10-0026
11/5/98

10-0026
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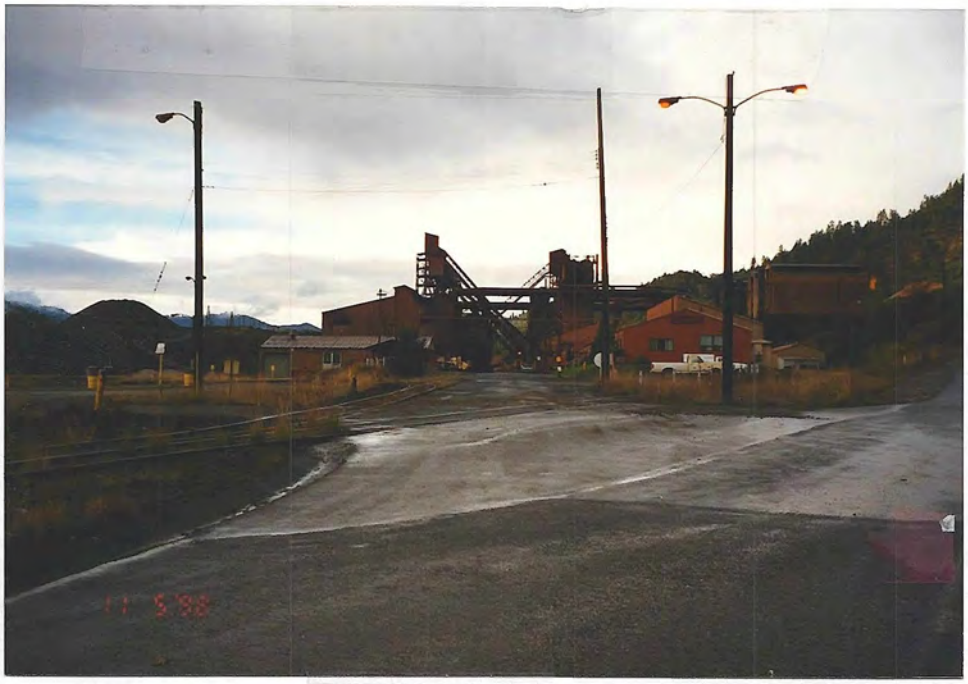
11/5/98

10-0026
11/5/98

ID-0026
11/5/98



Oregon
John A. Kitzhaber, M.D., Governor

Department of Geology & Mineral Industries
Mined Land Reclamation
1536 Queen Avenue SE
Albany, OR 97321-6687
(541) 967-2039
FAX (541) 967-2075

Report of Onsite Inspection

Glenbrook Nickel Company
PO Box 85
Riddle OR 97469

10-0026
Section 16 17, Twp 30S, Range 6W
Nickel Mountain

DEQ Permit: **Individual NPDES, 105366/A**

Date Of Inspection: September 9, 1998

I was accompanied on this inspection by Greg Schoen and others. Wetland planting in Thompson Creek is underway. Approximately 20 acres in the west pit have been reshaped. DOGAMI does not see any storm water discharge issues remaining at the Thompson Creek, Doe East, or Doe West areas.

Thompson Creek

Earthworks here were completed at Thompson Creek a year ago. The pond is no longer serving as a settling basin. With the consent of DOGAMI, DEQ and BLM, the storm water runoff from the north side of Nickel Mountain now flows directly into Thompson Creek. As noted in previous reports, the pond is being converted into a wetland and wildlife water source.

While wetland species were establishing themselves without help, Glenbrook has gone an extra mile to hire Freshwater Farms, Inc. from Eureka, CA to speed up the revegetation process. At the time of my visit they were planting four wetland species plus willows and cottonwoods. The four-wetland species mimic those which have started growing naturally on the site. A full report from the company is expected soon.

West Pit

About twenty acres have been reshaped at the West Pit. All the vertical high walls have been sloped. Storm water flowing into the old pit will concentrate on the bottom of the pit, forming a shallow settling pond since the outlet is higher than the pit floor. The water that collects may percolate into the ground or it may form another wetland. If it does, wetland vegetation will be considered for this area.

The entire twenty acres was being covered with straw or hydromulch by Dick Heard at the time of my visit. The steeper areas, which were hydromulched, are being seeded to grass. The area is being covered with straw, and will be planted with ponderosa pine during the spring.

Inspected by:

Allen H. Throop
Reclamationist
Mined Land Reclamation

c: Douglas County Planning Department
DEQ – Medford
Awards File

Encl.

AHT/cc:11/12/98, 10-0026 09-09-98IR

Lower Orebody

We reviewed once again the general plans for reclamation of the lower pit. A major item to be dealt with is how the watercourse will be established through and out of the pit. There is a larger amount of water running out of the pit now than there was prior to mining. Glenbrook asked for DOGAMI's assistance with mapping during reclamation. DOGAMI's interns will visit the site soon to discuss Glenbrook's needs. The aerial photos taken in March by DOGAMI for Glenbrook will be used as a base for further mapping.

Doe East and Doe West Ponds

We did not visit these two ponds. However, from a visit in the spring and from a review of the attached aerial photograph, DOGAMI is confident that no significant amount of sediments are reaching the ponds. A review of the original color photograph from which the copy is taken, shows the northern pond (Doe East) slightly lighter in color than the other pond (Doe West). A large landslide filled the pond about 20 years ago. When it was rehabilitated, the pond may have been left more shallow than the other pond. No delta or other indicator of significant deposition of sediment in the pond was seen in the aerial photograph or during the last field visit.

Doe West now receives very little runoff from the mined area. Control of runoff drainage so that all runoff enters the pond before leaving the southeast edge of the mine has not been maintained for years.

Since DOGAMI is not aware of any turbid or sediment laden waters from the parts of the mine that once drained into Doe East and West, we would have no objection to final decommissioning of the two ponds. The present plan is to construct permanent overflow structures to allow water to leave the ponds.

Voluntary Reclamation

Earlier in the year, Glenbrook removed the tram tower and associated equipment. Since the facilities have been place since the 1950's and the state's reclamation program did not start until 1972, tower removal was not required. For this effort and others that go above the requirements of the law, Glenbrook will be nominated for a reclamation award in 1998.

File Name: d:\sitemaps\ 10graph\100026DOE 3-98.CVS

DOGAMI ID#: 10-0026
Permittee: Glenbrook Nickel Company
Site Name: Nickel Mountain
Photo Source / Date: D. Shear / 3-20-98
Prepared By / Date: J. Boer / 10-13-98

0 300 600 ft

Approx. scale 1 in = 300 ft

Oregon Dept. of Geology and Mineral Industries
Mined Land Reclamation Program

10-0026
Glenbrook
9/10/98
A. Thoop

Reclaimed from loading area

cutting willows

10-0026
9/10/98

Planted cottonwoods

Reclaimed Thompson Creek mine area?

10-0026
9/10/98

Plant to 6 wetland species

Volunteer wetland species

10-0026
9/10/98

Planting

ripped access rd

Reclaimed w. ore body

Thompson Ck outfall

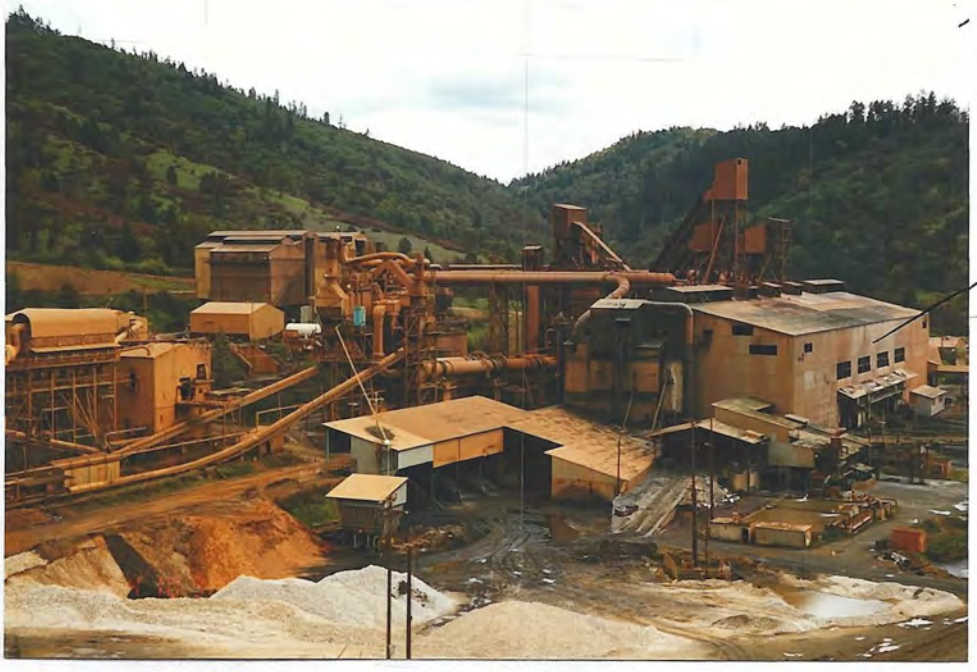
10-0026
9/10/98

10-0026
9/10/98

10-0026
Glenbrook
9/10/98
by: A. Thrasher

West Pit - after
mulch & hydro-mulch
(on steep slopes)

slag dump



smelter

10-0026
Glenbrook
4/10/98

10-0026

4/10/98

watching unsuccessful team tower blast.

10-0026
4/10/98

tower blast

- Rod Johnson
Co-Gen II -
fly ash

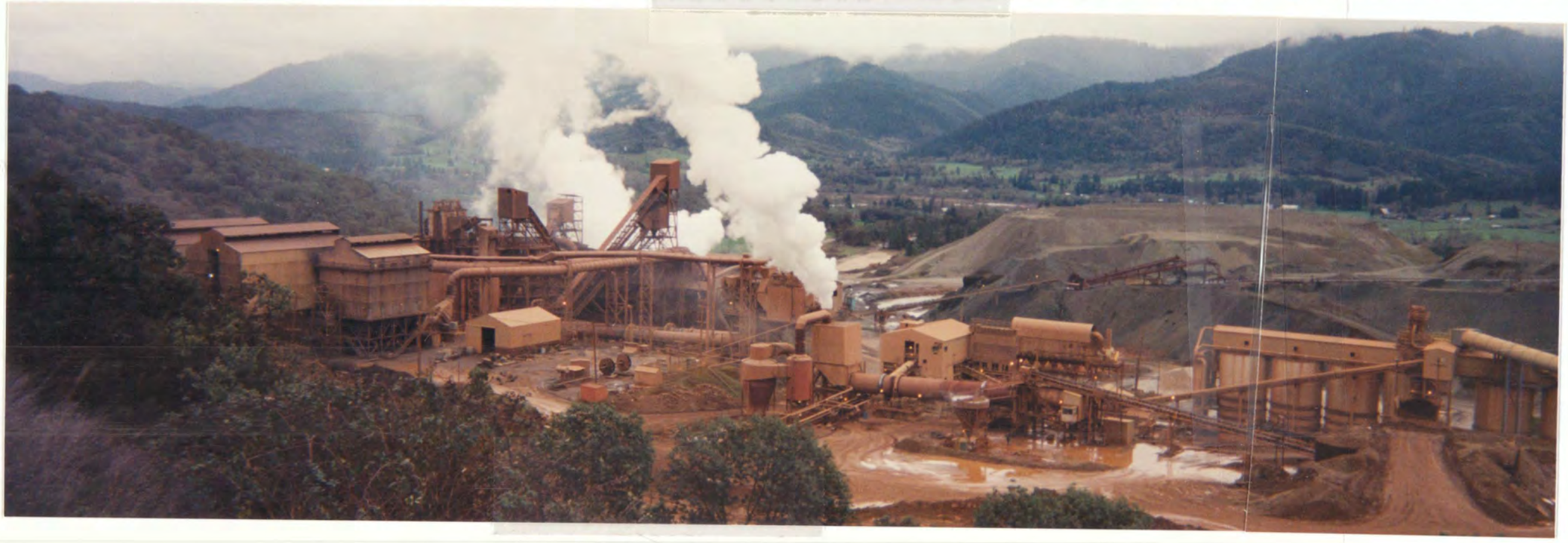
10-0026
Glenbrook
3-30-98
A. Troop

Lower ore body.

10-0026
3-30-98
Glen Brook
West Pit

by: A. Thrasyl

10-0026
Glenbrook
3/20/98?
A. Thorp



Top of frame

Rev. on beam - lower orebody.

10-0026
Glenbrook
2/19/98
by: A. Throop

10-0026
2/19/98
A Throop

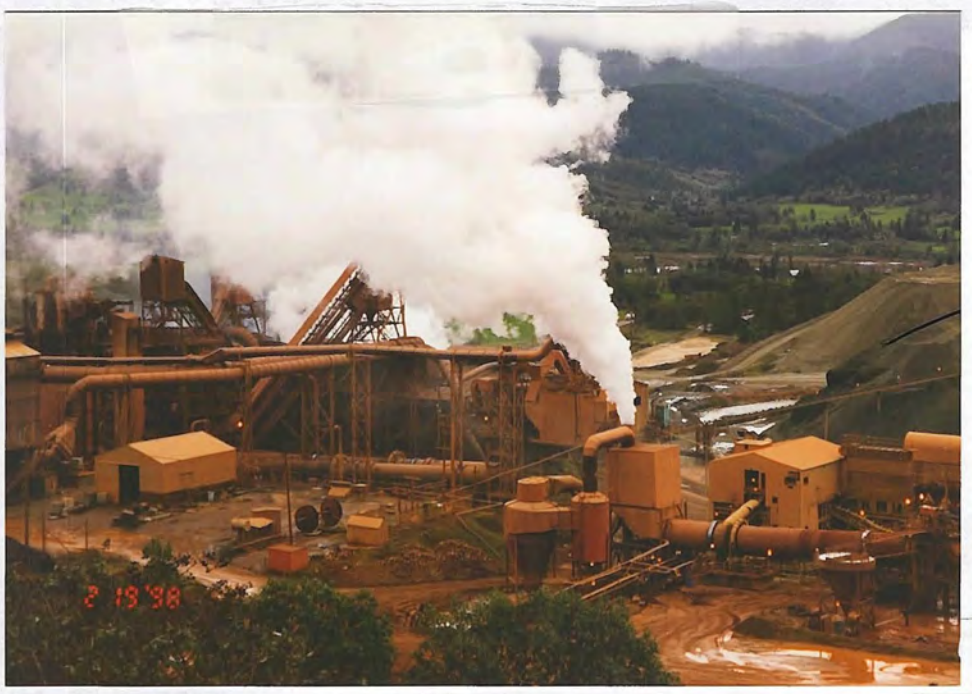
Doe East dam

Doe East dam

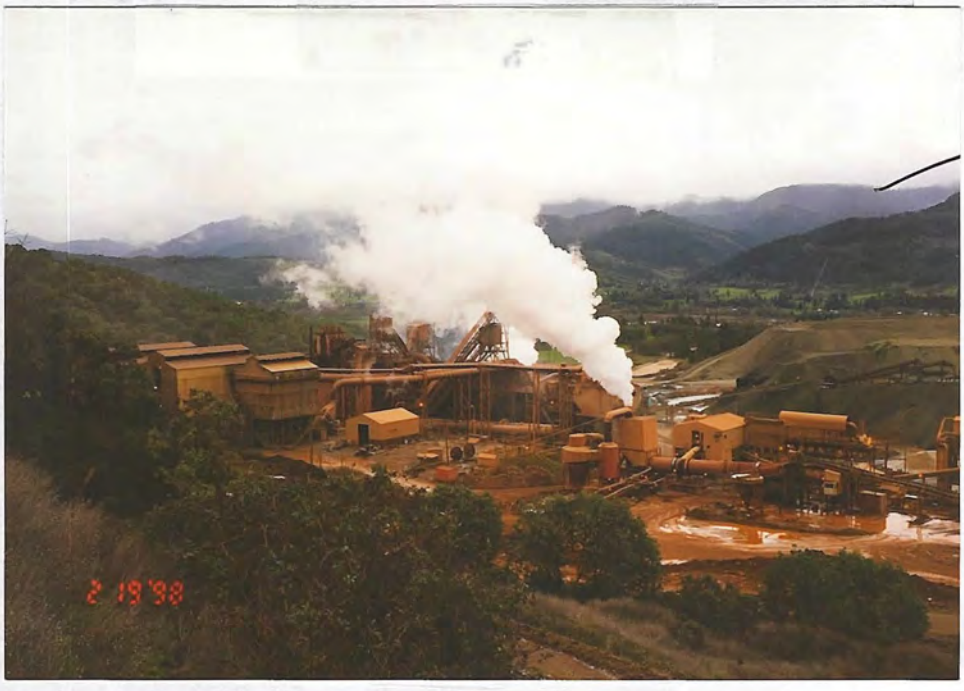
10-0026
2/19/98
A. Throop

— Doe East dam

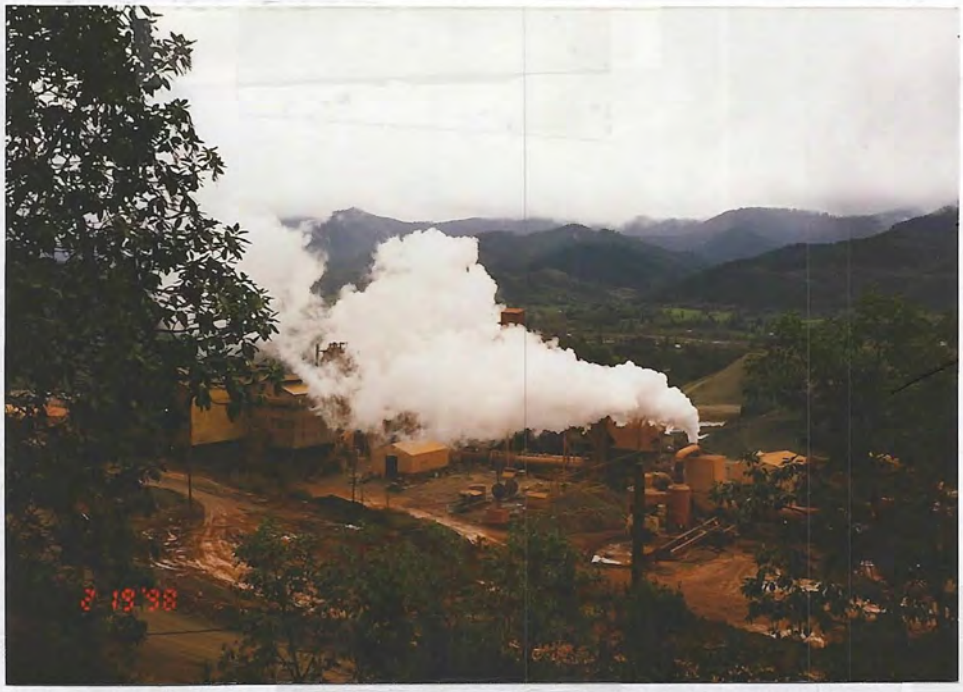
10-0026
2/19/98
A. Throop



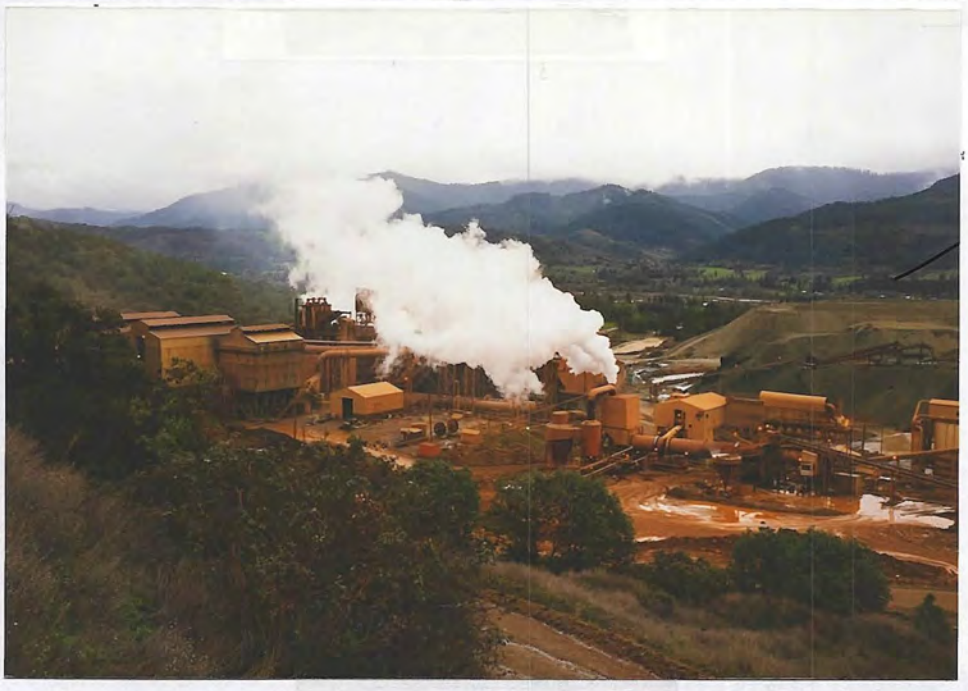
— last days of Smelter.



10-0026
2/19/98
A. Throop

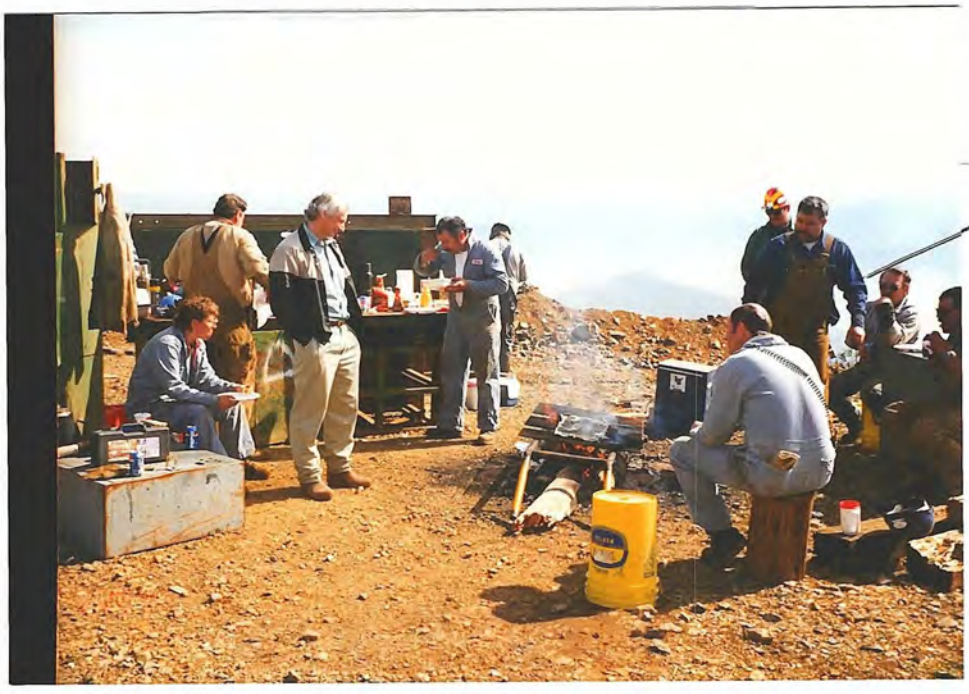


Smelter. last days



10-0026
2/19/98
A. Throop

Doe West pond



Barbeque by tower demolition crew.

Oregon Dept. of Geology & Mineral Industries
Mined Land Reclamation
1536 Queen Avenue SE
Albany OR 97321
(541) 967-2039

OPERATING PERMIT -- Renewal
ISSUED SUBJECT TO ANY LISTED CONDITIONS

Glenbrook Nickel Company
PO Box 85; Attention Greg Schoen
Riddle OR 97469

ID No.: 10-0026
County: Douglas
Site: Nickel Mountain
Section: 16,17
Twp: 30S
Range: 6W

This permit shall be in effect, unless revoked or suspended for cause, from the date of issuance and shall remain in effect so long thereafter as the Permittee pays the annual fee to renew the permit, complies with the provisions of ORS 517.750 through 517.955 as applicable, the Rules as promulgated to administer the Oregon Mined Land Reclamation Act, the approved reclamation plan, and any conditions attached to this permit, and maintains a performance bond as required by the Act.

Issuance of this permit is not a finding of compliance with state-wide planning goals or the acknowledged comprehensive plan. The applicant must receive land-use approval from local government before using this permit.

NOTE: Reclamation plans may be modified per ORS 517.830(4) and OAR 632-(30) and (35)-035.

CONDITIONS:

Conditions may be appealed per OAR 632-30-030. If an appeal is made, this permit is invalid until the condition(s) appealed is/are resolved and the permit reissued.

The Permittee shall:
1. mulch all topsoil stockpiles constructed between October 31 and April 1 as soon as constructed.
2. reconstruct rock-lined drainages with a similar gradient and width to the pre-mine condition.
3. seed and mulch outslopes of new haul roads.
4. restore new haul roads to pre-mine condition upon completion of mining.
5. reclaim all exploration work to the standards contained in OAR 632.33.

Issued 6-1, 1998

Gary W. Lynch
Supervisor

RENEWAL IS REQUIRED BY MARCH 31, 1999

c: Douglas County
DEQ - Roseburg

Oregon
John A. Kitzhaber, M.D., Governor

Department of Geology & Mineral Industries
Mined Land Reclamation
1536 Queen Avenue SE
Albany, OR 97321-6687
(541) 967-2039
FAX (541) 967-2075

Report of Onsite Inspection

Glenbrook Nickel Co.
PO Box 85
Riddle OR 97469

10-0026
Section 16,17, Twp 30S, Range 6W
Nickel Mountain

DEQ Permit: Individual NPDES 105366/A

Date Of Inspection: February 19, 1998 and March 20, 1998

I was accompanied on both inspections by Greg Schoen, Eric Norton, and Brad Davenport from Glenbrook; Jack Hart, Andy Alrich, Ruben Kretzmar, and John Gassig from DEQ were on the February inspection. The purpose of the visit was to review the status of the various storm water control ponds.

February 19, 1998

The Thompson Creek pond reclamation project is proceeding nicely. Not much has changed at this pond since my visit a few months ago.

At the Doe East pond, the more northerly of the two Doe ponds, water is going out the discharge pipe although the floating weir is broken. The water level is approximately eight feet higher than it has been during a visit earlier during last summer. Although the mine disturbances above the pond are, in part, very poorly vegetated, the drainage from the mine is carrying no significant sediment to the pond. Not even a small delta has built out into the pond from sediment eroded from the mine and deposited in the pond.

Water is flowing out from at least two seeps and also over the overflow spillway at the Doe West pond. The floating weir has been dismantled. The outlet is apparently clogged since the water level is now controlled by the spillway elevation rather than the weir elevation.. The drainages that once carried runoff from the active mining on Nickel Mountain no longer feed water to the pond.

Both Inspections

We discussed DOGAMI's reclamation requirements at the lower orebody. The biggest single item will be stream channel construction. A sizeable stream starts at various points of the highwall. Currently the water is diverted along benches on the east side of pit. Surface water flow has increased gradually as mining progressed. If it existed prior to mining, any stream was much smaller than the present one. Reconstruction of the stream was not contemplated in the reclamation plan but will be required. The stream channel is to be constructed in such a manner to adequately handle the maximum expected flows with eroding. The stream shall be relocated to the lowest point of the excavation. An opportunity exists to develop some wetlands and perhaps deep water ponds on the floor of the excavation.

Inspected by:

Allen H. Throop
Reclamationist
Mined Land Reclamation

c: Douglas County Planning Department
DEQ - Roseburg

AHT/cc:05/04/98, 10-0026-3-20-98ir

The benches on the highwall are too narrow to allow any equipment access during reclamation. The objective of reclamation should be:

1. To eliminate the highly visible, unbroken, horizontal benches. This can probably be best achieved by pushing overburden down over the highwall at various points. Care must be taken not to push material over the springs unless prior work is done to keep the water from saturating the overburden and causing bank failure.

   Reclamation blasting may be a viable approach on a few areas near the northeast corner of the site.

2. Leave the highwall in a stable non-eroding configuration. Since the surrounding hills are steeper than the normally required 1½:1 slopes, the reclaimed slopes may also be steeper but they need to be stable.

3. Establish vegetation on the slopes. This can be done with a combination of tree planting and grass seeding using the species that have proven successful on the site in the past.

A large amount of topsoil was salvaged and stockpiled by Glenbrook during mining operations. That material will be spread out over the pit floor after the land reshaping has been completed.

March 20, 1998

Nickel resources have been exhausted from a small pit located west of the lower orebody. Reclamation of that site should be done immediately since no further mining in that area is contemplated. The area should pose no significant problems for reshaping, topsoiling, and revegetation.

We drove over much of the area mined by Hanna which is exempt for the state's reclamation requirements. Although largely unvegetated, the area is erosionally stable. Hanna did extensive planting of conifers while mining and after mining ceased. The results are mixed but generally positive. In most cases, Jeffery pine, cedar, and KMX pine were planted in the safety berms established along the edges of all haul roads or on unvegetated outslopes. In some cases, the seedlings are still alive but have shown little or no growth in the 10 or more years since they were planted. In other cases, the trees are now over 10 feet. The revegetation effort by Hanna is such that the trees have had some effect of softening the view of the open pit mining from the I-5 and other places where the mountain top is visible to the public.

On the other hand, aerial photos recently taken by DOGAMI and Glenbrook show the total percentage of disturbed land that is now revegetated is small. Where mining was in hard rock, almost no plants have volunteered or survived. Since the area is exempt from our reclamation requirements, no change in this status is expected for many years.

Oregon
John A. Kitzhaber, M.D., Governor

Department of Geology & Mineral Industries
Mined Land Reclamation
1536 Queen Avenue SE
Albany, OR 97321-6687
(541) 967-2039
FAX (541) 967-2075

Report of Onsite Inspection

Glenbrook Nickel Company
PO Box 85; Attention Greg Schoen
Riddle OR 97469

10-0026
Section 16,17, Twp 30S, Range 6W
Nickel Mountain

Date Of Inspection: January 8, 1998

This inspection was conducted to review the reclamation of the Thompson Creek pond completed over the last year. The site will be nominated for a reclamation award. I was accompanied on this inspection by Greg Schoen from Glenbrook and Eric Heenan from the BLM.

Reclamation was undertaken on approximately 10 acres which was mined by Hanna, apparently in the late 1970's. A two acre pond was constructed on BLM land as a sediment control structure; the total disturbance of the pond and dam is about 4 acres. The impoundment was approximately 20 feet deep and had a discharge system that required constant attention. Since the pond has now been removed from part of the erosion control system required by DEQ and since the BLM had no long-term use for the pond, the pond was drained and much of the fill from the dam was pushed into the impoundment and a permanent surface outflow was constructed. The pond that remains has side slopes of approximately 4:1 and is no deeper than 8 feet. Wetlands vegetation will be planted around the edges of the water. Along the present water line 100 willow and 100 ash cuttings have already been planted. The regraded embankment was hydroseeded and planted with Douglas firs. The permanent outflow will require no maintenance and the limited pond capacity poses no threat should the remaining dam fail. Usage of the site as a water source for deer and elk will continue.

A major water diversion ditch that had severely eroded was filled in and the water flow returned to approximately the pre-mine drainage. The floor of the North Slope pit (the area that was mined just south of the dam) was ripped and then planted with about 1000 ponderosa pines. The reclaimed ditch line was left in a very rough condition and then planted with Douglas firs. Additional firs were planted along the roadway. A total of 5,000 firs were planted shortly before the visit.

Additional work planned includes:

- Diversion of one new water course that has caused slumping of an old fill slope.
- Further stabilization of the overflow channel. The structure consists of riprap overlying a geotextile.
- Planting of more willows to help stabilize some of the intermittent new water courses.
- Some culverts and other structures that once prevented mixing of mine runoff water and unaffected hillside runoff have been removed.
- Eventually, the access road to the pond and old mine area will be obliterated.

We discussed the possibility of using cattle to help in revegetation of some portions of the Glenbrook property. A summary paper of cattle usage in Arizona is attached to this report.

BLM is encouraged to submit a recommendation of this site for DOGAMI's 1997 reclamation award. A nomination for Reclamationist of the Year would also be welcomed. The deadline for applications is February 1.

Inspected by:

Allen H. Throop
Reclamationist
Mined Land Reclamation
c: Douglas County Planning Department
DEQ – Roseburg
Awards File
Encl.
AHT/cc:01/22/98, 10-0026-01/08/98ir

Smelter

outflow of Thompson Cr

10-0026
Glenbrook
2/19/98
by: A. Throop

10-0026
2/19/98
A. Throop

- In flow to Thompson CK.

Greg Schaen

10-0026
1/8/98 A. Throop

Backfilled ditch

firs planted
pond outfall

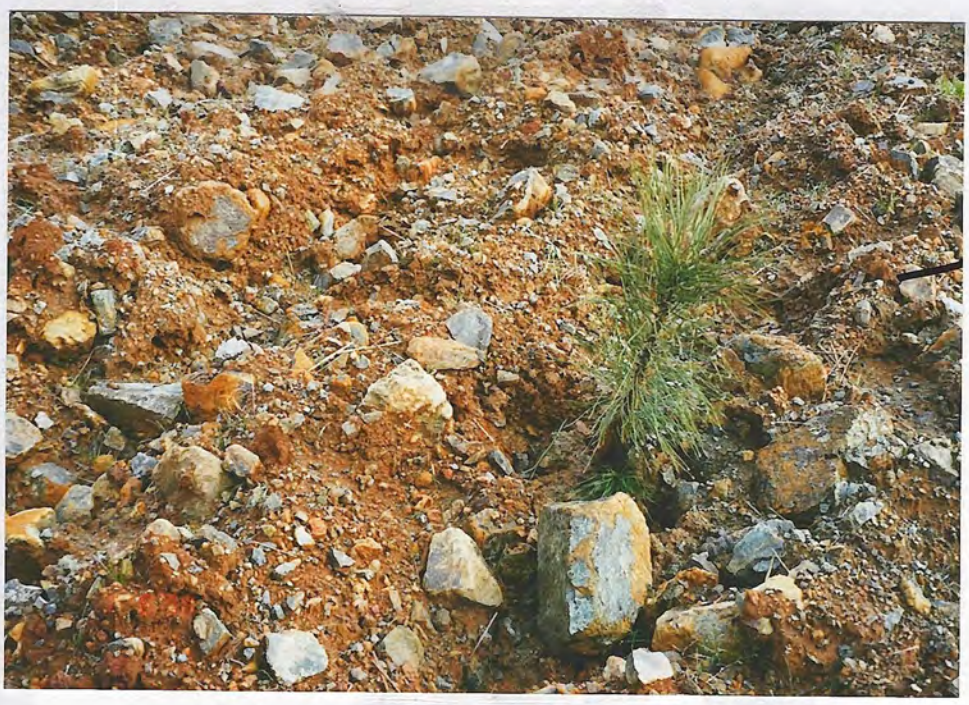
10-0026
1/8/98 A. Throop

Erosion in backfilled ditch

10-0026
1/8/98
A. Throop

backfilled ditch

old mine area



Ponderosa Pine Seedling

10-0026
1/8/98
A. Throop

overview of pond

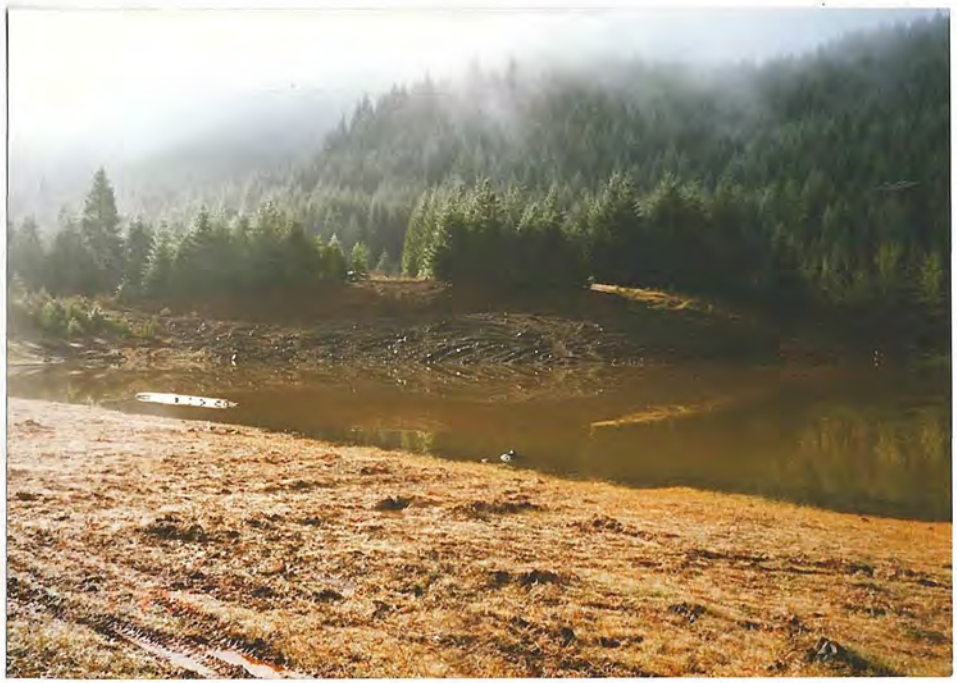
pond slopes

10-0026
1/8/98
A. Thropp

Oregon ash cutting

Willow cuttings

10-0026
1/8/98
A. Throop



Reclamation at Thompson Creek Pond

10-0026 1/8/98 A. Throop

Reclamation at Thompson Creek pond

10-0026 1/8/98 A. Throop

Reclamation at Thompson Creek Pond

10-0026 1/8/98 A. Throop

10-0026
1/8/98
A. Throop

Reclamation at Thompson Creek Pond

Oregon Dept. Of Geology & Mineral Industries
Mined Land Reclamation
1536 Queen Avenue SE
Albany OR 97321
(541) 967-2039

OPERATING PERMIT
ISSUED SUBJECT TO ANY LISTED CONDITIONS

Glenbrook Nickel Company
PO Box 85; Attention Greg Schoen
Riddle OR 97469

ID No.: 10-0026
County: Douglas
Site: Nickel Mountain
Section: 16,17
Twp: 30S
Range: 6W

This permit shall be in effect, unless revoked or suspended for cause, from the date of issuance and shall remain in effect so long thereafter as the Permittee pays the annual fee to renew the permit, complies with the provisions of ORS 517.750 through 517.955 as applicable, the Rules as promulgated to administer the Oregon Mined Land Reclamation Act, the approved reclamation plan, and any conditions attached to this permit, and maintains a performance bond as required by the Act.

Issuance of this permit is not a finding of compliance with state-wide planning goals or the acknowledged comprehensive plan. The applicant must receive land-use approval from local government before using this permit.

NOTE: Reclamation plans may be modified per ORS 517.830(4) and OAR 632-(30) and (35)-035.

CONDITIONS:

Conditions may be appealed per OAR 632-30-030. If an appeal is made, this permit is invalid until the condition(s) appealed is/are resolved and the permit reissued.

The Permittee shall:
1. mulch all topsoil stockpiles constructed between October 31 and April 1 as soon as constructed.
2. reconstruct rock-lined drainages with a similar gradient and width to the pre-mine condition.
3. seed and mulch outslopes of new haul roads.
4. restore new haul roads to pre-mine condition upon completion of mining.
5. reclaim all exploration work to the standards contained in OAR 632.33.

Issued 7-1, 1997

Gary W. Lynch
Supervisor

RENEWAL IS REQUIRED BY MARCH 31, 1998

c: Douglas County
DEQ - Roseburg

State of Oregon
Department of Geology and Mineral Industries

1536 Queen Ave. SE
Albany, Oregon 97321
Phone (541) 967-2039
Fax (541) 967-2075

Report of Onsite Inspection

Glenbrook Nickel Company
PO Box 85
Riddle OR 97469

10-0026
Nickel Mountain
Section 16,17, Twp 30S, Range 6W

Date Of Inspection: January 16, 1997

This inspection was conducted to review the proposed decommissioning of the pond in the Thompson Creek drainage. I was accompanied on this inspection by Greg Schoen and Walt Matschkowsky, Glenbrook; and Eric Heenan and Ted Weasma, BLM. Glenbrook is to supply a proposal outlining the complete reclamation work to be done in the Thompson Creek drainage area by April. The proposal submitted will be essentially that discussed among these three groups and other agencies in 1995. DOGAMI will coordinate responses with ODFW and DEQ for the proposal.

The work will consist of reconstructing the embankment holding in the Thompson Creek pond so that the final pond is no greater than eight feet deep. The floating weir and piping through the embankment will be removed. Final slopes will be 4:1 or flatter and the banks will be revegetated. The runoff ditch to the west of the pond will be filled in or have check dams constructed in places. Water from springs will be diverted out of the ditch west of the pond.

DOGAMI and Glenbrook also discussed the still active part of the site. Since the visit, Glenbrook has submitted maps showing the total disturbance area and the areas disturbed by Glenbrook. DOGAMI has previously stated that most of the Hanna disturbances were grandfathered from our reclamation requirements or were acceptably reclaimed. During this process DOGAMI agreed that some areas affected by Hanna and not visible to any frequently used viewpoints could be left unvegetated if Hanna would plant other more visible areas with trees. The areas where trees were planted are not shown on the map just submitted. If it is possible to add this information plus the property ownership on the 1":1000' map, having all the information on one map would be great. However, this may be too cluttered to make legible maps with all the information.

Inspected by:

Allen H. Throop
Reclamationist
Mined Land Reclamation

c: Douglas County Planning Department
DEQ - Roseburg
BLM - Roseburg

AHT/cc:04/07/97, 10-00260197.ir

10-0026
Glenbrook NV
1/16/07
by: A. Thorp

diversion pipe to be removed.
- Thompson Creek area

Oregon Dept. Of Geology & Mineral Industries
Mined Land Reclamation
1536 Queen Avenue SE
Albany OR 97321

OPERATING PERMIT
ISSUED SUBJECT TO ANY LISTED CONDITIONS

Glenbrook Nickel Company
PO Box 85
Riddle OR 97469

ID No.: 10-0026
County: Douglas
Site: Nickel Mountain
Section: 16,17
Twp: 30S
Range: 6W

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4. restore new haul roads to pre-mine condition upon completion of mining.
5. reclaim all exploration work to the standards contained in OAR 632.33.

Issued this 18 day of June, 1996.

Gary W. Lynch
Supervisor

RENEWAL IS REQUIRED BY MARCH 31, 1997

c: Douglas County
DEQ - Roseburg

10-0026
Glenbrook
5-24-96

by: A. Throop

Near Doe E (?) - the more northerly - pond.

T wampler
B. Ballou
E - Heenan (back to camera)

- some area

smelter slides

5 24 '96

5 24 '96

10-0126
Glen Creek Mine
May 24, 1996
by: A. Thoop

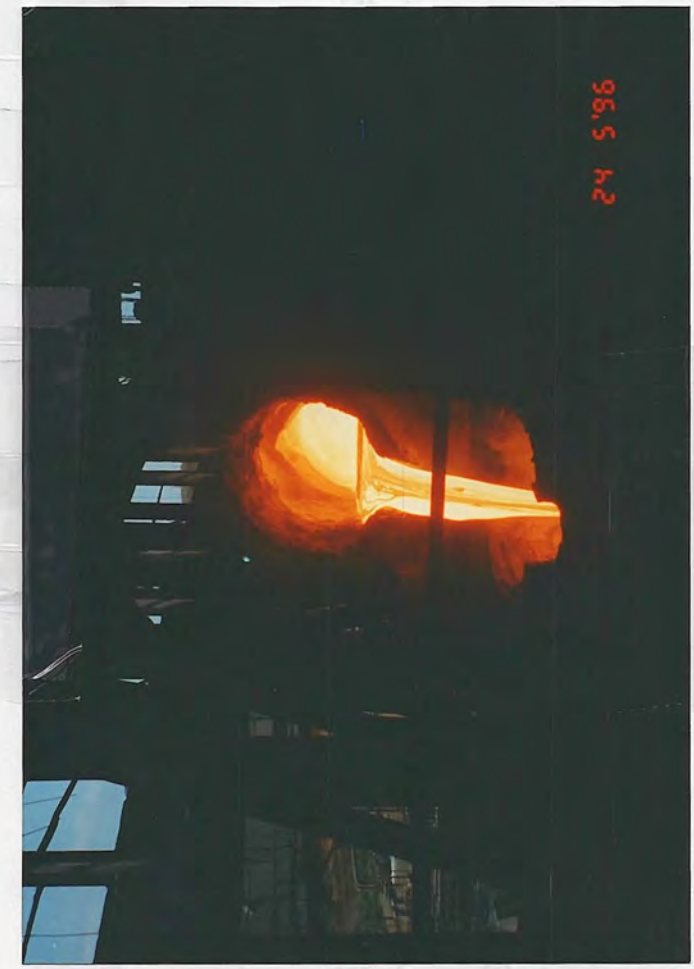
N approx

lower Ore body
from reclaimed area.

Site ID# 10-0026
Site Name: GLENBROOK NICKEL MTN
Date Taken: 5/24/96
Taken By Peter Wampler

96 5 24

10-0026
Glenbrook N.
May 24, 1996
by: A. Throop



Site ID# 10-0026
Site Name: NICKEL MTN
Date Taken: 5/24/96
Taken By Peter Wampler

96.5 h2

96.5 h2

96.5 h2

96.5 h2

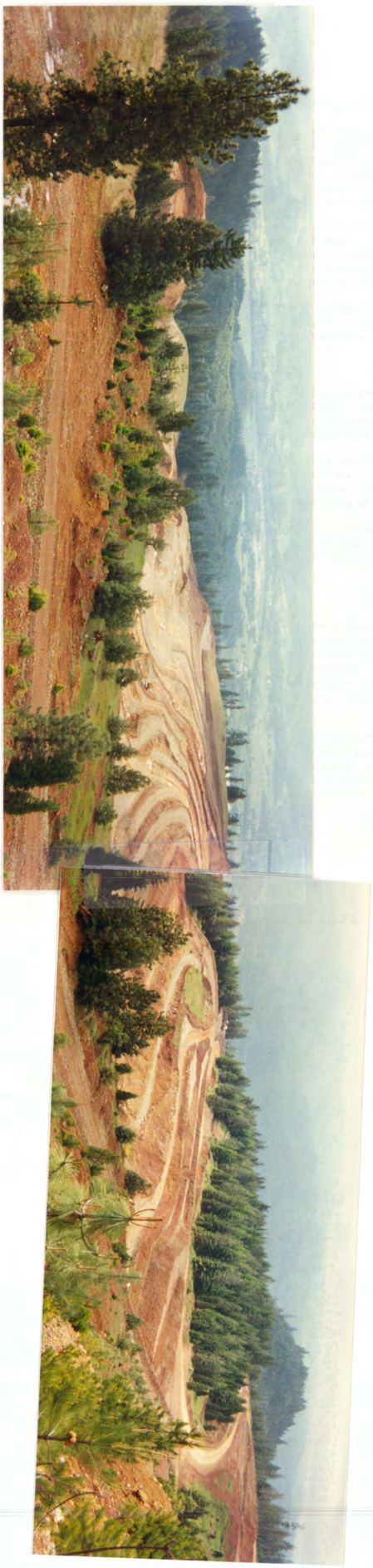
24 5'96

24
24 5'96

24 5'96

24 5'96

24 5'96



10-0026
Glenbrook N.
May 24, 1996
by: A. Throop

10-0026 Glenbrook
May 24, 1996 A. Throop

Doe E(?) pond P Wampler E Hanson-BLM

N. Slope orebody. Sloped areas resloped last year.

Planted trees.

Top of Tram

unvegetated pit area

picnic at tram loading area

10-0026
Glen Brook Mine
3/20/96
A. Throop

Planted trees

" "

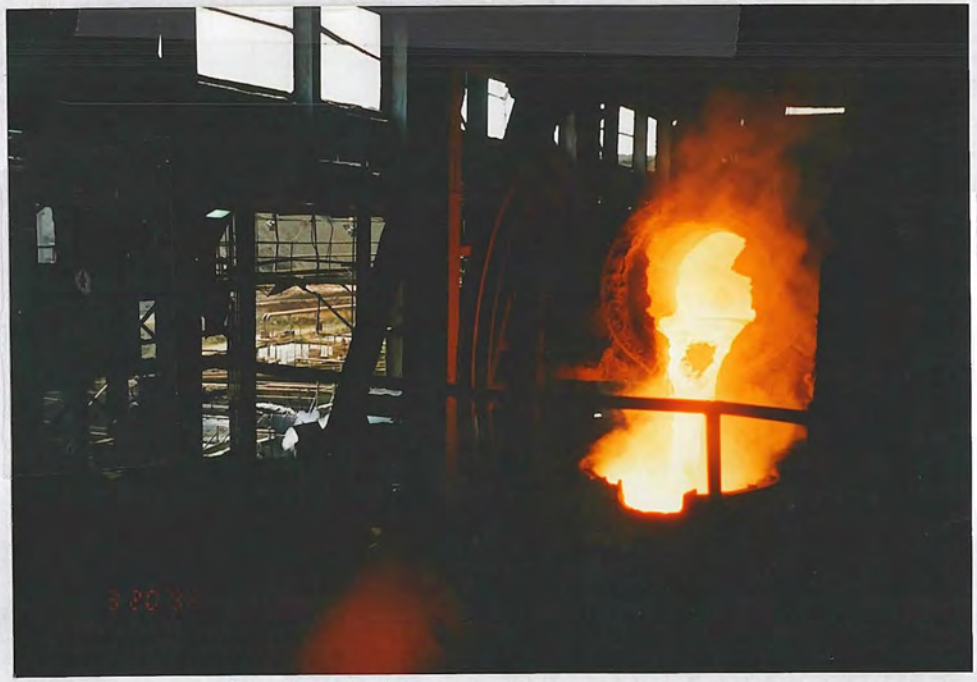
" "

in road berm

In thickener

" on waste dump

lower quarry area.



3 20 '98

3 20 '98

10-0026
Glenbrook
1/8/96
A. Throop

Pond outflow
w/ark Hooven

outflow & Doug fir

- Greg Schoen

Filled in ditch

filled in ditch

mine are wripped & seeded

P. Pine

Erosion scar

Pond overview

Pond
overview

Or Ash cutting

willow cutting

Oregon Dept. Of Geology & Mineral Industries
Mined Land Reclamation
1536 Queen Avenue SE
Albany OR 97321

OPERATING PERMIT

ISSUED SUBJECT TO ANY LISTED CONDITIONS

Glenbrook Nickel Company
PO Box 85
Riddle OR 97469

ID No.: 10-0026
County: Douglas
Site: Nickel Mountain
Section: 16,17
Township: 30
Range: 6W

This permit shall be in effect, unless revoked or suspended for cause, from the date of issuance and shall remain in effect so long thereafter as the Permittee pays the annual fee to renew the permit, complies with the provisions of ORS 517.750 through 517.955 as applicable, the Rules as promulgated to administer the Oregon Mined Land Reclamation Act, the approved reclamation plan, and any conditions attached to this permit, and maintains a performance bond as required by the Act.

Issued this 18 day of April, 1995.

Gary W. Lynch
Supervisor

See Page Two for Conditions

Issuance of this permit is not a finding of compliance with state-wide planning goals or the acknowledged comprehensive plan. The applicant must receive land-use approval from local government before using this permit.

NOTE: Reclamation plans may be modified per ORS 517.830(4) and OAR 632-(30) and (35)-035.

RENEWAL IS REQUIRED BY MARCH 31, 1996

c: Douglas County
DEQ - Roseburg

CONDITIONS:

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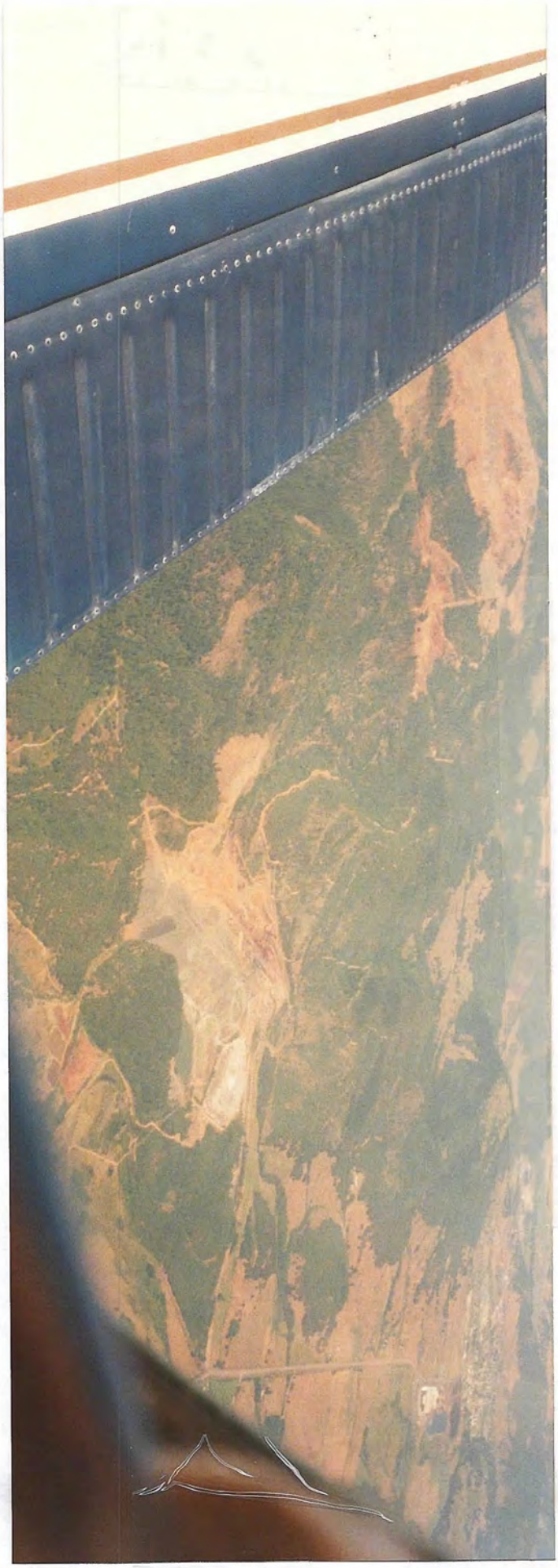
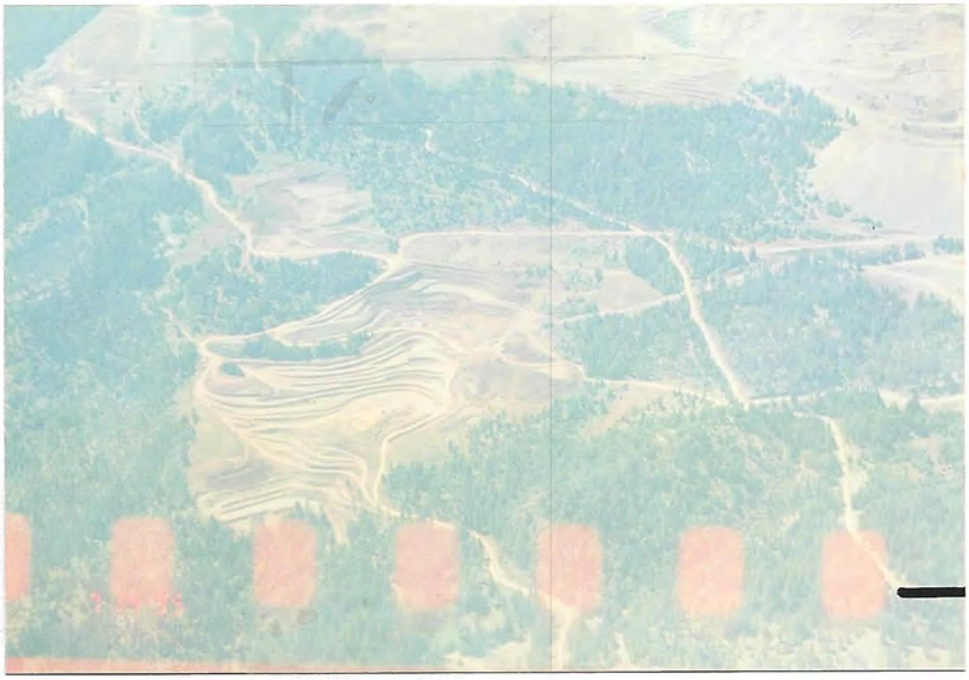
3. seed and mulch outslopes of new haul roads.

4. restore new haul roads to pre-mine condition upon completion of mining.

5. reclaim all exploration work to the standards contained in OAR 632.33.

10-0026
Glenbrook Wetland
7/14/95
by: D. Gellar





10-0026
Glenbrook N.
7/14/95

by:
A. Throop

lower
orebody

smelter
area

overall -
west end

State of Oregon
Department of Geology and Mineral Industries

1536 QUEEN AVE. SE
ALBANY, OREGON 97321
PHONE (503) 967-2039

REPORT OF ON-SITE INSPECTION

Glenbrook Nickel Co. PO Box 85 Riddle OR 97469	ID No: 10-0026 Nickel Mountain. Section 16,17, Township 30, Range 6W Douglas County

Interim Reclaimed Acres 0
Concurrent Reclaimed Acres 0

DATE OF INSPECTION: February 15, 1995

This inspection was conducted to review the status and reclamation of the Thompson Creek settling pond and to review future mining plans. Glenbrook will submit a plan calling for a greatly reduced sized pond as well as stabilization of the road leading to the pond and other work in that area for review and approval by the agencies. Glenbrook will also submit 1) an updated map to DOGAMI showing the permit boundary, the areas affected by mining before and after the grandfather dates (1972 and 1981, as appropriate) on their various parcels and 2) a written description of the grasses planted and the planting rate used for revegetation.

The following people were involved in this inspection:

From the Bureau of Land Management, Ted Weasma, Eric Heenen, and Dennis Hutchinson; from the Oregon Department of Fish and Wildlife, Marnie Allbrittain; and from Glenbrook Nickel, Brian Ballou.

Thompson Creek Pond

Final reclamation of this pond depends upon two items. DEQ must modify the NPDES permit to exclude maintenance of this settling pond. BLM, as landowner, must approve the second beneficial use of the site.

The current reclamation plan calls for obliteration of the pond and returning it to forest uses. An alternative to that discussed and favored by all parties at the meeting was greatly reducing the size of the pond and converting it from a permanent settling pond requiring moderate to high continuing maintenance to a permanent but much smaller pond requiring little or no maintenance. The formal proposal will be submitted by Glenbrook, and if approved by the BLM, work would begin this summer.

c: Douglas County Planning Department
DEQ - Roseburg
ODFW - Roseburg

ODFW - Roseburg
this time only.

- DM
3/2/95

Inspected by Allen H. Throop

Reclamationist
Mined Land Reclamation

Along with the reclamation of the pond itself, the drainage structures and erosion along the access road to the pond will be addressed. Work will include obliteration of some of the ditches, installing rolling ditches in the access road, cutting down the width of the access road, hydro-mulching some cutbanks, reshaping and replanting in the old Thompson Creek ore body area and tree, brush, and grass planting.

Lower Ore Body

Glenbrook is gearing up now to recommence active mining of the lower ore body. Mining will be concentrated in the lower ore body exclusively at this time.

The grass and trees planted on the site 18 months ago continue to do well. A written statement of the grass species planted and the planting rate must be submitted. The shift to native species seems to be paying off with much greater success rate. Documentation of what is being planted is needed. The one reclaimed area on the lower ore body will be smoothed out a little bit to make it look like a more natural slope; this item was previously addressed in an August 6, 1993, inspection report.

Brian and I discussed the possibility of leaving a pond around a spring which is now in the middle of the lower ore body. The concept is acceptable to the department. Given the good water quality expected in that spring, reclamation offers a good chance to create a pond with some fishery and wildlife value. State regulations require sloping of the pond banks at 3:1 or flatter down to normal low water level. In addition, numerous techniques can be employed to enhance the fishery habitat and wildlife utilization of the pond. An amendment to the reclamation plan must be submitted to address leaving a pond in this area.

Site Map

We have discussed in the past the need for an updated site map which would show the following items:

1. Permit boundary.

2. Areas grandfathered under the 1972 general grandfather date.

3. The areas grandfathered with a 1981 grandfather date for valid contract sites.

4. Expansion areas outside of the grandfathered areas which were done by Hanna Mining and not considered part of the Glenbrook disturbance.

5. Areas for which Glenbrook is responsible for reclamation.

The map(s) and seeding mix must be submitted by April 1, 1995.

Revegetation

edge of dump to be rounded off

10-0026
Feb 15 95
Glenbrook Nickel
by: A. M. Throop

Tree growth on outslope.

State of Oregon
Department of Geology and Mineral Industries

1536 QUEEN AVE. SE
ALBANY, OREGON 97321
PHONE (503) 967-2039

REPORT OF ON-SITE INSPECTION

Glenbrook Nickel Co. PO Box 85 Riddle OR 97469	ID No: 10-0026 Nickel Mountain Section 30, Township 30, Range 6W Douglas County

Interim Reclaimed Acres: 1
Concurrent Reclaimed Acres: 5

DATE OF INSPECTION: April 13, 1994

I was accompanied on this routine inspection by Brian Ballou from Glenbrook, and Ben Mundie from DOGAMI. (Note: This inspection report was not finalized until March 1995.)

Clover and a wheatgrass are doing well on the topsoil stockpile uphill from the lower orebody. A few blackberries have volunteered.

About five acres of reclaimed land were seeded last fall; grass is starting on that area southwest of the lower orebody. Despite predictions by DOGAMI to the contrary, rilling has not been a problem on the smoothly reshaped slopes. About 500 trees (some of which are nursery stock, some of which were transplanted from elsewhere on the site) were also planted in this area.

Some wild flowers are growing on the reclaimed area. They may be a result of the wild flower seed mix applied by Glenbrook.

On the topsoil stockpile on the southeast side of the lower ore body, a couple of kinds of grass, including a wheatgrass, are now doing very well. There is also star thistle and another thistle on the slopes. Since this material will be moved when the topsoil is needed for reclamation, the one-acre stockpile will be counted as interim rather than concurrent reclamation.

c: Douglas County Planning Department
DEQ - Roseburg

Inspected by Allen H. Throop

Signature

Title Reclamationist
Mined Land Reclamation

AHT/cc:03/03/95, 10-00260494.ir

OREGON DEPT. OF GEOLOGY & MINERAL INDUSTRIES
MINED LAND RECLAMATION

OPERATING PERMIT

ISSUED SUBJECT TO ANY CONDITIONS LISTED BELOW

Glenbrook Nickel Co.
PO Box 85
Riddle OR 97469

ID No.: 10-0026
Site : Nickel Mtn.
Legal : SW,T30S,R6W
County: Douglas

This permit shall be in effect, unless revoked or suspended for cause, from the date of issuance and shall remain in effect so long thereafter as the Permittee pays the annual fee to renew the permit, complies with the provisions of ORS 517.750 through 517.955 as applicable, the Rules as promulgated to administer the Oregon Mined Land Reclamation Act, the approved reclamation plan, and any conditions attached to this permit and maintains a performance bond as required by the Act.

Issued this 12 day of April, 1994.

Gary W. Lynch
Supervisor

CONDITIONS

Conditions may be appealed per OAR 632-30-030. If an appeal is made, this permit is invalid until the condition(s) appealed is/are resolved and the permit reissued.

See Page 2 for Conditions

c: Douglas County Planning Department
DEQ - Roseburg

Issuance of this permit is not a finding of compliance with state-wide planning goals or the acknowledged comprehensive plan. The applicant must receive land-use approval from local government before using this permit.

NOTE: Reclamation plans may be modified per ORS 517.830(4) and OAR 632-(30) and (35)-035.

RENEWAL IS REQUIRED BY March 31, 1995

Conditions

1. All topsoil stockpiles constructed between October 31 and April 1 will be mulched as soon as constructed.

2. Rock-lined drainages shall be reconstructed with a similar gradient and width to the pre-mine condition.

3. Outslopes of new haul roads shall be seeded and mulched.

4. New haul roads shall be restored to pre-mine condition upon completion of mining.

5. All exploration work shall be reclaimed to the standards contained in OAR 632.33.

State of Oregon
Department of Geology and Mineral Industries

1536 QUEEN AVE. SE
ALBANY, OREGON 97321
PHONE (503) 967-2039

REPORT OF ON-SITE INSPECTION

Glenbrook Nickel Co. PO Box 85 Riddle OR 97469	ID No: 10-0026 Nickel Mtn. Section 16,17, Twp 30S, Range 6W Douglas County

DATE OF INSPECTION: January 12, 1994

I was accompanied on this very short visit by Brian Ballou from Glenbrook, Dave Norman from Washington Dept. of Natural Resources, and Bruce Schuld from Idaho DEQ.

The site was inactive at the time of my visit. There have been no significant changes since the previous inspection.

Grass has just started to germinate on the area of the lower ore body that was seeded this fall.

A more detailed inspection of this site is needed. A review of the success of the tree planting done by Hanna and other revegetation efforts should be done at that inspection.

c: Douglas County Planning Department
DEQ - Roseburg

Inspected by Allen H. Throop

Signature

Title Reclamationist
Mined Land Reclamation

AHT/cc:01/20/94, 10-00260194.ir

State of Oregon
Department of Geology and Mineral Industries

1536 QUEEN AVE. SE
ALBANY, OREGON 97321
PHONE (503) 967-2039

REPORT OF ON-SITE INSPECTION

Glenbrook Nickel Co. PO Box 85 Riddle OR 97469	ID No: 10-0026 Nickel Mtn. S16,17,T30S,R6W Douglas County

DATE OF INSPECTION: August 6, 1993

I was accompanied on this routine inspection by Brian Ballou. Excellent progress has been made over the last year to begin interim reclamation on the site. Glenbrook should be considered for an Operator of the Year Award.

The small topsoil stockpile along a haul road on the north or uphill side of the lower ore body has revegetated much better than last year. A good growth of clover and rye grass, plus a fescue and one other grass has established. A number of different wildflowers have volunteered in that area, including coneflowers (Rudbeckia). Canada thistles, and some blackberries are also growing on the outslope.

On the west ore body, mining has continued as previously described. The low grade stockpile has been removed. Backfilling has continued, such that there is very little area which is not now free draining, i.e. no ponds or depressions are left. In another 6 months of active mining, the west ore body should be worked out. The trees buried on the outslope remain, and need to be cleaned up.

Mining has also continued on the lower ore body as previously outlined. Along the west side of the lower ore body, about 3 acres have been well resloped and topsoiled. The final slope angle is acceptable. A few suggestions should make the work look better: final blading was too smooth, erosion will occur here. Tracking with the blade raised on the bulldozer would improve water retention on the slope. A few ditches, almost on contour, across the face of this slope would break up the flow of water as it flows down the surface. These will prevent the formation of rills across the face of the dump. The transition from the top of the sloped area to the existing outslope should be rounded off; this could easily be done with a backhoe. A backhoe will also be necessary to pull back the trees that

c: Douglas County Planning Department
DEQ - Roseburg

Inspected by Allen H. Throop

Signature

Title Reclamationist
Mined Land Reclamation

AHT/cc:9-15-93

were knocked over during operations as mentioned in earlier reports. Those downed trees are now within reach of a backhoe. Any wood waste such as the downed trees should be spread back over the reclaimed area to add cover, erosion control, and organic matter to the reclaimed areas. This area will be reseeded this fall.

The large topsoil stockpile on the east side of the lower ore body now has a bench cut in it 2/3 of the way down from the top. The stockpile was seeded heavily last fall. In the heavy rain of last winter, there was a little bit of settling, but no serious erosion from that pile. On parts of the dump outslope, rye grass is doing extremely well. Towards the top there is less grass, but more star thistle and Canada thistle. There are also a few wildflowers, some of which were planted by the permittees. The stockpile is serving as a very good test plot to determine what species will grow in the lateritic soils. This pile will eventually be respread.

In the 2940 bench area, road construction has continued. Topsoil is now being stripped and stored on waste dumps to the east of the extraction area. Trees on the eastern end of that dump, planted by Hanna, are doing well.

Waste rock with a large amount of rebar in it has been dumped at the wet screening plant site recently. The waste rock has covered some area that had been revegetated. The rebar will be buried or removed, and the area replanted.

Most of the trees within and around the edge of the large thickener near the wet screening plant continue to do well.

Many of the trees planted by Hanna are now starting to do well after a 5 or 6 years of very slow progress. A future visit is planned to compare growth in different areas in detail.

The recent seedings used the following mix:

18% tall wheatgrass
10% creeping red fescue
19% sheep fescue
50% highland bent grass
1% blend of northwest wildflower

When the annual update of mined areas is submitted, the computer generated maps will include an outline of those areas exempt from reclamation since they were effected by mining prior to 1972 or 1981 as appropriate for the individual areas. Before the maps are submitted, this department should be consulted. Assuming that our computer capabilities have been upgraded by then, submitting data on a floppy disk as opposed to a large map would be acceptable.

Details of the erosion stabilization at the north slope are still being worked out with the BLM. Apparently a resolution of the work remaining is near.

OREGON DEPT. OF GEOLOGY & MINERAL INDUSTRIES
MINED LAND RECLAMATION

OPERATING PERMIT

ISSUED SUBJECT TO ANY CONDITIONS LISTED BELOW

Glenbrook Nickel Co.
PO Box 85
Riddle OR 97469

ID No.: 10-0026
Site : Nickel Mtn.
Legal : SW,T30S,R6W
County: Douglas

This permit shall be in effect, unless revoked or suspended for cause, from the date of issuance and shall remain in effect so long thereafter as the Permittee pays the annual fee to renew the permit, complies with the provisions of ORS 517.750 through 517.955 as applicable, the Rules as promulgated to administer the Oregon Mined Land Reclamation Act, the approved reclamation plan, and any conditions attached to this permit, and maintains a performance bond as required by the Act.

Issued this 16 day of March, 1993.

Gary W. Lynch
Supervisor

CONDITIONS

See Page 2 for Conditions

c: Douglas County Planning Department
DEQ - Roseburg

Issuance of this permit is not a finding of compliance with state-wide planning goals or the acknowledged comprehensive plan. The applicant must receive land-use approval from local government before using this permit.

NOTE: Reclamation plans may be modified per ORS 517.830(4) and OAR 632-(30) and (35)-035. Conditions of this permit are considered to be acceptable to the permittee unless written notice is received prior to the beginning of surface mining. This permit is invalid and will be reissued when the conditions in question have been resolved. A provisional operating permit may be issued per ORS 517.830(3) subject to the provisions of OAR 632-30-030(2) pending reissue of the operating permit.

THIS PERMIT EXPIRES March 31, 1994

Conditions

1. All topsoil stockpiles constructed between October 31 and April 1 will be mulched as soon as constructed.

2. Rock-lined drainages shall be reconstructed with a similar gradient and width to the pre-mine condition.

3. Outslopes of new haul roads shall be seeded and mulched.

4. New haul roads shall be restored to pre-mine condition upon completion of mining.

5. All exploration work shall be reclaimed to the standards contained in OAR 632.33.

State of Oregon
Department of Geology and Mineral Industries

1536 QUEEN AVE. SE
ALBANY, OREGON 97321
PHONE (503) 967-2039

REPORT OF ON-SITE INSPECTION

Glenbrook Nickel Company
PO Box 85
Riddle OR 97469

ID No: 10-0026
Nickel Mountain
SW, T30S, R6W
Douglas County

DATE OF INSPECTION: October 1, 1992, revised October 20, 1992

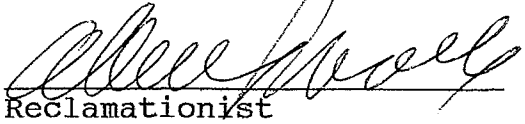
I was accompanied by Brian Ballou from Glenbrook and Dawn Marshall from the Department of Geology on this routine inspection. A revised reclamation plan is to be submitted for this site by January 1, 1993.

The site was active at the time of this inspection. Nickel ore is being mined from a number of places. A far more serious effort at reclamation is being made by Glenbrook than was done by the previous operators. An effort is still being made to clearly define what areas are exempt from reclamation on this site since they were affected by mining prior to 1972 or 1981, depending on their status; which areas were the responsibility of Hanna Mining Company, and which areas were affected by and will be reclaimed by Glenbrook. Previous deadlines have been set and not met by Glenbrook. However, we reviewed the progress that they are making in computerizing available information into a GIS system. The delays in submitting a final product should be more than offset by the quality of the product when it is finally produced.

Mining is now concentrated in, but not limited to, the lower orebody of which the west pit is a part.

c: Douglas County Planning Department
DEQ - Roseburg
BLM - Roseburg
SCS - Roseburg

Inspected by Allen H. Throop

Signature 

Title Reclamationist
Mined Land Reclamation

AHT/cc:12-2-92

Lower Orebody

A large stockpile of overburden has been built on the east side of this area. The side slopes are at the angle of repose and the pile is perhaps 50' high on the outer edge. This is much larger and steeper than topsoil piles are normally built but was done due to lack of suitable alternative level ground. The outslopes need to be seeded soon to prevent excessive erosion. Furthermore, a toe trench should be constructed around the base of the pile to retain eroded material next to the pile.

A smaller topsoil stockpile was constructed along a haul road on the north (uphill) side of the lower orebody and seeded. The top of the pile had obviously been compacted by vehicles running over it. The top of that pile was covered with volunteer annuals (wild lettuce?) plus a few unidentified grasses which had been heavily grazed by deer. Blackberries had also volunteered although planted blackberries failed to survive when planted near here a few years ago. The south slope of that pile does have ryegrass and some clover growing on it. Presumably the slopes were more amenable to the seeded species because they had not been compacted and were left rough and therefore could collect moisture.

Topsoil stripping in the main portion of the lower orebody is now essentially complete as I understand it. The trees that were removed have been stockpiled around the perimeter of the excavation. Rather than burning them, DOGAMI recommends that they be spread back over the mined area after it is reshaped, retopsoiled, and seeded. This procedure will help to retard wind and water erosion, add organic matter to the soils, and offer some habitat for small mammals and rodents.

On the east side of the lower orebody, below the topsoil stockpile, an intermittent stream has been diverted. Upon completion of mining the streambed must be returned to the approximate area where it originally flowed in a rock lined channel that approximates the size and gradient of the original streambed.

The west pit was inactive but one bench has been removed in the last year. This area may be backfilled with screen rejects from other parts of the mine. Once backfilled, the salvaged topsoil in the area will be respread. Pines planted in this area on topsoil are doing well.

Near what I believe is called the 2940 area, some mining has taken place in previously unmined areas. Jeffrey Pine were knocked over and then buried by overburden. This practice, identified earlier in the lower orebody, must be stopped. Vegetation is to be removed before topsoil and overburden removal and road building begins.

Near the site of Hanna's wet screening plant, we examined some of the Jeffrey pine planted during reclamation. Only a few are doing well; those that have are in sheltered north-facing depressions.

Plans to collect pine cones from the site for eventual use in reclamation were unsuccessful since the pines in the area did not set any cones this year. This was apparently true throughout the region presumably due to the very dry year.

Close cooperation with Jim Vancura of the SCS to develop an appropriate revegetation plan is strongly encouraged. The soils here are unusual and the success of commercial species has been limited. What success that has been reached has been done only after adequate topsoil has been respread. Although topsoil was generally lacking on the top of Nickel Mountain, Glenbrook has done an excellent job of topsoil salvage in the areas that they have moved onto. Work with native plant seed collection and replanting, while expensive in the short run, will probably be far more effective in the long run.

We did not look at the erosion control work being done by Glenbrook on the North Slope area under the direction of the BLM. Glenbrook is to submit a copy of the plan of work when that is agreed to.

10-0026
Glenbrook
oct 1, 92
by: A. Thrasher

Darron Marshall & Brian Bellow looking at Nickel - a 1st days production.

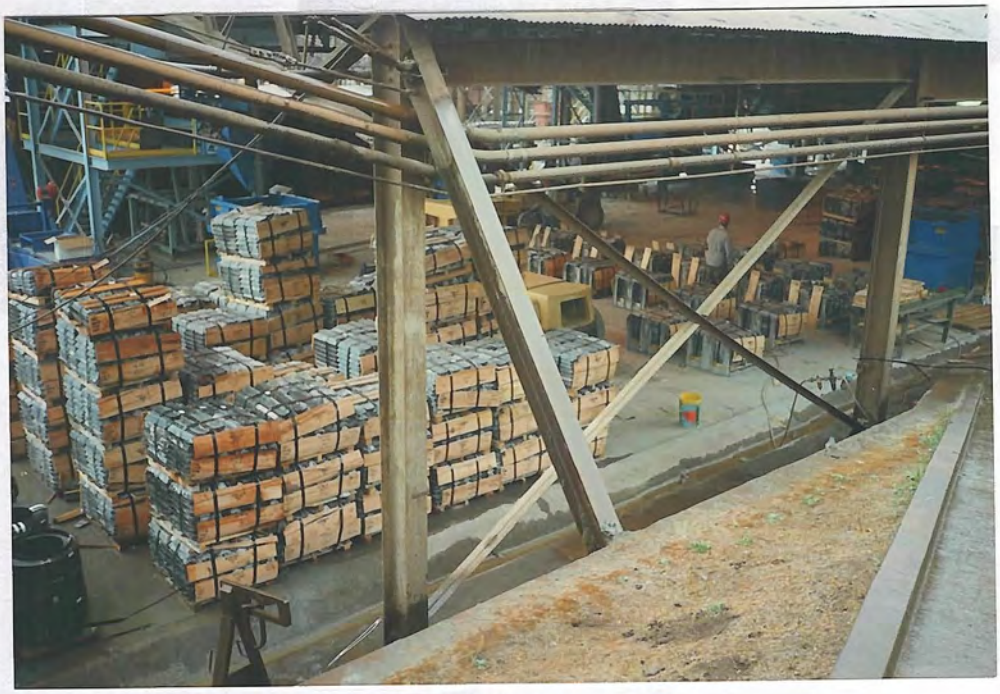
_ Smelter

_ Smelter

Ni ingots

topsoil stockpile

Tower orebody



Ni ingots

Current mining area

Dawn @ wet screening plant area-

OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
MINED LAND RECLAMATION OPERATING PERMIT
1534 Queen Avenue Southeast
Albany, Oregon 97321
(503) 967-2039

ID No. 10-0026
Site: Nickel Mountain
Legal: SW,T30S,R6W
County: Douglas
Fee Paid: $425
Renewal Month: March, 1993

Glenbrook Nickel Company
PO Box 85
Riddle, OR 97469

Issuance of this permit is not a finding of compliance with statewide planning goals or the acknowledged comprehensive plan. The applicant must receive land use approval from local government before using this permit.

ISSUED SUBJECT TO ANY CONDITIONS LISTED BELOW

This permit shall be in effect, unless revoked or suspended for cause, from the date of issuance and shall remain in effect so long thereafter as the Permittee pays the annual fee to renew the permit, complies with:

the provisions of ORS 517.750 through 517.955 as applicable, the Rules as promulgated to administer the Oregon Mined Land Reclamation Act, the approved reclamation plan, and any conditions attached to this permit, and maintains a performance bond as required by the Act.

Issued this 31st day of March, 1992.

E. Frank Schnitzer
Reclamationist
Mined Land Reclamation

CONDITIONS:

1. All topsoil stockpiles constructed between October 31 and April 1 will be mulched as soon as constructed.
2. Rock-lined drainages shall be reconstructed with a similar gradient and width to the pre-mine condition.
3. Outslopes of new haul roads shall be seeded and mulched.
4. New haul roads shall be restored to pre-mine condition upon completion of mining.
5. All exploration work shall be reclaimed to the standards contained in OAR 632.33.

c: Douglas County Planning Department
DEQ - Roseburg

NOTE: RECLAMATION PLANS MAY BE MODIFIED AS PROVIDED BY ORS 517.830(4) AND OAR 632-(30) (35)-035.

The conditions of this permit are considered to be acceptable to the permittee unless written notice is received prior to the beginning of surface mining under this permit. Upon receipt of such notice by the Department, this permit is invalid and will be reissued when the conditions in question have been solved.

A provisional operating permit may be issued (ORS 517.830(3)) to operators subject to the provisions of OAR 632-30-030 (2) pending reissue of the operating permit.

Department of Geology and Mineral Industries

1534 QUEEN AVE. SE, ALBANY, OREGON 97321 PHONE (503) 967-2039

REPORT OF ON-SITE INSPECTION

Glenbrook Nickel Company
PO Box 85
Riddle, OR 97469

ID No. 10-0026

SW,S17,T30S,R6W
Nickel Mountain
Douglas County

DATE OF INSPECTION: December 19, 1991

I was accompanied on this routine inspection by Brian Ballou from Glenbrook. The site is in compliance with the Operating Permit. A new map of the permit area and details on the planned development of this site are required.

The site was active at the time of this visit. Most recent mining of the activity has been concentrated on the lower ore body as outlined in my previous report. According to the present production schedule, the lower ore body will be mined out next summer and reclamation of that area can then begin.

Glenbrook has now computerized their mine information for this site. This will be helpful to clear up confusion as to how large the Glenbrook operation is, on what areas they are responsible for reclamation, and the amount of land subject to reclamation at any given time.

By April 30, new maps and cross sections showing the following items are needed:

1. The permit boundary, i.e., the area to be covered by mining and exploration on this site.

cc: Douglas County Planning Dept.
DEQ - Roseburg
BLM - Roseburg
SCS - Roseburg

Inspected by Allen H. Throop

Signature _____

Title Reclamationist

AHT/dm:03/18/92

MINED LAND RECLAMATION

2. The areas mined prior to 1972 or 1981, as appropriate, and therefore exempt from the state reclamation requirements. This information is shown on maps dated April 25, 1985, and March 17, 1987, from Hanna Nickel, are the best I am aware of showing the areas affected by Hanna. They were sent to Glenbrook on January 10, 1992, and are to be returned after copying. Any re-mining of areas affected by Hanna prior to 1981 on leased land or prior to 1972 on land owned or under claim by Hanna, remain exempt from the reclamation requirements. All lands mined after those dates are subject to reclamation.

   Care is needed to document areas not previously mined, areas reclaimed by Hanna and re-mined, and areas reaffected but exempt from the state requirement. The DOGAMI maps must be returned once the information has been transferred.

3. The total acreage affected or to be affected since Glenbrook started mining through March 1993.

4. A longer-term projection showing the areas to be mined within the next five years in sufficient detail to show what the maximum unreclaimed area is.

Reclamation will follow close upon completion of mining under Glenbrook's mining plan. Once operations are fully developed, the amount of new land opened should roughly balance the amount of land reclaimed. Therefore, the amount of ground affected should remain relatively constant. The plans mentioned above should be in sufficient detail to show what the acreage generally unreclaimed is.

Cross sections must be included of mined areas and dump areas showing the pre-mine topography and post-mine topography. The methods used to insure stable slopes is needed. The past practice of very-high end-dump waste dumps built out over steep slopes will not be permitted.

The dumps have been seeded with a local grass mixture. Since that seeding, the results of a Soil Conservation Service survey have been made available. From that, sheep fescue, blue wildrye, tall oatgrass, and Kentucky bluegrass are recommended for future plantings at SCS's recommended rates. Wedgeleaf ceanothus and Jeffery pine are the recommended shrub and tree species respectively.

Glenbrook has a large pile of hog fuel (bark and other sawmill waste) available for mulch. After verifying via standard soil analysis that the composition of the hog fuel is acceptable, the material will be used to cover dumps and reclaimed slopes to minimize erosion. If indicated by the soil tests, nitrogen fertilizer will be added to the mulch.

AHT:dm:03/18/92

Finally, rock is being hauled from a waste rock pile located near the base of the tramline. The material was produced from processing near one smelter. Since the smelter and associated waste dumps have always been considered an industrial facility rather than part of the mining operation, the reject from such an industrial process would not fall under DOGAMI jurisdiction. Therefore, the dump may be mined without a permit from this department.

Glenbrook has been working with the BLM and Water Resources Department to address soil erosion, impoundment structure stability, wetland, and other isuses. We concur with those recommendations.

AHT:dm:03/18/92

lower orebody from east

10-0026
Glenbrook
19 Dec 91
by: A. Throop

lower Ore body from
old settling pond

OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
MINED LAND RECLAMATION OPERATING PERMIT

ID No. 10-0026
Site: Nickel Mountain
Legal: SW,S17,T30S,R6W
County: Douglas
Fee Paid: $415
Renewal Month: March, 1992

Glenbrook Nickel Company
P o Box 85
Riddle, OR 97469

Issuance of this permit is not a finding of compliance with statewide planning goals or the acknowledged comprehensive plan. The applicant must receive land use approval from local government before using this permit.

ISSUED SUBJECT TO ANY CONDITIONS LISTED BELOW

This permit shall be in effect, unless revoked or suspended for cause, from the date of issuance and shall remain in effect so long thereafter as the Permittee pays the annual fee to renew the permit, complies with:

the provisions of ORS 517.750 through 517.955 as applicable,
the Rules as promulgated to adminster the Oregon Mined Land Reclamation Act,
the approved reclamation plan, and
any conditions attached to this permit, and
maintains a performance bond as required by the Act.

Issued this 29th day of April, 1991.

Gary W. Lynch, Supervisor
Mined Land Reclamation

CONDITIONS:

1. All topsoil stockpiles constructed between October 31 and April 1 will be mulched as soon as constructed.

2. Rock lined drainages shall be reconstructed with a similar gradient and width to the pre-mine condition.

3. Outslopes of new haul roads shall be seeded and mulched.

4. New haul roads shall be restored to pre-mine condition upon completion of mining.

5. All exploration work shall be reclaimed to the standards contained in OAR 632.33.

cc:
Co-Douglas
DEQ-Roseburg

NOTE: RECLAMATION PLANS MAY BE MODIFIED AS PROVIDED BY ORS 517.830(4) AND OAR 632-(30) (35)-035.

The conditions of this permit are considered to be acceptable to the permittee unless written notice is received pr to the beginning of surface mining under this permit. Upon receipt of such notice by the Department, this permit is inval and will be reissued when the conditions in question have been solved.

A provisional operating permit may be issued (ORS 517.830(3)) to operators subject to the provisions of OAR 632-30-((2) pending reissue of the operating permit.

SMLR-5 (rev. 3/91)

NEIL GOLDSCHMIDT
GOVERNOR

Department of Geology and Mineral Industries

1534 QUEEN AVE. SE, ALBANY, OREGON 97321 PHONE (503) 967-2039

REPORT OF ON-SITE INSPECTION

Glenbrook Nickel Company
P O Box 85
Riddle, OR 97469

ID No. 10-0026

SW,S17,T30S,R6W
Nickel Mountain
Douglas County

DATE OF INSPECTION: June 13, 1991

This inspection was conducted to help start a reclamation and revegetation study to be used in reclamation of the expansion area going on this site. I was accompanied on this inspection by Brian Ballou from Glenbrook; Jim Vancura and Gene Hickman from the Soil Conservation Service. An updated mine plan showing the areas affected in the last year, the location of the topsoil stockpiles, the amount of material stockpiled, the areas to be mined within the next 12 months, plus the reclamation to be done in the affected area, is needed by **August 31, 1991.**

The site was active at the time of our visit. The main mining site was the lower ore body. Expansion around the old settling ponds is continuing as outlined. Some topsoil has been stockpiled north of the lower ore body along an old haul road. Other soil material has been pushed to the side and not yet moved to the stockpile site.

A major concern on this site is runoff if the mining is not finished and reclamation completed on this site before fall rains. There is a stream running through the area to be mined. This must be placed back in a channel approximating the original one. It must be lined with rocks to prevent any erosion and approximate the stream width and gradient of the pre-mine situation. A good map of that stream drainage is needed before mining in that area commences. The water from this site eventually flows into the Rail Creek settling pond and is not discharged from the property. The water comes from a spring within an area extensively mined by Hanna.

Another concern is the construction of a haul road access to this site. It was constructed without proper clearing of the conifers. In future, all areas in which fill materials are placed, must be stripped of trees PRIOR to building those outslopes.

Inspected by Allen H. Throop

Signature Allen H. Throop

Title Reclamationist

rr:August 7, 1991

MINED LAND RECLAMATION

The primary purpose of the visit was to familiarize the Soil Conservation Service (SCS) with the area. Glenbrook and the SCS are going to sign a cooperative agreement. SCS will produce a species list on the affected and unaffected areas and will do some soils mapping in the area and make recommendations for revegetation. Our recommendation is that the seeding should emphasize short-term erosion control followed by long-term establishment of a variety of vegetation on the site.

In the past, the most revegetation success has been found with trees. However, the emphasis today was on looking at grasses which have naturally grown on the area. There is considerable colonization of grasses since mining ceased in the late 80's. A detailed report on this revegetation will come from the SCS.

To avoid any confusion over what areas were not affected by Hanna and which are now being affected by Glenbrook and therefore subject to reclamation, an annual updated map of the mined areas is required. According to Brian, this will be an easy task once all the data is computerized and a new aerial photography is available. An updated map is required by the end of August. If this date is not met, a written time schedule for compliance is needed. Hopefully, from the SCS the recommendations, a seeding mixture for areas reclaimed by this fall will be available. In addition to any areas reclaimed, test seeding should be done on the topsoil stockpiles.

The current bond of $94,000 should be adequate for reclamation of this site. The cooperation of Glenbrook with the SCS with this department is appreciated.

c: Douglas County Planning Department
DEQ - Roseburg

file

OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

MINED LAND RECLAMATION PERMIT

Glenbrook Nickel Company
P O Box 85
Riddle, Oregon 97469

RENEWAL

Location

Nickel Mountain
~~SW~~ 17 30S 6W
Sec. Twp. Rge.

Douglas
County

ISSUANCE OF THIS PERMIT IS NOT A FINDING OF COMPLIANCE WITH STATEWIDE PLANNING GOALS OR THE ACKNOWLEDGED COMPREHENSIVE PLAN. THE APPLICANT MUST RECEIVE LAND USE APPROVAL FROM LOCAL GOVERNMENT BEFORE USING THIS PERMIT.

ISSUED SUBJECT TO ANY CONDITIONS ON THE REVERSE SIDE *

March 1991
Renewal Month

Fee 415.00

10-0026
I.D.#

This permit shall be in effect, unless revoked or suspended for cause, from the date of issuance and shall remain in effect so long thereafter as the Permittee pays the annual fee to renew the permit, complies with:

the provisions of ORS 517.750 through 517.955 as applicable,
the Rules as promulgated to administer the Oregon Mined Land Reclamation Act,
the approved reclamation plan, and
any conditions attached to this permit, and

maintains a performance bond as required by the Act.

Issued this 7th day of January 19 91

STATE DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

By _____, Supervisor
Gary W. Lynch
Mined Land Reclamation

SMLR-5 Rev. 2/85

CONDITIONS:

1. All topsoil stockpiles constructed between October 31 and April 1 will be mulched as soon as constructed.

2. Rock lined drainages shall be reconstructed with a similar gradient and width to the pre-mine condition.

3. Outslopes of new haul roads shall be seeded and mulched.

4. New haul roads shall be restored to pre-mine condition upon completion of mining.

c.c. DEQ - Roseburg

NOTE: RECLAMATION PLANS MAY BE MODIFIED AS PROVIDED BY ORS 517.830(4) AND OAR 632-(30) (35)-035.

The conditions of this permit are considered to be acceptable to the permittee unless written notice is received prior to the beginning of surface mining under this permit. Upon receipt of such notice by the Department, this permit is invalid and will be reissued when the conditions in question have been solved.

A provisional operating permit may be issued (ORS 517.830(3)) to operators subject to the provisions of OAR 632-30-030(2) pending reissue of the operating permit.

NEIL GOLDSCHMIDT
GOVERNOR

Department of Geology and Mineral Industries

1534 QUEEN AVE. SE, ALBANY, OREGON 97321 PHONE (503) 967-2039

file

REPORT OF ON-SITE INSPECTION

Glenbrook Nickel Company
PO Box 85
Riddle, OR 97469

ID No. 10-0026

Nickel Mountain Site
SW,S17,T30S,R6W
Douglas County

DATE OF INSPECTION: November 19, 1990

This inspection was conducted to review a proposed resumption and expansion of mining on Nickel Mountain. A new reclamation plan has been submitted and is being circulated for comment. I was accompanied on this inspection by Tom Krause of Glenbrook Nickel.

Site, Location, Setting, and Pre-Mine Condition

This site is located northwest of the City of Riddle on Nickel Mountain. Extensive mining covering approximately 1,000 acres has occurred on this site since the 1950s. Only 34 acres were subject to reclamation, the rest pre-dates the state's reclamation laws.

The reclaimed areas were planted with Jefferey pine and KMX pine, plus a mixture of Ellett ryegrass, intermediate wheatgrass, slepner brome, and common vetch. Initially, the grasses had poor success. A specific evaluation of those plantings was not done during this visit. However the pine planted on the lower ore body in respread topsoils appeared, for the most part, to be doing very well. Previous observations of pine planted in the laterite subsoils showed very poor growth.

The area of present interest is a southward extension of what is known as the lower orebody. Access to this site is via a private road from Glenbrook's smelter. The general location and specific access are shown on map No. 1.

Mining on Nickel Mountain resumed in the fall of this year. Initial mining was restricted to former low grade ore dumps and cleaning out a number of settling ponds. The major settling pond had regrown with a good cover of unidentified grass and some volunteer pines. Revegetation of this area will be required upon completion of mining.

C: Co DEQ-Rose Co Land Dept BLM-Rose SCS-Rose

Inspected by Allen H. Throop

Signature Allen H Throop

Title Reclamationist
MINED LAND RECLAMATION

AHT:rr 12/04/90

Of particular interest for this report is the planned expansion of approximately ten acres outside of areas mined previously. The location of this expansion is shown on map 2. The area to be mined is a moderately steep south facing hillside with an ephemeral drainage towards the east side of the area. The pre-mine vegetation consists of a moderately thick stand of mixed Jeffery pine, Douglas fir, and incense cedar second growth trees up to 30' high. There is understory of grasses and blackberries.

Topsoil is a red clayey soil varying from one to three foot thick. There is a distinctive break into a yellowish subsoil which is the nickeliferous lateritic material to be mined.

Mining and Reclamation Procedures

The general plan to be followed will start with cutting and removal of major vegetation on this site. Merchantable timber will be cut and removed, the other trees will be decked and burned. Stumps which are relatively small can be incorporated in the stripped topsoil material as long as they are not abundant enough or large enough to preclude spreading back over the site during reclamation. Other woody debris less than three feet long may also be incorporated in the topsoil stockpiles.

An existing topsoil stockpile location is shown on the accompanying map. The topsoil as stripped should be stored nearer to the perimeter of the new disturbance. The cross section shows the pre-mine and post-mine topography. Upon completion of mining, topsoil will be spread back over the affected area. The area will be seeded with grass species to be specified later and planted with local Jeffery pine. Any recommendations about acceptable grass species would be welcome.

The topsoil stockpiles created between October and April must be mulched to prevent erosion.

The reestablished ephemeral drainage must be lined with rock and have no topsoil spread in it.

Other Concerns, Bonding, and Conditions

The site is in a remote location with no residences within at least two miles. The site is barely visible from the Glenbrook county road.

A major concern of off-site environmental effects is the escape of turbid waters generated during winter mining operations. Turbidity will be controlled by the settling pond above the stockpile near the smelter and by the major Rail Creek settling pond below the smelter. This is the same runoff water control system used previously by Hannah Nickel with little problem.

Glenbrook has submitted a bond of $90,000 to cover reclamation of this site. The bond should be more than adequate for the proposed reclamation.

I recommend that the permit be issued with the following conditions:

1. All topsoil stockpiles constructed between October 31 and April 1 will be mulched as soon as constructed.

2. Rock lined drainages shall be reconstructed with a similar gradient and width to the per-mine condition.

3. Outslopes of new haul roads shall be seeded and mulched.

4. New haul roads shall be restored to pre-mine condition upon completion of mining.

AHT:rr 12/04/90

soil sobsoil

mining old settling pond

10-0026
Glenbrook
15 Nov 90
by: A. Thorp

secondary pond
major old settling pond

Area to be mined

Pines growing on old spoil above topsoil.

regrowth on reclaimed area

settled fines

OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
MINED LAND RECLAMATION PERMIT

Glenbrook Nickel Company
P. O. Box 85
Riddle, OR 97469

RENEWAL

Location
Nickel Mountain
SW 17 30S 6W
Sec. Twp. Rge.

Douglas
County

ISSUANCE OF THIS PERMIT IS NOT A FINDING OF COMPLIANCE WITH STATEWIDE PLANNING GOALS OR THE ACKNOWLEDGED COMPREHENSIVE PLAN. THE APPLICANT MUST RECEIVE LAND USE APPROVAL FROM LOCAL GOVERNMENT BEFORE USING THIS PERMIT.

ISSUED SUBJECT TO ANY CONDITIONS ON THE REVERSE SIDE*

March 1991
Renewal Month

Fee $415.00

10-0026
I.D.#

This permit shall be in effect, unless revoked or suspended for cause, from the date of issuance and shall remain in effect so long thereafter as the Permittee pays the annual fee to renew the permit, complies with:

the provisions of ORS 517.750 through 517.955 as applicable,
the Rules as promulgated to administer the Oregon Mined Land Reclamation Act,
the approved reclamation plan, and
any conditions attached to this permit, and

maintains a performance bond as required by the Act.

Issued this 4th day of April 19 90

STATE DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

By Gary W. Lynch, Supervisor
Mined Land Reclamation

SMLR-5 Rev. 2/85

C: Co dog Rose
B Land Dept
BLM-Rose
SCS-Rose

CONDITIONS:

1. A new reclamation plan must be submitted prior to resumption of mining.

NOTE: RECLAMATION PLANS MAY BE MODIFIED AS PROVIDED BY ORS 517.830(4) AND OAR 632-(30) (35)-035.

The conditions of this permit are considered to be acceptable to the permittee unless written notice is received prior to the beginning of surface mining under this permit. Upon receipt of such notice by the Department, this permit is invalid and will be reissued when the conditions in question have been solved.

A provisional operating permit may be issued (ORS 517.830(3)) to operators subject to the provisions of OAR 632-30-030(2) pending reissue of the operating permit.

NEIL GOLDSCHMIDT
GOVERNOR

Department of Geology and Mineral Industries
1534 QUEEN AVE. SE, ALBANY, OREGON 97321 PHONE (503) 967-2039

fill

REPORT OF ON-SITE INSPECTION

Glenbrook Nickel Company
P. O. Box 85
Riddle, OR 97469

I.D. #10-0026

T30S,R6W
Douglas County

DATE OF INSPECTION: March 13, 1990; Revised April 10, 1990

We were accompanied by Tom Krause from Glenbrook Nickel. The purpose of the inspection was to review the success of the tree planting. Another season's growth is needed to confirm the survival rate.

Our first stop was the lower ore body near the dump pocket (mine grid 32N,58E). There we found Jeffrey pine seedlings and KMX hybrid seedlings planted in both topsoil and in crushed rock. These seedlings were planted in 1989. There was very little growth on these seedlings. The Jeffrey pine looked better than the others, however they were yellow in color and appeared lacking in nitrogen. The KMX crosses showed no growth and were generally in a stressed condition. Some of the seedlings which were planted on a right-of-way for a conveyer belt had made some growth, and looked much better than the others. It was hard to determine why trees should be in better condition than those surrounding them. In all cases the better seedlings were growing in the south row of seedlings along the right-of-way.

All the blackberries cutting along the right-of-way are dead. Seedling and grass around the Doe East Pond are doing very well. These were planted in soil materials from a slide which once filled the Doe East Pond. The grass appears to be a mixture of a fescue and a wheatgrass. Whether this is a volunteer, planted as mixed community is unclear. We were told by Hanna Nickel that Ellett ryegrass, intermediate wheatgrass, Slepner brome, and common vetch were planted. Some cedar have volunteered in this area.

CONT. ON PAGE TWO

Inspected by SAMUEL K. DICKINSON

Signature

Title RECLAMATIONIST
MINED LAND RECLAMATION

c: Co
DEQ - Roseburg
County Land Dept
BLM - Roseburg
Soil Cons. - Roseburg

NEIL GOLDSCHMIDT
GOVERNOR

Department of Geology and Mineral Industries
1534 QUEEN AVE. SE, ALBANY, OREGON 97321 PHONE (503) 967-2039

REPORT OF ON-SITE INSPECTION

The fir seedlings planted in the 1975 (approximate 63N, 32E) continue to survive but not grow. Apparently the compaction on the bench floor is just to strong to allow root growth. The seedling planted along the road berms are also surviving but not growing.

The seedlings planted in topsoil in and around the thickener (48N, 80E) are doing very well. Those on the dump outslope east of the crusher near the thickener (55N, 90E) are doing well if in soil material but poorly when in crushed rock.

In general the Jeffrey or Ponderosa Pine that were planted are doing much better than the others. In some cases volunteer seeding of these species looked quite good in the disturbed area. There were also some fir and cedar which had volunteered into the disturbed area. Last year's KMX cross seedlings looked very stressed and were a wine color similar to that of container seedlings that are planted shortly after a short curing period. It was especially prevalent where the seedlings had been planted in crushed rock. Apparently Knobcone and Ponderosa Pines were planted in a few locations. These localities are not specifically documented in the DOGAMI correspondence.

It is suggested that the planting records be checked to determine what species were planted, where they came from and, if possible, what the seed source was. It's possible that the genetics may have something to do with this condition or it may be environmental, meaning either a weather or a site factor. From what we saw today the longer needled Jeffrey or Ponderosa Pine were definitely superior to the others.

CONT. ON PAGE THREE

Inspected by _____

Signature _____

Title _____

MINED LAND RECLAMATION

NEIL GOLDSCHMIDT
GOVERNOR

Department of Geology and Mineral Industries
1534 QUEEN AVE. SE, ALBANY, OREGON 97321 PHONE (503) 967-2039

REPORT OF ON-SITE INSPECTION

If the planting records don't give us answers then a controlled planting should be made with plants of local seed source and planted in soil that had been tested for possible inhibitors and nutrients. If Glenbrook wishes to reactivate the mine, extensive long term revegetation studies will need to be implemented.

Inspected by _____

Signature _____

Title _____

MINED LAND RECLAMATION

OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
MINED LAND RECLAMATION PERMIT

Glenbrook Nickel Company
P. O. Box 85
Riddle, OR 97469

Location

30S 6W
Sec. Twp. Rge.

Douglas
County

ISSUANCE OF THIS PERMIT IS NOT A FINDING OF COMPLIANCE WITH STATEWIDE PLANNING GOALS OR THE ACKNOWLEDGED COMPREHENSIVE PLAN. THE APPLICANT MUST RECEIVE LAND USE APPROVAL FROM LOCAL GOVERNMENT BEFORE USING THIS PERMIT.

ISSUED SUBJECT TO ANY CONDITIONS ON THE REVERSE SIDE*

March 1990
Renewal Month

Fee $385.00

10-0026
I.D.#

This permit shall be in effect, unless revoked or suspended for cause, from the date of issuance and shall remain in effect so long thereafter as the Permittee pays the annual fee to renew the permit, complies with:

the provisions of ORS 517.750 through 517.955 as applicable,
the Rules as promulgated to administer the Oregon Mined Land Reclamation Act,
the approved reclamation plan, and
any conditions attached to this permit, and

maintains a performance bond as required by the Act.

Issued this 25th day of January 19 90

STATE DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

By Gary W. Lynch
Gary W. Lynch

Supervisor
Mined Land Reclamation

SMLR-5 Rev. 2/85

c: co dog-R-burg
co Land Dept
bcm - Rburg
Soil Cons - Rburg

CONDITION:

1. A new reclamation plan must be submitted prior to resumption of mining.

NOTE: RECLAMATION PLANS MAY BE MODIFIED AS PROVIDED BY ORS 517.830(4) AND OAR 632-(30) (35)-035.

The conditions of this permit are considered to be acceptable to the permittee unless written notice is received prior to the beginning of surface mining under this permit. Upon receipt of such notice by the Department, this permit is invalid and will be reissued when the conditions in question have been solved.

A provisional operating permit may be issued (ORS 517.830(3)) to operators subject to the provisions of OAR 632-30-030(2) pending reissue of the operating permit.

OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

MINED LAND RECLAMATION PERMIT

Renewal

Hanna Nickel Smelting Company
1301 E. Ninth Street Suite 3600
Cleveland, Ohio 44114

Location
Nickel Mountain

Sec.	Twp.	Rge.
	30S	6W

Douglas
County

ISSUANCE OF THIS PERMIT IS NOT A FINDING OF COMPLIANCE WITH STATEWIDE PLANNING GOALS OR THE ACKNOWLEDGED COMPREHENSIVE PLAN. THE APPLICANT MUST RECEIVE LAND USE APPROVAL FROM LOCAL GOVERNMENT BEFORE USING THIS PERMIT.

ISSUED SUBJECT TO ANY CONDITIONS ON THE REVERSE SIDE

MARCH 1990
Renewal Month

Fee $385.00

10-0026
I.D.#

This permit shall be in effect, unless revoked or suspended for cause, from the date of issuance and shall remain in effect so long thereafter as the Permittee pays the annual fee to renew the permit, complies with:

the provisions of ORS 517.750 through 517.955 as applicable,
the Rules as promulgated to administer the Oregon Mined Land Reclamation Act,
the approved reclamation plan, and
any conditions attached to this permit, and

maintains a performance bond as required by the Act.

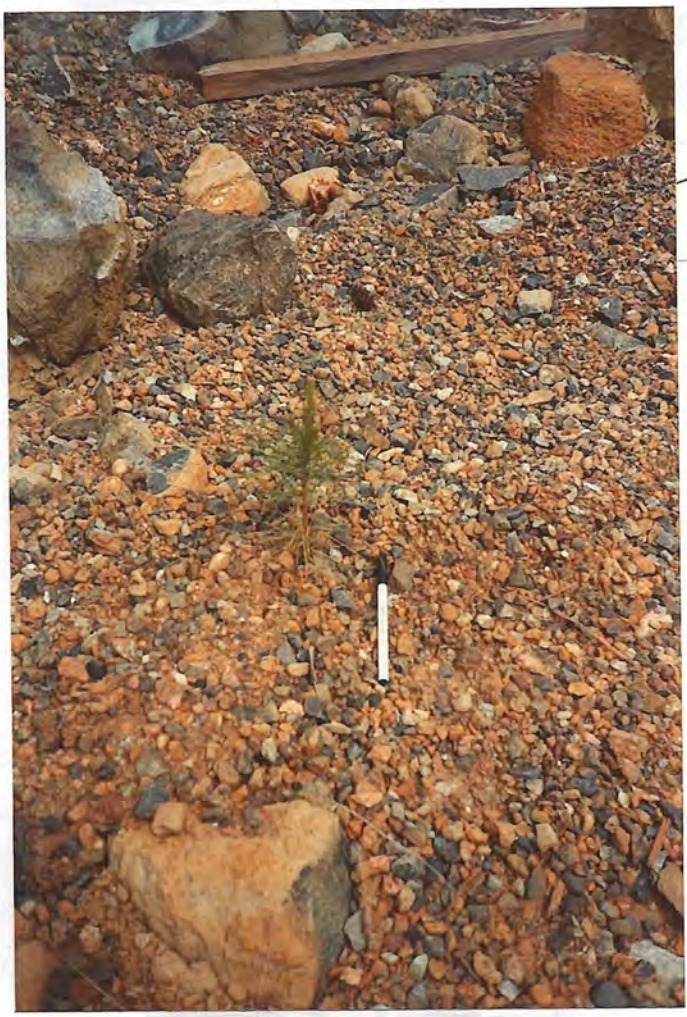
Issued this 27th day of March 19 89

STATE DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

By [signature], Supervisor
Gary W. Lynch Mined Land Reclamation

SMLR-5 Rev. 2/85

c: co
deq. Rose
O land dept
Hon Roses
SCWD Rose



'89 planting on conveyor right-of-way

10-0026
Manna
14 April 89
by: A Tinsley

test plot N of office

'88 plantings on road berm

'89 planting near thickener

buried conveyor pocket

old mine office

inside of fence w/ plantings

dead black-berry plantings

top end of "waste" dump to be mined.

Nickel Mtn

10-0026
Hanna
26 Jan '89
by: A. H. Throod

OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
MINED LAND RECLAMATION PERMIT

Renewal

Hanna Nickel Smelting Company
P.O. Box 85
Riddle, Oregon 97469

Location
Nickel Mountain

Sec.	Twp.	Rge.
	30S	6W

Douglas
County

ISSUANCE OF THIS PERMIT IS NOT A FINDING OF COMPLIANCE WITH STATEWIDE PLANNING GOALS OR THE ACKNOWLEDGED COMPREHENSIVE PLAN. THE APPLICANT MUST RECEIVE LAND USE APPROVAL FROM LOCAL GOVERNMENT BEFORE USING THIS PERMIT.

ISSUED SUBJECT TO ANY CONDITIONS ON THE REVERSE SIDE

MARCH 1989
Renewal Month

Fee $375.00

10-0026
I.D.#

This permit shall be in effect, unless revoked or suspended for cause, from the date of issuance and shall remain in effect so long thereafter as the Permittee pays the annual fee to renew the permit, complies with:

the provisions of ORS 517.750 through 517.955 as applicable,
the Rules as promulgated to administer the Oregon Mined Land Reclamation Act,
the approved reclamation plan, and
any conditions attached to this permit, and

maintains a performance bond as required by the Act.

Issued this 28th day of March 19 88

STATE DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

By Gary W. Lynch, Supervisor
Gary W. Lynch
Mined Land Reclamation

SMLR-5 Rev. 2/85

copies
co
deq-R
co Land Dept
Vlm-R
SWCD-R

Department of Geology and Mineral Industries
1534 QUEEN AVE. SE, ALBANY, OREGON 97321 PHONE (503) 967-2039

NEIL GOLDSCHMIDT
GOVERNOR

REPORT OF ON-SITE INSPECTION

Hanna Nickel Smelting Company
P.O. Box 85
Riddle, Oregon 97469

I.D. #10-0026

Nickel Mountain
T30S,R6W
Douglas County

DATE OF INSPECTION: December 1, 1987

This inspection was conducted to evaluate the progress of reclamation on the site. Given the limited amount of area on which reclamation is mandatory, Hanna has or will undoubtedly spend more on reclamation of the site than the amount of the bond held by this Department. I was accompanied on this inspection by John Murphy; we spoke to Herb Wedge.

A status of various projects is:

1) Documentation that runoff water is meeting the DEQ permit standards is needed to allow close-out of the DEQ permit for the mine site and decommissioning of the sediment ponds. Discussions on that permit should be arranged directly with DEQ.

2) The north waste dump and the west screen dump are stable. Tree planting on the slopes is not recommended.

3) Grass seeding has been unsuccessful. No more is recommended at this time.

4) The overall seedling survival rate was an excellent 59%. In addition, 25,000 trees will be planted in January.

5) The conveyor between the lower orebody and the thickener has been removed. Some additional work will be required along the route.

6) A hole will be broken through the wall of the thickener for long-term safety.

Pond Decommissioning

One item that must be resolved before reclamation can be

CONT ON PAGE TWO

Inspected by ALLEN H. THROOP

Signature Allen Throop

Title RECLAMATIONIST
MINED LAND RECLAMATION

copies
Leg-R
w land dept
Hm-R
SWCD

SMLR-6 Rev.1/26/87

NEIL GOLDSCHMIDT
GOVERNOR

Department of Geology and Mineral Industries
1534 QUEEN AVE. SE, ALBANY, OREGON 97321 PHONE (503) 967-2039

REPORT OF ON-SITE INSPECTION

considered complete is the final status of the sediment collecting ponds. According to Kent Ashbaker (DEQ-Portland) Hanna needs to submit a decommissioning program for the ponds. Documentation that sediment runoff from the mine site has ceased will be required by DEQ. According to Greg Ferrell of DEQ, excessive amounts of suspended solids have left the site every winter. The pond near the north slope mining area is subject to the reclamation law. Final resolution of the pond cannot be made until the DEQ permit conditions are met.

North Slope and Wet Screen Dumps

Due to past instabilities, overly steep slopes, and reclamation obligations, this Department asked Hanna to submit an engineering study of the stability of these two areas. Northwest Geotechnical Consultants have submitted the required analysis and stated that the minimum factor of safety is 1.2 for either dump. No more work on the dumps is required or recommended. We do recommend that the trees scheduled to be planted on these slopes be planted elsewhere.

The earlier failure of the North Dump was probably heavily influenced by a spring under the dump. No more material has been placed over the spring and the dump has been stable for at least five years. The consultants report indicate no failure problems are expected within the dump. Loose rock will continue to roll from the site for many years. The loose rock will stay on the site. The general public has no access to the area. The hazards to people or animals at the base of the slope should be no greater than at any steep-faced natural outcrop.

Hanna has scheduled planting of trees on the slope in January 1988. We recommend that the trees purchased for that purpose be

CONT ON PAGE THREE

Inspected by _____

Signature _____

Title _____

MINED LAND RECLAMATION

NEIL GOLDSCHMIDT
GOVERNOR

Department of Geology and Mineral Industries
1534 QUEEN AVE. SE, ALBANY, OREGON 97321 PHONE (503) 967-2039

REPORT OF ON-SITE INSPECTION

PAGE THREE
FILE #10-0026

used on the south slope planting project even if the areas are not subject to reclamation.

The failure on the wet screen dump was due to a mixture of saturated fines and coarse rock. Procedures were changed after the failure. Northwest's test indicate that the dump is now stable.

Grass Seeding

A mixture of Ellett ryegrass, intermediate wheatgrass, slepner brome, and common vetch was broadcast seeded in the spring. The seeding was a failure. The seeding departed from the recommended varieties but failure of grasses is consistent with earlier test plots which included at least one attempt at hydromulching. No more seeding is recommended at this time.

Nickel Mountain has never had a thick grass cover. An important function of seeding is to stabilize the fines at the surface. In the two years since mining ceased at Nickel Mountain, much of the surface fines have eroded off. Seeding the small areas where reclamation is required will have little affect on the total sediment load in the drainage systems on the mountain. If a significant erosion/sedimentation exists on the entire mountain, control is probably best undertaken through numerous small catch basins, diversion structures, ditches, etc. built all over the mountain. This approach will give immediate direct results. Considerable time and money could be wasted trying to discover a viable seed mix.

Tree Planting

Of the 3,500 Jeffery pine planted on the mountain last year,

CONT ON PAGE FOUR

Inspected by _____

Signature _____

Title _____

MINED LAND RECLAMATION

NEIL GOLDSCHMIDT
GOVERNOR

Department of Geology and Mineral Industries
1534 QUEEN AVE. SE, ALBANY, OREGON 97321 PHONE (503) 967-2039

REPORT OF ON-SITE INSPECTION

59% survived according to John Murphy. The result is excellent given the very dry year. Another 25,000 trees are scheduled to be planted in early 1988.

A breakdown of tree survival rate is:

Lower orebody	76%
Upper orebody	52%
North slope dump	73%
North slope bench	44%
Along roads	30 - 70%
Average	59%

Survival and growth of the KMX seems to be slightly better than for the Jeffery pine. One identifiable problem was frequent "J" rooted plantings.

In January of 1988 Hanna plans to start planting 17,000 KMX pine and 8,000 Jeffery pine. Stricter supervision will be made of the contract planters. We would recommend strong emphasis on replanting the south slope. Most plantings would be in road berms. If last years plantings can yield information about suitable planting sites (inside, outside or top of berm, etc), survival rate on the new plantings would be enhanced.

Conveyor Right-of-Way

The belt conveyor installed between the lower orebody and the thickener has been removed. Final clean-up of the scrap wood and steel remains. Hanna also plans to fill in the vertical ore pocket and entry at the conveyor loading point. The ends of the corrugated pipes leading to and from the ore pocket are to be sealed off.

CONT ON PAGE FIVE

Inspected by _____

Signature _____

Title _____

MINED LAND RECLAMATION

NEIL GOLDSCHMIDT
GOVERNOR

Department of Geology and Mineral Industries
1534 QUEEN AVE. SE, ALBANY, OREGON 97321 PHONE (503) 967-2039

REPORT OF ON-SITE INSPECTION

The area affected by the conveyor and its access road was not severely disrupted. Revegetation should not be difficult; we would recommend planting that area with blackberries. Since this has not been suggested or tried before, the Department will be willing to assist in the test planting.

Thickener

All parts of the large thickener recently built near the wet screening plant are to be removed. Most of the concrete foundation can remain if the floor is planted and an exit from the inside of the thickener and from the space between the two walls of the thickener is provided. The pumps, pipes, and steel framework are to be removed.

Summary

Progress on reclamation of the site is being made. Contact with DEQ should be initiated to work on solving any remaining problems with suspended sediments. The trees being planted are oriented towards long-term screening of the site not towards solving the continuing erosion problems which are mostly in areas exempt from reclamation.

Inspected by _____

Signature _____

Title _____

MINED LAND RECLAMATION

KMX pine

10-0026
Hanna
Dec 1, '87
By: A. H. Throop

Thickener

2.2 Program for Cooperation with and Technical Assistance to Local Governments

A. Participation in the Development of Comprehensive Plans

The Department has little need to review city and county compliance schedules from the standpoint of Department operations and regulatory functions. However, selective review is necessary to assure that the jurisdictions with data needs for geologic hazards and mineral potential properly address their needs for geologic information. This review is primarily done when the compliance schedules are submitted. Further review is not needed at this time. Selective review means that special attention is paid to those jurisdictions for which we know that geologic information is a significant concern. Generally, counties are of more concerns than cities and towns. Our perception of jurisdictions with geologic data needs changes with time as geologic information is accumulated, and it is not possible to develop an actual list of cities. Our concerns will be communicated to the jurisdictions using comprehensive plan review forms supplied by LCDC or in correspondence within the context of programs. Participation in the planning process is achieved in the following ways:

Public Information: We respond to requests for information by jurisdictions orally, by letter, or with publications as deemed appropriate and to the extent that needed information is readily available. The types of information we can provide are described under Section B below. Our library is available to the public. A list of all our publications (attached) is supplied upon request. Inquiries can be addressed to the following locations:

Portland Office - 229-5580
1069 State Office Building
Portland, Oregon 97201

Grants Pass Office - 476-2496
P.O. Box 417
Grants Pass, Oregon 97526

Baker Office - 523-3133
2033 First Street
Baker, Oregon 97814

Albany Office - 967-2039
1129 S.E. Santiam Road
Albany, Oregon 97321

Receptionists will route the calls to the appropriate personnel or will handle them personally.

Projects: Where significant technical assistance is required, we contract our services on a jointly funded basis within the context of the appropriate Geological Services program. Time scheduling

OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
MINED LAND RECLAMATION PERMIT

Renewal

Hanna Nickel Smelting Company
P.O. Box 85
Riddle, Oregon 97469

Location
Nickel Mountain

Sec.	Twp.	Rge.
	30S	6W

Douglas
County

ISSUANCE OF THIS PERMIT IS NOT A FINDING OF COMPLIANCE WITH STATEWIDE PLANNING GOALS OR THE ACKNOWLEDGED COMPREHENSIVE PLAN. THE APPLICANT MUST RECEIVE LAND USE APPROVAL FROM LOCAL GOVERNMENT BEFORE USING THIS PERMIT.

ISSUED SUBJECT TO ANY CONDITIONS ON THE REVERSE SIDE

MARCH 1988
Renewal Month

Fee $290.00

10-0026
I.D.#

This permit shall be in effect, unless revoked or suspended for cause, from the date of issuance and shall remain in effect so long thereafter as the Permittee pays the annual fee to renew the permit, complies with:

the provisions of ORS 517.750 through 517.955 as applicable,
the Rules as promulgated to administer the Oregon Mined Land Reclamation Act,
the approved reclamation plan, and
any conditions attached to this permit, and

maintains a performance bond as required by the Act.

Issued this 3rd day of April 19 87

STATE DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

By John D. Beaulieu
John D. Beaulieu
Supervisor
Mined Land Reclamation

SMLR-5 Rev. 2/85

copies
cc
deq-R
cc land dept
Hm-R

area of slide

← wet screening plant

lower ore body

10-0626
Manna Ni
9 April 87
by: A. Throop

Area of slide from wet screening plant

Department of Geology and Mineral Industries
1129 S.E. SANTIAM ROAD, ALBANY, OREGON 97321 PHONE (503) 967-2039

VICTOR ATIYEH
Governor

IDENT. NO. _____

REPORT OF ON-SITE INSPECTION

Hanna Nickel Smelting Company
P.O. Box 85
Riddle, Oregon 97469

I.D. #10-0026

Nickel Mountain Mine
T30S,R6W
Douglas County

DATE OF INSPECTION: February 17, 1987

This inspection was conducted to review the mandatory and voluntary reclamation planned for Nickel Mountain. The most serious problem noted was a potentially unstable dump located on the north side of the site. The dump is subject to the state reclamation laws. Seeding portions of the area where reclamation is required in lieu of planting with trees is acceptable to this department. We encourage the voluntary plantings of pine trees on areas not legally subject to reclamation. A map or aerial photograph showing the final areas affected is required prior to a final determination of what areas are and are not subject to reclamation.

I was accompanied on this inspection by John Murphy representing Hanna and by Frank Schnitzer from DOGAMI.

Seeding and Planting

The existing reclamation plan emphasizes planting trees on the disturbed areas. Hanna has proposed planting grass on some areas where reclamation is required and planting the trees which would have gone on those areas on more visible areas of the mountain. Such an approach is acceptable and encouraged by DOGAMI since the grasses will be more effective than trees in controlling runoff from the recently disturbed areas, but trees will be far more effective in providing a visual screen of the site from the south.

Hanna has proposed seeding with perennial rye which is inexpensive and available locally. According to state rules, reclamation is evaluated by success of the revegetation after one

CONT ON PAGE TWO

Inspected by ALLEN H. THROOP

Signature [signature]

Title RECLAMATIONIST
MINED LAND RECLAMATION

Copies to deg. R
CO land dept
Hon. Rosebury

SMLR-6 Rev. 1/20/82

VICTOR ATIYEH
Governor

Department of Geology and Mineral Industries
1129 S.E. SANTIAM ROAD, ALBANY, OREGON 97321 PHONE (503) 967-2039

IDENT. NO. _____

REPORT OF ON-SITE INSPECTION

PAGE TWO
FILE #10-0026

full growing season. We recommend that a grass mixture chosen specifically for a tolerance to high Mg soils be used instead of a straight ryegrass seeding. The California Department of Transportation recommendation for serpentine soils is:

Species	lbs/Ac
Luna Pubescent wheatgrass	25
Blando Brome	30
Lana Vetch	5
	60

They also recommend fertilizing with 500 lbs/Ac of 16-20-0 and 230 lbs/Ac of 0-0-50 applied with the fall seeding followed with 50 lbs/Ac of Urea in March. Follow-up fertilization is also recommended. Another seed mix was given to Hanna in a meeting in January.

Some areas could be seeded using a cyclone seeder. However, given the total large acreage involved and the rough terrain, helicopter seeding is recommended. Application costs would be in the order of $500 to $1,000 for 30 acres.

Approximately 3,000 Jeffrey pine seedlings and 500 KMX seedlings are to be planted later during the week. Most of these will be planted at 20' or closer centers along haul road berms. Others will be planted on the benches of the lower orebody, on the benches of the North Slope, near the Doe Creek settling pond, and elsewhere. The results of the plantings will be used as a guide to further plantings next year. A map showing all planting

CONT ON PAGE THREE

Inspected by _____

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VICTOR ATIYEH
Governor

Department of Geology and Mineral Industries
1129 S.E. SANTIAM ROAD, ALBANY, OREGON 97321 PHONE (503) 967-2039

IDENT. NO. _____

REPORT OF ON-SITE INSPECTION

locations is to be supplied to this department.

Areas Examined

Specific areas evaluated for mandatory reclamation follows. This information was updated after the site inspection and following conversations with Hanna and with other agencies after and a review of the file.

North Side Dumps

There are two dumps on the north side of Nickel Mountain which are subject to reclamation. The more westerly dump (mine coordinates 88N, 64E) is the one which caused the major slide into the Thompson Creek drainage. Although not previously included as an area needing reclamation, the northern one-third of the dump, which is on land owned by Hanna, is subject to reclamation. The dump was constructed between 1972 and 1981. Mining activity on land owned by the operator is subject to the 1972 grandfather date and not the 1981 date which pertains only to valid contract areas (ORS 517.770(1)(c)).

The dump appears to be overly steep. In addition to the major slide, the dump has been subject to numerous small slides and excessive erosion. As a result, the flat area below the dump is covered by material that has slide or eroded from the dump. The long-term stability of the dump must be resolved.

The general rule for dumps requires a final slope of 1-1/2:1

CONT ON PAGE FOUR

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1129 S.E. SANTIAM ROAD, ALBANY, OREGON 97321 PHONE (503) 967-2039

IDENT. NO. _____

REPORT OF ON-SITE INSPECTION

or flatter. As an alternative to regrading to such a slope, we would accept stabilization to a standard approved by a registered engineer and appropriate revegetation of that portion of the dump subject to reclamation under state law. Such an approach is called for in the existing reclamtion plan (Item 4.4.4).

West Slope - Doe Creek

This area has been mostly revegetated. No more seeding is needed on the dam wall or on the thickly vegetated portions of the slide area itself. However, better revegetation of the poorly grassed part of the slide area and of the area on which the slide material is placed will be required.

North Slope

Most of the north slope was disturbed prior to 1972 and is thus exempt from reclamation. Much of the area is naturally revegetated with grasses, firs, and cedar. The settling pond is a post-1972 expansion. If acceptable to the landowner (BLM), the pond may remain. However, the reclamation plan (4.6.6) clearly calls for its removal. The pond must stay until DEQ is satisfied that all turbidity problems have been rectified. By then the disposition of the pond must be settled.

North Side Slide Area

The old slide area is mostly well vegetated. However, one to

CONT ON PAGE FIVE

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1129 S.E. SANTIAM ROAD, ALBANY, OREGON 97321 PHONE (503) 967-2039

IDENT. NO. _____

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two acres located 100 yards or more uphill from the road to the North Slope must be revegetated.

Lower Orebody

At least four areas around the lower orebody are subject to reclamation. They are 1) the benches in the pit floor where the last mining occurred; 2) the stripped area to the east of those benches and west of the older portions of the lower orebody; 3) a small overburden waste dump just below the last active portion of the lower orebody, and a large mud slide which has gone down over the hill from the lower orebody; and 4) the area around the large spring which is not shown as mined on any of our maps, but is definitely affected by mining.

Hanna has suggested planting conifers on the benches. We would strongly recommend that the benches be ripped first. Also the material piled on the last working bench should be spread out over the pit floor as a growth medium for the trees prior to planting. I suggest that the final bench not be planted this year. The upper two benches might be planted to see if the compaction has broken down sufficiently to allow planting without decompaction. However, experience elsewhere suggests that such is not the case and replanting will be needed. Again, reclamation will be judged on successful planting.

There is an area to the east of the last active portion of the lower orebody which has had the vegetation removed. In this area the root wads and slash should be burned and the area planted with either grass or trees.

CONT ON PAGE SIX

Inspected by _____

Signature _____

Title _____

MINED LAND RECLAMATION

VICTOR ATIYEH
Governor

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1129 S.E. SANTIAM ROAD, ALBANY, OREGON 97321 PHONE (503) 967-2039

IDENT. NO. _____

REPORT OF ON-SITE INSPECTION

PAGE SIX
FILE #10-0026

The two slides down over the hill and the spring area must be also planted.

Other Concerns

This inspection brought out a number of areas which are subject to reclamation that had not previously been known to this department.

To confirm that all areas subject to reclamation have been included in the reclamation planning, a final map or aerial photograph is required. A 1985 aerial photograph available from BLM could be used as a base with field comparison between the photograph and the present situation. Such documentation must be submitted by April 1, 1987. Of particular interest will be the area around the waste dump at the wet screening plant. According to DEQ, the dump has had problems with instability and erosion. Assuming that the area is subject to state reclamation laws, stabilization work will also be required in that area. Once the post-mine map or photograph has been submitted, the total acreage subject to reclamation can be established.

Inspected by _____

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Title _____

MINED LA[illegible]RECLAMATION

10 - 0026
Hanna Nickel
17 Feb '87
by: A. Thrasp

(1)

Erosion from dump.

This is the slope on the north side that is subject to reclamation. We have asked Hanna to submit an engineered plan to guarantee stability. Numbers are locations of other photos.

10-0026
Hanna
17 Feb '87
by: A. Throop

Jeffery Pine
N. of Doe
Creek
pond on
outslope of
[illegible] to the
N. slope

See photo under this one.

Dam on west slope - Doe Creek drainage

revegetated

reseeding needed.

(2) Slide from N. dump - No revegetation.

(3) Slide from N. dump - revegetated.

10-0026
Manna
17 Feb '87
by: A. Throop

Dam on North Slope
Floating Weir is of primary concern.
How long will it last?

(5)

10-0026
Hanna
17 Feb '87
by: A. Throop

(4)

North Slope - prior mined.
Natural reveg. doing well on upper areas.

VICTOR ATIYEH
Governor

Department of Geology and Mineral Industries

1129 S.E. SANTIAM ROAD, ALBANY, OREGON 97321 PHONE (503) 967-2039

IDENT. NO. _____

REPORT OF ON-SITE INSPECTION

Hanna Nickel Smelting Company
P.O. Box 85
Riddle, Oregon 97469

I.D. #10-0026

Riddle Mine
T30S,R6W
Douglas County

DATE OF INSPECTION: January 22, 1986

Frank Schnitzer and I were accompanied on this annual inspection by Victor Mejia. Prior to the visit I spoke with Mr. M.L. Johnson.

Operations at the time of my visit were at a very limited level due to the installation of a new ore beneficiation process. Startup of the new process should begin shortly.

During our review of the site the following items were noticed:

1) Very little grass has started on the fill area on the west side of the mine created during the removal of material from the slide in 1984. A spring seeding of perennial ryegrass (15 lbs/Ac) creeping red fescue (5 lbs/Ac) and innoculated white clover (3 lbs/Ac) are recommended. Ryegrass is the predominant species which naturally volunteers on disturbed slopes at the mine site. There is also what appears to be a bentgrass. Identification of grasses and forbes at this time of year is difficult.

2) The trees planted on the revegetation plot at 62 N and 29 E remain barely alive. The greenish-yellow coloring is most likely due to toxicity from the metals in the soils combined with low soil fertility.

3) Trees planted on the outslope at 76 N and 83 E are growing better than those mentioned in the previously paragraph but still are not doing well. Both Jeffrey (?) and Bishop Pine are growing on that slope.

CONT ON PAGE TWO

Inspected by ALLEN H. THROOP

Signature _____

Title RECLAMATIONIST
MINED LAND RECLAMATION

VICTOR ATIYEH
Governor

Department of Geology and Mineral Industries

1129 S.E. SANTIAM ROAD, ALBANY, OREGON 97321 PHONE (503) 967-2039

IDENT. NO. _____

REPORT OF ON-SITE INSPECTION

PAGE TWO
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4) As previously noted the best revegetation is occurring at 71 N and 82 E. The two rows of trees nearest the outslope continue to be doing very well as does the one Ponderosa (?) volunteer. Frank Schnitzer discovered during this visit that half of the trees, including the one with the best growth, are Monterey Pine. The other half are Jeffrey or Ponderosa Pine. Supposedly, Jeffery Pine were planted on the site; confirmation of which species is present is impossible until the trees bear cones. The remainder of trees on this bench, mostly firs with a few pines, are barely alive. The evidence suggests that those near the outslope are doing better because of residual amounts of topsoil since those first rows are very close to the original land surface.

We noticed again that volunteer trees are doing very well at portions of this site. The best way to ensure such volunteers would be to leave as many of the original trees as long as possible. In areas that are completely mined out or in dumps that are finished, perhaps it would be possible to physically move in large (10') trees. Alternatively, seeding could be done by collecting cones from trees already growing in this area and using them for seed stock.

5) A large new waste dump is being created near the newly installed wet screening plant. Initially the rock dumped onto the waste dump will be on land grandfathered from reclamation. As the dump grows, areas subject to reclamation will be affected. On those areas, the existing trees must be cut prior to dumping. Also, construction plans of the dump, prepared by a registered engineer will be required to demonstrate the stability of that dump. The dump will be covering an existing settling pond. Adequate new pond capacity shall be maintained in the drainage.

CONT ON PAGE THREE

Inspected by _____

Signature _____

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MINED LA[illegible] RECLAMATION

VICTOR ATIYEH
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Department of Geology and Mineral Industries
1129 S.E. SANTIAM ROAD, ALBANY, OREGON 97321 PHONE (503) 967-2039

IDENT. NO. _____

REPORT OF ON-SITE INSPECTION

6) In the lower ore body there are up to four acres from which trees have been stripped and on which mining has begun. The bond must be increased by $500 for each of the new acres. The bond increase must be supplied by March 1, 1986.

Overall there has been no significant change in the area affected by this operation. A new map will not be required at this time, but in a year or two this department will require either an updated map or an acceptable aerial photo outlining the areas affected since January 1, 1981, or 1972, depending on the property owner, and therefore subject to full reclamation.

The cooperation of Mr. Mejia in showing us around the site is appreciated.

Inspected by _____

Signature _____

Title _____

MINED LAND RECLAMATION

trees behind Frank & Vic are Bishop pines.

10-0026
Hanna Ni
22 Jan '86
By: A. Nunez

New cyclones

New thickener

STATE DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

SURFACE MINING OPERATING PERMIT

Hanna Nickel Smelting Company
P.O. Box 85
Riddle, Oregon 97469

Renewal

Location
Nickel Mountain
30S 6W
Sec. Twp. Rge.

Douglas
County

MARCH 1986
Renewal Month

Fee $290.00

THIS OPERATING PERMIT DOES NOT RELIEVE THE PERMITTEE FROM THE REQUIREMENTS OF CITY, COUNTY, OR OTHER GOVERNMENT AGENCY AUTHORITY.

10-0026
I.D. #

Pursuant to ORS 517.830(4), this permit shall be in effect, unless revoked or suspended for cause, from the date of issuance and shall remain in effect so long thereafter as the Operator pays the annual fee to renew the permit, complies with the provisions of ORS 517.750 to 517.900 as amended and subsection (4) 517.990, the Rules and Regulations as promulgated to administer the Oregon Mined Land Reclamation Act, complies with the reclamation plan submitted and maintains a performance bond as required by the Act.

Issued this 1st day of April 1985

STATE DEPARTMENT OF GEOLOGY & MINERAL INDUSTRIES

By Paul F. Lawson
Paul F. Lawson
Supervisor
Mined Land
Reclamation

SMLR-5-C(rev.7/31/80)

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VICTOR ATIYEH
Governor

Department of Geology and Mineral Industries

1129 S.E. SANTIAM ROAD, ALBANY, OREGON 97321 PHONE (503) 967-2039

IDENT. NO. _____

REPORT OF ON-SITE INSPECTION

Hanna Mining Company
P.O. Box 85
Riddle, Oregon 97469

I.D. #10-0026

Nickel Mountain
T30S,R6W
Douglas County

DATE OF INSPECTION: February 20, 1985

I was accompanied on this annual inspection by Victor Mejia.

There has been no significant expansion of this site since my visit of last year. Mining during the year was in previously disturbed areas.

The landslide material which filled up a sedimentation pond on the west side of the site has been removed. This waste material was neatly piled adjacent to that pond and will be reseeded this spring with a local grass mix. It would be beneficial to record the type of seeds used for reseeding that material and the results of the seeding.

We reexamined the three revegetation plots mentioned in last years report. The test plots are within 100' of the mine coordinates listed.

Area 1 is an old bench at 62 north and 29 east. The plants show no significant change from last year. Both pines and fir are alive but barely so. This area will probably be remined within the coming 12 months; the demonstration plot will be obliterated.

At 71 north and 82 east there is a more successful plot. Some of the pine are now approaching six feet high. Some have a very good green color to them. The two rows closest to the outer edge of the bench are doing much better than the pine and fir closer to the back of the bench. The difference in pine growth rates between the outer and inner portion of the bench is unclear.

CONT ON PAGE TWO

Inspected by ALLEN H. THROOP

Signature Allen H Throop

Title FIELD REPRESENTATIVE
MINED LAND RECLAMATION

VICTOR ATIYEH
Governor

Department of Geology and Mineral Industries

1129 S.E. SANTIAM ROAD, ALBANY, OREGON 97321 PHONE (503) 967-2039

IDENT. NO. _____

REPORT OF ON-SITE INSPECTION

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The planting of ponderosa on the waste dump outslopes at 76 north and 83 east continues to survive, although the lower portions have been obliterated by a new dump. There was no major growth on the trees in this area during the last year.

Mr. Mejia pointed out a voluntar grass which is growing on some of the dumps and has transplanted successfully. A sample of this was taken back to our office, but it is not yet identified.

There is a chance that new dumps will be established within the coming few years. Prior to starting these dumps, the Department should be contacted regarding dump construction, reclamation and bonds. Since there has been no significant change in the site, the current bond of $16,950 for 34 acres remains acceptable.

Inspected by _____

Signature _____

Title _____

MINED LAND RECLAMATION

— 62N 29E
Pine & fir plantings
- all grass is dead

10-0026
Hanna
20 Feb 85
A. Throop

Crusher

Crusher

71N 82E

76N 83E

Ponderosa pine on dump outslope

10-0026
Hanna
20 Feb 85
A. Throop

VICTOR ATIYEH
Governor

Department of Geology and Mineral Industries
1129 S.E. SANTIAM ROAD, ALBANY, OREGON 97321 PHONE (503) 967-2039

IDENT. NO. _____

REPORT OF ON-SITE INSPECTION

Hanna Mining Company
P. O. Box 85
Riddle, OR 97469

I.D. #10-0026

Nickel Mountain
T30S,R6W
Douglas County

DATE OF INSPECTION: January 31, 1984

I was accompanied on this inspection by Jim Coyle, mechanical engineer, and Victor Mejia, mining engineer and geologist. I also spoke to John Murphy, mine superintendent, and Merv Johnson, manager of engineering.

The purpose of this inspection was to familiarize myself with the site and begin evaluating the areas currently affected by mining and those entitled to the grandfather provision and not subject to reclamation. I also wanted to evaluate the test plantings on the site.

Since the reclamation plan submitted for this site has never been circulated, this inspection plan will also review the reclamation plan submitted for this operation. A summary of the plan is being circulated along with this report.

Location and Site Description

Hanna's nickel operation is the largest mine in the state and has been operating about 2-1/2 miles west of Riddle since 1954. Nickel is mined from laterite on this site. Ore is crushed and screened on the site and then moved by aerial tramway to a smelting and refining operation located about 1-1/2 miles to the south.

Prior to mining, the areas were steep rolling hills with a relief of some 1500 feet. The areas of laterite were probably open forests of ponderosa pine and madrone. The adjacent lands underlain by sediments contain much thicker stands of mixed conifers, oak, and madrone.

CONT ON PAGE TWO

Inspected by Allen H. Throop

Signature _____

Title Field Representative
MINED LAND RECLAMATION

VICTOR ATIYEH
Governor

Department of Geology and Mineral Industries
1129 S.E. SANTIAM ROAD, ALBANY, OREGON 97321 PHONE (503) 967-2039

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PAGE TWO

Prior to 1972 large acreages had already been affected by mining. The actual acreages affected are currently being evaluated but are at a maximum 969 acres. The figures finally accepted as prior mined by this department will probably be considerably smaller.

Reclamation Procedures

Attached to this inspection report is Chapter 5 of a 1977 report entitled "Mine Reclamation for the Hanna Nickel Mine Riddle, Oregon". Chapter 5 summarizes the reclamation as outlined by the operators. The more detailed full report is available for review in this office, at Hanna Nickel, and at the Douglas County Planning Department. Upon completion of mining, the area is to be planted with trees.

Towards this goal, test plots of trees were established in 3 level locations and trees were also planted on the outslope of a number of dumps. Unfortunately, Mr. D. E. Babbitt, who did the planting and was evaluating the survival of the various species, died within the last year. Mr. Coyle is to evaluate the success of the tests plots sometime this year using Mr. Babbitt's records. Since much can be learned from these plots which are now about 7 years old, this data should be properly recorded since the locations of the plantings are subject to mining again in the future.

I made the following observations about the planting during the visit. On the flat top of a waste dump near the mine office (approx. mine grid 60N, 26E), plantings of pine species have been more successful than plantings of firs. Even various pine species are not doing well. There is no evidence of survival of any

CONT ON PAGE THREE

Inspected by _____

Signature _____

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MINED LAND RECLAMATION

VICTOR ATIYEH
Governor

Department of Geology and Mineral Industries
1129 S.E. SANTIAM ROAD, ALBANY, OREGON 97321 PHONE (503) 967-2039

IDENT. NO. _____

REPORT OF ON-SITE INSPECTION

PAGE THREE

grasses on this test plot. Poor growth may be due to severe compaction by truck traffic as the dump was constructed.

On an old bench floor located well to the east of the first site (estimated mine grid 72N, 84E), the relative results were similar (i.e., the pines are doing much better than the firs). On this site, the pines were 3' to 4' high and some looked very healthy. The best and tallest tree on the site was one which is naturally regrown. It is not certain when this started growing and, therefore, whether it is taller because it has grown quicker or because it has had longer to grow than the planted trees. A volunteer incense cedar is growing next to the large pine.

On this bench there is also a good growth of grass and other low ground cover. It would be beneficial to identify the species as they obviously do better than the grasses which were seeded on the mine site. An observation made by Mr. Mejia is that the peridotite on the pit floor weathers quickly and there are now abundant fines for establishment of plants on this bench. This did not appear to be the case on the top of the dump mentioned previously.

A third area where we looked at revegetation is a planting of pines on the outslope of a dump (estimated mine grid 76N, 84E). There was no natural revegetation of this site but yet it appeared that most, if not all, of the pines planted in this area have survived.

Another area which was laid out with test planting was removed by mining a few years ago.

Due to the mountaintop nature of this operation, it will not be possible to do any significant final reclamation of this site

CONT ON PAGE FOUR

Inspected by _____

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Title _____

MINED LAND RECLAMATION

VICTOR ATIYEH
Governor

Department of Geology and Mineral Industries
1129 S.E. SANTIAM ROAD, ALBANY, OREGON 97321 PHONE (503) 967-2039

IDENT. NO. _____

REPORT OF ON-SITE INSPECTION

until such time as mining is actually completed. As mining progresses downward, taking off additional slices of the hill, areas which have not been mined for numerous years are reactivated. New dumps are built upon and expanded at various intervals.

The Soil Conservation Service can offer some valuable advice on revegetation of this site.

Drainage

All water running off this site flows into South Umpqua River drainage. Most enters Cow Creek from one of 6 smaller drainages.

Settling ponds have been established in the drainages where necessary. The drainages were not examined in detail during this visit. Runoff control has been handled under permits from the Department of Environmental Quality.

Other Considerations

There is no nearby housing. The nearest dwellings to the mining operation are probably 1-1/2 to 2 miles to the southeast. The site is visible from northbound traffic on Interstate-5, westbound traffic on Route 227, and also on a number of local roads. However, due to the distance these sites are removed from the mine, the effect is not noticeable. Visual screening would be economically and physically impractical for this site.

CONT ON PAGE FIVE

Inspected by _____

Signature _____

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VICTOR ATIYEH
Governor

Department of Geology and Mineral Industries

1129 S.E. SANTIAM ROAD, ALBANY, OREGON 97321 PHONE (503) 967-2039

IDENT. NO. _____

REPORT OF ON-SITE INSPECTION

PAGE FIVE

Recommendations and Bonding

As mentioned above, this is a very large site of which the majority was mined prior to 1972 and is therefore not subject to reclamation. It is recommended that the following conditions be added to this permit upon renewal:

1. Details of reclamation as contained in the June 1977 reclamation plan shall be followed for reclamation of this site.

2. No turbid waters shall be allowed to escape from this site.

Currently there is a bond of $16,950 covering reclamation of 33.9 acres. This shall remain sufficient until a revised acreage has been agreed upon by Hanna and DOGAMI. Mr. Mejia is to compile a 1" = 400' map showing the areas currently affected by mining and, therefore, showing any areas which have been affected by mining and not shown on the existing 1975 plan. Mr. Coyle will submit a report on the survival of the various plantings to date.

Inspected by _____

Signature _____

Title _____

MINED LAND RECLAMATION

STATE DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

SURFACE MINING OPERATING PERMIT Renewal

Hanna Mining Company
P. O. Box 85
Riddle, OR 97469

MARCH 1984
Renewal Month

Location
Nickel Mountain
30S 6W
Sec. Twp. Rge.

Douglas
County

Fee $290.00 Paid

#10-0026
I.D. #

THIS OPERATING PERMIT DOES NOT RELIEVE THE PERMITTEE FROM THE REQUIREMENTS OF CITY, COUNTY, OR OTHER GOVERNMENT AGENCY AUTHORITY.

Pursuant to ORS 517.830(4), this permit shall be in effect, unless revoked or suspended for cause, from the date of issuance and shall remain in effect so long thereafter as the Operator pays the annual fee to renew the permit, complies with the provisions of ORS 517.750 to 517.900 as amended and subsection (4) 517.990, the Rules and Regulations as promulgated to administer the Oregon Mined Land Reclamation Act, complies with the reclamation plan submitted and maintains a performance bond as required by the Act.

Issued this 18th day of March 1983

STATE DEPARTMENT OF GEOLOGY & MINERAL INDUSTRIES

By Paul F Lawson
Paul F. Lawson
Supervisor
Mined Land
Reclamation

SMLR-5-C(rev.7/31/80)

copies to DEQ

STATE DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

SURFACE MINING OPERATING PERMIT

Renewal

Hanna Mining Company
P. O. Box 85
Riddle, OR 97469

MARCH 1983
Renewal Month

Fee $290.00 Paid

Location
Nickel Mountain
30S 6W
Sec. Twp. Rge.

Douglas
County

THIS OPERATING PERMIT DOES NOT RELIEVE THE PERMITTEE FROM THE REQUIREMENTS OF CITY, COUNTY, OR OTHER GOVERNMENT AGENCY AUTHORITY.

10-0026
I.D. #

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RENEWED WITHOUT INSPECTION, THE DEPARTMENT RESERVES THE RIGHT TO INSPECT DURING CURRENT PERMIT YEAR AND TO ATTACH CONDITIONS FOR ANY DEFICIENCIES DETERMINED TO EXIST.

SMLR-5-C(rev.7/31/80)

Issued this 1st day of April 1982

STATE DEPARTMENT OF GEOLOGY & MINERAL INDUSTRIES

By Paul F. Lawson
Paul F. Lawson

Supervisor
Mined Land
Reclamation

copies: to DEQ

STATE DEPARTMENT OF GEOLOGY
AND MINERAL INDUSTRIES
1129 SE Santiam Road
Albany, Oregon 97321
Telephone: (503) 967-2039

Ident. No. 10-0026

REPORT OF ON-SITE INSPECTION

Hanna Mining Company
P. O. Box 85
Riddle, OR 97469

¼Sec. ___ Sec. ___ Twp. 30S Rge. 6W

County Douglas

Date of Inspection: May 7, 1980

REMARKS:

I was accompanied on this inspection by Mr. Dale Foster of Hanna Mining Company and by Frank Walker of our office. Our inspection was conducted after discussion with Mr. John Murphy, the mine manager, and was followed by a briefing by Mr. Ed Jakes, mining geologist at Hanna Mining.

Due to the physical size of this operation and the complexity of the operations and of terrain, I decided to limit this inspection to specific objectives.

The tree seeding program observed included plantings made, I believe, in the fall of the years of 1978 and 1979. The small lots or sites on which some of these plantings were made varied from an area on top of dumps that was composed of very coarse rock, with a minimum of fines, to scree slopes, to grassy areas below the dumps, and a site which was below the original contour of the land, but which was not disturbed. Most of the seedlings appeared to be Douglas fir, Ponderosa pine with a few cedar, and perhaps there were other species I did not note. It appears that most of the seedlings were between 14 and 20 inches when planted. Most of them were protected by plastic guards, and in one plot at least they had been staked, but wind had blown over the stakes, and some of the seedlings were horizontal to the ground. The results of the plantings to this point appeared to be both predictable and surprising. The seedlings on the dump area where the rocks were large and the fine materials scarce, appear to be in trouble, which is not surprising, in that they would have a struggle for moisture, and they would also be exposed to intense heat during the summer months. Seedlings on a fairly steep scree slope seem to be doing moderately well at this time, perhaps mostly because there is enough fine material for roots to take hold, and

Continued on Page 2

Inspected by Paul F. Lawson

Signature Paul F. Lawson

Title Supervisor, Mined Land Reclamation

copies: to DEQ

SMLR-6 Rev. 11/02/77

to hold capillary water. Surprising to me was that the planting in fairly lush grass,where stumps existed indicating a previous stand of timber, were not doing well at all. I would have expected that it would have been a suitable environment by virtue of the previous timber and that the grass would have served as a nurse crop and cooled the soil somewhat. The stand that appeared to be doing the best was on a pinnacle or a small portion of a bench, which otherwise was relatively undisturbed, had a considerable amount of fine material and slight discolored depressions indicated that it had caught and held water at times. This planting appeared to be thriving.

The hydro seeding program appears to have generally been a failure, except that there are, I believe, some lessons that can be learned from it. In those areas where no mulch was used, it appears to have been a total failure, with no remnant traces. In those areas where a mulch was used, it has not been appreciably successful, however, there is at least a start, and at least one of the grasses used appears to be taking hold and appearing fairly healthy. In general, it appears that the grasses are starting in areas that had at least a little shade, that is, along the back edges of rocks and on north slopes and in very slight depressions where apparently the seeds held and/or there is a minor collection of moisture. In each place where the seeded grasses appear to be taking hold, there are remnant traces of the mulch.

A native grass, which at this time of the year is doing very well indeed in undisturbed areas, is also showing signs of natural reseeding on the parts of the affected land. It is desirable to obtain a positive identification of this grass and investigate the availability of seeds, and then to experiment with re-establishing the wild grass. There might also be some merit in experimenting, or at least in further investigating the habitat requirements for lespideza or kudzu, both of which do well on poor red soils of the deep south.

We examined one series of settling ponds and their outlet on a west slope area and they appear to be functioning quite satisfactorily at this time although I would suspect that in times of heavy runoff that they might be strained. I note also that near

the center of the berm of the lower pond that the berm has settled and would recommend that it be built up again. I note also that there are some longitudinal cracks in this berm. They should be examined and some repairs made, I believe.

As noted above, I made no effort to attempt to examine the entire operation on this trip. In general, the operation appears to be a thoroughly professional mining operation, and the efforts expended in attempting to learn how best to revegetate are commendable, and certain facts are already apparent. Some of these may include, I believe, that seedlings will do proportionately better in areas where there is fine material with some density or compaction for moisture holding capabilities, and surfaces other than bare rock, or some degree of shadow or texture, which provides something less than the full summer intensity of heat. As to the grasses or small plants, it appears that plantings without mulch are a complete waste, and that there may be merit in attempting to re-establish the wild grass. Also, at least, an investigation of the possibilities of lespideza or kudzu might be in order.

The capacities of all settling ponds against heavy runoff and the condition of all retaining walls of these settling basins should be periodically checked, and the retaining walls of the berms should be kept in good condition.

The friendliness and the courtesies extended by personnel of Hanna Mining Company with whom we came in contact is most sincerely appreciated.

STATE DEPARTMENT OF GEOLOGY
AND MINERAL INDUSTRIES

Renewal

SURFACE MINING

OPERATING PERMIT

Site Location

30S 6W
Sec. Twp. Rge.

Douglas
County

Hanna Mining Company
P. O. Box 85
Riddle, OR 97469

MARCH 1981
Renewal Month

Fee $195.00 Paid

10-0026
Identification No.

THIS OPERATING PERMIT DOES NOT RELIEVE THE PERMITTEE FROM THE REQUIREMENTS OF CITY, COUNTY, OR OTHER GOVERNMENT AGENCY AUTHORITY

Pursuant to ORS 517.830(4), this permit shall be in effect, unless revoked or suspended for cause, from the date of issuance and shall remain in effect so long thereafter as the Operator pays the annual fee [redacted] to renew the permit, complies with the provisions of ORS 517.750 to 517.900 as amended and subsection (4) 517.990, the Rules and Regulations as promulgated to administer the Oregon Mined Land Reclamation Act, complies with the reclamation plan submitted, and maintains a performance bond as required by the Act.

RENEWED WITHOUT INSPECTION. THE DEPARTMENT RESERVES THE RIGHT TO INSPECT DURING CURRENT PERMIT YEAR AND TO ATTACH CONDITIONS FOR ANY DEFICIENCIES DETERMINED TO EXIST.

Issued this 25th day of March 1980

STATE DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

By Paul F Lawson Acting
Paul F. Lawson, Administrator
Mined Land Reclamation Division

SMLR-5-C

copies: Co
DEQ

STATE DEPARTMENT OF GEOLOGY
AND MINERAL INDUSTRIES

RENEWAL

SURFACE MINING

OPERATING PERMIT

Site Location

Sec.	Twp.	Rge.
	30S	6W

Hanna Mining Company
P. O. Box 85
Riddle, Oregon 97469

March 1980
Renewal Month

Fee $165.00 Paid

Douglas
County

THIS OPERATING PERMIT DOES NOT RELIEVE THE PERMITTEE FROM THE REQUIREMENTS OF CITY, COUNTY, OR OTHER GOVERNMENT AGENCY AUTHORITY

10-0026
Identification No.

Pursuant to ORS 517.830(4), this permit shall be in effect, unless revoked or suspended for cause, from the date of issuance and shall remain in effect so long thereafter as the Operator pays the annual fee of $165.00 to renew the permit, complies with the provisions of ORS 517.750 to 517.900 as amended and subsection (4) 517.990, the Rules and Regulations as promulgated to administer the Oregon Mined Land Reclamation Act, complies with the reclamation plan submitted, and maintains a performance bond as required by the Act.

ISSUED WITHOUT INSPECTION. THE DEPARTMENT RESERVES THE RIGHT TO INSPECT THE SITE DURING CURRENT PERMIT YEAR.

Issued this 28th day of February 19 79

STATE DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

Paul F Lawson
Field Representative, for Stanley L. Cummings, Administrator
Mined Land Reclamation Division

SMLR-5-C

Copies to: County
&
D.E.Q.

STATE DEPARTMENT OF GEOLOGY
AND MINERAL INDUSTRIES

SURFACE MINING

Renewal

OPERATING PERMIT

Hanna Mining Company
P. O. Box 85
Riddle, Oregon 97469

MARCH, 1979
Renewal Month

Fee $165.00 Renewal Pd.

10-0026
Identification No.

Site Location
Nickel Mountain
30S 6W
Sec. Twp. Rge.

Douglas
County

THIS OPERATING PERMIT DOES NOT RELIEVE THE PERMITTEE FROM THE REQUIREMENTS OF CITY, COUNTY, OR OTHER GOVERNMENT AGENCY AUTHORITY

This permit issued subject to conditions on the reverse side

Pursuant to ORS 517.830(4), this permit shall be in effect, unless revoked or suspended for cause, from the date of issuance and shall remain in effect so long thereafter as the Operator pays the annual fee of $50.00 to renew the permit, complies with the provisions of ORS 517.750 to 517.900 as amended and subsection (4) 517.990, the Rules and Regulations as promulgated to administer the Oregon Mined Land Reclamation Act, complies with the reclamation plan submitted, and maintains a performance bond as required by the Act.

Issued this 24th day of March 1978

STATE DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

By [signature] Title Administrator Mined Land Reclamation

SMLR-5-B

Copies to Co
WEZ

Condition

This permit is issued and recognizes the receipt of a tentative development plan for the entire Nickel Mountain mine site. This plan was received on March 10, 1978, and will be circulated to the appropriate Natural Resource Agencies upon notification by Hanna Mining Company that no further substantial changes are to be made.

NOTICE

The conditions of this permit are considered to be acceptable to the permittee unless written notice is received prior to the beginning of surface mining under this permit. Upon receipt of such notice by the Department, this permit is invalid and will be reissued when the conditions in question have been resolved.

A provisional operating permit may be issued according to the provisions of ORS 517.830 (2) and (3) and chapter 632, 30-030 (1) and (2) pending reissue of the operating permit.

STATE DEPARTMENT OF GEOLOGY
AND MINERAL INDUSTRIES

SURFACE MINING

OPERATING PERMIT

Hanna Mining Company
P. O. Box 85
Riddle, Oregon 97469

MARCH, 1977
Renewal Month

Site Location
Nickel Mountain
30S 6W
Sec. Twp. Rge.

Douglas
County

THIS OPERATING PERMIT DOES NOT RELIEVE THE PERMITTEE FROM THE REQUIREMENTS OF CITY, COUNTY, OR OTHER GOVERNMENT AGENCY AUTHORITY

Fee $50.00 renewal paid

10-0026
Identification No.

This permit issued subject to conditions on the reverse side.

Pursuant to ORS 517.830(4), this permit shall be in effect, unless revoked or suspended for cause, from the date of issuance and shall remain in effect so long thereafter as the Operator pays the annual fee of $50.00 to renew the permit, complies with the provisions of ORS 517.750 to 517.900 as amended and subsection (4) 517.990, the Rules and Regulations as promulgated to administer the Oregon Mined Land Reclamation Act, complies with the reclamation plan submitted, and maintains a performance bond as required by the Act.

This permit not subject to bonding as per provisions of ORS 517.770 (2) and ORS 517.810.

Issued this 23rd day of August 19 76

STATE DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

By L. L. Ormsbee Title Administrator Mined Land Reclamation

SMLR-5-B

Condition:

This permit is issued with the understanding that a development plan for the entire Nickel Mountain Mine is being prepared by Hanna Mining Company and will be made available for review and comment by the Mined Land Reclamation office when completed.

NOTICE

The conditions of this permit are considered to be acceptable to the permittee unless written notice is received prior to the beginning of surface mining under this permit. Upon receipt of such notice by the Department, this permit is invalid and will be reissued when the conditions in question have been resolved.

A provisional operating permit may be issued according to the provisions of ORS 517.830 (2) and (3) and chapter 632, 30-030 (1) and (2) pending reissue of the operating permit.

The Hanna Mining Company

Riddle, Oregon 97469

June 5, 1964

Mr. Hollis M. Dole, Director
Dept. of Geology & Mineral Industries
State of Oregon
1069 State Office Building
Portland 1, Oregon

Dear Hollis:

Some time ago, we leased some additional land from Douglas County and one of the provisions of the lease was that a determination be made as to whether or not any valuable minerals existed on these lands.

We have had John Cumberlidge check the lands carefully and two copies of his report are enclosed. Also Len Ramp spent two days with John on the property examining it and has stated that he agrees with John's findings. It is my understanding that Len will write you to confirm these conclusions. I am also enclosing a copy of the lease so you may confirm the provisions that I have referred to as set forth under item 4.

After you have examined this material, if you agree with our conclusions, I would very much appreciate your writing a letter to the Douglas County Court confirming that no valuable mineral exists on the land in question. You may wish to mail them one copy of the Cumberlidge report for their use.

Very truly yours,

THE HANNA MINING COMPANY

E. E. Coleman
General Manager-Oregon

EEC/il
Encls.

RECEIVED
JUN 9 1964
STATE DEPT. OF GEOLOGY
& MINERAL INDS.

INTER-OFFICE MEMORANDUM

The Hanna Mining Company
Riddle, Oregon

TO: E. J. Maney

DATE: 30 April, 1964

FROM: J. T. Cumberlidge

SUBJECT: Mineral Deposits in New Douglas County Mineral Leases.

This report covers a geological survey of certain Douglas County lands under mineral lease to The Hanna Mining Company. Description of the survey area follows.

T 30S, R 6W W. M., Douglas County, Oregon

Sec 18 — NW 1/4 SE 1/4; SW 1/4 SE 1/4
Sec 19 — NE 1/4 NE 1/4 ~~NE 1/4~~
Sec 20 — NW 1/4 NW 1/4; SW 1/4 NW 1/4; NW 1/4 SW 1/4

Survey Methods

Both pace and compass, and stadia traverses were used to cover the area. Stadia locations are correct to within a few feet; while pace and compass locations are probably correct to within a few tens of feet. Traverses were tied to corner posts, bench marks, and triangulated hubs where available.

Geology

The general geology in the area can be summarized as follows:

Younger Sediments. Umpqua Fm. (Eocene) and/or Knoxville Fm. (L. Cret). Chiefly siliceous pebble conglomerate with hard siliceous cement.

- - - - - Unconformity - - - - -

Peridotite and Dunite, serpentinized at contacts

- - - - - Intrusive (?) Contact - - - - -

Basalt and greenstone, locally andesitic

- - - - - Intrusive Contact - - - - -

Older Sediments. Dothan Fm. (Jur). Chiefly thinly bedded shales; indurated mudstones and sandstones, locally gritty. Usually steeply dipping. Brachiopods abundant along some bedding planes.

The relative age of the greenstone is in some doubt; and the distinction between Umpqua Fm and Knoxville Fm is not clear.

Older sediments can be seen at the centre and at the SE corner of Sec. 18. Almost the whole of the NW 1/4 of the SW 1/4 Sec. 20 is underlain by older sediments. Basalt and greenstone underlie most of NE 1/4 NE 1/4 Sec. 19 and NW 1/4 NW 1/4 Sec. 20. Peridotite and serpentinite cover most of the remaining area.

Potential Ore Deposits

The main reason for making this survey was to examine known mineralized areas and to check for potential ore deposits. The basalts and greenstones were checked primarily for traces of sulfides, the peridotite for Ni-laterite, chromite and magnetite. The sediments might generally be considered as unfavorable prospecting ground, however the outcrops were checked for mineral content with negative results.

A small area of Red Soil was located in the SE 1/4 Sec. 18 (see 1" = 400 ft. map). Surface exposures suggest that this is thin and probably contains low Ni values. This was the only area of potential Ni ore located by the survey, and only part of it is in the new mineral lease area.

An abandoned chromite pit in the NW 1/4 Sec. 20 was located. A thorough examination of the walls of the pit showed that all the available chromite ore has been mined out. Chromite can be seen on the waste dump but was not located in situ. Most of the chromite deposits in Southern Oregon occur as small pods or lenses, and this one seems to follow the rule. No other chromite veins were found.

Magnetite occurs in trace amounts throughout the peridotite, but no veins or pods of magnetite were found. The possibility of finding an iron deposit of commercial size is fairly well ruled out.

One basalt outcrop contained trace amounts of pyrite, but generally the basalts and greenstones are barren of sulfide mineralization. Quartz veins are few in number, and tend to be thin and discontinuous. No commercial gold deposit is indicated.

Summary

One small area of potential Ni ore was located. Peridotites, basalts and sediments covering the remaining area appear to be barren, and the chances of covering an ore deposit with mining waste appear to be vanishingly small.

J. T. Cumberlidge

J. T. Cumberlidge

JTC/jr

cc: E. E. Coleman
F. M. Chace
File (3)

Bergais

INTER-OFFICE MEMORANDUM

The Hanna Mining Company
Riddle, Oregon

TO: E. J. Maney DATE 21 May, 1964

FROM: J. T. Cumberlidge

SUBJECT: Auger Samples SE 1/4 Sec. 18.

Four hand auger samples were taken in the area of red soil shown on the 1 inch=400 ft geologic map previously submitted. Samples were augered or dug, and coned and quartered to about five pounds in the field. Colorimetric assay for Ni was made on a dried pulverized split. Sample descriptions follow.

Description	% Ni
Sample No. 1 Red soil and boulders. Depth approximately 2'6". Hit packed perid. boulders at 2½ ft.	1.00
Sample No. 2 Thin Red soil over tightly packed perid. boulders. Depth 1 ft. Several holes in this area gave some result.	0.98
Sample No. 3 Old test pit. 4 ft channel down wall. Red soil and very large perid. boulders, hence sample is biased low on perid, high on grade.	0.97
Sample No. 4 Red soil and perid. boulders. Depth 12". Tightly packed boulders at 12", possibly similar to sample 3.	0.71

These holes do not indicate any appreciable depth of red soil in this area. Furthermore, spot auger tests have caused me to redraw the red soil boundary so as to reduce almost to zero the area of red soil in the new Douglas County mineral lease lands.

Nickel assays are average for red soil. However, because a hand auger will not penetrate large peridotite boulders, and tends to push the smaller ones aside, the assays are probably biased on the high side. A reduction in grade of from 0.1% to 0.2% Ni would probably be realistic.

The way in which the peridotite boulders are packed suggests that this area of red soil may have been washed or slid from the main orebody. In any case, the tonnage of mineable ore is very small, and the grade marginal.

J. T. Cumberlidge

J. T. Cumberlidge

JTC/jr
cc: EEC, FMC - Cv.

December 7, 1942

702 Woodlark Building
Portland, Oregon

Mr. W. T. Lundy
Freeport Sulphur Company
122 East 42nd Street
New York City, New York

Dear Mr. Lundy: Subject: Riddle access road

Believe I suggested that you write St. Clair about having an estimate made on the cost of gravelling and maintaining the road you are using at Nickel Mountain. I think I can give you some assistance in getting some road work done under the same procedure that is used to obtain Federal aid for access roads to other strategic mineral deposits.

If you or St. Clair will send me an estimate of the cost of the road work, the description by section, township, and range of where the work is to be done, the length of the road to be improved, difference in the elevation of termini, and preferably a note from Freeport expressing your intention to continue work of development for some months, I shall be pleased to start the ball rolling. It should not take more than a couple of weeks to get action under present circumstances if equipment and materials are available to do the work in question.

Cordially yours,

Earl K. Nixon
Tech. Cons. Matls. Div.

EKN:jr
cc Mr. St. Clair

FREEPORT SULPHUR COMPANY

122 EAST 42ND STREET

NEW YORK 17, N.Y. July 17, 1950

Mr. Fay W. Libbey, Director
State Department of Geology
and Mineral Industries
702 Woodlark Building
Portland 5, Oregon

Dear Mr. Libbey:

Under our lease with the Oregon Nickel Mining Company we were required to furnish them with the results of our exploration work; accordingly, we have assumed that the Hanna Company has access to this information. Incidentally, since writing you before, I have remembered that at one time we gave the Bureau of Mines a complete report of our drilling there in connection with a program for the investigation of electric furnace treatment of the ore which they undertook for us under Zimmerley at Salt Lake City. I delivered the Riddle data personally to Mr. R. S. Dean in Washington. You may wish to pass this information along to your friends in the Bureau who are now interested in the property.

Very sincerely yours,

E. H. Thaete, Jr.

EHT:ffs

RECEIVED
JUL 21 [illegible]
STATE DEPT. OF GEOLOGY
& MINERAL INDS.

July 7, 1950

Mr. E. H. Thaete, Jr.
Freeport Sulphur Company
122 East 42nd Street
New York 17, New York

Dear Mr. Thaete:

I do not want to draw out too long this subject of obtaining your company's permission to take records of your drilling of the Nickel Mountain deposit out of our confidential file, but it occurs to me that since you state in your letter of July 5 that M.A. Hanna Company now has the lease, they would certainly want to obtain records of your drilling if they have not already done so. I would assume from your letter that this would be agreeable to you but wish you would verify it.

Thanking you and with very kind regards,

Sincerely yours,

Director

FWL:jr

FREEPORT SULPHUR COMPANY

122 EAST 42ND STREET

NEW YORK 17, N.Y.

July 5, 1950

Mr. F. W. Libbey, Director
State Department of Geology and
Mineral Industries
702 Woodlark Building
Portland 5, Oregon

Dear Mr. Libbey:

I do not think that my company would have any objections to your releasing to the Bureau of Mines the data on the Riddle, Oregon, nickel deposit which I sent you. However, we have long since relinquished our lease on the property and no longer have any interest in it and I am wondering if you should not request permission from the owners, the Oregon Nickel Mining Company of Oakland, California, and also from the present lessees, the M. A. Hanna Co. I understand that Mr. John K. Gustafson of Hibbing, Minnesota, is now looking after the Riddle work for Hanna and Mr. Vedensky, consulting metallurgical engineer of San Francisco, is doing some work for them on it.

It has been a good many years since I have had the opportunity of visiting with you in Portland and I should like to take this opportunity of renewing our acquaintance and extending my very best wishes.

Sincerely yours,

E. H. Thaete Jr

EHT:MM

E. H. Thaete

RECEIVED
JUL 7 1950
STATE DEPT. OF GEOLOGY
& MINERAL INDS.

June 19, 1950

Mr. E. H. Thaete, Jr.
Freeport Sulphur Company
122 East 42nd Street
New York 17, New York

Dear Mr. Thaete:

Please refer to some correspondence we had in February of 1947 referring to a map of the Nickel Mountain area, Oregon, drilled by your company together with assay records. You gave us these records on a confidential basis and we have held them under this condition ever since.

It now appears that the U. S. Bureau of Mines is planning some extensive field studies in the peridotite areas of Oregon which will be related to metallurgical research on nickel ores carried out at their Albany, Oregon laboratory. A copy of your records of drilling done on Nickel Mountain would undoubtedly be of great assistance to the Bureau and I am wondering if you would be willing to allow them to have a copy of the map which you sent to us.

Considering the quite critical nature of nickel in relation to national defense, it would seem to me that any assistance we can render in strengthening our domestic position in nickel would be of real service to the country.

Sincerely yours,

Director

FWL:jr

February 13, 1947

Mr. E. H. Thaete, Jr.
Freeport Sulphur Company
122 East 42nd Street
New York 17, New York

Dear Mr. Thaete:

Thank you for your letter of February 10.

I am today writing the Oregon Nickel Mining Company to inform them of our wish to do some testing work in the Riddle area this summer and I am also requesting their permission to have you furnish the geological map on a confidential basis, as mentioned in your letter.

We shall publish some preliminary information on Curry County laterite very soon and I shall be glad to send you the report.

A few days ago in looking through some of our records which are kept locked, I found a sealed map tube labelled "Property of Freeport Sulphur Company", which I think must have been left here by Mr. Nixon. Would you like to have us forward this to New York or Salt Lake City?

Kind regards,

Sincerely yours,

Director

FWL:jr

FREEPORT SULPHUR COMPANY

122 EAST 42ND STREET

NEW YORK 17, N.Y.

February 10, 1947

Mr. F. W. Libbey, Director
State Department of Geology
and Mineral Industries
702 Woodlark Building
Portland 5, Oregon

Dear Mr. Libbey:

Mr. Williams has asked me to reply to your letter of February 1st.

A short time ago, we were obliged to relinquish our lease on the Riddle orebody owing to the fact that we had been unable to develop a means for working the deposit commercially. Accordingly, I would suggest that you write to the Oregon Nickel Mining Company, Farmers and Merchants Savings Bank, 15th & Franklin Streets, Oakland, California, and request from them permission to do the work there that you have in mind.

We would, of course, be glad to furnish the geological map that you request, on a confidential basis, provided Oregon Nickel Mining Company would be willing that we should do so. Accordingly, when you write them, you might request this permission also. If you will write me as soon as you obtain approval from the Oregon Nickel Mining Company, I shall be glad to send you a copy of the map.

Incidentally, I should be very much interested in the occurrences of laterite in Curry County and would appreciate your sending me any published information which you may have available.

With very best wishes.

Very sincerely yours,

E. H. Thaete, Jr.

EHT:mh

FEB 13 1947
STATE DEPT OF GEOLOGY
& MINERAL INDS.

Estate of
EDSON F. ADAMS
~~FARMERS AND MERCHANTS~~
~~SAVINGS BANK~~
OAKLAND
CALIF.

Room 401
1706 Broadway

September 5, 1947

F. W. LIBBEY, Director
State Department of Geology and
Mineral Industries
702 Woodlark Building
Portland 5, Oregon

Dear Mr. Libbey:

Thanks for your letter of September 2nd regarding Nickel Mountain.

We have made no firm commitment but have given the M. A. Hanna Company permission to examine our property at their request.

As I explained to you when in Portland, my responsibility as Executor of the Estate of Edson F. Adams is to liquidate its affairs promptly and should the Hanna people call upon you for any information it will be appreciated if you can help them.

I do not know how far their investigation will go but I did tell them that you had done some work on the property.

Very truly yours,

F. J. EARLY

RECEIVED
SEP 8 1947
STATE DEPT OF GEOLOGY
& MINERAL INDS.

September 2, 1947

Mr. F. J. Early
Room 401, 1706 Broadway
Oakland, California

Dear Mr. Early:

When you called at this office, I told you that we were planning to continue this summer our studies of nickel occurrences in southwestern Oregon and that I would write you when we obtained some results of the study which might bear on the Nickel Mountain deposit.

Although we do not have any definite results as yet, I have just returned from a field trip in which we did some sampling on several of these deposits including a few samples on Nickel Mountain. The Freeport Sulphur Company has done so much work on Nickel Mountain that the little we could do would hardly add very much to our present knowledge. I wish to state, however, that I was very favorably impressed with possibilities on Nickel Mountain after studying the area using records and maps furnished me by Freeport Sulphur Company. I should be very much interested to know if you have made any deal with a company for further investigation of the Nickel Mountain deposit.

Very truly yours,

Director

FWL:jr

FREEPORT SULPHUR COMPANY

122 EAST 42ND STREET

NEW YORK 17, N.Y.

April 3, 1947

Mr. F. W. Libbey, Director
State Department of Geology and
Mineral Industries
702 Woodlark Building
Portland 5, Oregon

Dear Mr. Libbey:

Thank you very much for sending me a copy of your report on the nickel-bearing laterite at Red Flat, Oregon.

I think that a detailed search of the areas of basic igneous rocks in southwestern Oregon may reveal a number of lateritic deposits similar to Riddle or the Red Flat deposit. As I wrote you before, we made some investigation of the area south of Riddle to the California line and found small unimportant deposits on Eight Dollar Mountain and Woodcock Mountain. We were guided in our search by recognizing the terrace remnants of the old erosional surface described by Hobbs and Pecora.

You might be interested in having your department continue the investigation of this general area, and it is possible that other deposits as large or even larger than Riddle might be discovered.

Very sincerely yours,

E. H. Thaete, Jr.

EHT:mh

APR 5 1947
STATE DEPT OF GEOLOGY & MINERAL INDS.

March 8, 1947

Mr. E. H. Thaete, Jr.
Freeport Sulphur Company
122 East 42nd Street
New York 17, New York

Dear Mr. Thaete:

Thank you very much for your interesting letter of March 3 enclosing the maps showing the geology and records of drilling by Freeport Sulphur Company. These will be of very great assistance to us. As stated before, we shall hold this information as confidential.

Referring to the last paragraph of your letter, I would appreciate it greatly if you would comment at such length as you wish on the ideas you have on the subject of the occurrence of nickel in the peridotite areas. I am sure that your comments would be of great help to us.

Sincerely yours,

Director

FWL:jr

FREEPORT SULPHUR COMPANY

122 EAST 42ND STREET

NEW YORK 17, N.Y.

March 3, 1947

Mr. F. W. Libbey, Director
State Department of Geology and
Mineral Industries
702 Woodlark Building
Portland 5, Oregon

Dear Mr. Libbey:

I am enclosing herewith for your confidential use a geological map of the Riddle deposit and a map showing the location of our prospect holes on which a summary of the sampling results has been printed. By using these data, one of your engineers can give you a very clear picture of this nickel occurrence.

The geological picture is, of course, relatively simple. The fresh peridotite contains small amounts of nickel usually in the range of .2% to .3% which when subjected to lateritic weathering becomes concentrated into higher percentages that give indications of being of economic interest. Accordingly, at Riddle the higher nickel values are confined to the altered peridotite.

We have added practically nothing to the geological picture presented by Hobbs and Pecora in the USGS bulletin on Riddle which you no doubt have already read. As you can see from our drilling, Pecora's "root pockets" occasionally extend much deeper into the peridotite mass than he had visualized.

I should also emphasize the importance of topography in connection with the Riddle deposit. This has been discussed in some detail by Hobbs and Pecora, and by following their conclusions, we were able to discover two other deposits, one on Eight Dollar Mountain and the other on Woodcock Mountain, several miles to the south of Riddle. Being small and low-grade, they are, of course, of only academic interest. However, it is possible that other areas of basic rock in western Oregon might contain deposits similar to Riddle.

If a general reconnaissance of the area would be of interest to your department, I would be glad to hear from you as I have some ideas about it that I think would be worth considering.

Very sincerely yours,

E. H. Thaete, Jr.

EHT:mh
encls.

February 24, 1947

Mr. F. J. Early
Room 401, 1706 Broadway
Oakland, California

Dear Mr. Early:

Thank you very much for your letter of February 21. I have forwarded a copy to the Freeport Sulphur Company.

I am very glad to have the information concerning the testing work by the U. S. Bureau of Mines Albany station. I shall get in touch with Mr. Shelton so that there will be a minimum of duplication of work on Nickel Mountain.

Yours very truly,

Director

FWL:jr

Estate of
EDSON F. ADAMS
FARMERS AND MERCHANTS
SAVINGS BANK
OAKLAND
CALIF.
Room 401
1706 Broadway

February 21, 1947

Mr. F. W. Libbey, Director
State Department of Geology &
Mineral Industries
702 Woodlark Building
Portland 5, Oregon

Dear Sir:

Your letter of February 13, addressed to the Oregon Nickel Mining Company, has been referred to me as one of the Executors of the Estate of Edson F. Adams, principal owner in the Oregon Nickel mining property.

We have no objection to you doing some exploration work on the property and we have no objection to the Freeport Sulphur Company furnishing you with any information they wish to give you.

It may interest you to know that we have received a letter from Stephen M. Shelton, Chief of the Metallurgical Branch of the Bureau of Mines , Albany, Oregon, requesting permission to pick up as much as 50 tons of ore in connection with their investigation of the property. We are enclosing a duplicate of this letter, should you desire to forward it to the Freeport Sulphur Company as authority from us for you to accept any information they are willing to furnish you.

Very truly yours,

T. H. Early

RECEIVED
FEB 24 1947
STATE DEPT OF GEOLOGY
& MINERAL INDS.

February 13, 1947

Oregon Nickel Mining Company
Farmers and Merchants Savings Bank
13th & Franklin Streets
Oakland, California

Gentlemen:

Last summer this Department did some exploration work in testing certain characteristics of nickel-bearing laterites in Curry County, Oregon. During the coming summer we wish to carry on the same type of testing work in the Riddle area and this letter is a request for permission for us to put down a few shallow auger drill holes on your property.

I requested some information on a confidential basis from the Freeport Sulphur Company and was informed that this company would be glad to furnish us with a geological map of your property provided you would be willing. The map would, of course, be kept confidential and would be used only to assist us in our work and would not be for publication. The results of our work on Oregon nickel-bearing laterites will be published sometime. We are planning to get out a preliminary report on our work in Curry County in the near future.

Yours sincerely,

Director

FWL:jr

February 24, 1947

Mr. E. H. Thaete, Jr.
Freeport Sulphur Company
122 East 42nd Street
New York 17, New York

Dear Mr. Thaete:

Thank you for your letter of February 20. We are forwarding you today by express the map tube which was left in this office by Mr. Nixon.

I am enclosing copy of letter received from Mr. F. J. Early, an executor of the estate of Edson F. Adams. This letter is self-explanatory. If you have any records other than the geologic map which you would be willing to release to us on a confidential basis, of course we should be very glad to have such information and it might shortcut some of our field work.

With best regards.

Yours sincerely,

Director

FWL:jr
Encl.

FREEPORT SULPHUR COMPANY

122 EAST 42ND STREET

NEW YORK 17, N.Y.

February 20, 1947

Mr. F. W. Libbey, Director
State Department of Geology
and Mineral Industries
702 Woodlark Building
Portland 5, Oregon

Dear Mr. Libbey:

I have no idea of what might be in the sealed map tube which was undoubtedly left in your office some time ago by Mr. Nixon. However, would you be good enough to forward it to me, express collect. Should there be anything belonging to Mr. Nixon in it, I will, of course, send it along to him.

I note from a recent news item that he has accepted a position with the Kansas State Geological Survey, but I regret to say that I have not heard from him personally since he resigned from the company.

Best wishes.

Very sincerely yours,

E. H. Thaete, Jr.

EHT:mh

RECEIVED
FEB 24 1947
STATE DEPT OF GEOLOGY
& MINERAL INDS.

April 29th 1946

Mr. LaMont West,
Freeport Sulphur Company,
PO Box 1556, Salt Lake City, Utah

Dear Mr. West:

Please refer to your letter of the 22nd regarding the box of stationery and office supplies left with us by Mr. MacAfree for Mr. Nixon.

This box was forwarded April 27th by prepaid express. If you do not receive it in due season, please advise us.

Yours very truly,

for F. W. Libbey, Director

fas/

FREEPORT SULPHUR COMPANY

122 EAST 42ND STREET

NEW YORK 17, N.Y.

P. O. Box 1556
Salt Lake City, Utah

April 22, 1946

Mr. F. W. Libbey
Director
State Dept. of Geology & Mineral Industries
702 Woodlark Building
Portland 5, Oregon

Dear Mr. Libbey:

Your letter of April 17, addressed to Dr. Ralph E. Taylor, has been brought to my attention.

We will appreciate it if you will send to this office the cardboard box containing stationery, office supplies and other items left at your office last year by Mr. Mac Afee.

We appreciate your kindness in bringing this matter to our attention.

Very truly yours

LaMont West

LMW:mw

RECEIVED
APR 26 1946
STATE DEPT OF GEOLOGY
& MINERAL INDS

April 17, 1946

Mr. R. E. Taylor
Freeport Sulphur Company
810 Walker Bank Building
Salt Lake City, Utah

Dear Mr. Taylor:

Early last year Mr. MacAfee left a small cardboard box containing stationery and office supplies, together with a roll containing a few maps, at this office for Mr. Nixon. These packages were never taken away by Mr. Nixon and it seems to me that you would wish to have them sent to you.

If you will so advise us, we will be glad to ship them.

Yours very truly,

Director

FWL:jr

FREEPORT SULPHUR COMPANY

122 EAST 42ND STREET

NEW YORK

810 Walker Bank Building
Salt Lake City, Utah
January 15, 1946

State Department of Geology & Mineral Industries
702 Woodlark Building
Portland 5, Oregon

Dear Sirs:

I am writing to advise that the Freeport Sulphur Company has changed its mailing address from 55 New Montgomery Street, San Francisco to P. O. Box 1556, Salt Lake City 11, Utah. I shall appreciate it very much if you will continue us on your mailing list, using this new address.

Yours very sincerely

R. E. Taylor

RET:jb

RECEIVED
JAN 18 1946
STATE DEPT OF GEOLOGY
& MINERAL INDS.

CLASS OF SERVICE

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WESTERN UNION

(50)

NEWCOMB CARLTON
CHAIRMAN OF THE BOARD

J. C. WILLEVER
FIRST VICE-PRESIDENT

N. WILLIAMS
PRESIDENT

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DL = Day Letter
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BG323 59 DLC=TDBG RIDDLE ORG 21 1224P JAN 21 PM 12 50

STATE DEPT OF GEOLOGY=

702 WOODLARK BLDG PORTLAND ORG=

WOULD APPRECIATE YOUR CONTACTING R N KELLOGG SENIOR ENGINEER PRA PORTLAND AND ADVISING HIM AS FOLLOWS ROADS SERIOUSLY DAMAGED BY HEAVY SLIDE CAN HE SHIP SMALL SHOVEL IMMEDIATELY TO BEGIN REPAIR WORK ALSO AS MANY TRUCKS AS POSSIBLE SUGGEST HE PHONE ME COLLECT SOON AS POSSIBLE. I HAVE NOTHING BUT HIS POST OFFICE NUMBER AND CANNOT REACH HIM DIRECT=

FREEPORT SULPHUR CO DAVID STCLAIR.

JAN 21 1943

PRA

THE COMPANY WILL APPRECIATE SUGGESTIONS FROM ITS PATRONS CONCERNING ITS SERVICE

January 11, 1943

702 Woodlark Building
Portland, Oregon

Mr. David St. Clair, Geologist
Freeport Sulphur Company
Riddle, Oregon

Dear Dave:

Please tell Mr. Wilson that the property about a mile south of Glendale, the name of which I was trying to remember, is the Willis Mine and the owner is, or was, one Adeline Willis. The "mine" consists of a tunnel about 200 feet long, carrying as I recall disseminated pyrite for its entire length. I looked at it in 1938, but am advised by our Grants Pass laboratory that they do not have pulps of samples sent in that long ago. The mineralization carried no precious metals worth the name and probably little if any copper.

Ray Treasher reminds me that the Benton Mine, a gold operation closed down a few months ago, carried a lot of sulphides that he believes are copper free. I will check on that here in Portland and advise if it looks any good.

Public Roads Administration advised me that their forms and recommendations went in to Washington on your access road project on December 30. I have this morning wired Mr. Hughey B. Hudson, Chief of Access Roads Section, W.P.B., asking that he expedite this project all possible.

Sincerely yours,

Earl K. Nixon
Tech. Cons. Matls. Div.

EKN:jr

Charge to the account of _____ $_____

CLASS OF SERVICE DESIRED			
DOMESTIC		CABLE	
TELEGRAM		ORDINARY	
DAY LETTER		URGENT RATE	
SERIAL		DEFERRED	
OVERNIGHT TELEGRAM		NIGHT LETTER	
SPECIAL SERVICE		SHIP RADIOGRAM	

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WESTERN UNION

1206

A. N. WILLIAMS, PRESIDENT — NEWCOMB CARLTON, CHAIRMAN OF THE BOARD — J. C. WILLEVER, FIRST VICE-PRESIDENT

CHECK
ACCOUNTING INFORMATION
TIME FILED

Send the following telegram, subject to the terms on back hereof, which are hereby agreed to

WANT A REPLY?
"Answer by WESTERN UNION" or similar phrases may be included without charge.

JANUARY 12, 1943

MR. DAVID ST. CLAIR
FREEPORT SULPHUR COMPANY, RIDDLE, OREGON
(TELEPHONE RIDDLE 125)

HUDSON ACCESS ROADS CHIEF WPB WIRES QUOTE ACCESS ROAD NICKEL MOUNTAIN MINE OF FREEPORT SULPHUR WAS RECOMMENDED ON JANUARY 7 UNQUOTE. THIS MEANS PROJECT CLEARED BY ACCESS ROAD SECTION WPB AND PRESUMABLY BUT NOT NECESSARILY BY REQUIREMENTS COMMITTEE. PROBABLY NOW IN HANDS OF PUBLIC ROADS ADMINISTRATION. SUGGEST YOUR EASTERN CORRESPONDANT CONTACT MACDONALD COMMISSIONER PUBLIC ROADS PRA WASHINGTON EXPRESSING WPB DESIRE FOR SPEED.

KARL K. NIXON
TECH. CONS. MATLS. DIV.

Send Day letter - government rate
Charge to: State Dept. of Geology
702 Woodlark Building

See Nixon telegram to Stowe re Gen. Acc. Road file

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WESTERN UNION

(34)

A. N. WILLIAMS, PRESIDENT — NEWCOMB CARLTON, CHAIRMAN OF THE BOARD — J. C. WILLEVER, FIRST VICE-PRESIDENT

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BG323 26=TDBG RIDDLE ORG 9 633P Dlr Mon am 1943 JAN 9 PM 6 39

EARL K NIXON= 702 Woodlack Bldg

Dlr ~~2527 SOUTHEAST MARKET~~ PORTLAND ORG=

PLEASE PHONE ME COLLECT RIDDLE 125 YOUR CONVENIENCE REGARDING POSSIBILITY OUR EXPEDITING PRA ACTION THROUGH EASTERN CONTACTS. WE HAVE LOCATED CONTRACTOR WHO CAN BEGIN WORK IMMEDIATELY=

DAVID STCLAIR.

1943

125 PRA.

RECEIVED JAN 11 1943 STATE DEPT OF GEOLOGY & MINERAL INDS.

Wl6-1028P mc note left

Ea 5218

To EKN

MC 1040P To Dlr Mgr

WE 650P Cate EC

THE COMPANY WILL APPRECIATE SUGGESTIONS FROM ITS PATRONS CONCERNING ITS SERVICE

RECEIVED
DEC 31 1942
STATE DEP'T OF GEOLOGY
& MINERAL INDS.

December 30, 1942

AIR MAIL

Commissioner of Public Roads
Public Roads Administration
Washington, D. C.

Dear Sir:

Further reference is made to the PR-DA-1 proposing access construction to the Nickel Mountain Mine in Douglas County, Oregon, forwarded you with our letter of December 16. The endorsement of the Bureau of Mines has now been received, and the following documents necessary for certification are forwarded, in duplicate, accordingly:

1. Project statement
2. Preliminary Report
3. Sketch map
4. PR-DA-1 prepared by the Bureau of Mines
5. PR-DA-1 prepared by Earl K. Nixon

The number Oregon DA-RM-27 has been assigned to this project.

Since the purpose of this proposal is to provide for winter hauling and since the road is at present practically impassable, these papers are being forwarded directly to you, rather than through the Regional office, so that no delay in the start of construction will result if the project is certified.

The work is considered to be essential to the war effort and its postponement would be detrimental to the war effort. The scope of the work is considered to be the simplest consistent with providing reasonably adequate temporary service. Equipment and personnel should be available to carry on the work, either as a day labor job or as a negotiated contract, particularly during the coming winter months.

Very truly yours,

W. H. LYNCH
District Engineer

By
L. J. Caufield
Sr. Highway Engineer

Attach.

CC - Fed. Aid
Regional office
F. H.
E. K. Nixon

(COPY)

Form PR-DA-1

Place Portland, Oregon
Date December 15, 1942

District Engineer
Public Roads Administration

W. H. Lynch, District Engineer, Public Roads Administration,
Box 3900, Portland, Oregon.

Dear Sir:

The provision of access road to a source of raw materials in Douglas County, Oregon is considered to be of importance to the war effort. The raw materials source is known as Nickel Mountain Mine and is situated Sec. 17, T. 30 S., R. 6 W. Information can be obtained locally from Mr. A. A. Gustafson, Engineer of the Freeport Sulphur Co., Riddle, Oregon.

Investigation by Forest Service shows - it is believed there is over million tons of better than 1% nickel ore.

Study by Forest Service shows that 8.0 miles of betterment type road between the existing county road and summit vicinity of Nickel Mountain will be required, estimated to cost $12,000.00.

Upon completion of the access road the property will be developed by Freemont Sulphur Company, Riddle, Oregon.

Request is made for cooperative construction, improvement by the Forest Service.

By _____ Name
_____ Title
_____ Address

The Bureau of Mines considers the proposed work to be justified by the potential production from this source of raw material.

By /s/ PAUL T. ALLSMAN, PRINCIPAL MINING ENGR.
PAUL T. ALLSMAN
FOR S. R. ZIMMERLEY, REGIONAL ENGINEER
WESTERN REGION

1600 E. 1st So. St., Salt Lake City, Utah.

CLASS OF SERVICE

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WESTERN UNION

1201

(40)

SYMBOLS

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NT = Overnight Telegram
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A. N. WILLIAMS, PRESIDENT
NEWCOMB CARLTON, CHAIRMAN OF THE BOARD
J. C. WILLEVER, FIRST VICE-PRESIDENT

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1942 DEC 28 PM 1 41

BG329 10=TDBG RIDDLE ORG 28 132P

EARL K NIXON, DEPT OF MINERAL INDUSTRY=

WOODLARK BLDG PORTLAND ORG=

PLEASE PHONE ME COLLECT REGARDING PROGRESS OF ROAD PROGRAM

REGARDS

=DAVID STCLAIR.

RECEIVED
DEC 28 1942
STATE DEP'T OF GEOLOGY
& MINERAL INDS.

THE COMPANY WILL APPRECIATE SUGGESTIONS FROM ITS PATRONS CONCERNING ITS SERVICE

HEAD OFFICE

ESTABLISHED 1891

THE UNITED STATES NATIONAL BANK

OF PORTLAND, OREGON

CABLE ADDRESS:
"UNITBANK"

December 24, 1942.

PAUL S. DICK
PRESIDENT

Mr. E. K. Nixon, Director
State Department of Geology
and Mineral Industries,
Woodlark Building,
Portland, Oregon.

Dear Mr. Nixon:

Thanks for your thoughtfulness in supplying me with a copy of your letter of December 23, 1942, to Mr. E.S.McClain, Manager of our Roseburg Branch.

It is the policy of the Head Office to encourage Branch Managers to cooperate with the business leaders of their respective communities, and to assist in attracting new business whenever possible. Mr. McClain is a capable, aggressive type, and is decidedly interested in the up-building of Douglas County.

With cordial best wishes and the Compliments of the Season, I am,

Sincerely,

D H

President.

Marked Mt Access Rd.

RECEIVED
DEC 26 1942
STATE DEPT OF GEOLOGY
& MINERAL INDS.

December 23, 1942

Mr. E. S. McClain, Manager
The U. S. National Bank
Roseburg, Oregon

Dear Mr. McClain:

Thank you for your letter of December 17. I am pleased to note that you are interested in furthering the program of the Freeport Sulphur Company in their exploration of the Riddle nickel property.

Might advise you that I discussed the predicament from the road angle of the Freeport people with their president in New York on November 25 and promised at that time to see what I could do about Federal aid toward road repairs. On returning here I sponsored, as a representative of the War Production Board, a road maintenance project estimated to cost about $12,000 and got the project on its way east about a week ago.

Under the circumstances then, the matter you bring to my attention has been taken care of in as satisfactory a way as I know how, although I am sure you will find it will be some little time on account of red tape before the project is approved. I should say it will be some time in January, 1943.

Your interest in calling this road matter to our attention nevertheless warrants favorable comment on our part, and we want you to know that this Department is ready at all times to give ear to responsible parties interested in furthering mining development of the State.

Cordially yours,

Director

EKN:jr
cc Mr. Paul Dick

HEAD OFFICE

ESTABLISHED 1891

THE UNITED STATES NATIONAL BANK

OF PORTLAND, OREGON

CABLE ADDRESS:
"UNITBANK"

ROSEBURG BRANCH
ROSEBURG, OREGON

RECEIVED
DEC 21 1942
STATE DEPT OF GEOLOGY
& MINERAL INDS.

December 17, 1942

Mr. Earl Nixon
State Department of Mines
Salem, Oregon

Dear Sir:

You are doubtless aware that the Freeport Sulphur Company has been expending considerable money in the southern part of Douglas county in preliminary work looking toward the possible establishment of a nickel mine.

It is understood that they now have three diamond drills operating on the property but that they have had some difficulty getting material and supplies in because of the condition of something in the neighborhood of five miles of road which leads to the property from Riddle. The road has been abandoned by the county, and efforts to have the county assist either through the lending of equipment or direct maintenance have been unsuccessful. The company has, therefore, had to spend considerable of its own funds in order to keep the road in condition for use.

Having in mind the expensive work being done by the Public Roads Administration in the Coquille area in connection with chrome, it has occurred to me to inquire upon what basis the company might be able to secure assistance on this small stretch of road. If you care to write to me in a general way along these lines I can refer the company to you if there appears to be any opportunity for working out something which would be practical. It seems that this is something in which the government might be interested as every bit of time which the company must give to maintaining the road detracts from its prospecting efforts, and if the prospect should develop satisfactorily the subsequent necessity for constructing roads would delay the actual operation of a mine.

Yours very truly,

E. S. McClain
Manager

ESM:EB

WAR PRODUCTION BOARD

WASHINGTON, D. C.

December 23, 1942. IN REPLY REFER TO:

Mr. Earl K. Nixon,
702 Woodlark Building,
Portland, Oregon.

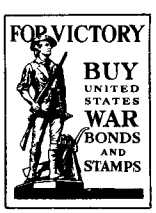
My dear Mr. Nixon:

With reference to your telegram of December 12 concerning Freeport Sulphur Company's Oregon nickel exploration, this is to advise that we have submitted this matter to the proper authorities, but they are unable to give us the necessary information at this time but will advise us just as soon as they can secure this information.

Sincerely yours,

H. B. Hudson, Chief,
Access Roads Section.

RECEIVED
DEC 30 1942
STATE DEP'T OF GEOLOGY
& MINERAL INDS.



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DOMESTIC		CABLE	
TELEGRAM		ORDINARY	
DAY LETTER		URGENT RATE	
SERIAL		DEFERRED	
OVERNIGHT TELEGRAM		NIGHT LETTER	
SPECIAL SERVICE		SHIP RADIOGRAM	

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WESTERN UNION

1206

A. N. WILLIAMS, PRESIDENT
NEWCOMB CARLTON, CHAIRMAN OF THE BOARD
J. C. WILLEVER, FIRST VICE-PRESIDENT

CHECK
ACCOUNTING INFORMATION
TIME FILED

Send the following telegram, subject to the terms on back hereof, which are hereby agreed to

WANT A REPLY?
"Answer by WESTERN UNION" or similar phrases may be included without charge.

DECEMBER 12, 1942

DR. WILBUR A. NELSON, ADMINISTRATOR
MINING BRANCH, WAR PRODUCTION BOARD
TEMPORARY R BUILDING, WASHINGTON, D.C.

PLEASE CONSIDER THEN CONVEY FOLLOWING TO NICKEL CHIEF FOR IMMEDIATE ACTION IF JUSTIFIED. FREEPORT SULPHUR HAVE SPENT PROBABLY THIRTY FORTY THOUSAND OREGON NICKEL EXPLORATION. NOW USING THREE DRILLS AND ADDING ANOTHER. COMMITTED TO SPEND ADDITIONAL FIFTY THOUSAND APPROXIMATELY IN LIGHT PRESENT RESULTS. GEOLOGICAL SURVEY ESTIMATES SIX MILLION TONS ONE TO TWO PERCENT NICKEL. FREEPORT ENDEAVORING INCREASE TONNAGE. WEATHER CONDITIONS SNOW RAIN RENDERING EIGHT MILE ROAD IMPASSABLE. PRA ESTIMATES TWELVE THOUSAND DOLLARS GRAVEL AND MAINTAIN. PERSONALLY RECOMMEND IMMEDIATE EXPENDITURE BUT DESIRE REACTION NICKEL SECTION RETURN WIRE. IF FAVORABLE WILL START ROAD PROJECT DETAILS. HAVE NO WORD ON ANYTHING FROM ACCESS ROAD SECTION SINCE I LEFT WASHINGTON.

EARL K. NIXON
TECH. CONS. MATLS. DIV., W.P.B.

Send Night Letter - government rate
Send COLLECT

Nickel Mt.

Form No. PR-DA-1
Nickel Mountain Access Road

Portland, Oregon
December 15, 1942

EK.N Copy

Mr. W. H. Lynch, District Engineer
Public Roads Administration
Box 3900
Portland, Oregon

Dear Sir:

The provision of an access road to a source of raw materials in Douglas County, Oregon, is considered of importance to the war effort. The raw materials source is known as the Nickel Mountain Mine and is situated in Sec. 17, T. 30 S., R. 6 W., W. M. Information can be obtained locally from Mr. A. A. Gustafson, engineer of the Freeport Sulphur Company, Riddle, Oregon.

Investigation by _____
(U.S.Bureau of Mines-Geo. Survey)
showed _____

_____
(Information as to ore, content, extent, etc.)

Study by the Public Roads Administration shows that 8.0 miles of betterment construction between the existing county road and summit vicinity of Nickel Mountain will be required, estimated to cost $12,000.00.

Request is made for construction by the Public Roads Administration.

/s/ E. K. NIXON
Tech. Cons. Mtls. Div.
War Production Board

The _____ considers
(Bureau of Mines-Geo. Survey)
the proposed work to be justified by the potential production from this source of raw material.

_____(Name)

_____(Title)

C
O
P
Y

WAR PRODUCTION BOARD

Washington, D.C.

December 5, 1942

702 Woodlark Building
Portland, Oregon

Mr. W. H. Lynch, District Engineer
Public Roads Administration
Postal Building
Portland, Oregon

Dear Mr. Lynch: Subject: Riddle nickel access road

I wish to request that you take whatever action is necessary to initiate an access road project for maintenance or improvement of a road near Riddle, Oregon, southwest of Roseburg, that leads to what is known as the Riddle nickel deposit. I am not concerned with who officially sponsors the road, whether it is I or Freeport Sulphur Company or who. I am merely anxious to get some action on it.

The situation is as follows: There is no production of virgin nickel in the United States. The Oregon deposit near Riddle is described to me by Dr. D. F. Hewitt of the U. S. Geological Survey as one of only two or three known deposits in the United States that may have a chance for commercial production. The Freeport Sulphur Company became interested in this deposit a year ago this month and started active development as soon as a contract or lease was completed which was early this season. They have been developing with one drill and I recently learned, while visiting their New York office last week, they are adding one or two drills in order to expedite the work. If you are not familiar with the Freeport Company, I might say that they are one of the two largest producers of sulphur in the United States and a very large producer of manganese from their Cuban operations, and they are now engaged in building a very large nickel plant in Cuba with U. S. Government funds. I should say that assistance on a road to their exploration is indeed justified.

I have just received a letter from Mr. A. A. Gustafson, engineer with the Freeport Company and whose address is Box 160, Riddle, Oregon, indicating that the company is carrying on some road work with two teams and two trucks as the road has been quite impassable. I have agreed to look into the question of obtaining some assistance through the access road arrangement and that is my reason for writing you. I hope you will be able to have an engineer make an estimate of the amount of gravel or work that is necessary to permit the nickel exploration to carry on satisfactorily. Your engineer should contact Mr. Gustafson at Riddle.

The exploration is located on what is known as Nickel Mountain, seven or eight miles of Riddle and is not in the U. S. Forest Service area so far as I know. Gustafson states that the County authorities have been unable to give them any assistance for lack of funds. I had suggested that they obtain the estimate of a County road engineer but apparently that cannot be done.

The maintenance or betterment in question at the present stage of development of the nickel deposit should be merely enough to permit the Freeport people to get out and in in connection with their drilling. Later if it should happen that conditions justify the building of a plant, a thorough job of the road building can be considered.

Thanking you, I am,

Very truly yours,

/s/ Earl K. Nixon
Tech. Cons. Matls. Div.

EKN:jr
cc H. G. Iverson
cc Forest Service

FREEPORT SULPHUR COMPANY

122 EAST 42ND STREET

NEW YORK

Box 160
Riddle, Oregon
December 11, 1942

Mr. Earl K. Nixon
702 Woodlark Building
Portland, Oregon

Subject: Riddle access road

Dear Mr. Nixon:

In accordance with the request contained in your letter of December 7 to Mr. Lundy, we are submitting herewith our estimate of the cost of graveling and repairing the road to the upper workings on Nickel Mountain. The estimate also includes the cost of building and surfacing about one additional mile of road to the summit of the mountain. This additional mile is required in order that we may reach all favorable ground with our drills and trucks. During the past five months we have maintained a crew of men on the mine road during a large part of the time and, for the past month, we have had a gravel truck and two teams of horses at work in an attempt to keep the road in passable condition. From the point at which the road branches off the county road to the upper workings, the distance is about seven and one-half miles and, of this distance, we have now graveled approximately one and one-half miles. Our estimate for putting the remainder of the road in condition is attached.

Mr. McMullen of the Public Roads Administration visited us on Wednesday in company with Mr. Harpham of the Forest Service, and he assured me that the P.R.A. was going to take some immediate action with regard to our problem.

We appreciate the steps you have taken to get this matter under way and wish to take this opportunity to thank you for the cooperation you have continued to give us during our prospecting at Riddle.

With kindest personal regards, I am

Yours very truly,

David St. Clair

DS:ptl
cc: Mr. Lundy
Mr. Gustafson

ROAD ESTIMATE

Graveling:	
6 miles, 6000 yards gravel, $1.25	$ 7500
Ditching, widening and cleaning landslides:	1000
Culverts:	
25 - Material, $15.00; Labor, $30.00	1125
Turnouts:	
25 at $25.00	625
New Road:	
1 mile	
Graveling	1250
Bulldozing	750
	$12250
Moving in, Supervision:	1000
Contingencies - 10%:	1325
	$14575
Cost of gravel if charged for by County:	
7000 yards at $.35	2450
Total:	$17025

December 5, 1942

702 Woodlark Building
Portland, Oregon

Mr. W. H. Lynch, District Engineer
Public Roads Administration
Postal Building
Portland, Oregon

Dear Mr. Lynch: Subject: Riddle nickel access road

I wish to request that you take whatever action is necessary to initiate an access road project for maintenance or improvement of a road near Riddle, Oregon, southwest of Roseburg, that leads to what is known as the Riddle nickel deposit. I am not concerned with who officially sponsors the road, whether it is I or Freeport Sulphur Company or who. I am merely anxious to get some action on it.

The situation is as follows: There is no production of virgin nickel in the United States. The Oregon deposit near Riddle is described to me by Dr. D. F. Hewitt of the U. S. Geological Survey as one of only two or three known deposits in the United States that may have a chance for commercial production. The Freeport Sulphur Company became interested in this deposit a year ago this month and started active development as soon as a contract or lease was completed which was early this season. They have been developing with one drill and I recently learned, while visiting their New York office last week, they are adding one or two drills in order to expedite the work. If you are not familiar with the Freeport Company, I might say that they are one of the two largest producers of sulphur in the United States and a very large producer of manganese from their Cuban operations, and they are now engaged in building a very large nickel plant in Cuba with U. S. Government funds. I should say that assistance on a road to their exploration is indeed justified.

I have just received a letter from Mr. A. A. Gustafson, engineer with the Freeport Company and whose address is Box 160, Riddle, Oregon, indicating that the company is carrying on some road work with two teams and two trucks as the road has been quite impassable. I have agreed to look into the question of obtaining some assistance through the access road arrangement and that is my reason for writing you. I hope you will be able to have an engineer make an estimate of the amount of gravel or work that is necessary to permit the nickel exploration to carry on satisfactorily. Your engineer should contact Mr. Gustafson at Riddle.

The exploration is located on what is known as Nickel Mountain, seven or eight miles south of Riddle and is not in the U. S. Forest Service area so far as I know. Gustafson states that the County

(over)

authorities have been unable to give them any assistance for lack of funds. I had suggested that they obtain the estimate of a County road engineer but apparently that cannot be done.

The maintenance or betterment in question at the present stage of development of the nickel deposit should be merely enough to permit the Freeport people to get out and not in connection with their drilling. Later if it should happen that conditions justify the building of a plant, a thorough job of the road building can be considered.

Thanking you, I am,

Very truly yours,

Earl K. Nixon
Tech. Cons. Matls. Div.

EKN:jr
cc H.G. Iverson
cc Forest Service

FREEPORT SULPHUR COMPANY

122 EAST 42ND STREET

NEW YORK

RECEIVED
DEC 5 1942
STATE DEP'T OF GEOLOGY
& MINERAL INDS.

Box 160
Riddle, Oregon
December 4, 1942

Mr. Earl K. Nixon
702 Woodlark Building
Portland, Oregon

Dear Mr. Nixon:

I have just had a letter from our Mr. Thaete in regard to your visit to our New York office in which he refers to the possibility of obtaining aid on the eight miles of road to Nickel Mountain which we are now endeavoring to keep in good enough shape so that we will not have to discontinue prospecting before the winter is over. Most of the time we have spent on road work to date has been on the section of road leading up to the property. Besides a number of men, we now have two teams and two trucks working on this road.

I note in Mr. Thaete's letter that you would have to have a formal estimate for the county engineers of the cost of road work and maintenance. Since the county's response to date has been entirely negative and since we have been informed that they abandoned this road in 1927, I believe it would be best if you could request the estimate from the county engineers instead of us. If it would be sufficient to take our estimate, I believe we could furnish as accurate an estimate as the county engineers might give you and much more quickly. If there is a possibility of obtaining this aid, it would be desirable to have same as soon as possible as it would not be practical for us to stop our road work while waiting for another crew to move in. Please advise us if you have taken any action on this road work and, if not, advise the steps necessary by us to initiate same.

I also understand it may be possible to have the Bureau do some geophysical work.

Yours very truly,

A. A. Gustafson

A. A. Gustafson

AAG:ptl

June 18, 1943

Mining Division
Serial No. Section
Room 1419
Tempo. B

REGISTERED

Freeport Sulphur Company
122 E. 42nd Street
New York, New York

Gentlemen:

On recommendation of Mr. A. M. Dixon, Regional Technical Adviser for the state of Oregon, we are cancelling serial number 33-65 assigned your prospecting operations at Michel Mountain, Riddel, Oregon. Please return to this office the certificate showing the above mentioned number.

If you have received an autherisation for a quota assignment, please return this also to the Mining Division, Washington, D. C.

Yours very truly,

A. S. Knoisen
Director
Mining Division

RFI:AN:ej

cc: Mr. A. M. Dixon
Mr. Earl K. Nixon

October 16, 1942

Mr. David St. Clair
Freeport Sulphur Company
Box 190
Grants Pass, Oregon

Dear Mr. St. Clair:

Receipt is acknowledged of your letter dated October 15 and concerned with priority matters.

It has been very difficult for this office to keep abreast of the various amendments and revisions relating to the original Order P-56 under which mine serial numbers are in force. The object of having a State Emergency Coordinator of Mines originally was to certify mining operations to the Mining Branch of the War Production Board in order that those mining operations could receive mine serial numbers and be allowed to operate under Order P-56. It was never clearly outlined that this office was to give advice on priority matters but we have endeavored to do this to the best of our ability. You can readily see that in order to do this efficiently, it would be necessary for us to receive copies of orders and amendments together with interpretations promptly and completely from the Mining Branch of the War Production Board. We have not always received these orders, but I will try to explain the questions raised in your letter, although I am not entirely sure that I am up-to-date.

Supposedly when you obtain the rating of A-1-c and A-1-a in order to purchase special equipment, the Mining Branch of the War Production Board grants an authorization number to cover the particular purchase. I rather feel, however, that in some cases I have known about recently, the authorization number was not issued and yet the Mining Branch granted the preference rating to the miner.

As far as making reports on PD-119 is concerned, you should report all rated purchases made under their various ratings such as A-1-a, A-1-c, et cetera. If an authorization number was obtained for a special purchase, the number should be reported. If you made a purchase under a priority rating but without obtaining an authorization number, the blank covering authorization number could be left open or the words "no number received" inserted.

Referring to the material sent you by Mr. Bergesch of the Divisional Office in Portland, I think that there are other amendments which you should have. I suggest that you write to Dr. Wilbur A. Nelson, Chief, Mining Branch, War Production Board, Washington, D.C., stating that you have received copy

(over)

FREEPORT SULPHUR COMPANY

122 EAST 42ND STREET

NEW YORK

Box 190
Grants Pass, Oregon
October 15, 1942

Mr. Earl K. Nixon
702 Woodlark Building
Portland, Oregon

Dear Mr. Nixon:

I am sorry that we overlooked the clause in Preference Rating Order P-56 requiring us to make out a monthly report on Form PD-119. You will find enclosed our reports for the months of August and September.

As I advised you in a wire on October 12, we apparently have not received an authorization number from the War Production Board. As I understand it, this number is given by the Board for specific purchases only on orders covered by Preference Ratings A-1-a and, in certain instances, A-1-c. However, I note that Form PD-119 requires an authorization number even for orders covered by Preference Rating A-8. It appears, therefore, that I do not know all I should about the matter. The material sent us by Mr. Bergesch of the War Production Board consisted only of a copy of Preference Rating Order P-56, together with Interpretation No. 1 and Amendment No. 2. This literature does not contain a reference to authorization numbers.

I note that certain purchases under A-1-c may only be obtained under a quota which apparently must be authorized by the Director of Industry Operations. We have no information on hand as to the precise steps which must be taken in order to obtain this authorization. In view of the fact that we are not now actually producing at Riddle but are simply engaged in prospecting, it would appear that we have no basis for obtaining a quota rating unless the company's production of sulphur and manganese will apply to our present prospecting campaign on Nickel Mountain. I hope that the latter is the case, because we shall undoubtedly require an occasional A-1-c rating from time to time.

If you could supply me with some specific literature and information on the question of authorization numbers and on whatever else would appear to you to be relative, the favor would be appreciated.

Yours very truly,

RECEIVED
OCT 16 1942
STATE DEP'T OF GEOLOGY
& MINERAL INDS.

David St. Clair

DS:ptl
Encs:-2

October 13, 1942

Mr. David St. Clair
Freeport Sulphur Company
Riddle, Oregon

Dear Mr. St. Clair:

Receipt is acknowledged of your telegram reading as follows: "Re form PD-119 do not believe we received authorization number from WPB. Please advise necessary steps obtain this number. Regards."

It is not clear to me just what you mean by an authorization number in relation to Form PD-119. The latter is a form for making monthly reports of rated purchases made to the office of the State Coordinator of Mines. Under the last regulations that we have seen, an authorization number was the number given to a producer to cover a special request for a high priority rating. For instance, if a producer required a piece of equipment at once and telegraphed his request to the Mining Branch, an authorization number for that piece of equipment was granted the producer. This number could be used only for that particular order.

It is possible that you mean mine serial number. We have been informed by the Mining Branch of the War Production Board that your operation was given mine serial number 33-65 allowing you to operate under Order P-56. You should have been so notified and should have received copies of the various orders and amendments necessary to enlighten you how to proceed in using priorities allowed you. If such is not the case, please let us know.

Very truly yours,

Earl K. Nixon
Oregon Emergency Coordinator
of Mines

FWL:EKN:jr

PACIFIC TELEGRAM

CLASS OF SERVICE

Full Rate		Day Letter	SYMBOL DAY L	Night Letter	SYMBOL N L

IF NEITHER OF THE TWO SYMBOLS SHOWN ABOVE APPEARS AFTER THE CHECK (NUMBER OF WORDS) THIS IS A FULL RATE TELEGRAM. OTHERWISE ITS CHARACTER IS INDICATED BY THE SYMBOL APPEARING AFTER THE CHECK.

RIDDLE 6 20 RIDDLE OREGON OCT 12 1942 355P

EARL K NIXON

702 WOODLARK BLDG PORTLAND ORE

REFORM PD 119 DO NOT BELIEVE WE RECEIVED AUTHORIZATION NUMBER FROM WPB. PLEASE ADVISE NECESSARY STEPS OBTAIN THIS NUMBER. REGARDS.

FREEPORT SULPHUR CO DAVID STCLAIR

RECEIVED
OCT 13 1942
STATE DEPT OF GEOLOGY & MINERAL INDS.

READ TO EARL K NIXON
AT TELEPHONE NO. BRY 2276
BY OPERATOR 241 TIME 425P

Earl K. Nixon
Oregon Emergency Coordinator
of Mines

FWL:EKN:jr

August 3, 1942

Mr. David St. Clair
Freeport Sulphur Company
Box 190
Grants Pass, Oregon

Dear Mr. St. Clair:

We are just in receipt of a telegram from the Administrator, Mining Branch, War Production Board stating that mine serial number 33-65 has been issued to the Freeport Sulphur Company for nickel operations in Oregon. Certificate was mailed to 122 East 42nd St., New York City.

Sincerely yours,

Earl K. Nixon
Oregon Emergency Coordinator
of Mines

FWL:EKN:jr

CLASS OF SERVICE
This is a full-rate telegram or Cablegram unless its deferred character is indicated by a suitable symbol above or preceding the address.

WESTERN UNION

1201

SYMBOLS
DL = Day Letter
NT = Overnight Telegram
LC = Deferred Cable
NLT = Cable Night Letter
Ship Radiogram

A. N. WILLIAMS, PRESIDENT
NEWCOMB CARLTON, CHAIRMAN OF THE BOARD
J. C. WILLEVER, FIRST VICE-PRESIDENT

The filing time shown in the date line on telegrams and day letters is STANDARD TIME at point of origin. Time of receipt is STANDARD TIME at point of destination

CA258 GOVT TWS PAID 3=TDC WASHINGTON DC 3 615P DAY AUG 3 PM 5 16

EARL K NIXON, EMERGENCY COORDINATOR OF MINES:

=708 WOODLARK BLDG PORTLAND ORG:

=RETEL SERIAL NUMBER THREE THREE DASH SIX FIVE UNDER MINE PREFERENCE RATING ORDER P-56 HAS BEEN ISSUED FREEPORT SULPHUR COMPANY FOR NICKEL OPERATIONS IN OREGON AND CERTIFICATE MAILED TO 122 EAST 42ND STREET NEWYORKCITY=

WILBUR A NELSON ADMINISTRATOR OF MINING BRANCH WAR PRODUCTION BOARD.

P-56 122 42.

THE COMPANY WILL APPRECIATE SUGGESTIONS FROM ITS PATRONS CONCERNING ITS SERVICE

SERVICE DESIRED

DOMESTIC		CABLE	
TELEGRAM		ORDINARY	
DAY LETTER		URGENT RATE	
SERIAL		DEFERRED	
OVERNIGHT TELEGRAM		NIGHT LETTER	
SPECIAL SERVICE		SHIP RADIOGRAM	

Patrons should check class of service desired; otherwise the message will be transmitted as a telegram or ordinary cablegram.

WESTERN UNION

1206

$

CHECK

ACCOUNTING INFORMATION

TIME FILED

A. N. WILLIAMS, PRESIDENT
NEWCOMB CARLTON, CHAIRMAN OF THE BOARD
J. C. WILLEVER, FIRST VICE-PRESIDENT

Send the following telegram, subject to the terms on back hereof, which are hereby agreed to

WANT A REPLY?
"Answer by WESTERN UNION" or similar phrases may be included without charge.

702 Woodlark Bldg.
Portland, Oregon
August 1, 1942

DAVID ST CLARE
FREEPORT SULPHUR CO
RIDDLE OREGON

APPLIED MINES SERIAL NUMBER JUNE NINTH. WIRING ADMINISTRATOR MINING BRANCH TODAY ASKING SERIAL NUMBER BE ISSUED WITHOUT DELAY.

EARL K. NIXON

EKN:ac
Send Collect

DOMESTIC		CABLE DESIRED	
TELEGRAM		ORDINARY	
DAY LETTER		URGENT RATE	
SERIAL		DEFERRED	
OVERNIGHT TELEGRAM		NIGHT LETTER	
SPECIAL SERVICE		SHIP RADIOGRAM	

Patrons should check class of service desired; otherwise the message will be transmitted as a telegram or ordinary cablegram.

WESTERN UNION

1206

A. N. WILLIAMS, PRESIDENT
NEWCOMB CARLTON, CHAIRMAN OF THE BOARD
J. C. WILLEVER, FIRST VICE-PRESIDENT

CHECK
ACCOUNTING INFORMATION
TIME FILED

Send the following telegram, subject to the terms on back hereof, which are hereby agreed to

WANT A REPLY?
"Answer by WESTERN UNION" or similar phrases may be included without charge.

702 Woodlark Bldg., Portland, Oregon
August 1, 1942

DR. WILBUR A. NELSON, ADMINISTRATOR
MINING BRANCH, PRIORITIES DIVISION
WAR PRODUCTION BOARD
WASHINGTON, D. C.

REFER MY LETTER JUNE NINTH REQUESTING SERIAL NUMBER FREEPORT SULPHUR CO. BOX 190 GRANTS PASS ORE. MY LETTER STATES THIS COMPANY EXPLORING NICKEL DEPOSIT RIDDLE ORE REQUIRES PRIORITY ASSISTANCE. THIS OPERATION VERY IMPORTANT WAR PROGRAM. BELIEVE YOU SHOULD ISSUE SERIAL NUMBER WITHOUT DELAY. ADVISE.

EARL K. NIXON

EKN:FWL:ac
Send Dayletter
Federal Gov't rate Collect

WESTERN UNION

1201

(56)

A. N. WILLIAMS
PRESIDENT

NEWCOMB CARLTON
CHAIRMAN OF THE BOARD

J. C. WILLEVER
FIRST VICE-PRESIDENT

SYMBOLS
DL=Day Letter
NT=Overnight Telegram
LC=Deferred Cable
NLT=Cable Night Letter
Ship Radiogram

The filing time shown in the date line on telegrams and day letters is STANDARD TIME at point of origin. Time of receipt is STANDARD TIME at point of destination

BG331 31/30=TD BG RIDDLE ORG 31 454P

D1

EARL K NIXON=

DIRECTOR STATE DEPT OF MINERALS INDUSTRY WOODLARK

BLDG PORTLAND ORG=

URGENTLY NEED PRIORITY RATING. JAMES DOUGLAS CHIEF METAL SECTION WPB WASHINGTON ADVISES OUR APPLICATION FOR RATING UNDER P-56 NOT RECEIVED CAN YOU CLARIFY PLEASE WIRE OR PHONE COLLECT 125 RIDDLE=

=FREEPORT SULPHUR CO DAVID STCLAIR.

WPB P-56. 125.

THE COMPANY WILL APPRECIATE SUGGESTIONS FROM ITS PATRONS CONCERNING ITS SERVICE

(24)

WESTERN UNION

1942 JUN 30 PM 4 47

SYMBOLS
DL = Day Letter
NT = Overnight Telegram
LC = Deferred Cable
NLT = Cable Night Letter
Ship Radiogram

...is a full-rate telegram or Cablegram unless its deferred character is indicated by a suitable symbol above or preceding the address.

A. N. WILLIAMS, PRESIDENT — NEWCOMB CARLTON, CHAIRMAN OF THE BOARD — J. C. WILLEVER, FIRST VICE-PRESIDENT

1942 JUN 30 PM 4 42

The filing time shown in the date line on telegrams and day letters is STANDARD TIME at point of origin. Time of receipt is STANDARD TIME at point of destination

SKA374 23 GOVT DLC 4 EXTRA=TDC WASHINGTON DC 30 607P

EARL K NIXON=

EMERGENCY COORDINATOR OF MINES PORTLAND ORG=

RETEL SERIAL NUMBER THREE THREE DASH SIX FIVE HAS BEEN ASSIGNED FREEPORT SULPHUR COMPANY AND CERTIFICATE MAILED JUNE SEVENTEENTH=

WILBUR A NELSON ADMINISTRATOR OF MINING BRANCH WAR PRODUCTION BOARD.

✓

THE COMPANY WILL APPRECIATE SUGGESTIONS FROM ITS PATRONS CONCERNING ITS SERVICE

		FOREIGN	
DAY LETTER		FULL RATE	
NIGHT LETTER		CDE RATE	
SERIAL		URGENT	
RESERVATION		DEFERRED	
TOUR-RATE		NIGHT LETTER	
		SHIP RADIO	

Postal Telegraph

Mackay Radio · Commercial Cables · All America Cables · Canadian Pacific Telegraphs

CHARGE ACCOUNT NUMBER	
CASH NO.	TOLLS
CHECK	
TIME FILED	(STANDARD TIME)

Form 2

Send the following message, subject to the Company's rules, regulations and rates set forth in its tariffs and on file with regulatory authorities

JUNE 29, 1942

DR. WILBUR A. NELSON, ADMINISTRATOR
MINING BRANCH, PRIORITIES DIVISION
WAR PRODUCTION BOARD
ROOM 1055, TEMPORARY R BUILDING
WASHINGTON, D.C.

REFER OUR LETTER JUNE NINE GIVING INFORMATION CONCERNING FREEPORT SULPHUR COMPANY'S OREGON EXPLORATION TO DEVELOP NICKEL ORE. HAVE WORD COMPANY HAS NOT RECEIVED SERIAL NUMBER AND NEED ONE IN ORDER TO EXPEDITE DRILLING CAMPAIGN. CONSIDER THIS COMPANY'S PROGRAM ONE OF THE MOST IMPORTANT IN THIS STATE. BELIEVE YOU SHOULD GRANT SERIAL NUMBER PROMPTLY.

EARL K. NIXON
OREGON EMERGENCY COORDINATOR OF MINES

Send Night Letter
Send Government Rate
Send COLLECT

WESTERN UNION

1201

(03)

is a full-rate telegram or Cablegram unless its deferred character is indicated by a suitable symbol above or preceding the address.

SYMBOLS
DL = Day Letter
NT = Overnight Telegram
LC = Deferred Cable
NLT = Cable Night Letter
Ship Radiogram

A. N. WILLIAMS, PRESIDENT — NEWCOMB CARLTON, CHAIRMAN OF THE BOARD — J. C. WILLEVER, FIRST VICE-PRESIDENT

The filing time shown in the date line on telegrams and day letters is STANDARD TIME at point of origin. Time of receipt is STANDARD TIME at point of destination

PZ43 20/19 XC=GRANTSPASS ORG 29 201P 1942 JUN 29 PM 2 22

EARL K NIXON=

702 WOODLARK BLDG PORTLAND ORG=

HAVE NOT YET RECEIVED P-56 PRIORITY RATING. WILL APPRECIATE ANY ASSISTANCE YOU CAN GIVE US IN EXPEDITING MATTER. REGARDS=

DAVID STCLAIR.

RECEIVED
JUN 29 1942
STATE DEP'T OF GEOLOGY & MINERAL INDS.

Letter to W.A.N June 9 — Giving info re Freeport

Freeport Sulphur

XC EXCLUSIVE!

WESTERN UNION

THE COMPANY WILL APPRECIATE SUGGESTIONS FROM ITS PATRONS CONCERNING ITS SERVICE

806 Bedell Building
Portland, Oregon

June 6, 1942

Mr. David St. Clair
Freeport Sulphur Company
Box 190
Grants Pass, Oregon

Dear Mr. St. Clair:

At the request of Mr. Earl K. Nixon, Coordinator of Mines for the State of Oregon, we enclose herewith PD-1A form which we suggest you complete and mail as directed under the general instructions.

Will you kindly read it carefully and follow the instructions so that your application will not be delayed.

When listing material for which a rating is requested, do not use the words, "immediately", or any such relative term, but be definite and state when the material is required.

Very truly yours,

J. Fred Bergesch
PRIORITIES DISTRICT MANAGER
Bureau of Field Operations

Enclosure
PD-1A
cc Mr. Nixon

JFMcIndoesal

June 5, 1942

Mr. J. Fred Bergesch
Divisional Priorities Office
Bedell Building
Portland, Oregon

Dear Mr. Bergesch:

Will you please forward copies of form PD-1-a direct to Mr. David St. Clair, Freeport Sulphur Co., Box 190, Grants Pass, Oregon.

Thanking you, I am,

Yours very truly,

Earl K. Nixon, Oregon Emergency
Coordinator of Mines

FWL:EKN:ac

June 5, 1942

Mr. David St. Clair
Freeport Sulphur Co.
Box 190
Grants Pass, Oregon

Dear Mr. St. Clair:

Your letter dated June 3rd and concerned with priority matters has been received. This office has nothing to do with assigning priority ratings for various equipment and supplies. Our work is in supplying certain required information concerning a mining operation to the Administrator, Mining Branch, War Production Board, Washington, D. C., who then decides from the information supplied whether or not such operation shall receive a serial number which allows referred priority ratings under order P-56.

I am inclosing a form specified by the Administration, which please fill out and return to this office. It would be to your advantage to supply any additional information you can bearing on your proposed exploration for strategic minerals.

Referring to your immediate need for the sheet iron, the proper procedure would be (assuming that an A-10 rating would not be sufficient) to fill out form PD-1-a and submit it to Dr. Wilbur A. Nelson, Administrator, Mining Branch, W.P.B., Washington, D. C. I am requesting Mr. Bergesch of the divisional office of W.P.B. to forward the PD-1-a forms to you today.

As to the A-10 rating, this is allowed you under order P-100 designed for those operators who cannot qualify under order P-56. You will note that in order to apply the A-10 rating, it is necessary only to use the formal endorsement on your purchase orders as given on Page 2. Copy of P-100 is enclosed.

Yours very truly,

Earl K. Nixon, Oregon Emergency
Coordinator of Mines

FWL:EKN:ac

Encl:-1

FREEPORT SULPHUR COMPANY

122 EAST 42ND STREET

NEW YORK

Box 190
Grants Pass, Oregon
June 3, 1942

Mr. Earl K. Nixon
702 Woodlark Building
Portland, Oregon

Dear Mr. Nixon:

Mr. Bergesch of the War Production Board has advised us that you are in charge of assigning priority ratings for mining operations in Oregon. We shortly expect to receive word to go ahead with our proposed drilling campaign in this area, and we are therefore interested in learning the procedure necessary for obtaining a priority rating.

An item which we wish to obtain an immediate rating on is as follows:

5 sheets of 16 gauge black iron, 48" x 96".

This metal will be used for making drying pans for drill samples.

Any information you can supply us on general procedure will be appreciated.

Kindest personal regards,

David St. Clair

DS:ptl

RECEIVED
JUN 5 1942
STATE DEPT OF GEOLOGY & MINERAL IND.

David St. Clair

DS:ptl
Enc:-1

FREEPORT SULPHUR COMPANY

122 EAST 42ND STREET

NEW YORK 17, N.Y. June 26, 1950

Mr. F. W. Libbey, Director
State Department of Geology and
Mineral Industries
702 Woodlark Building
Portland 5, Oregon

Dear Mr. Libbey:

In Mr. Thaete's absence I am acknowledging receipt of your letter of the 19th.

Mr. Thaete will return to the office next week and your letter will then be brought to his attention.

Sincerely yours,

Frances Swanton

Frances Swanton
Secretary to Mr. Thaete

RECEIVED
JUN 2[illegible]
STATE DEPT. OF GEOLOGY
& MINERAL INDS.

February 1, 1947

Mr. Langbourne M. Williams, Jr., President
Freeport Sulphur Company
122 East 42nd Street
New York City, New York

Dear Mr. Williams:

Last summer our Department did some work on nickel-bearing laterites in Curry County, Oregon, and we are planning to continue the investigation during the coming summer. We should like to do some work in the general area of Nickel Mountain, Douglas County, and I am wondering if your company would be willing to give us a print of a geologic map of your holdings on Nickel Mountain. We would, of course, consider the map confidential and it would be used solely for the purpose of assisting us in field work.

We should also like to have your permission to obtain some auger hole samples of the laterite which occurs on your property. We would not be able to do extensive sampling but we have in mind comparing samples of the laterite in your area with those obtained in Curry County.

Yours sincerely,

Director

FWL:jr

The Hanna Mining Company

Riddle, Oregon 97469

June 6, 1968

Mr. Len Ramp
Dept. of Geology
521 NE "E" Street
Grants Pass, Oregon 97526

Dear Len:

Enclosed find property map of Mine area. The area controlled by Hanna is outlined in red and the proposed area for acquisition has been colored blue.

Please keep this map in confidence.

Very truly yours,

THE HANNA MINING COMPANY

C. A. Dowd

C. A. Dowd
Mineral Properties

CAD:clb

cc EJM

Len! We are mailing under separate cover-

The blown up Topo maps of Sec. 17, 19, 20 + 21.

C. A. Dowd

Len Ramp

HATCH ASSOCIATES CONSULTANTS, INC. CONSULTING ENGINEERS

HATCH ASSOCIATES

8th Floor, Rand Bldg., 14 Lafayette Square
Buffalo, New York 14203
Telephone (716) 853-7800
Telex 91-593

May 19, 1987

Mr. G. Anthony Kuhn
Executive Director
C.C.D. Business Development Corporation
744 S.E. Rose Street
Roseburg, Oregon 97470

Dear Mr. Kuhn:

This is in response to your request for a formal proposal covering an "Alternative Use Study" for the smelter located at Nickel Mountain owned by the M.A. Hanna Company of Cleveland, Ohio. The objective of this study will be to identify ways by which the assets of the smelter plant can be used to create jobs.

The alternative use concepts included in the scope of work of this proposal have not been prioritized. Some of these concepts could require a very long time to implement. For example, the concept of producing ferrochrome from black sands will require a full scale feasibility study aside from whether or not the subject smelter is utilized in the eventual process. It is apparent from your letter to Mr. Welsh of M.A. Hanna Company that we have a serious time constraint and therefore we should give first priority to those concepts that can be implemented in the shortest possible time.

Members of our study team will be available to meet with you and other interested parties during the course of the project. It may be that we will be able to identify prospective investors for certain concepts and they can be contacted even before the study is completed.

We are very optimistic that the proposed project will yield positive results. It was obvious during our visit that we will be working with a highly motivated group of people and we look forward to seeing the project to a successful conclusion.

Yours very truly,

HATCH ASSOCIATES CONSULTANTS, INC.

Richard W. Wilson, P.E.
President

RWW/ml
Enclosure

STATE OF OREGON INTEROFFICE MEMO

TO: **LEN RAMP**, 312 S.E. "H" St.
P.O. Box 417
Grants Pass, OR 975226

DATE: **AUGUST 11, 1988**

FROM: **DON HULL**

SUBJECT: **HANNAH NICKEL SMELTER SLAG AT RIDDLE, OREGON**

I am attempting to locate analytical information on the chemistry of the slag piles at the Hannah nickel smelter near Riddle. Could you please send any file information that you may have directly to Barry Harrington, Division Manager, Cojon Corporation, 11917 N.E. 95th Street, Vancouver, WA 98685 (206-892-8988). Please treat his interest in this matter as confidential.

cc: Barry Harrington

hull1/ramp8-11
81188/ch

bcc: Ron Geitgey
Jerry Gray

Copy of Info Sent 8/18/88

1-125-1387

CONFIDENTIAL

The Hanna Mining Company

Riddle, Oregon 97469

November 22, 1966

Mr. Hollis Dole
Department of Geology & Mineral Industries
1069 State Office Building
Portland 1, Oregon

Dear Hollis:

Having read with interest your temporary draft of a mining lease between the State of Oregon and Harlow Wright, Inc., here are some suggestions for what they are worth.

Referring to paragraph (7) I'm wondering how gross value of the ore will be established? Probably this will be established between an ore buyer and a mining company.

Below is a tabulation of an escalated rate scale used in one case to determine gross value of shipped ore.

TABLE

Ore Grade % Ni	Price Per Pound	Lbs. Ni Per Ton	Value Per Ton	5% Royalty Per Ton	4% Royalty Per Ton
1.00	$.1375	20.0	$ 2.75	$.1375	.1100
1.10	.1500	22.0	3.30	.1650	.1320
1.20	.1625	24.0	3.90	.1950	.1560
1.30	.1750	26.0	4.55	.2275	.1920
1.40	.1875	28.0	5.25	.2625	.2100
1.50	.2000	30.0	6.00	.3000	.2400
1.60	.2125	32.0	6.80	.3400	.2720
1.70	.2250	34.0	7.65	.3825	.3060
1.80	.2375	36.0	8.55	.4275	.3420
1.90	.2500	38.0	9.50	.4750	.3800
2.00	.2625	40.0	10.50	.5250	.4200

From paragraph (5) of your proposed lease you have suggested 5% of gross value. In the tabulation I have shown what this would amount to - also what it would be at 4%.

Hanna's Agreement -- An agreement with Wright would probably be written with royalty on a straight cents/ton basis with no escalation by grade.

We are not prepared to pay royalty totaling above .25/ton as this figure is a maximum figure in any of our nickel agreements. Due to the economics of some areas this figure is often reduced.

The parcel of land in question, from our present knowledge, has very little potential. Any potential there, would probably be under 1.00% nickel crude. (Natural ore in the ground) This potential ore could possibly be upgraded through screening, 1.30 or 1.40% nickel if the pattern is similar to our Riddle Ore. These upgraded shipped grades would then be the grades used in establishing gross value.

My suggestion would be for a 4% gross value figure, as this would make our negotiation with Mr. Wright somewhat easier. On the other hand we would rather see the State of Oregon receive the monies than Wright, Inc.

The alternative in this case is to go to a straight cents per ton figure as this simplifies sampling analytical and handling procedures and is a more normal method of calculating nickel royalties.

Thank you again for sending the temporary drafts. I would be most interested in hearing from you on the out come.

Very truly yours,

THE HANNA MINING COMPANY

C. A. Dowd

C. A. Dowd
Mineral Properties

CAD:clb

RECEIVED
NOV 25 1966
STATE DEPT. OF GEOLOGY
& MINERAL INDS.

The Hanna Mining Company

Riddle, Oregon 97469

March 6, 1978

Copies to Len, Stan, ori to Joh

Mr. Donald A. Hull
State Geologist
Department of Geology & Mineral Industries
1069 State Office Building
Portland, Oregon 97201

Dear Mr. Hull:

Attached is a news release from our corporate offices in Cleveland announcing the transfer of E. J. Maney, Nickel Division General Manager, to Hanna's Domestic Iron Ore Division, and, subsequently, the transfer of R. P. Matson, Iron Ore Division General Manager, to the Nickel division effective January 15, 1978. We look forward to continued good relationships with all of our business associates under the leadership of Mr. Matson and hope you will have an opportunity to get acquainted soon.

Please adjust your mailing lists accordingly.

Very truly yours,

R. M. Hughes, Jr.

R. M. Hughes, Jr.
General Superintendent

pb
Enclosure

RECEIVED-PTLD
MAR 16 1978
DEPT OF GEOLOGY
& MINERAL INDUS.

EEC/EJM

New Address

ROBERT A. BARNES, Inc.
FOUNDRY & INDUSTRIAL SUPPLIES & EQUIPMENT

5611 - 1st AVENUE SOUTH
SEATTLE, WASHINGTON 98108
RO. 2-0920

AREA CODE 206-622-0637

2450 SIXTH AVENUE SOUTH
SEATTLE, WASHINGTON, 98134

December 12, 1966

Hanna Nickel Smelting Company

Riddle, Oregon 97469

Attention: Mr. H. D. Wedge

SUBJECT: NICKEL SLAG

Gentlemen:

In September 1965, you gave us a quotation of $ 1.25 per yard for your slag material. Would you please inform us if this price is still applicable and what the approximate chemical analysis of the slag would run.

Thank you for your consideration. We look forward to your reply.

Sincerely,

ROBERT A. BARNES, INC.

Doug Pritchard

Doug Pritchard

DP:nlm

Copy sent to Don Gertsey 4/26/88

Slag ? EEC/EJM

Hanna Nickel Smelting Company

Riddle, Oregon 97469

December 16, 1966

Mr. Doug Pritchard
Robert A. Barnes, Inc.
5611 First Avenue South
Seattle, Washington 98108

Dear Mr. Pritchard:

The price which we quoted to you of $1.25 per yard for slag as is in our pile still applies. I think perhaps the best analytical description I could give you is to show the results of our assay of monthly composite analyses for the last three months. These are as follows:

	September	October	November
SiO_2	53.7	54.3	54.1
FeO	13.1	12.9	12.6
Al_2O_3	1.3	1.4	1.4
Cr_2O_3	0.87	0.95	0.87
MnO	0.24	0.23	0.23
TiO_2	0.03	0.03	0.03
CaO	0.45	0.45	0.48
MgO	30.0	29.5	30.0

We are aware that the assays range outside the values shown at times. SiO_2 is one of the more variable constituents and may range from 53 to 56%. The increase in SiO_2 is usually attended by the equivalent decrease in MgO which ranges commonly from 26 to 30%.

I hope that this information is of service to you and that you will be able to make some use of this waste product material.

Very truly yours,

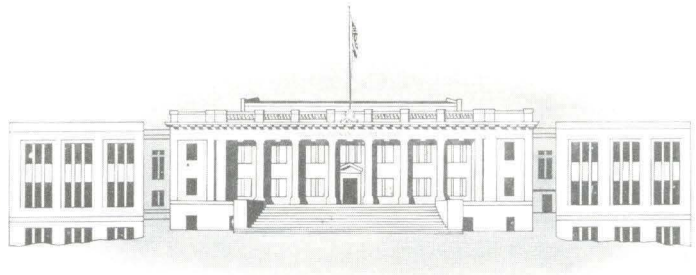
H. D. Wedge
Smelter Superintendent

HDW:pb

cc: E. E. Coleman
E. J. Maney
M. A. Eitzen

LAND DEPARTMENT

TELEPHONE: ORchard 2-3311
EXTENSION 79



COUNTY OF DOUGLAS
COURTHOUSE
ROSEBURG, OREGON

December 3, 1963

Department of Geology & Minerals Ind.
State of Oregon
1069 State Office Building
Portland 1, Oregon

Attn: Mr. H.M. Dole, State Geologist

Dear Sir:

Thank you for your letter of November 29th, clarifying the position of your Department regarding the furnishing of geological study.

I had hoped to discuss the terms of the Countys new lease with Hanna with you, but the time was not available.

In order that you can better determine just how this lease does affect your department, I am enclosing a copy of same for your use and keeping. No doubt the Hanna people shall be contacting you soon.

Sincerely yours,

Robert E. Kischel

Robert E. Kischel
Land Agent

REK:rh
encl.

RECEIVED
DEC 4 1963
STATE DEPT. OF GEOLOGY
& MINERAL INDS.

COPY

STATE DEPARTMENT OF GEOLOGY AND
MINERAL INDUSTRIES
1069 STATE OFFICE BUILDING
PORTLAND 1, OREGON

November 29, 1963

Mr. Robert E. Kischel, Land Agent
Douglas County Land Department
Courthouse
Roseburg, Oregon

Dear Mr. Kischel:

This is further in regard to my letter of October 4 in reply to your letter of October 2 concerned with the Department's availability for a geological study in the Riddle area.

Firm action has been taken by the Legislature, the Governor, and our Governing Board in regard to our budget. Although we will not lose any of our permanent staff members, our clerical staff has been severely cut as well as our field funds and other accounts. This makes it impossible for us to make a geological study for you at no cost. However if you would care to pay for the field expenses, which would include meals, lodging and cost of transportation, we can make Mr. Len Ramp, geologist in charge of our Grants Pass field office, available to you for evaluation of the area Douglas County is concerned about.

Sincerely yours,

HMD

Hollis M. Dole
State Geologist

HMD:jr
cc Len Ramp

COPY

STATE DEPARTMENT OF GEOLOGY AND
MINERAL INDUSTRIES
1069 STATE OFFICE BUILDING
PORTLAND 1, OREGON

June 10, 1964

Douglas County Court
Court House
Roseburg, Oregon

Gentlemen:

I am in receipt of correspondence from Mr. E. E. Coleman, General Manager - Oregon, The Hanna Mining Company, Riddle, Oregon, in which he notes that Hanna leased land from Douglas County and that one of the provisions of the lease was that a determination be made as to whether or not any valuable mineral existed on these lands.

To this end Mr. J. T. Cumberlidge, geologist for Hanna Mining Company, prepared a map and a report of the geology and possible mineral potential of said land, a copy of which is attached. Also attached is a letter from our field geologist in charge of our Grants Pass office who accompanied Mr. Cumberlidge in the field in reviewing his work. You will note that it is his considered opinion that under present conditions there is nothing of economic interest in the area under consideration. I concur with our field geologist in this determination.

A copy of the lease form has been sent to me by Mr. Coleman and I would agree with the statement on the first page where it says that the leasing of this land would be in the public interest.

If this Department can be of any further assistance to you in this matter, please feel free to call upon us.

Sincerely yours,

Hollis M. Dole
State Geologist

HMD:jr
Encl.
cc E.E. Coleman
bc Len Ramp

Nickel Mtn File -

COPY

January 6, 1977

Mr. David Lindsey
U. S. Bureau of Mines
Western Field Operation Center
East 315 Montgomery
Spokane, Washington 99207

Dear Dave:

Here is the Nickel Mountain file as requested. The M. A. S. coded forms are not complete. I am not very good at filling them out; haven't time, and don't like it very well either. I spent a couple of hours on them and got frustrated. Some information that I obtained from E.J. Maney, General Manager in 1975 may be helpful in completing or improving your files.

1. Average grade of ore mined was 1.14 percent Ni.
2. They were mining at a rate of 9,000 tons per day (5 days a week).
3. Total rock mined is slightly more than twice the amount put through the smelter. The remainder goes on reject piles.

Also enclosed is a copy of a confidential letter from Jack Maney dated December 9, 1975 with information on their calculated reserves as of January 1, 1975.

I intend to prepare a cross section for my geologic map showing the probable structure of the peridotite thrust plate over serpentinite and the Dothan Formation. I also intend to write up a revised report to go with the map; but haven't had time to do so as yet.

I'll get back on the Nickel Project as soon as I finish my work on Curry County.

Sincerely,

Len Ramp
Resident Geologist

LR:rep
Encls: As stated

Hanna Nickel Smelting Company
P.O. Box 85
Riddle, Oregon 97469

March 2, 1978

Mr. Len Ramp
State Geology Office
Box 417
Grants Pass, Oregon 97526

Dear Mr. Ramp:

Attached please find a copy of the New Review clipping, as per our discussion.

Very truly yours,

HANNA NICKEL SMELTING COMPANY

Steven T. Maher
Personnel Director

ar
Enclosure

HANNA DEVELOPMENT COMPANY

RIDDLE, OREGON

April 20, 1953

Mr. David White
State Dept. Geology & Mineral Industry
239 Southeast H. Street
P. O. Box 417
Grants Pass, Oregon

Dear Dave:

Enclosed please find 50' contour map of Nickel Mountain area. Scale 800' to inch.

Sorry that I couldn't spend some time with you when you were here last week.

Sincerely,

Walt

W. A. Foster
Geologist

Len's Copy

COPY

January 6, 1977

Mr. David Lindsey
U. S. Bureau of Mines
Western Field Operation Center
East 315 Montgomery
Spokane, Washington 99207

Dear Dave:

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I'll get back on the Nickel Project as soon as I finish my work on Curry County.

Sincerely,

Len Ramp
Resident Geologist

LR:rep
Encls: As stated

COPY

STATE DEPARTMENT OF GEOLOGY AND
MINERAL INDUSTRIES
1069 STATE OFFICE BUILDING
PORTLAND 1, OREGON

October 4, 1963

Mr. Robert E. Kischel, Land Agent
Douglas County Land Department
Courthouse
Roseburg, Oregon

Dear Mr. Kischel:

The State of Oregon Department of Geology and Mineral Industries would be most happy to assist the County of Douglas in the evaluation of land near the Hanna Mining Company's operation at Riddle.

We could prepare a geologic map of the area in question and give our opinion on the possible mineral potential underlying the land. Inasmuch as we are prevented by law from evaluating a property, we could give you no recommendations on what you should do or conclusions as to the value of the property. However we would be glad to discuss this with you.

Ordinarily there would be no charge for this service but in view of the impending defeat of the Oregon tax law it appears quite likely that our budget will be reduced anywhere from 10-25 percent. The minimum reduction of 10 percent would deprive us of all field funds and operating accounts. Any cut larger than this will result in the elimination of personnel within the Department. Therefore any decision to aid you in this respect must await the outcome of the October 15 election. Following that we will be in a position to let you know whether manpower will be available and if it will be necessary to charge you for this work. We would expect this work to be done out of the Grants Pass office by Mr. Len Ramp, District Geologist in charge of the Grants Pass field office.

Sincerely yours,

Hollis M. Dole
State Geologist

HMD:jr
cc Len Ramp

Len: Dave White and I prepared a green sheet report and geologic map for Douglas County on the original 80 acres noted in the letter. I suggest that you refer to this report. If you do not have it in the Grants Pass office, we will send one from here.

VICTOR ATIYEH
GOVERNOR

Department of Geology and Mineral Industries
ADMINISTRATIVE OFFICE
1005 STATE OFFICE BLDG., PORTLAND, OREGON 97201 PHONE (503) 229-5580

April 2, 1985

Mr. Herbert D. Wedge
General Manager
Hanna Nickel Smelting Company
P.O. Box 85
Riddle, Oregon 97469

Dear Herb:

Enclosed is copy of a letter I received recently from the U.S. Forest Service regarding road use fees in the Umpqua National Forest.

Our discussions with the USFS do not suggest any obvious ways to reduce road fees. However, I am wondering if the recreational and other public use of portions of your haulage roads might encourage the county to assume a greater share of the maintenance cost.

Sincerely,

Donald A. Hull
State Geologist

DAH:jr
cc Len Ramp
cc John Beaulieu

United States Department of Agriculture
Forest Service
Umpqua National Forest
P.O. Box 1008
Roseburg, OR 97470

REPLY TO: 2730

DATE: March 26, 1985

Donald A. Hull, State Geologist
State of Oregon
Department of Geology & Mineral Industries
1069 State Office Building
Portland, OR 97201

Dear Mr. Hull:

Carlin Jackson asked me to drop you a line explaining how we compute the Road Use Fees for Hanna-Nickel Company. The Umpqua NF road use rates for commercial hauling activities which are required as the result of traffic on the road. The cost of this work is equitably distributed to all users, with the Forest Service assuming the financial responsibility for all noncommercial use and with each commercial user assuming their commensurate financial responsibility for their use. In addition, each commercial user is assessed a capital recovery rate commensurate to their use of forest improvement roads. These rates are based on capital improvement records maintained on the Forest.

The unit costs for required work are based on R-6, Zone Six Cost Guide Book. This book was developed and is maintained specifically for the Southwest Oregon area and displays local experienced costs for performing restoration work.

The Forest is sensitive to the local economy and has always pursued a policy of cooperation with industries which are forest road users and provide jobs to the community.

In the case of Hanna Nickel Company, we are unaware of any specific problem that might affect the local economy resulting from our policies or from the use rates which are charged them, commensurate to their use. If they have a concern with our policies and/or use rates, which are imposed on <u>all</u> users on our road system, it is important that they communicate their concerns to us. We cannot provide adequate answers to problems or to questions which are not clear to us. Thus in the spirit of cooperation, we invite Hanna Nickel Company to present their concerns to us.

Sincerely,

RONALD M. SKRIP
Acting Forest Supervisor

RECEIVED-PTLD
APR 1 1985

December 7, 1984

To: Don Hull

From: Len Ramp

Subject: Quartz Mountain Silica Deposit

Please refer to the November 1960 issue of the Ore Bin article on the Quartz Mountain Silica deposit. Although I have no access to drilling information on the deposit, I would estimate that there is more than adequate tonnage to outlive the Riddle Smelter's needs. Reserves are probably in the neighborhood of 75 to 100 million short tons.

The nearest other possible supplier of silica is the Bristol Silica and Limestone Company in Rogue River. It appears, however, that they now have quite limited reserves of high-purity silica rock. I am unsure where the next nearest possible supplier is; but perhaps somewhere in Northeastern Washington or Idaho.

It may be of interest also to refer to the article by Ralph entitled "The Miner and the Troll" published in the December 1959 Ore Bin, p. 121.

Perhaps Herb Wedge will be able to supply some additional information pertinent to the subject.

Len Ramp
Resident Geologist

LR:rep
CC: Herb Wedge

call Gordon Lyda re Rules
479-4301

November 9, 1984

To: Don Hull

From: Len Ramp

Subject: U.S.F.S. road maintenance fees on Quartz Mountain Silica Deposit, Eastern Douglas County.

I talked with Herb Wedge, General Manager, Hanna Nickel operation in Riddle this morning to get an up-date on mining activity of both the Nickel mine and Quartz Mountain Silica mine. In the course of our conversation the matter of road-use charges for hauling the silica rock over U.S.F.S. roads came up. It seems they are paying about $4.50 per ton road-use fees. This is about pricing the operation out of the market and they are looking at other possible sources.

I suggested that perhaps you would be willing to discuss this matter with Forest Service officials to see if there is any possibility of re-negotiating these charges to achieve a more reasonable rate. Hope I didn't speak out of turn. I also asked Herb to send us a summary of the situation in writing. I'll forward the information when it arrives.

Sincerely,

Len Ramp
Resident Geologist

LR:rep

cc: Herb Wedge, General Manager
Hanna Nickel Smelter
P.O. Box 85
Riddle, Oregon 97469

X Copy

STATE OF OREGON INTEROFFICE MEMO

TO: Don Hull & John Beaulieu DATE: May 15, 1987

FROM: Len Ramp

SUBJECT: Hanna Nickel Smelter facility

There have been two meetings since my last written report to you on this project. The first meeting, which I reported to you verbally and which I arranged, was held Friday morning, April 24th at the CCD office in Roseburg. In attendance were Tony Kuhn and Peter Graff of CCD Business Development Corp., Herb Wedge and Don Meyer of Hanna Nickel and myself. The topic of discussion was to determine the feasibility of a feasibility study.

Herb Wedge proposed getting Richard W. Wilson, president of Hatch Associates, Metals Industry Engineering Consultants from Buffalo, New York, and Walter D. Atchison, former Hanna Metals Sales Representative and industry consultant from Hudson, Ohio, to attend a pre-feasibility meeting along with the present group and include also Dennis Goodman of PP&L, Ralph Nafziger of BuMines, and perhaps Don Hull.

CCD was to arrange travel expenses for Wilson and Atchison through the Douglas County Industrial Development Board. This all was accomplished through the efforts of CCD and Herb Wedge.

The second meeting was in two parts. Dick Wilson and Walt Atchison arrived in Roseburg Monday, about noon, May 11th and toured the smelter facility Monday afternoon. A sit-down meeting was held Tuesday morning at CCD in Roseburg. The participants were: Dick Wilson, Walt Atchison, Herb Wedge, Don Meyers, Tony Kuhn, Peter Graff, Dick Seamons (U.S. BuMines for Ralph Nafziger who had a conflict). Wynn Walkerfrom Canyonville, Joe Hannon, Administrator and Bob Cotterell, Mayor of Myrtle Creek were also in attendance, and myself. No one representing PP&L was in attendance.

Dick Wilson of Hatch Associates outlined the kind of research work they were involved in and made a few suggestions regarding suitable use for the furnaces such as master alloy production from scrap, black sand utilization, baghouse dust processing, waste disposal plant, etc.

It was suggested that a 90-day moratorium be requested from Hanna for scraping the furnaces and kilns and related equipment; also that Hanna be requested to aid in funding a study.

The proposal to come from Hatch Associates is for an alternative use study (Phase 1 study) to answer the question: How can we use the assets we have? Such a study would probably cost no more than $50,000.

81-125-1387

The results of this study would be presented to industry to help fund a final feasibility study which may cost in the neighborhood of $100,000 if so indicated.

The proposed Coos Bay ferro chromium plant was discussed briefly but no one seemed to know much about it. Its affect on our proposals will also be researched.

The meeting ended at about 10 A.M. as Wilson and Atchison had to catch a plane. CCD was to prepare a letter to Bill Welsh of Hanna outlining our request to them and Herb was to transmit that request the same day (copy enclosed).

I will keep you informed of further developments.

Len

LR:rep
cc: Bill Rice (BuMines, Spokane)

Hanna File

STATE OF OREGON INTEROFFICE MEMO

TO: Don Hull and John Beaulieu DATE: April 8, 1987

FROM: Len Ramp

SUBJECT: Hanna Nickel Smelter

Following our meeting Wednesday afternoon, April 1, in Portland; on Thursday morning, April 2, I met briefly with Lynn Youngbar in Salem at the EDD office. I learned from her that feasibility studies can be funded up to 75% by EDD and the limit is $50,000 total. I also learned that Mark Huston of CCD was involved in the reopening of the Dalles Aluminum plant. She indicated the involvement was minimal, however. She also suggested that Northwest Natural Gas may be willing to sponsor Herb Wedge's proposed G.R.I. Conference trip to Chicago. She promised to contact Craig Honeyman on that subject. (Later Honeyman called me to get more information and has determined that Hanna is a customer of C.P. National and that I should contact them. I have recently (4-7-87) contacted Tom Bean of C.P. National in Medford. He wasn't encouraging; but promised to look into the possibility of funding Herb's trip to Chicago and get back to me.)

On my return to Grants Pass later the same day (4-2-87), I stopped to see Herb Wedge at the Smelter. He informed me that CCD has weekly presentation on Fridays and he would probably be scheduled in a couple of weeks as soon as he was able to gather enough preliminary information on supply and markets of scrap and stainless steel. While I was there Herb called Walter Atchison, a former Hanna Sales Manager and now a metals industry consultant, on the subject of producing stainless steel, stainless scrap availability, etc. Atchison promised to send Herb a letter with some preliminary information that he could use in his presentation to CCD. Herb also took me on a tour of the smelter facility. We looked mainly at the two refining furnaces. He explained how they worked and the general smelting procedure. It was a worthwhile tour for me. Herb suggested that if a feasibility study is approved a monitoring committee made up of himself, Ralph Nafziger, Lynn Youngbar, someone from CCD, and myself should probably be formed to keep things moving in the proper direction.

Herb said that two nickel-producing companies interested in the Riddle facility have recently visited to look it over. A third company is scheduled to look it over later this month. At least part of the interest is apparently in the new wet-screening plant. I have the company names; but they may wish confidentiality.

I will keep you informed of any further developments.

Len

LR:rep
cc: Herb Wedge
Ralph Nafziger
Lynn Youngbar
Bill Rice

Don & John March 31, 1987

Len Ramp

Hanna Nickel Smelter

You have a copy of Herb Wedge's letter report of 3-16-87 to me on possible use of the Hanna Nickel Smelter for production of stainless steel, and discussion of charge chrome (high carbon ferrochrome) and high carbon ferronickel.
I'm pretty sure that "charge chrome" is a high carbon ferrochrome used to charge a blast furnace in the steel-making process.
Attached is a copy of Herb's 3-18-87 letter to Tony Kuhn, CCD Business Development Corp., Roseburg on the subject of melting unclassified stainless steel scrap. I have not talked with Kuhn; but have talked with his assistant Peter Graff on March 20th. Tony was to call back; but hasn't.
I called Bill Welch of Hanna in Cleveland instead of Richard Hahn on the advice of Herb. Mr. Welch is Director in Charge of Lands and Leases and is directly involved with disposition of the Riddle facility. Copies of all of Herb's correspondence on the subject have gone to Mr. Welch. Bill Welch's message to me is they intend to continue pursuing a buyer for the facility and will not postpone doing this. He is happy that the State and others are interested in finding a possible future use for the smelter; but he says it has to be a simultaneous endeavor. He is reasonbbly certain theis disposal program will take at least a year. He believes the smelter facility should be considered an important regional asset because within a 3 to 5 year period it may find a place in the economic development of the area. He indicated that the smelter will probably be the last item to be sold and if no buyers are found it will be available at scrap prices. He assured me they are not turning their back on us; but that they have to explore their possibilities and continue looking for buyers at the same time we are searching for alternate uses.
I talked again with Herb Wedge, both before and after he talked with Peter Graff (Tony Kuhn's assistant). Herb has agreed to make a presentation to CCD on melting of stainless scrap. Herb was going to contact Dick Box and others for preliminary information on availability of stainless scrap and markets. I asked Herb if he would be interested in going to the conference: "Natural Gas use in the production of virgin iron units" in Chicago April 23, if funding could be obtained for his travel, and he said "yes". He said the plane fare is about $480 and two nights hotel would be about 150 for a total of probably about $700. My next question is: is there any place we can find the money to send him? I think sending him would be a good investment as he is very interested in the possibility of reactivating the smelter and is willing to devote his talents toward that end. I think he is an important and valuable key in this proeess. He has a consulting agreement with Hanna; but they will encourage his

participation so long as it is parallel to their interests. If it becomes otherwise, he can and may terminate his agreement with them and continue to aid the cause. Herb says it would be personally satisfying to him to be able to help put people back to work and his only caution was becoming overly involved in a high-pressure job due to his health. (He had a heart attack and open-heart surgery last year).
I have invited Lynn Youngbar to attend our meeting April 1st in response to Don's suggestion. I have also invited Ralph Nafziger, U.S. BuMines, Albany to attend. He is a very qualified pyrometallurgist and can help us with advice and council on that subject. I would have written them both; but Ruthie is taking a short vacation.
Bill Rice, U.S. BuMines, Spokane, called back and reiterated their interest and willingness to help in any way they can. Bill suggested we work with Ralph Nafziger from Albany. He wants to be kept informed and will help fo facilitate the BuMines cooperation.
On the subject of possible chromite resources that may be made available to the smelter, see pages copied from U.S. BuMines IC 9087. The offshore black sand resource should also be considered as chromite is a major mineral constituent and the potential tonnage is very large (See GMS-37, Mineral Resources Map, Offshore Oregon by J.J. Gray and L.D. Kulm, 1985).

LR:rep
cc: Herb Wedge
Bill Rice
Encl: copy of Herb Wedge's letter of 3-16=87

Ron Geitgey March 20, 1987

Len Ramp

Olivine at Nickel Mountain

Enclosed are copies of correspondence with Herb Wedge of Hanna Nickel Smelting Company along with an article from World Mining Equipment February '86 on olivine mining in Norway for your files. This was sent to Herb by their geologist, Vic Mejia. Herb wants to know if any tests were done on the samples I collected and sent to you. The L.O.I. is apparently an important factor as is the MgO content.

Len
Encl: 7 pages

Hanna Nickel Smelting Company
P.O. Box 85
Riddle, Oregon 97469

RECEIVED - PTLD
AUG 12 1986
DEPT. OF GEOLOGY

August 8, 1986

file

Dr. Donald A. Hull
State Geologist
Oregon Dept. of Geology & Mineral Industries
1069 State Office Building
Portland, Oregon 97201

Dear Dr. Hull:

I have enclosed a news release announcing an indefinite shutdown of Hanna Nickel Smelting Company approximately August 15. Unfortunately, we have been forced to shut down because nickel prices have dropped more than 20 percent since construction of our wet screening system was started last summer.

Since 1982 when nickel production was indefinitely stopped for 18 months because of severely depressed nickel market conditions, Hanna has implemented two programs to reduce production costs. These programs, the off-peak power operation and the wet screening system, have required the support of legislators and the business community at both state and federal levels. The legislative group, business leaders, the community and our employees have cooperated and much progress has been achieved.

We continue to monitor market conditions and to study ways to make our operation more competitive. Hanna will keep you informed of developments as we seek ways to again become a viable member of Oregon's business community.

Sincerely,

Herb

Herbert D. Wedge
General Manager

hdw:pb
Enclosure

NEWS from HANNA

For Immediate Release

August 8, 1986

MARKET CONDITIONS FORCE
INDEFINITE SHUTDOWN
OF HANNA NICKEL

CLEVELAND, Ohio -- M. A. Hanna Company announced today that Hanna Nickel Smelting Company in Riddle, Oregon, will be indefinitely shut down approximately August 15, primarily due to slumping nickel sales prices.

Prices have dropped more than 20 percent since last summer when Hanna Nickel began construction of an innovative wet screening system that was hoped to make ferronickel produced at the nation's only integrated nickel mining and smelting operation competitive worldwide. In July, nickel prices on the London Metal Exchange averaged only $1.77 per pound, with little hope for significant improvement in the near future.

"Although depressed nickel prices have indefinitely shut down Hanna Nickel, company management continues to evaluate results of the wet screening tests conducted over the past few months," General Manager Herbert D. Wedge said in the employee letter. "We expect our studies to be concluded this fall, at which time we hope to have better information for employees concerning the outlook for the operation.

"We are extremely disappointed that nickel market conditions have deteriorated to this point, particularly after the exceptional efforts displayed by employees as we have worked to implement the wet screening process over the past year," Wedge added.

M. A. Hanna Company is an international natural resources concern engaged in five principal business areas: iron ore, oil and gas, nickel and silicon, coal, and management services.

#

Company Contact: Mary Jackson
216/589-4018

GR - 6

Len

MEMO TO FILE

To: Don, John, Gary & Frank Date: December 1, 1987

From: Allen

Subject: Hanna Nickel Smelting Co

As of today, Hanna Nickel Smelting Company no longer owns the Nickel Mountain site. The operation is now in the control of Universal Consolidated Companies which is owned by the Niggemyers of Ohio. They have purchased other abandoned mining facilities such as an iron ore pellet plant in Wyoming. They will sell off the major pieces of equipment and try to find other uses for the plant itself. Operating the smelter as a ferrosilicate plant is be one option here. Another would be selling the smelter slag as sand blasting sand.

For the present, Hanna remains responsible for the reclamation. However, we have had inquiries from an unidentified source in Ohio asking about taking over the Reclamation Permit. Herb Wedge will be maintaining an office in his house for the foreseeable future. It was not certain if there will be a Hanna number available but I do have his home number.

Herb Wedge pointed out to me that when Hanna made the decision to sell, nickel was selling at about $1.60 a pound; Hanna needed $2.25 to operate profitably. As of today the price is over $3.00. Herb attributes some of the rise, at least, to the cessation of Russian sales of Cuban nickel into Europe. However, he points out that the reserves at Nickel Mountain are only five or six years. To reopen the site as a nickel mine at this time with the limited reserves, and no guarantee that the price of nickel will stay high, is questionable. New owners are negotiating with the BPA for off-peak rates. It is, of course, possible that a new company could approach things differently then the Hanna folks did and restart the operation. There is no promise of this; selling of equipment is continuing. The conveyor system and slurry piping installed shortly before the shutdown have been removed.

Herb wedge - 672-8919
354 W. Casey St.
Roseburg 97470

Hanna Nickel

STATE OF OREGON INTEROFFICE MEMO

TO: Don Hull DATE: August 3, 1987

FROM: Len Ramp

SUBJECT: Hanna Smelter Facility Study
Douglas County Industrial Development Board Meeting, 7-30-87, 3:00 p.m.

The Group, including two representatives of Hatch Associates (the Spokesman's name - Paul O'Shaughnessy), Peter Graff, Secretary of the Douglas County Industrial Development Board, three members of the board, Herb Wedge, Lynn Youngbar of EDD, a TV reporter with his camera and recorder and me.
The meeting went into "executive session" excluding the media so the TV cameraman folded his camera and left.
Paul O'Shaughnessy summarized the preliminary investigations they have done (see enclosed summary sheets) and handed out a few copies of the "background data" consisting of about 400 pages of everything from some of my inter office memos to you (that I sent copies of to Herb Wedge), newspaper clippings and numerous calculation sheets with hand written figures related to production costs and various other costs and values to products, as well as numerous telephone memorandum from various contacts in industry on numerous subjects related to processes of interest.
At the end of the presentation, Herb Wedge and I were asked to comment. Herb wanted time to digest the data. He was concerned that possibly some things were being overlooked. We agreed and a second meeting is to be held August 4th at 3 P.M. in Roseburg.
Following the meeting I inquired as to the status of the proposed Coos Bay Ferro-Chrome plant. Peter Graff indicated that it was shelved temporarily for lack of funding but that the latest information he had was that funding would soon be, or was now available; but didn't relate the source.
I also asked Lynn Youngbar about EDD funding for the Hanna feasibility study and she indicated that there was a good possibility that they would be funding 75 percent of the cost.
I'll attend the meeting August 4th and report to you on it.

Len

LR:rep
Encl: Preliminary investigations of Hatch Associates

STATE OF OREGON INTEROFFICE MEMO

TO: JOHN B. & TOM DATE: NOVEMBER 12, 1989

FROM: DON

SUBJECT: NICKEL MOUNTAIN MINE AND SMELTER - DOUGLAS COUNTY, OREGON

The attached memo summarizes information provided in my recent visits to Riddle. This information should be treated as confidential.

DAH:dej
H2NickN7.mem

STATE OF OREGON INTEROFFICE MEMO

Wiley

TO: **FILE** DATE: **NOVEMBER 12, 1989**

FROM: **DON**

SUBJECT: **GLENNBROOK NICKEL - DOUGLAS COUNTY, OREGON**

On November 1, 1989, I visited the refurbished nickel smelter at Riddle now being operated by Glennbrook Nickel, a partnership with Cominco American, as the operator. This smelter operated from 1954 until 1985 and intermittently thereafter. At the present time, the mine is inactive and smelter feed is obtained from crushing and screening of former reject oversized material.

Economic Factors

The plant currently employs 234 individuals and will likely reach a maximum employment of 250 in the near future. The company is debating on the merits of operating the adjacent mine, which would require an additional 150 employees, or possibly importing nickel ore from New Caledonia. It is noteworthy that a number of the current employees are veteran smelter employees who formerly worked with Hanna Mining Company. Only 5% of the current employees were hired from outside of the local area.

Technology

The current smelter operation is much like the former Hanna operation. Silica is being produced at Quartz Mountain in Douglas County by Jerry Rannels, and sold to Glennbrook. The silica is used to produce ferrosilicon, which is used, in turn, as a reductant for the nickel ore.

Economic Impact

Approximately $10 million have been spent by Glennbrook to refurbish the plant, which will likely produce 14 million pounds of ferronickel product in 1990. An additional $2.5 million is now being expanded to update the skull plant. It is likely that a further $1 million will be spent on new crushing and screening facilities, which will allow Glennbrook to perform the functions rather than hire outside contractors. Thus a total of $13.5 million has been committed to date by the new operator for repairs and

upgrading of facilities. It is likely that a further $30 million will be required to recapitalize the Nickel Mountain mine, or $20 million would be needed to provide facilities for importation of foreign ore. It is conceivable, but unlikely, that ore would be trucked or rail-hauled from other nickel laterite deposits in southwestern Oregon and northern California. The Nickel Mountain mine has approximately 10-15 years of "reserves", totalling 26 million tons with a mine grade of 0.8% nickel, which could be upgraded for smelter feed to approximately 1% nickel. In contrast, the New Caledonian ore would likely grade 2.4% nickel and could be imported at a transportation of $5-7 per ton on the water into Portland and an additional $19 per ton rail rate on Southern Pacific from Portland. A more likely option for transportation of ores would be via Coos Bay as a backhaul on chip and lumber trucks, at a rate of perhaps $5-7 per ton, plus the cost of modifying the chip trucks.

Future Possibilities

In the future, it is conceivable that ferronickel and ferrochromium could both be produced at Riddle in the existing furnaces. Consultants indicate that the present furnaces could handle sand-sized chromium ores. By combining ferronickel and ferrochromium at the Riddle location, stainless steel could be produced with a significant value added component. A stainless steel end-product operation would enhance the value of chromite-bearing black sand placer resources offshore of Oregon. Alternatively, a ferrochromium operation at Riddle could operate on chromite resources contained in the Stillwater ultramafic complex in Montana, where an Australian group, Boulder Gold, is currently discussing with Kennacott the possibilities of operating a new chromium mine and/or new ferrochromium smelter. The decision on the future utility of the Nickel smelter at Riddle will likely be made in the next several months. The remaining reserves of "ore" at the smelter will last approximately 3-1/2 to 4 years at the current rate of production.

DAH:dej
HGlennN7.cnf

Tom W- FYI

Oregon

DEPARTMENT
OF GEOLOGY
AND MINERAL
INDUSTRIES

ADMINISTRATIVE
OFFICE

November 10, 1992

Dr. Sooi P. Chong
Vice President
Total Quality Planning & Technical Services
M A Hanna Company
1301 E 9th Street
Cleveland, OH 44114

Dear Dr. Chong:

The Oregon Department of Geology and Mineral Industries has been communicating with Richard W. Ruhanen of the Minnesota Department of Natural Resources regarding the data holdings belonging to M.A. Hanna Mining Company. Specifically, in response to October 29, 1992 correspondence to our State Geologist Donald A. Hull (Oregon), we have been discussing the disposition of data files pertinent to the state of Oregon.

Mr. Ruhanen has indicated that the data files focus primarily on beneficiation and geology of a site specific nature of the Riddle site here in Oregon. We understand the desire of Hanna Company personnel for the data to remain in confidential status under the trade secret clauses of the various states involved. On behalf of the state of Oregon, we would like to take possession of the files of data relating to the Riddle facility. We would honor the trade secret wishes of M.A. Hanna Mining Company.

If a letter is provided with the data indicating that the data is to remain confidential according to the Minnesota DNR-Hanna Mining Company Minerals agreement, then we can keep the data confidential in accordance with the trade secret laws applicable in Oregon. A copy of pertinent language is provided.

We contemplate that memos and letters may be of a more confidential nature than technical reports. If it is possible for our agency to use the technical reports in assisting in further development of the Riddle site, then we would appreciate receiving language to that effect.

In any case, however, we would like to receive the documents and would honor any trade secret request that would accompany them to the extent provided in Oregon law. Please advise us as to the next steps we should be taking in acquiring the files. Thank you very much.

Sincerely,

John D. Beaulieu
Deputy State Geologist

Attachment

JDB:ch/chong.let/3

Suite 965
800 NE Oregon Street # 28
Portland, OR 97232
(503) 731-4100
FAX (503) 731-4066

STATE OF OREGON INTEROFFICE MEMO

TO: Don Hull DATE: February 25, 1987

FROM: Len Ramp

SUBJECT: Hanna Nickel Smelter

I met with Herb Wedge and Marv Johnson at Riddle last Thursday (Feb. 19). We discussed their time frame for disposing of the mine and smelter facility. They are starting to dispose of a few items now such as office furniture and are in the process of inventorying all the property for evaluation and sale. They said that time is short and much could be sold within 6 months. They do, however, have 2 to 3 years to complete the salvage sale of the facility and real property. Herb is retired and is retained as a consultant during this period.

We also discussed the mineral resources on the property, i.e., the slag, the mill tailings (fines), and the olivine in reject piles. I sampled the – 100 mesh mill tailings as a possible suggested use for foundry sand. They have been selling the dunite and peridotite reject rock for road ballast and are receiving $3.00 a ton at the pile.

Our main discussion was the feasibility of converting the facility to produce stainless steel using charge chrome, ferro nickel and/or scrap steel. Herb seemed to think this could have some potential and promised to put together a letter summarizing the major requirements and potential problems. He thought that a feasibility study may be in order. He also suggested research on the use of natural gas as a smelting reductant could perhaps be done by the U.S. BuMines in Albany.

We also discussed scrap melting and the need to know how much unsorted scrap may be available in the area.

81-125-1387

Interoffice Memo
February 25, 1987
to Don Hull from Len Ramp
Subject: Hanna Nickel Smelter

The cost of re-starting the smelter within one year was estimated at about $1,000,000. A two year delay would undoubtedly cost more; but the proportionate cost is unknown.

A few other items such as the ferro silicon market, the slag products market, and the employment potential of these were also discussed briefly.

I contacted Lynn Youngbar, EDD, by phone following the meeting to let her know of it, and she promised to follow up with a call to Herb Wedge and perhaps set up another meeting.

Will keep you informed.

Len Len Ramp

LR:rep
cc: Herb Wedge, Hanna Ni Smelter
Lynn Youngbar, EDD

Hanna Nickel Smelting Company
P.O. Box 85
Riddle, Oregon 97469

March 18, 1987

(Peter Graff asst tel con 3-20-87)

Mr. Tony Kuhn
CCD Business Development Corporation
744 S. E. Rose
Roseburg, OR 97470

Dear Tony:

During our meeting in your office on March 5, the feasibility of melting unclassified stainless scrap metal, adjusting and standardizing the grade and casting the product for sale to stainless melters was discussed. Perhaps the two 10-ton steel furnaces previously used for refining ferronickel at Riddle could be utilized for the purpose. In the past, W. D. Atchison, formerly manager of metal sales for the M. A. Hanna Company, has told me that there are small companies in the Pittsburgh area who do this profitably. During a business trip to Treibach, Austria in March 1983, I observed an operation in which nickel catalyst containing over 20% nickel, purchased worldwide, was being reduced to metallic form, the grade standardized and cast in shotted form. A single 7.5 megawatt steel furnace with a 10-foot diameter shell was used to process the catalyst. Perhaps a combination of scrap melting and nickel catalyst might be worthy of an examination of feasibility in connection with the Riddle facility.

The following information would be necessary to develop a feasibility:

1. Quantity of raw material (stainless scrap and nickel catalyst) available within an economic transportation zone probably in the western U.S. but also perhaps including sources in the Pacific Rim.

2. Price at which the raw material could most likely be purchased.

3. Number and location of domestic companies engaged in a similar activity.

4. Survey of the potential market to estimate probable quantity of product which could be sold and at what price. This survey should perhaps include potential buyers in the Pacific Rim countries to take advantage of possible freight advantage.

5. Subsequent to the estimation of the limitation of and subject to either supply of raw material or sale of product, the cost of modification of existing equipment should be engineered and estimated.

6. Based on the agreed equipment configuration, as modified, the operating costs including power, labor, process material and maintenance material would be determined.

Obviously, the feasibility would then be based on sale of a realistic quantity of product at an agreed upon price less operating costs, depreciation of capital over an agreed fixed period and debt service on the capital, all in accordance with estimates based on the surveys enumerated.

The question of who should be commissioned to accomplish the work has no obvious answer. I would prefer to select an Oregon based engineering firm but perhaps an organization like Stanford Research or Battelle has more of the needed international capability. I suggest that a small group be established to interview prospects and to make a selection. I think Ralph Nafziger would function well as one of the members and I will have a continuing interest in the work.

A number of men might prove a source of additional preliminary information. They are:

W. D. Atchison - Former Hanna Sales Manager - Cleveland 216/653-9416
Dick Box - Luria Brothers Salesman - Seattle 206/228-5100
Ross Hogan - UCC National Carbon Salesman - Boring, Oregon 503/658-6142
Bill Ferris - V.P. Oregon Steel - Portland 503/240-5222
Vince Vellella - President Inmetco - Pittsburgh 412/771-2654

Following the preliminary investigations and discussions and as significant information is obtained, a series of "trial feasibilities" should be attempted by a management-type group to evaluate whether or not additional phases of the project should be pursued. Careful and constant evaluation of the work should be an effective tool in making the best use of money spent.

Very truly yours,

H. D. Wedge

pb
cc: W. E. Welsh
D. D. Morgan
D. G. Meyers
Lynn Youngbar (Econ.Dev.-Salem)
Len Ramp (Dept. of Geol.-Grants Pass)
W. L. Rice (Interior Dept.-Spokane)
Ralph Nafziger (Bur.Mines-Albany)

Hanna Nickel Smelting Company
P.O. Box 85
Riddle, Oregon 97469

March 16, 1987

Mr. Len Ramp
Resident Geologist
Oregon Dept. of Geology & Mineral Ind.
P. O. Box 417
Grants Pass, Oregon 97526

Dear Len:

As I promised you, I am forwarding my discussion regarding a method of producing stainless steel in the existing nickel smelter at Riddle, Oregon. The economic feasibility of producing either ferronickel or charge chrome individually is difficult for several reasons:

1. The Riddle smelter is designed to produce low carbon ferronickel (L.C. FeNi). Pilot testing would be needed to establish viability of a more economic gas reduction.

2. Only one of the exisitng furnaces is a submerged arc type capable of production of charge chrome and is not equipped for slag production. There is no single, large consistent chromite deposit available locally to my knowledge.

3. The Nickel Mountain orebody has been depleted to conservatively 40 million crude tons of remanent ore types averaging about 0.76 to 0.78% nickel. Reasonable economics depend on production of a concentrate which represents only 8 to 10% of the natural crude tons mined. Stripping quantities can vary based on the geological concept utilized but clearly include red soils which can not be upgraded. Dilution of 5% to 10% should also be included in tonnages to be moved.

During visits some years ago to Pacific Metals, a competitor located in Hachinohe, Japan, I have observed that their approach to maintaining economic viability of nickel smelting has been through vertical integration of the process. Pamco traditionally produced high carbon ferronickel from high grade ores (2.5% Ni) imported from New Caledonia and sold pigged product to producers of stainless steel. Their development was to install submerged arc furnace capacity for charge chrome production from imported ores. The two products, HCFeCr and HCFeNi, were then charged into a new argon-oxygen vessel (AOD) along with scrap steel and blown with gaseous oxygen to lower carbon levels. The stainless

steel produced was then cast into billet form through a modern but small continuous caster. As billet, the product is ready for rolling or drawing by sheet and shape fabricators with only a single reheating.

The feasibility of converting the Riddle nickel smelter to a process configuration similar to that of Pamco could give attractive operating costs but substantial capital funds would be required for modification of existing equipment, testing and addition of the decarburization and casting equipment.

Modification and additions needed are:

1. Testing in pilot scale the kinetics of reduction of ferric iron and nickel oxide with natural gas. Tests should provide parameters needed to estimate ladle freeboard at various levels of gas injection. You might wish to attend a seminar on the subject in Chicago on April 23.

2. If local chromites were used to produce charge chrome, the existing ferrosilicon furnace is a submerged arc type but would have to be equipped with casting and hoisting equipment to handle slag in ratio of up to twice the metal volume.

3. Rearrangement of the pit area and provision to introduce the natural gas into molten laterite would be needed.

4. Acquisition of an argon-oxygen vessel of sufficient capacity (perhaps 25 tons) to decarburize proportionate mixtures of HCFeNi and HCFeCr would be required.

5. A continuous casting machine is needed capable of supplying the desired shape. (Demag of Germany supplied Pamco and obviously has design parameters for stainless steel.)

I'll be happy to respond to any further questions or comments you may have in the future.

Very truly yours,

H. D. Wedge

hdwl130:pb
Attachments

cc: W. E. Welsh
D. D. Morgan
D. G. Meyers
Lynn Youngbar (Salem)
Dr. Donald A. Hull
W. L. Rice (Spokane)
Tony Kuhn (Roseburg)

(all w/attach.)

ROUGH DRAFT

MEMO DATE: February 23, 1987

TO: File

FROM: Don H.

SUBJECT: Conversion of Riddle Smelter

In various conversations in recent weeks we have discussed the possibility of conversion of the existing ferro-nickel smelter at Riddle, Oregon to alternative uses including the production of ferrochromium and/or stainless steel by remelting scrap metal. On February 17, 1987 I talked to Jim Haight at Woodburn about these possibilities to follow further conversations involving the Economic Development, Hanna personnel, perspective chrome miners including Haight. Jim loaned several reports which will need to be xeroxed with originals returned to him. I indicated that we would pursue these possibilities and report back to him on or before March 9, 1987 in order to indicate progress.

At the present time the Economic Development Department appears to have no funding available to pursue a feasibility and marketing study which would ascertain the technical factors involved in converting the Hanna Nickel Smelter to production of alternative alloys or evaluate markets for potential products from a converted facility.

It appears that domestic sources of chromite in west coast states will be unavailable near term. For this reason alternative sources of chromite might be (1) by-product chromite from the Still Water complex in Montana produced (unlikely) during forthcoming palladium-platinum mining and recovery or (2) imported chromite from foreign sources including Philippines, Turkey and southern Africa.

The availability of scrap stainless steel is unknown at the present time.

Haight indicates that Hanna views the conversion to ferrochromium production as technically feasible whereas Len Ramp indicated earlier that this conversion would be economically unfeasible at the present time. His point will need to be clarified.

Len will meet with Hanna personnel on February 19, 1987 or February 20, 1987

to pursue the feasibility of converting the ferronickel smelter to production of alternative alloy. I indicated to Len on February 18, 1987 that we would need to understand Hanna's interest at Riddle in order to ascertain the time available to undertake feasibility studies for the purposes described above. We need to understand the alternative being considered by Hanna. If the property tax burden is an issue, perhaps some relief could be sought at the county level. If the cash salvage value of the existing plant and related facilities is of concern to Hanna, then we need to establish a price at which sale to another operator would be considered. It is not clear at this time why Hanna is considering salvage of the facility.

I also indicated to Len and Ron Geitgey on February 18 that production of olivine and/or slag from the Riddle waste is of lesser interest at the present time neither possibility offers significant emmployment potential. The availability and application of the slag are well established in the market place. Olivine producers are established in Washington State and elsewhere and it is difficult to foresee large employment possibilities related to olivine production at Riddle.

If near term conversations with Hanna indicate a willingness to delay scrapping the Riddle palnt, we should pursue the availability of monies to investigate the technical feasibility in markets for ferrochrome and/or stainless steel scrap products. Likely participants in the study would be the U.S. Bureau of Mines and possibly the Economic Development Department. We should move quickly to answer the quesitons posed above so that I can discuss the possibility of a joint study with the director of the Bureau of Mines during his visit to Portland in April, 1987.

DAH:ab

CC: John Beaulieu
Len Ramp
Ron Geitgey

C. C. D. BUSINESS DEVELOPMENT CORPORATION

744 Southeast Rose Street – Roseburg, Oregon 97470
Telephone (503) 672-6728
Toll Free in Oregon: 1-800-452-6010

May 12, 1987

W. E. Welsh
Director, Lands and Leases
M.A. Hanna Company
100 Erieview Plaza
Cleveland OH 44114

Re: Facilities at Riddle, Oregon

Dear Mr. Welsh:

We are writing to you on behalf of an informal group comprising ourselves, the Douglas County Commissioners and Industrial Development Board, and the cities of Riddle, Canyonville and Myrtle Creek, Oregon.

Following meetings with Messrs. Herb Wedge, Don Myers and Walter Atchison, and representatives of Hatch Associates, the U. S. Bureau of Mines and the Oregon Department of Geology, we are reasonably encouraged at the prospects for employment-generating new enterprise at the Hanna site in Riddle.

To take the next step toward identification and delineation of possible feasible opportunities, we would like to request Hanna's permission for a study team, headed by Hatch Associates of Buffalo, NY, to conduct an Alternative Use Study of the Riddle site and facilities.

For this purpose, we would request a moratorium for the months of June, July and August on the dismantling and salvage of smelter processing equipment, including dewatering, drying, calcination, furnacing, refining and associated water systems.

We hope that this Alternative Use study, to be conducted by Hatch on a not-to-exceed $50,000 basis, will point the way to one or more specific opportunities for the site, toward further development of which interested parties can participate in subsequent detailed feasibility analyses. Since the "first-phase" Alternative Use study might also provide information useful to Hanna, we would invite Hanna to participate in this first-phase study as well.

If Hanna is interested, we would like to have your thoughts on the form such participation might take. To initiate discussion, we might suggest that for a commitment of up to 25% of the final cost of the first-phase Alternative Use study we would 1) send you next week a copy of Hatch's proposed work program, 2) invite your comments and suggestions for inclusion in the work to be performed, and 3) provide you, on completion, with a copy of Hatch's work.

DRAFT

John B.

April 17, 1989

Don

Nickel Smelter at Riddle, Oregon

Contact with Cominco limited on April 7, 1989 indicates that a subsidiary is engaged in reactivation of the Ferronickel Smelter Act at Riddle, Oregon. A majority owned subsidiary Cominco Resources International, through a 50-50 joint venture with U.S.A. Investments has reach agreement with Universal Equipment Co., which had purchased the plant and properties from Hanna Nickel. The joint venture operates as Glenbrook Nickel. The agreement between Glenbrook and U.S.A. involves a smelter, smelter property and remaining equipment but not the mine at this time. The smelter will be reactivated as rapidly as possible so as to produce ferronickel this calendar year using a low-grade stock pile of oversized material. The anticipated rate of ferronickel production is approximately one half the prior rate under Hanna. A responsible individual at Cominco in Spokane is Terry Gilbregh(?). It is possible that the successful reactivation of the smelter might lead longer to the resumption of mining. I have indicated to Cominco that it would be important to us to anticipate any plans to reactive the mines.

A copy of Dominto's press release is attach. Please treat the above ownership information as confidential.

DAH:dg
hull/bea41789

Attachment

STATE OF OREGON INTEROFFICE MEMO

TO: John B., Jerry G., Ron G. DATE: August 10, 1987

FROM: Don Hull

SUBJECT: Hanna smelter alternate use study

The attached information has some interesting insights regarding industrial minerals.

DAH:rm
attachment

STATE OF OREGON INTEROFFICE MEMO

TO: Don Hull

RECEIVED
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MINERAL IND

DATE: August 3, 1987

FROM: Len Ramp

SUBJECT: Hanna Smelter Facility Study
Douglas County Industrial Development Board Meeting, 7-30-87, 3:00 p.m.

The Group, including two representatives of Hatch Associates (the Spokesman's name - Paul O'Shaughnessy), Peter Graff, Secretary of the Douglas County Industrial Development Board, three members of the board, Herb Wedge, Lynn Youngbar of EDD, a TV reporter with his camera and recorder and me.
The meeting went into "executive session" excluding the media so the TV cameraman folded his camera and left.
Paul O'Shaughnessy summarized the preliminary investigations they have done (see enclosed summary sheets) and handed out a few copies of the "background data" consisting of about 400 pages of everything from some of my inter office memos to you (that I sent copies of to Herb Wedge), newspaper clippings and numerous calculation sheets with hand written figures related to production costs and various other costs and values to products, as well as numerous telephone memorandum from various contacts in industry on numerous subjects related to processes of interest.
At the end of the presentation, Herb Wedge and I were asked to comment. Herb wanted time to digest the data. He was concerned that possibly some things were being overlooked. We agreed and a second meeting is to be held August 4th at 3 P.M. in Roseburg.
Following the meeting I inquired as to the status of the proposed Coos Bay Ferro-Chrome plant. Peter Graff indicated that it was shelved temporarily for lack of funding but that the latest information he had was that funding would soon be, or was now available; but didn't relate the source.
I also asked Lynn Youngbar about EDD funding for the Hanna feasibility study and she indicated that there was a good possibility that they would be funding 75 percent of the cost.
I'll attend the meeting August 4th and report to you on it.

Len

LR:rep
Encl: Preliminary investigations of Hatch Associates

STATE OF OREGON

INTEROFFICE MEMO

TO: Don Hull

DATE: June 9, 1987

FROM: Len Ramp

SUBJECT: Hanna Nickel Smelter facility

The enclosed copies of correspondence, proposals, etc., were sent to me by CCD in Roseburg. They will help keep you informed on progress of the project.

LR:rep

Len

RECEIVED-PTLD
JUN 11 1987
DEPT. OF GEOLOGY
MINERAL INDUS.

C. C. D. BUSINESS DEVELOPMENT CORPORATION

744 Southeast Rose Street – Roseburg, Oregon 97470
Telephone (503) 672-6728
Toll Free in Oregon: 1-800-452-6010

June 4, 1987

Mr. Richard W. Wilson, P.E., President
Hatch Associates Consultants, Inc.
8th Floor Rand Bldg., 14 Lafayette Square
Buffalo, NY 14203

Dear Dick:

As discussed with your secretary today, enclosed are a copy of the application submitted to the Oregon "Stabilization and Conversion" Fund, and a second letter to Hanna. As of last week, we had some verbal information from Herb Wedge as to which way Hanna seemed to be leaning, but we still have nothing from Hanna itself.

Please note items 14 and 17 in the proposal. Give me a call if you would like to discuss them. When your response is ready, call and we'll decide (depending on length, I suppose) whether you should fax the material to us or use some other method. We'll convene another meeting of the Douglas County Industrial Development Board as soon as we can get the material to the members, and as soon as we have some response from Hanna.

Look forward to hearing from you soon.

Very truly yours,

Peter L. Graff
Assistant Director

Enclosures

cc: Walter D. Atchison
Len Ramp
W. D. Smiley
Ralph Nafziger/Dick Siemens
W. L. Rice
Douglas County Bd. of Commissioners
Douglas County Industrial Development Board
Lynn Youngbar
H.D. Wedge
D. G. Meyers

C. C. D. BUSINESS DEVELOPMENT CORPORATION

744 Southeast Rose Street – Roseburg, Oregon 97470
Telephone (503) 672-6728
Toll Free in Oregon: 1-800-452-6010

June 1, 1987

Mr. W. E. Welch
Director, Lands and Leases
M.A. Hanna Company
100 Erieview Plaza
Cleveland, OH 44114

Re: Facilities at Riddle, Oregon

Dear Mr. Welch:

In reference to our letter of May 12, 1987, we would like to advise that the Douglas County Industrial Development Board (potential sponsor of the proposed Alternative Use Study of the Nickel Mountain site) has met with us and Mr. H.D. Wedge and discussed developments to date.

The DCIDB's position may be summarized in principle as follows:

1. They are most anxious to proceed generally as outlined in our letter of May 12, and in the Hatch Consultants proposal. As you will appreciate, confirmation from Hanna of a 90-day moratorium on dismantling and sale of smelter equipment is a prerequisite to approval by the DCIDB and other funding sources (The Oregon Department of Economic Development) of the Hatch proposal.

2. The DCIDB agrees that the requested moratorium will not apply to the dewatering equipment such as centrifuges, 50' thickener, etc.

3. The DCIDB would in addition like to have in-principle assurance that, in the event the Hatch Alternative Use Study suggests one or more potentially profitable uses, Hanna would be willing to extend the moratorium on such equipment and for such time(s) as may be appropriate to allow completion of subsequent site-specific feasibility studies on the part of interested sponsoring investors/operators.

4. The DCIDB would very much like to have Hanna's participation in the Alternative Use Study under any reasonable terms acceptable to Hanna. The DCIDB has discussed potential funding alternatives for the $50,000 with the state, and would like to propose the following specific arrangement for funding (all up front): Hanna 15% or $7,500; State and DCIDB to fund the balance of $42,500 on a 75/25 basis, with the state paying $31,875 and DCIDB $10,625. This would supersede the suggestion in our letter of May 12. Again, however, we would emphasize that, if this for any reason is not acceptable to Hanna, the DCIDB would be happy to consider alternative suggestions.

We hope that the matters discussed herein and in our letter of May 12 are reasonably clear and acceptable to Hanna, and look forward to your response.

Very truly yours,

G. Anthony Kuhn
Executive Director

PLG:as

DOUGLAS COUNTY
INDUSTRIAL DEVELOPMENT BOARD

744 S.E. Rose Street – Roseburg, Oregon 97470
Telephone (503) 672-6728

OREGON STABILIZATION & CONVERSION FUND
FEASIBILITY STUDY APPLICATION:
NICKEL MOUNTAIN SMELTER--ALTERNATIVE USE STUDY

II. Project Information

6. Describe the facility (including type of construction and construction sector, pertinent features, current value, building sq. ft., land area and ownership)

The mine and smelting facility are described in some detail in an attached brochure. Since the brochure was written, rapidly increasing supply and especially power costs in the face of declining selling prices of FeNi during 1981 and 1982 resulted in a 19-month closure of the facility in April 1982. Events preceding closure are described in a copy of Hanna's pre-filed testimony at the Bonneville Power Administration rate case hearing. Subsequently, relying on an amendment in the Northwest Regional Power Bill which provided that the Bill should not adversely affect industries using materials indigenous to the region, Hanna worked out the techniques necessary to operate on an "off peak" form of power which was sold to them at $0.007 per KWH. Off-peak operations reduced costs by more than 30% but sales prices by 1984 were 10% less than production costs.

In a further attempt to regain economic operations, a modification costing approximately $12 million was made. The modification provided for recovery of an ore concentrate by a process of wet screening and separating the high grade fine fractions of ore at approximately 100 mesh size. Only economic ore was processed, melted and reduced to FeNi while the lower grade size fractions were rejected from the process as soon after mining as possible.

After construction in 1985 the new facility was tested during the end of that year and during early 1986. Approximately 70,000 tons of ore concentrate was produced, dewatered, agglomerated and stock piled. Smelting tests during June through August 1986 indicated that many unestimated advantages would be realized but that costs could not be reduced to a level roughly half of 1980 levels. The tests to produce the concentrate revealed that the $3 million wet screening and classification system required additional equipment to increase its capacity by about 60% to the 650,000 to 675,000 tons per year of concentrate needed to supply the smelter on the 104 hour per week "off peak" operating basis.

After completion of testing in August 1986, an indefinite shutdown of facility was declared. This was converted to a permanent shutdown in January 6, 1987 and plans were made to dismantle and salvage the equipment. Estimates of salvage value range from $7 to $10 million.

The land area involved includes approximately 5,200 acres of which nearly 4,000 acres is owned by M.A. Hanna Co. The balance is mostly BLM land on which Oregon Nickel and Wright leases have unpatented mining claims. Hanna has surface rights to their land but, although unmineralized, Douglas County has mineral rights. Nearly 2000 acres of the Hanna land is probably tillable.

7. Describe the most recent activity employed at the facility.

The most recent activity at this facility was the production of low carbon ferronickel and testing of the new equipment.

8. Based on available information, describe the prospects for a re-start and/or conversion of the facility.

The prospects for restarting are very remote. The equipment will be dismantled and the land sold unless an economic alternative use can be found. Even then, the equipment would most likely be sold to prospective users since, as a result of a major policy change, mining and metals are outside Hanna's corporate objective for use of new funds.

9. Please attach the facility's past three years financial statements (if available).

Financial statements are not available, but it is public knowledge that losses from Nickel Mountain operations were as follows:

FYE Sept. 30	Pre-Tax Operating Loss (000)
1982	($8,101)
1983	($5,321)
1984	($4,435)
1985	($2,228)
1986	($9,866)

The 1986 jump in the loss was due to the combination of new facility costs and a precipitate decline in nickel prices. A table showing sales prices and a graph of nickel prices for 1986 are attached.

10. Describe the facility's existing or last markets and customers for its product(s). Describe these products.

See the next to last page of the enclosed Hanna brochure for a brief description of product and markets. It is to be emphasized that an evaluation of uses of the facility other than the production of nickel are the subject of the current grant application.

11. Identify the level of employment during the last twelve months, and over the past three years.

Employment history

1987 Jan.- April	4	employees
1986 Dec.	9	"
1985 Dec.	59	"
1984 Dec.	277	"
1981	550-600	"

12. Describe the potential product mix for the facility.

See enclosed proposal from Hatch Associates

13. Describe any impediments to successful operation of the facility.

The equipment design is early 1950 vintage. It has been well-maintained and modernized where possible but modern equipment is larger by a factor of 3 to 4 and takes advantage of economy of scale.

It is somewhat difficult to speculate about other impediments prior to selecting an alternate use. For many (but not all) possible uses, the site's relative isolation and distance from major markets could be a significant impediment.

14. Describe the elements and an estimate of the cost of the feasibility study. Include specific costs for such study components as market research, asset appraisal and production cost analysis.

The Alternative Use Study will be generally as delineated in the enclosed proposal from Hatch Associates.

Hatch has been asked to provide additional information regarding:

- Definition of end-product, and likely scenario of next steps following submission of a positive report.

- Rough outline and schedule of work, with proposed review-and-reconfirm points.

- Breakdown by study component of probable type and level of effort for the not-to-exceed-$50,000 total.

15. List all individuals and/or organizations you believe are qualified to perform the feasibility study.

We are informed by former Hanna personnel that this study is sufficiently technical in nature that very few firms are qualified to undertake it. Hatch Associates is perhaps the only firm among them (others would be Bechtel Corporation, Ralph M. Parsons, Davey-McKee) who could be described as "medium" sized and who would be, in all likelihood, interested in bidding on this comparatively small project.

Hatch, whose brochure is enclosed, is perhaps uniquely qualified to perform this "Phase I" study because a) they are experts in both the iron and steel and the non-ferrous metals industries, b) they have done similar studies, currently performing a study for the State of Pennsylvania to determine alternative uses for closed steel mills in and around Pittsburgh, c) they offer an excellent potential for bringing potential investor/operators to the table in the event one or more of the alternative uses appears profitable, and d) they are available to do the study immediately, a significant factor in view of Hanna's plan to sell off the facilities (see enclosed letter from CCD Business Development Corporation to Hanna dated June 1, 1987).

16. List those individuals and community organizations supporting this application and re-starting the facility. Attach any letters of support.

Re-establishing some form of meaningful manufacturing activity at the Nickel Mountain site has virtually universal support throughout south and central Douglas County. A news article is enclosed, describing the effect of the loss of local property taxes on the local community.

The loss of the Hanna payroll, and of the trade and service jobs that the Hanna payroll supported, are if anything more dramatic. Metals industry jobs are family wage jobs--historically slightly outstripping even lumber and wood products.

In response to testimony from the neighboring communities of Canyonville and Myrtle Creek, the Douglas County Economic Strategy Committee named the $50,000 Nickel Mountain Alternative Use Study a priority project even though the primary focus of their (draft) strategy is tourism.

17. Attach a commitment letter for the 25 percent matching funds source for the feasibility study.

The Douglas County Industrial Development Board were handed the Hatch proposal on May 22. The results of their discussion are summarized in CCD's letter to Hanna of June 1. As soon as Hatch has responded to the questions listed in item 14 above, the DCIDB will reconvene and formalize its commitment. This is expected in the next two weeks.

John B

STATE OF OREGON

INTEROFFICE MEMO

RECEIVED-PTLD
APR 27 1987
DEPT. OF GEOLOGY & MINERAL INDUS

TO: Don Hull

DATE: April 24, 1987

FROM: Len Ramp

SUBJECT: Low carbon ferro chromium smelter for Coos Bay

A newly formed company - Sherwood Pacific Limited was initiated to construct and operate a chromium smelter in Coos Bay, Oregon. Announced on the 11th of April, 1987 to the Vancouver, B.C. Stock Exchange by parent company, P.S.M. Technologies, Inc., a subsidiary of U.S. Chrome, Inc. and U.S. Nickel Corp. (See copy of announcement by Bill Wood, President & clippings enclosed).

Pacific Power and Light is reportedly funding the project in the amount of $2,000,000 as well as offering an incentive power rate agreement and installation of a $4,000,000 transmission and substation facility.

The Governor through EDD is also expected to contribute to the project. P.S.M. (Precious Strategic Metals) will provide $10,000,000 to the project and have exclusive right to supply raw material to the smelter.

The Port of Coos Bay is providing a fully-serviced site including deep water dock on very attractive terms for the first six years. Frank G. Martin, Jr. Port General Manager is credited with arrangements.

Primary suppliers of Domestic Chromite are reported to be Del Norte Chrome and Asamera Metals from mines in N. California.

I have been told that minimum grade ore acceptable at the smelter will be 46% Cr_2O_3 with a Cr:Fe ratio of 2.05 to 1.

The U.S. BuMines estimates California has 1.6 million metric tons of Cr_2O_3 contained in 14.6 million mt with a Cr:Fe ratio of greater than 2.0. How much of this is greater than 2.5 Cr:Fe ratio isn't reported but it may be about 1 million mt. One million mt of Cr_2O_3 contains 684,250 mt of Cr. If the plant is to produce only 30,000 mt of LCFC which contains about 50% Cr, the 1 million mt of Cr_2O_3 would last more than 40 years. LCFC (March market quotes E & MJ effective 9-25-86) sells for about 83¢ a pound (.82 to .84) of contained Cr. Better check my figures. They sound too good.

81-125-1387

Lloyd Frizzell indicated to me that the plant would probably be using imported foreign ore also.

I seem to recall that Jim Haight said the John Day ore could be upgraded to only about 43% Cr_2O_3 with a less than 2 to 1 Cr:Fe ratio so it wouldn't be considered a source.

I'll have more details regarding this subject following my meeting with Tony Kuhn of CCD business development and Herb Wedge and Don Meyers of Hanna Nickel this Friday A.M.

See you in Portland.

Len

LR:rep
Encl: 4 pages photo copies

MEMO DATE: April 15, 1987

TO: John B.

FROM: Don H.

SUBJECT: Hanna Nickel Smelter

On April 13, 1987 I talked to Len about the status of our work on the Hanna facility with respect to conversion of the smelter for alternative uses. We agreed that Len would keep in touch with the local Economic Development group (CCD) and Herb Wedge to get the results of Herb's preliminary analysis on the production of ferrochrome and/or stainless from scrap materials. I indicated that we could review the status of this subject during the Pacific Northwest metals and Minerals Conference on April 27-28, 1987.

The key question at this point is the desirability of undertaking a preliminary feasibility study to evaluate economic parameters of the production of alternative products by the Hanna plant.

DAH:ab

CC: Len Ramp

STATE OF OREGON INTEROFFICE MEMO DRAFT

TO: Hanna File DATE: March 17, 1987

FROM: John B.

SUBJECT: Status of Activities

In recent weeks, Len has been researching options for use of the Hanna smelter. His contacts have included individuals at EDD, USBM, and Hanna. Various pieces of information promised by various individuals have not been received.

In an attempt to accelerate the process, we met with Don Hull and Jim Haight to discuss future activities.

It appears that Hanna Nickel, in their haste to leave town is the prime mover. Any strategic plan must mesh well with their plans. Our plan for the present is as follows:

1) Receive from Herb Wedge a feasibility statement regarding use of the smelter for ferrochrome or ferronickel manufacturing.

2) Advise Hanna Nickel that they may be able to get tax breaks from the county. Included is a reduction is a reduction of assessment owing to inactivity or some other loophole. In the future, conceivably lottery money could be used to upgrade the facility for a new use (this is pure speculation at this point).

3) Discuss with higher level people in Economic Development, the possibility of strategizing towards a secondary use for the smelter given the international metals situation and the presence of the plant and work force. The Hanna facility and local infrastructure is analogous to that for reopened aluminum plants along the Colubmia River.

4) It is possible that the plant could be factored into the regional economic comeback plan being solicited by the new administration. Specifically how this could be accomplished is best defined for us by appropriate staff at EDD.

A strategic plan then for the Hanna facility, would recognize its capabilities, would define with some measure of confidence possible future uses such as ferrochrome, would slow down the Hanna pullout by soliciting favorable tax breaks, and would factor the second use into the regional economic plan now being developed.

Conversations needed to make this happen probably must be conducted concurrently and should include discussions with Hanna Nickel, EDD, and perhaps the Governor's office.

DRAFT

For Hanna Nickel, a key legal spokesperson is Richard Hahn (216/589-4040). Mr. Hahn's address is 100 Erie View Plaza, Cleveland, Ohio 44114.

As an afterthought, it is possible that ferrochrome manufacture at Hanna could include use of black sands from the Oregon Coast and load chromite from the John Day area, where 200,000 tons plus have been drilled out with a refractory grade of .22% Cr_2O_3.

JDB:ab

STATE OF OREGON INTEROFFICE MEMO

TO: Len DATE: March 20, 1987

FROM: John Beaulieu

SUBJECT: Hanna Meeting

We have scheduled a Hanna Meeting for 1:00 p.m. Wednesday, April 1, here in Portland.

At that time we will discuss your findings and attachments as requested in my earlier memo of March 17.

We will also outling a specific course of action for future agency involvement.

Note: As Don requested, please also prepare a general statement outlining sources of chrome ore (with volumes) that might feed a regional ferrochrome smelter at Riddle.

JDB:rm
cc: Don Hull

STATE OF OREGON

INTEROFFICE MEMO

TO: Len Ramp

DATE: March 17, 1987

FROM: John B.

SUBJECT: Hanna Nickel

By April 1, 1987, please complete the following task and submit written material on each:

1) Receive from Mr. Rice of the BLM, his opinion about the feasibility of converting Hanna Nickel to a ferrochrome facility.

2) Receive from Herb Wedge his opinion about the feasibility of converting Hanna Nickel to a ferrochrome facility.

3) Dicuss with Richard Hahn of Hanna Nickel in Cleveland, Ohio, the major concepts we discussed on March 16 here in Portland. Some of these are summarized in a separate memo. Richard Hahn's phone number is (216) 589-4040.

4) Dicuss in person with Ms. Youngbar of EDD, the following two items:

   a) Bring her up-to-date on all of our discussions regarding options for the future at Hanna Nickel;

   b) Identify through her the individual EDD who facilitated the reopening of the aluminum plant at The Dalles.

5) Receive from Mr. Hahn, their strategic plan for dismantling or walking away from the Hanna operation.

6) Receive from Mr. Hahn a set of deadlines related to the disengagement from Hanna.

7) Communicate specifically to Mr. Hahn, our ideas that it is possible to get tax breaks either through reductions in assessment or loopholes and communicate that it might be beneficial to receive these tax breaks, to decelerate the disengagement schedule, and to pursue creative second uses through a willing buyer.

In a later discussion with EDD we will want to examine the manner in which the Hanna facility can be placed on the regional economic comeback strategy sheet. We don't want to do that now however, since we have not fully scoped out the feasibility of this concept. It would be best then not to mention it to Ms. Youngbar in your next conversation.

In committing the above conclusions to writing, please attach copies of documents submitted to you from other individuals such as Rice and Wedge. Thank you.

JDB:ab

Manna file

United States Department of the Interior

OFFICE OF THE DIRECTOR

BUREAU OF MINES
2401 E STREET, NW.
WASHINGTON, D.C. 20241

MAR 20 198
DEPT. OF GEOLOGY
MINERAL IND

March 16, 1987

Dr. Donald A. Hull
State Geologist
Department of Geology
and Mineral Industries
910 State Office Building
1400 SW 5th Avenue
Portland, Oregon 97201-5528

Dear Don:

Unfortunately, I will not be able to attend the Portland conference on May 27. On May 28 I must attend a hearing before the Senate Appropriations Committee.

As regards the possibility for a joint effort to investigate the conversion of the Riddle nickel smelter, I fear that we could contribute little in the way of funds. However, I believe we could assist you with technical advice, if you desired, as to the possibility of achieving a conversion. A proper first step might be to evaluate the probable economics of such an operation were conversion possible. Have you identified sources of chromite or of stainless steel scrap? Are their costs such as to allow competition with domestic or foreign suppliers?

If we can be of assistance in determining the economics of operation we will be pleased to do so if you can supply the base data regarding the raw materials.

Sincerely,

Bob

Robert C. Horton
Director

STATE OF OREGON INTEROFFICE MEMO

TO: Don & John DATE: March 31, 1987

FROM: Len Ramp

SUBJECT: Hanna Nickel Smelter

You have a copy of Herb Wedge's letter report of 3-16-87 to me on possible use of the Hanna Nickel Smelter for production of stainless steel, and discussion of charge chrome (high carbon ferrochrome) and high carbon ferronickel. I'm pretty sure that "charge chrome" is a high carbon ferrochrome used to charge a blast furnace in the steel-making process.

Attached is a copy of Herb's 3-18-87 letter to Tony Kuhn, CCD Business Development Corp., Roseburg on the subject of melting unclassified stainless steel scrap. I have not talked with Kuhn; but have talked with his assistant Peter Graff on March 20th. Tony was to call back; but hasn't.

I called Bill Welch of Hanna in Cleveland instead of Richard Hahn on the advice of Herb. Mr. Welch is Director in Charge of Lands and Leases and is directly involved with disposition of the Riddle facility. Copies of all of Herb's correspondence on the subject have gone to Mr. Welch. Bill Welch's message to me is they intend to continue pursuing a buyer for the facility and will not postpone doing this. He is happy that the State and others are interested in finding a possible future use for the smelter; but he says it has to be a simultaneous endeavor. He is reasonably certain their disposal program will take at least a year. He believes the smelter facility should be considered an important regional asset because within a 3 to 5 year period it may find a place in the economic development of the area. He indicated that the smelter will probably be the last item to be sold and if no buyers are found it will be available at scrap prices. He assured me they are not turning their back on us; but that they have to explore their possibilities and continue looking for buyers at the same time we are searching for alternate uses.

I talked again with Herb Wedge, both before and after he talked with Peter Graff (Tony Kuhn's assistant). Herb has agreed to make a presentation to CCD on melting of stainless scrap. Herb was going to contact Dick Box and others for preliminary information on availability of stainless scrap and markets. I asked Herb if he would be interested in going to the conference: "Natural Gas use in the production of virgin iron units" in Chicago April 23, if funding could be obtained for his travel, and he said "yes". He said the plane fare is about $480 and two nights hotel would be about 150 for a total of probably about $700. My next question is: is there any place we can find the money to send him? I think sending him would be a good investment as he is very interested in the possibility of reactivating the smelter and is willing to devote his talents toward that end. I think he is an important and valuable key in this process. He has a consulting agreement with Hanna; but they will encourage his

participation so long as it is parallel to their interests. If it becomes otherwise, he can and may terminate his agreement with them and continue to aid the cause. Herb says it would be personally satisfying to him to be able to help put people back to work and his only caution was becoming overly involved in a high-pressure job due to his health. (He had a heart attack and open-heart surgery last year).
I have invited Lynn Youngbar to attend our meeting April 1st in response to Don's suggestion. I have also invited Ralph Nafziger, U.S. BuMines, Albany to attend. He is a very qualified pyrometallurgist and can help us with advice and council on that subject. I would have written them both; but Ruthie is taking a short vacation.
Bill Rice, U.S. BuMines, Spokane, called back and reiterated their interest and willingness to help in any way they can. Bill suggested we work with Ralph Nafziger from Albany. He wants to be kept informed and will help to facilitate the BuMines cooperation.
On the subject of possible chromite resources that may be made available to the smelter, see pages copied from U.S. BuMines IC 9087. The offshore black sand resource should also be considered as chromite is a major mineral constituent and the potential tonnage is very large (See GMS-37, Mineral Resources Map, Offshore Oregon by J.J. Gray and L.D. Kulm, 1985).

Len

LR:rep
cc: Herb Wedge
Bill Rice
Encl: copy of Herb Wedge's letter of 3-16-87

Hanna Nickel Smelting Company
P.O. Box 85
Riddle, Oregon 97469

March 18, 1987

Mr. Tony Kuhn
CCD Business Development Corporation
744 S. E. Rose
Roseburg, OR 97470

Dear Tony:

During our meeting in your office on March 5, the feasibility of melting unclassified stainless scrap metal, adjusting and standardizing the grade and casting the product for sale to stainless melters was discussed. Perhaps the two 10-ton steel furnaces previously used for refining ferronickel at Riddle could be utilized for the purpose. In the past, W. D. Atchison, formerly manager of metal sales for the M. A. Hanna Company, has told me that there are small companies in the Pittsburgh area who do this profitably. During a business trip to Treibach, Austria in March 1983, I observed an operation in which nickel catalyst containing over 20% nickel, purchased worldwide, was being reduced to metallic form, the grade standardized and cast in shotted form. A single 7.5 megawatt steel furnace with a 10-foot diameter shell was used to process the catalyst. Perhaps a combination of scrap melting and nickel catalyst might be worthy of an examination of feasibility in connection with the Riddle facility.

The following information would be necessary to develop a feasibility:

1. Quantity of raw material (stainless scrap and nickel catalyst) available within an economic transportation zone probably in the western U.S. but also perhaps including sources in the Pacific Rim.

2. Price at which the raw material could most likely be purchased.

3. Number and location of domestic companies engaged in a similar activity.

4. Survey of the potential market to estimate probable quantity of product which could be sold and at what price. This survey should perhaps include potential buyers in the Pacific Rim countries to take advantage of possible freight advantage.

5. Subsequent to the estimation of the limitation of and subject to either supply of raw material or sale of product, the cost of modification of existing equipment should be engineered and estimated.

6. Based on the agreed equipment configuration, as modified, the operating costs including power, labor, process material and maintenance material would be determined.

Obviously, the feasibility would then be based on sale of a realistic quantity of product at an agreed upon price less operating costs, depreciation of capital over an agreed fixed period and debt service on the capital, all in accordance with estimates based on the surveys enumerated.

The question of who should be commissioned to accomplish the work has no obvious answer. I would prefer to select an Oregon based engineering firm but perhaps an organization like Stanford Research or Battelle has more of the needed international capability. I suggest that a small group be established to interview prospects and to make a selection. I think Ralph Nafziger would function well as one of the members and I will have a continuing interest in the work.

A number of men might prove a source of additional preliminary information. They are:

W. D. Atchison - Former Hanna Sales Manager - Cleveland 216/653-9416
Dick Box - Luria Brothers Salesman - Seattle 206/228-5100
Ross Hogan - UCC National Carbon Salesman - Boring, Oregon 503/658-6142
Bill Ferris - V.P. Oregon Steel - Portland 503/240-5222
Vince Vellella - President Inmetco - Pittsburgh 412/771-2654

Following the preliminary investigations and discussions and as significant information is obtained, a series of "trial feasibilities" should be attempted by a management-type group to evaluate whether or not additional phases of the project should be pursued. Careful and constant evaluation of the work should be an effective tool in making the best use of money spent.

Very truly yours,

H. D. Wedge

pb
cc: W. E. Welsh
D. D. Morgan
D. G. Meyers
Lynn Youngbar (Econ.Dev.-Salem)
Len Ramp (Dept. of Geol.-Grants Pass)
W. L. Rice (Interior Dept.-Spokane)
Ralph Nafziger (Bur.Mines-Albany)

South Douglas
Soil and Water Conservation District

~~2621 NE Stephens~~ - Roseburg, Oregon 97470 - (503) 673-8316

MAR 1 1 1987
DEPT OF GEOLOGY

March 10, 1987

Mr. Allen Throop
Department of Geology
1534 Queen Street SE
Albany, Oregon 97321

Dear Mr. Throop,

As we agreed on the phone this morning, I am enclosing copies of the letters from the Board of Directors of South Douglas Soil and Water Conservation District concerning reclamation concerns at the Hanna Nickel Mine site in this County.

I will be reporting our discussion to the Board at their April meeting and passing on your suggestion that we contact Hanna to arrange an on-site tour. I hope that the copies you promised to send will have arrived by that time so that I may also share that information.

As we discussed, I believe much of this confusion could have been avoided if more information had been provided to the local District Board. I appreciate your offer to answer the Board's questions after the inspection and look forward to working with you in the future.

Sincerely,

Karla Jane Palmer

Karla Jane Palmer
District Office Manager

South Douglas
Soil and Water Conservation District

2621 NE Stephens · Roseburg, Oregon 97470 · (503) 673-8316

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MAR 1 1 1987
DEPT OF GEOLOGY

February 17, 1987

Senator Robert Packwood
259 Russell Senate Office Building
Washington D.C. 20510

Dear Senator,

Enclosed is a copy of a recent letter to Oregon's Director of Natural Resources, Gail Achterman, concerning reclamation of the Douglas County lands which were surface mined by Hanna Nickel Company until recently.

As a locally elected Board, our Directors are very concerned about the reclamation of this land and its potential effect on water quality in southern Douglas County. We are requesting your assistance to assure that this problem is investigated. The effects of ignoring this problem will be disasterous. Please help us.

We have proposed an on-site inspection of the 600+ acres involved. We would appreciate your support of this inspection and would invite you to join us when it us scheduled. It is very important for us to speak up now before it is too late. Your assistance in this matter is greatly appreciated.

Sincerely,

Jeffery Kruse
Board Chairman

South Douglas
Soil and Water Conservation District

1376 NE Walnut Suite L, Roseburg, OR 97470

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February 10, 1987

Ms Gail Achterman
Director of Natural Resources
State Capitol Building Room 160
Salem, Oregon 97310

Dear Ms Achterman,

I am writing to express the concern of the South Douglas Soil and Water Conservation District's Board of Directors with the reclamation of the area in South Douglas County which was, until recently, the site of the Hanna Nickel Mine. Mr. Paul Lawson, Supervisor, Reclamation of Surface Mined Land, Department of Geology and Mineral Industries in Albany, has said that all but 34 acres of the 600 acre site are exempt from legal requirements for reclamation because they were being mined prior to the legislation. Our Board is concerned that the unreclaimed land may have a detrimental impact on water quality, will increase the potential for erosion problems, and at the very least will be a permanent eyesore.

The Board would like to invite you to accompany them to inspect the site and determine whether these concerns are valid, and, if so, what options exist for solving the problems. Please contact Karla Palmer, District Office, 673-8316, or myself at 673-7201, if you would be interested in making an on-site inspection, or if you have other questions concerning this problem.

Our Board looks forward to working with you in the near future to help preserve our area's resources. Thank you for your attention to this matter.

Sincerely,

Jeffery B Kruse

Jeffery Kruse
Board Chairman

John B. 22481

OREGON
ECONOMIC
DEVELOPMENT
DEPARTMENT

595 Cottage Street, NE
Salem, Oregon 97310, U.S.A.
Telephone: (503) 373-1200

Telex: 821481
Cable: ORECONDEV
FAX: (503) 581-5115

August 21, 1987

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Norm Gershon
Douglas County Industrial Development Board
744 S.E. Rose Street
Roseburg, Oregon 97470

Dear Mr. Gershon:

Thank you for your letter of August 11, 1987 regarding the application to the Stabilization and Conversion Fund for feasibility study assistance on the Nickel Mountain facility.

While the Economic Development Commission (Commission) denied funding for the feasibility study, they did not close the option of providing assistance to you in finding alternatives for the site. We are happy to have you reapply for assistance on the study.

We would like you to send a letter to the Economic Development Department which includes the following information:

1. What are the results of phase one of the study which warrant continuing with phase two?

2. What are the expected results of phase two? The work plan states what the consultant will do, but I would like an explanation of the goals and end product of the study (other than a report).

3. What is the role of the M.A. Hanna Company in phase two? What are they doing to facilitate the sale?

4. How much money are you requesting from the state for phase two? How is this amount derived?

Neil Goldschmidt
Governor

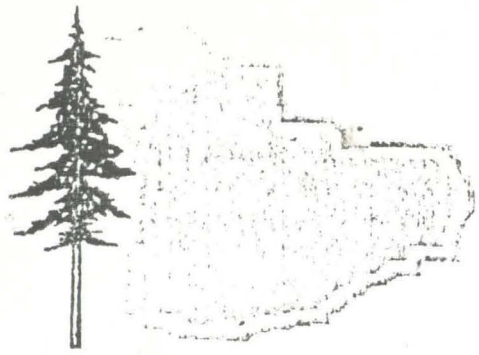
When we receive your letter, Lynn Youngbar will work with you on the details of the application. The Stabilization and Conversion Fund functions directly as a result of new legislation, Senate Bill 950. Until we adopt administrative rules, the application must go before the Commission. The Economic Development Department will make a recommendation to the Commission which they will consider at their next meeting, September 22, 1987.

We look forward to receiving your letter and to putting together a workable project.

Sincerely,

Richard G. Reiten
Director

RGR:sb



DOUGLAS COUNTY
INDUSTRIAL DEVELOPMENT BOARD

744 S.E. Rose Street — Roseburg, Oregon 97470
Telephone (503) 672-6728

August 31, 1987

Mr. Richard G. Reiten, Director
Oregon Department of Economic Development
595 Cottage Street, N.E.
Salem, Oregon 97310

Re: Nickel Mountain Smelter Facility
Alternative Use Study

Dear Mr. Reiten:

I am taking the liberty of responding to your letter of August 21 addressed to Norm Gershon, DCIDB President, because he is on vacation out-of-state and will not return until September 8.

We are pleased that you and the Commission will reconsider our request for Stabilization and Conversion Fund participation in the cost of our efforts to put at least part of the Nickel Mountain facilities back into productive use. We would respond to your specific questions as follows:

1. What are the results of phase one of the study which warrant continuing with phase two?

   On July 30, Hatch Associates presented their Interim Status Report. A summary sheet showing the alternative uses thus far identified is enclosed as Attachment 1. Based on the existence of one solid prospect (EAF dust development by Horsehead Resources), and reasonable prospects for two or three other possibilities, it was decided to have Hatch continue with phase two.

   It should be stated that it is difficult to separate the progress of this study into distinct "phases". Alternative use identification, market testing, costing, and identification of potential investor/operators is a fluid process. Hatch's revised work program for the rest of the study is enclosed as Attachment 2, and modifications suggested by DCIDB's Technical/Financial Review Committee are enclosed as Attachment 3.

2. What are the expected results of phase two?

   It is not yet possible to state with any degree of precision what the results of phase two will be. Note that phase two ends, if you will, on September 30th, which is the date after which the M.A. Hanna Company is free to do as they wish with their facilities. Development work is continuing at full speed with four distinct alternative uses, at least some of which would be compatible with each other and could co-exist at the site.

In addition to the metallurgical process possibilities being developed by Hatch, negotiations are going on for at least two other industrial uses of the site which do not involve metallurgical processing. The existence of the Hatch study, and the potential uses and investors/operators resulting therefrom, are being coordinated with (and are, in fact, a prime motivation for) some of these other negotiations.

The point is that the Hatch study has generated in many circles a great deal of interest about the site and possibilities for productive uses of its assets. Development of the many possibilities will continue concurrently, with efforts during the month of September increasing on the strongest ones and diminishing on the weaker ones. We have every confidence (though obviously we cannot guarantee) that by September 30th at least one investor/operator will be seriously negotiating with Hanna for the acquisition of facilities at Riddle. Hatch's future role will depend on the desires of the investor/operator(s) identified at that point. In any case, both the DCIDB and the CCD Business Development Corporation are firmly committed to continue working with whatever possibilities and investors/operators have been identified at that time. Hatch's final report will in any case be a critical part of that ongoing work.

3. What is the role of the M.A. Hanna Company in phase two? What are they doing to facilitate the sale?

It is to be emphasized that Hanna is now totally out of the mining and metals business. This fact notwithstanding, Hanna has stated on a number of occasions their desire to do everything possible to facilitate the employment of the maximum number of people in alternative uses of these facilities. To this end, they agreed to a moratorium until September 30th on the dismantling or sale of all of their facilities. Throughout, they have made available, as requested by either Hatch or the DCIDB, the paid services of H.D. Wedge and D.G. Meyers. It also should be noted that for the duration of this study Hanna has continued to pay property taxes and has, in addition, actively solicited investor/operators in its own right, negotiations resulting from which are being coordinated with the DCIDB/Hatch work discussed above.

4. How much money are you requesting from the state for phase two? How is this amount derived?

We respectfully request that the state again entertain our original application for participation in the cost of the entire Alternative Use Study, to the extent of 75% of the total cost which has been agreed with Hatch Associates as not more than $50,000. We feel that Douglas County took the risk of fronting a potentially non-productive phase one. All are now generally agreed that completion of the study will greatly enhance the probability of significant long term job creation at the Nickel Mountain site. Under the circumstances, we would again state our feeling that this

is precisely the sort of project that the legislature had in mind when it created the Stabilization and Conversion Fund. In fact, Hatch Associates' costs through July 31, which is an approximation of the end of the phase one, were $20,750. We would hope, however, that the state will agree now to participate in the entire effort, not just a somewhat arbitrarily defined "phase two."

We hope that the foregoing is responsive to your questions. Please do not hesitate to contact us if any further information is required.

Sincerely,

DOUGLAS COUNTY INDUSTRIAL DEVELOPMENT BOARD

By: Ronald K. Culbertson

Ronald K. Culbertson
Vice President

RKC:sb

cc: Douglas County Board of Commissioners

C. C. D. BUSINESS DEVELOPMENT CORPORATION

744 Southeast Rose Street – Roseburg, Oregon 97470
Telephone (503) 672-6728
Toll Free in Oregon: 1-800-452-6010

August 28, 1987

Dick Wilson and
Paul O'Shaughnessy
Hatch Associates Consultants, Inc.
8th Floor, Rand Bldg.; 14 Lafayette Square
Buffalo, New York 14203

Re: Nickel Mountain Smelter Facility
Alternative Use Study

Dear Dick and Paul:

This confirms my conversation with Paul today. Enclosed are notes of Tuesday's meeting with the Technical/Financial Review Committee on this project.

Other points are as follows:

1. We (including the T/FRC) have as yet heard nothing further from Walter Atchison.

2. We have as yet not received the signed contract from you.

3. Notwithstanding the reduction in priority on fly ash processing, please send such technical and other information as you feel appropriate on the possible production of gypsum to Mr. Lee Simpson, Vice President for Operations, Louisiana-Pacific Corporation, 111 SW Fifth, Portland, OR 97204. Their potential interest would be as a buyer of the gypsum, not as an investor in any pilot plant operation.

4. With regard to your invoice for July, in anticipation of receiving the contract so that we can process for payment, please provide an itemized breakdown of the $1,499.13 claimed for travel expenses.

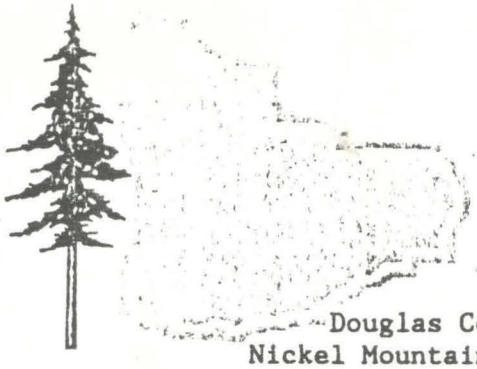
Please call if you have any questions.

Very truly yours,

Peter L. Graff
Assistant Director

PLG:sb

cc: T/FRC
DCIDB
Bill Welsh (Hanna)



DOUGLAS COUNTY
INDUSTRIAL DEVELOPMENT BOARD

744 S.E. Rose Street — Roseburg, Oregon 97470
Telephone (503) 672-6728

Meeting Notes
Douglas County Industrial Development Board
Nickel Mountain Technical/Financial Review Committee
Willis House Conference Room
Roseburg, Oregon
August 25, 1987

Committe Members Present

Herb Wedge
Ralph Nafziger
Len Ramp
Ron Culbertson
Lynn Youngbar

Peter Graff (Staff)

The committee met at 1:45 p.m. Principal review item was Hatch Associates' letter and attachments of August 14, 1987. Peter Graff informed the committee, section by section, as to the current status of Hatch's activity as related by Paul O'Shaughnessy in a telephone conversation on August 24.

After 2+ hours of review and discussion, the committee's principal recommendations were as follows:

1. Place high priority on the new possibility regarding smelting of platinum group metals mined in Montana.

2. Reduce priority on fly ash processing.

3. Recheck preliminary investment and return projections for EAF dust processing.

4. With regard to scrap catalyst processing:

   a. What kind of market exists for Ni/Sn or Ni/W? (It is now understood that these metals would not be left in combined form but would be separated.)

   b. Why restrict investigations to petroleum industry catalysts? Edible oil catalysts from the USA are being processed profitably in Austria.

   c. Within the petroleum industry, why restrict investigations to Chevron? Texaco, for example, has a major refinery at Anacortes, WA, near Seattle.

Other than the foregoing, and a new possibility (to be dealt with by others) that has arisen regarding repair and refurbishing of railroad cars, the consensus was that Hatch should proceed as proposed.

Respectfully submitted,

Peter L. Graff
Acting Secretary

PLG:sb

Len

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(D) to John B

9/24

John B,

Could we get an update from Len Ramp on the Hanna situation prior to Oct. 1. I'll be meeting w/ Gail on that date.

Len - please call Don with an update.

John B

9/29

Don:

I have copies of these two segments of the alternative use study. I've looked through them quickly and will loan them to you if you wish. They are quite thick documents. We should be having another meeting soon; but havent recieved notice as yet.

Len

C. C. D. BUSINESS DEVELOPMENT CORPORATION

744 Southeast Rose Street – Roseburg, Oregon 97470
Telephone (503) 672-6728
Toll Free in Oregon: 1-800-452-6010

September 18, 1987

Mr. H.D. Wedge
c/o Thomas J. Wedge
73897 Pleasant Grove
Adena, OH 43901

Dear Herb:

As discussed, I am enclosing copies of Hatch Reports Nos. 1 and 2, Metals from Fly Ash and Zinc Recovery From EAF Steelmaking Dust.

I will talk with you next week about other possibilities, as well as your schedule and prospects for a meeting on September 30, October 1 or October 2.

Very truly yours,

Peter L. Graff
Assistant Director

PLG:shb

cc: Lynn Youngbar w/Same Enclosures
Ralph Nafziger w/Same Enclosures
Len Ramp w/Same Enclosures
Ron Culbertson w/Summaries
Bill Vian, Douglas County Commissioner
Hatch Associates

C. C. D. BUSINESS DEVELOPMENT CORPORATION

744 Southeast Rose Street – Roseburg, Oregon 97470
Telephone (503) 672-6728
Toll Free in Oregon: 1-800-452-6010

September 18, 1987

Mr. H.D. Wedge
c/o Thomas J. Wedge
73897 Pleasant Grove
Adena, OH 43901

Dear Herb:

This is in reference to our conversations regarding possible production at the Nickel Mountain Smelter Facilities of 75% ferrosilicon utilizing Douglas County quartzite.

As I indicated to you, we have been apprised in general terms of the history and present status of potential charges by the U.S. Forest Service attributable to road maintenance resulting from transportation of the quartzite. We understand that the feasibility of the overall operation may hinge on the delivered cost of this quartzite, and that the level of these USFS charges puts us at a serious disadvantage relative to other producers.

We are not certain whether we (CCD, the Douglas County Industrial Development Board and Board of Commissioners, other local industry leaders) can help convince the Forest Service of the wisdom of lowering these rates, but we are certainly willing to try. If Walter Atchison and his associates are able to provide us with some facts and figures on the history and present impact of these charges, together with comparative figures from elsewhere, we will pick up the spear and see what we can accomplish. What we need are some facts and figures.

It would also be helpful, of course, if we could have some relative idea of the probability of actually establishing this 75% FeSi production operation in relation to a range of possible reductions in USFS road maintenance charges.

Very truly yours,

Peter L. Graff
Assistant Director

PLG:shb

cc: Douglas County Board of Commissioners
Douglas County Industrial Development Board

THIS LEASE, made this _____ day of _____, 1963, by and between DOUGLAS COUNTY, a body politic and corporate of the State of Oregon, party of the first part, hereinafter sometimes called "Lessor" and THE HANNA MINING COMPANY, a corporation duly organized and existing under and by virtue of the laws of the State of Delaware, party of the second party, hereinafter sometimes called "Lessee",

W I T N E S S E T H :

WHEREAS, Lessor is the owner in fee of the following described mineral rights on lands located in the County of Douglas, State of Oregon:

> All of the mines, minerals, ores and valuable substances (excluding timber) in, on or under the West half of the Southeast quarter of Section 18; Northeast quarter of the Northeast quarter of Section 19; West half of the Northwest quarter of Section 20; and Northwest quarter of the Southwest quarter of Section 20, all in Township 30 South, Range 6 West, Willamette Meridian,

hereinafter referred to as the "mineral rights"; and

WHEREAS, in accordance with Chapter 271, Oregon Revised Statutes, the County Court of Douglas County, Oregon, has determined that the mineral rights on the above-described property are not needed for public use and has further determined that the public interest would be furthered by leasing the mineral rights to the Lessee for the term and for the purpose hereinafter set forth and that the execution of this lease has been authorized by order of the County Court of Douglas County, Oregon, duly entered in its journal and dated _____, 1963, and

WHEREAS, it is expressly understood that the Lessor has deeded the rights to timber and other rights in and to said premises to the Roseburg Lumber Company as more particularly set forth in deed to Roseburg Lumber Company dated May 6, 1959, recorded in Vol. 284, page 223 and 228, Deed Records, Douglas County, Oregon, subject to all minerals and mineral rights in and to the same, said minerals and mineral rights having been retained by Douglas County.

NOW THEREFORE, In consideration of the sum of one dollar ($1) to it in hand paid, and in consideration of the agreements hereinafter set forth to be kept and performed by Lessee, Lessor has let, leased and demised and by these presents hereby does let, lease and demise to the Lessee the mineral rights for such period of time and upon such terms and conditions as are hereinafter set forth.

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GEDDES, FELKER, WALTON & RICHMOND
435 S. E. KANE STREET
ROSEBURG, OREGON

1. The term of this lease shall be ten (10) years from and after the date hereof, provided, however, that the Lessee shall have the sole and exclusive option to renew this lease for five (5) year periods for the next thirty-five (35) years by giving the Lessor written notice of its desire for each respective renewal at least thirty (30) days prior to the first day of such renewal period, and provided further, however, that Lessee shall have the right at any time to terminate this lease or any renewal thereof as a whole by giving sixty (60) days' written notice to the Lessor of its intention so to do. On the expiration of said sixty days, this lease shall terminate and all liabilities of the Lessee under this agreement, except such liabilities as shall have then accrued, whether or not then payable, shall cease and terminate.

2. The Lessee desires to acquire the rights of said Roseburg Lumber Company in and to the said above described premises in order that it may use the surface of the above described premises for roadways, power lines, pipe lines, stockpiles, and for any other uses and purposes which shall be necessary or convenient in connection with its mining and treating operations in or on other properties.

3. The mineral rights are leased to Lessee for the purpose of enabling the Lessee to construct, maintain and use on the above described premises any or all of the facilities described in Section 2 hereof.

4. While the parties hereto expect that there is not contained in the mineral rights, a merchantable ore body, it is the desire of the Lessor that the Lessee shall verify the non-existence of a merchantable ore body in the manner hereinafter set forth prior to the use of the mineral rights by the Lessee for the construction and use of facilities on the surface thereof. The geological representatives of the Lessee, as soon as possible after the execution and delivery of this agreement, shall submit to the State Geologist of the State of Oregon, a proposed program for the exploration of the mineral rights, and when the Lessee shall have obtained the approval of said State Geologist to such proposed program, it shall cause such exploration program to be carried out. During the course of such exploration, geological representatives of the Lessee shall confer with the said State Geologist with respect to the results being obtained,

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438 S. E. KANE STREET
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and at the completion of the exploration program, the geological representatives of the Lessee and the said State Geologist shall agree as to the existence or non-existence of a merchantable ore body on the mineral rights. The State Geologist shall thereupon make a report of such agreement to the Lessor, furnishing a copy of such report to the Lessee, and if such report shall indicate there is contained no merchantable ore body on the mineral rights, the Lessee shall thereafter, during the term of this lease or any renewal thereof, have the sole and exclusive right to use the mineral rights for the purposes herein set forth. If such report shall indicate that there is contained on the mineral rights a merchantable ore body, the said report shall also indicate the area covered by such merchantable ore body, and such area shall thereafter be excluded from the operation of this lease without any further action on the part of the parties hereto, but the Lessee shall thereafter during the term of this lease or any renewal thereof, have the sole and exclusive right to use all of the mineral rights, except the area so excluded, for the purposes herein set forth. The Lessee shall pay all costs and expenses incurred in connection with such exploration. For all purposes of this lease, a merchantable ore body shall be understood to be a concentration of minerals which could be mined and sold or mined, treated and sold on the market by the Lessee in the year in which such exploration is made.

5. In the event that the Lessor shall acquire at any time during the term of this lease or any renewal thereof, any interest or interests in the above described premises in addition to its ownership of the mineral or mineral rights therein, such additional interest or interests shall be automatically included herein and covered hereby with the same force and effect as if such interest or interests had been included herein on the date hereof.

6. Beginning with the date hereof and during the period this lease or any renewal thereof continues in force and effect, Lessee covenants and agrees to pay to Lessor, an annual rental, payable annually in advance, of the sum of twenty-five cents (25¢) for each acre of mineral rights covered by this lease at the time of each respective payment of rental.

7. The Lessor agrees that Lessee shall have the right to sub-lease the mineral rights or any part thereof and to contract with others to use the mineral rights or any part thereof for the purposes herein specified with the

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435 S. E. KANE STREET
ROSEBURG, OREGON

and required of the Lessee.

8. The Lessee agrees during the term of this lease to pay any and all taxes of every kind and all assessments duly and lawfully made against all improvements or use of the premises as may be provided by the laws and statutes of the State of Oregon and which may be levied against that part of the mineral rights covered by this lease at the time of each levy of said taxes and assessments (excluding all of the surface thereof except that part used by the Lessee in its operations) and any and all taxes which may be assessed against the improvements placed by Lessee thereon, provided that the Lessee shall have the right to bond, in the manner provided by law, any assessments levied against any such leased property for local improvements and to pay the same in installments in the manner provided by law; provided further that only such installments of any such assessments as shall become due during the lease term shall be paid by the Lessee; PROVIDED, however, the Lessee shall always have the right to contest in the courts, or otherwise, the validity of any such tax or assessment in case it shall deem the same unlawful, unjust, unequal, or excessive, before it shall be required to pay or discharge it, or any part thereof; but all such taxes and assessments, or so much thereof as shall not have been cancelled or set aside, shall be paid by Lessee in time to prevent any sale of the mineral rights, or property or any part thereof, for said taxes and assessments.

9. The use and occupancy of the above described premises by the Lessee, and all of its operations hereunder shall be conducted in strict compliance with all laws applicable thereto, and with all rules and regulations promulgated, adopted and published by any commission or other governmental body having jurisdiction in the matter.

10. Lessor reserves and shall have a lien upon all machinery, implements and personal property of Lessee that may be on mineral rights as security for the payment of any annual rental that may have accrued under this lease, and for all unpaid taxes and assessments on the mineral rights and for any and all liabilities of Lessee. Any such unpaid annual rental or taxes or liabilities shall be deemed to be and be treated as a balance or balances of unpaid accounts under this lease, and such lien thereof may be enforced under the laws of the State of

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Oregon by action or otherwise. Such lien, however, shall not follow any of said property after it has been shipped or removed from within the boundaries of the State of Oregon, and nothing herein contained shall prevent the removal of any or all of said property at any time when the Lessee shall not be in default hereunder, and the above referred to lien shall not, in case of sale of such property to third parties, be deemed to follow the same as against said third parties.

11. The grants of Lessor as contained herein are subject, however, to the express condition, that in case, and as often as Lessee shall make default in the performance, or by the violation of, any of the several agreements expressed herein to be kept and performed on its part, and such default shall continue uncorrected or unsatisfied for the period of ninety (90) days after written notice specifying the default complained of shall be given to Lessee by Lessor, then and in such case Lessor shall have the right to enter in and upon the mineral rights and to have and possess them again as of its first and former estate, and to exclude Lessee and all parties claiming under it.

12. The Lessor hereby represents and covenants to and with the Lessee that, at the time of the execution hereof, it owns the mineral rights in fee simple, and that the same are free and clear from all encumbrances and that (the Lessee keeping, performing and carrying out all of the covenants, promises and agreements, on its part to be kept, performed and carried out) the Lessor will, during the term aforesaid or until the termination of this lease as herein provided, warrant and defend the Lessee in the quiet and peaceable possession of the mineral rights and privileges herein granted, against all persons and corporations whomsoever, and the Lessor further covenants that at the beginning of the term hereunder, it will turn over and deliver the mineral rights to the Lessee in such condition that nothing therein or thereon shall constitute a continuing nuisance, or a continuing menace to adjacent property.

13. Lessee agrees that whenever this lease is terminated, Lessee shall peacefully surrender the mineral rights to Lessor, provided that Lessee shall be entitled and permitted to remove within ninety (90) days after such termination all buildings, structures (including milling and treatment plants), engines, tools, machinery, railroad tracks, pipe and power lines, improvements, and other property

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436 S. E. KANE STREET
ROSEBURG, OREGON

Lessee shall leave all roads, complete with culverts and bridges necessary for their usefulness intact for the use of the Lessor upon expiration or termination of this lease.

Lessee further agrees to peaceably surrender the leased premises or the governmental descriptions affected thereby, as the case may be to the Lessor with all caves and openings properly fenced, filled or protected as may be required by any laws or proper regulations of any duly constituted governmental authority then in effect and in good order and condition, ordinary wear and tear in use and deterioration from and damage by the elements excepted.

Lessee agrees that when this lease terminates it will, at the request of Lessor, enter or cause to be entered a certificate of that fact upon the proper books of record in said Douglas County, Oregon, provided this lease shall have been recorded there.

14. Any difference or controversy which may arise between Lessor and Lessee, as to the construction or carrying out of this lease, or the rights of Lessor or Lessee under it, shall not interrupt or suspend Lessee's right to use the mineral rights for the purposes herein set forth, provided Lessee shall duly pay the annual rental herein provided for at the time or times and in the manner stated in this lease.

15. It is mutually covenanted and agreed that in case any controversy or disagreement shall arise between the Lessor and the Lessee relative to the due observance and fulfillment of the terms and obligations hereof by either party, then such controversy or disagreement shall be determined by arbitration in the manner herein specified. Either Lessor or Lessee may within thirty (30) days after such controversy or disagreement arises demand [illegible] party or parties making such demand shall in writing to be served upon the other in the manner herein specified for the service of notice, specify the matter to be submitted to arbitration, and at the same time choose and nominate some competent and wholly disinterested person to act as an arbitrator; thereupon within ten (10) days after the receipt of such written notice, the other shall in writing choose and nominate a competent and wholly disinterested arbitrator, and the two arbitrators

so chosen shall forthwith select a third arbitrator giving written notice to Lessor and Lessee of the choice so made and fixing a place and time for a meeting not later than ten (10) days thereafter, at which Lessor and Lessee may appear and be heard touching such controversy or disagreement. The arbitrators shall then make a decision as to the controversy or disagreement within thirty (30) days, which decision of said arbitrators shall be made in writing, and when signed by a majority of them, shall be final and conclusive upon all parties and the award so made shall be forthwith complied with. In case either Lessor or Lessee shall fail to choose and nominate an arbitrator, after notice as aforesaid from the other party, or in case the first two arbitrators selected fail to agree upon a third arbitrator within ten (10) days, then such arbitrator or arbitrators may, upon application made by either Lessor or Lessee, after ten (10) days written notice thereof given to the other, be appointed by any judge of the federal court having jurisdiction within the federal judicial district in which the mine is located. The expense of any such arbitration, including reasonable compensation for the arbitrators, shall be paid by the party against which the award shall be made, unless otherwise provided in the award of the arbitrators.

16. Any request or notice which either party may desire to give hereunder shall be properly served on the other party or parties only when reduced to writing placed in an envelope, sealed, stamped, registered and deposited in any United States Post Office addressed as follows, to wit:

County Court, Douglas County
County Courthouse
Roseburg, Oregon

Hanna Mining Company
1300 Leader Building
Cleveland 14, Ohio

Either party hereto may upon written notice to the other party (which shall be served as herein provided for service of notices generally) change the address to which notices to such party may be sent, or designate a new party with the same or a different address to which such notices may be sent.

17. In the event Lessor, in any instance, shall waive any default by Lessee or waive any provision hereof, such waiver shall not constitute a waiver by Lessor of any other default or, as to any other instance, of any provision hereof.

LAW OFFICES
GEDDES, FELKER, WALTON & RICHMOND
435 S. E. KANE STREET
ROSEBURG, OREGON

If any provision of this Lease or the application of such provision to any circumstance shall be held unlawful, the remainder of this lease shall not be affected thereby.

18. It is further agreed that the covenants, terms and conditions of this Lease shall both bind and benefit the heirs, executors, administrators, successors and assigns of the Lessor and the Lessee.

IN WITNESS WHEREOF, the parties hereto have executed or cause this agreement to be duly executed as of the day and year first above written.

DOUGLAS COUNTY

By _____
County Judge

_____
County Clerk

_____
County Commissioner

_____
County Commissioner

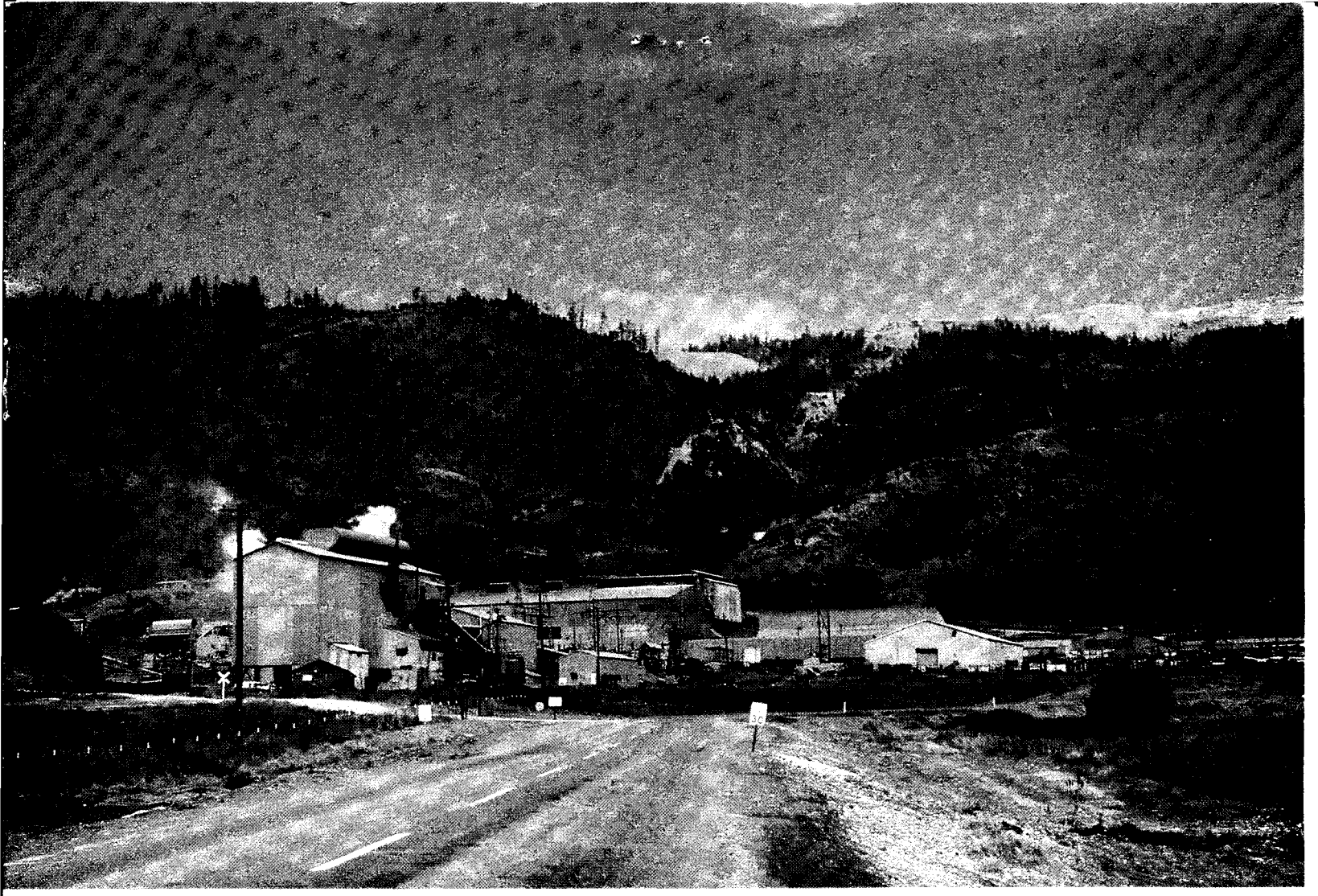
THE HANNA MINING COMPANY

By _____
President

_____
Secretary

Signed, sealed, and acknowledged
in the presence of:

_____



The Hanna Nickel Operation

Nickel Mountain is located in southwestern Douglas County, Oregon, four miles west of the town of Riddle. The deposit was discovered in 1864 by local settlers, but it was not until 1881 that the ore was recognized to contain nickel, rather than copper as originally assumed. Subsequent to 1881, much prospecting and preliminary development work was done, but no ore was processed, other than for testing purposes, until the present mining operation began.

The Hanna Mining Company and Hanna Nickel Smelting Company began production of ferronickel (a combination of iron and nickel), the first to be produced in the United States from domestic ores, in July, 1954. The companies have operated on an around-the-clock schedule since that time and provided steady, year-around work for approximately 600 employees.

Mine

Geology

The deposit is made up of six major areas, covering approximately 600 acres. Ten percent of the nickel-bearing mineral (garnierite) is found filling voids in fractured rock. The majority of nickel ore occurs in weathered rock. Average nickel grade in the crude ore presently under active development is approximately 1.0%.

Grade Control

Overall chemistry, as well as nickel content of ore delivered to the smelter stockpile, must be maintained as uniform as possible to produce the maximum amount of ferronickel. This is somewhat difficult due to the wide, inconsistent variations in ore type and nickel content throughout the deposit. Twenty-foot bench heights, narrow shovel cuts, bank samples, drill hole samples, geologic interpretations, mobile grade control trucks, slice maps and visual classification, combined with widely spaced daily cuts, make up the grade control pattern.

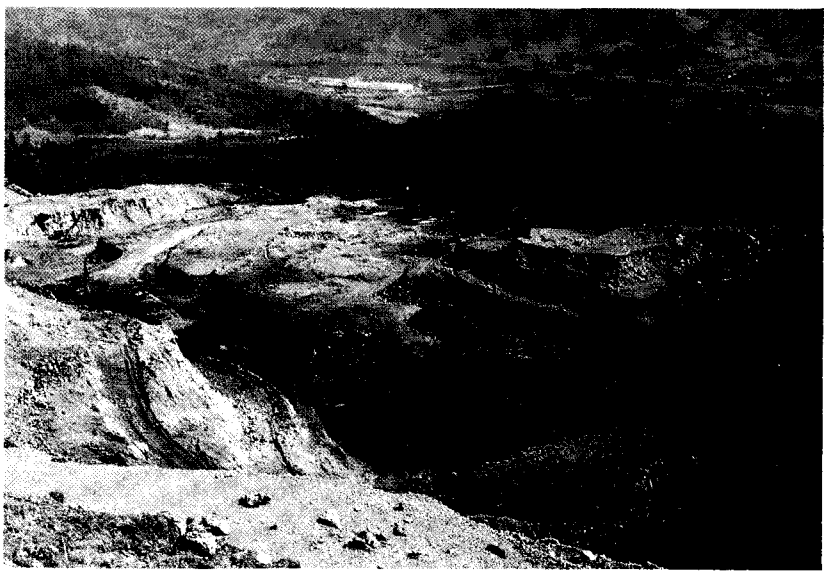
Development

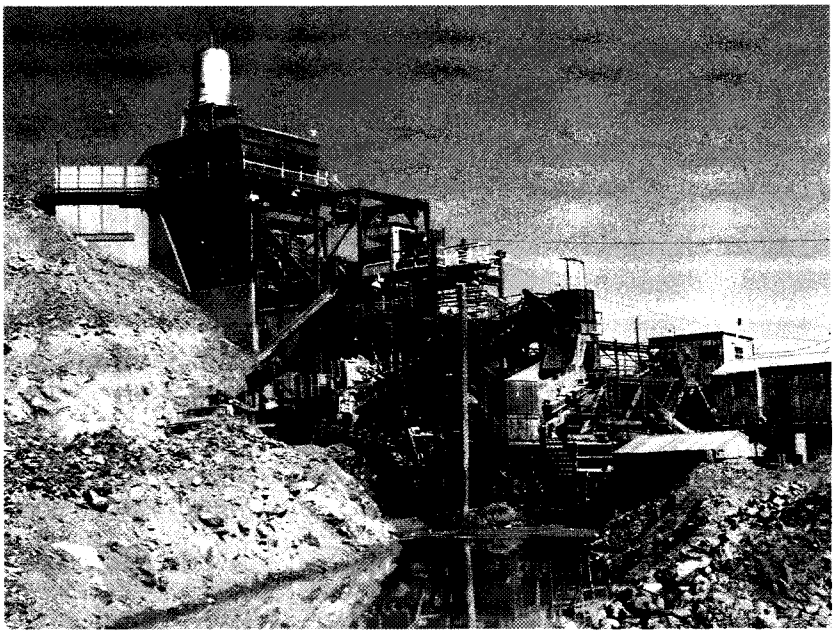
Open-cut methods are utilized. The lay of the land is ideal for the development of level mining benches at 20-foot vertical intervals. This interval was chosen for grade control purposes. Benches, a minimum of 50 feet wide, extend to the limits of the deposit, and main haulage roads, 60 feet wide, traverse the area.

Mining and Hauling

Up to 80 percent of the ore can be dug without blasting. When blasting is necessary, however, a hole is drilled and filled with an explosive and set off.

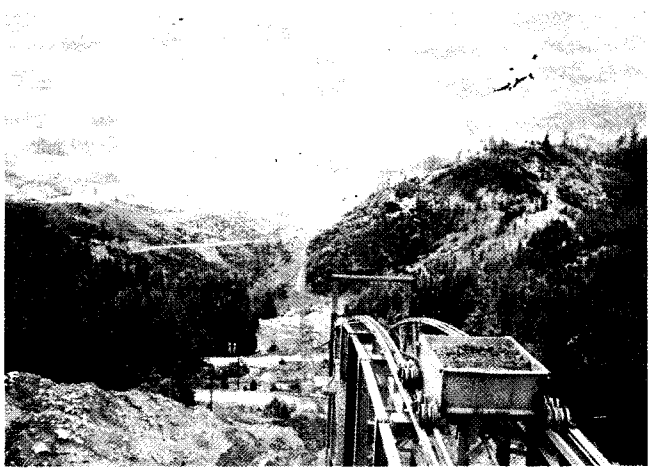
Loading crude ore is accomplished with diesel shovels. Large boulders, called pit rejects, are separated from the ore by the shovel operator and ultimately deposited on waste dumps, as they have low amounts of nickel in them. The ore is loaded into 60-ton diesel trucks and hauled to the screening plant.





Screening and Crushing

The ore is deposited directly into the screening plant feed hopper. A separation is made according to the size of the material, with the smaller going directly to the tramway and the larger to the crusher. After crushing, the material is visually classified and directed to the ore product or the reject stockpile.



Tramway

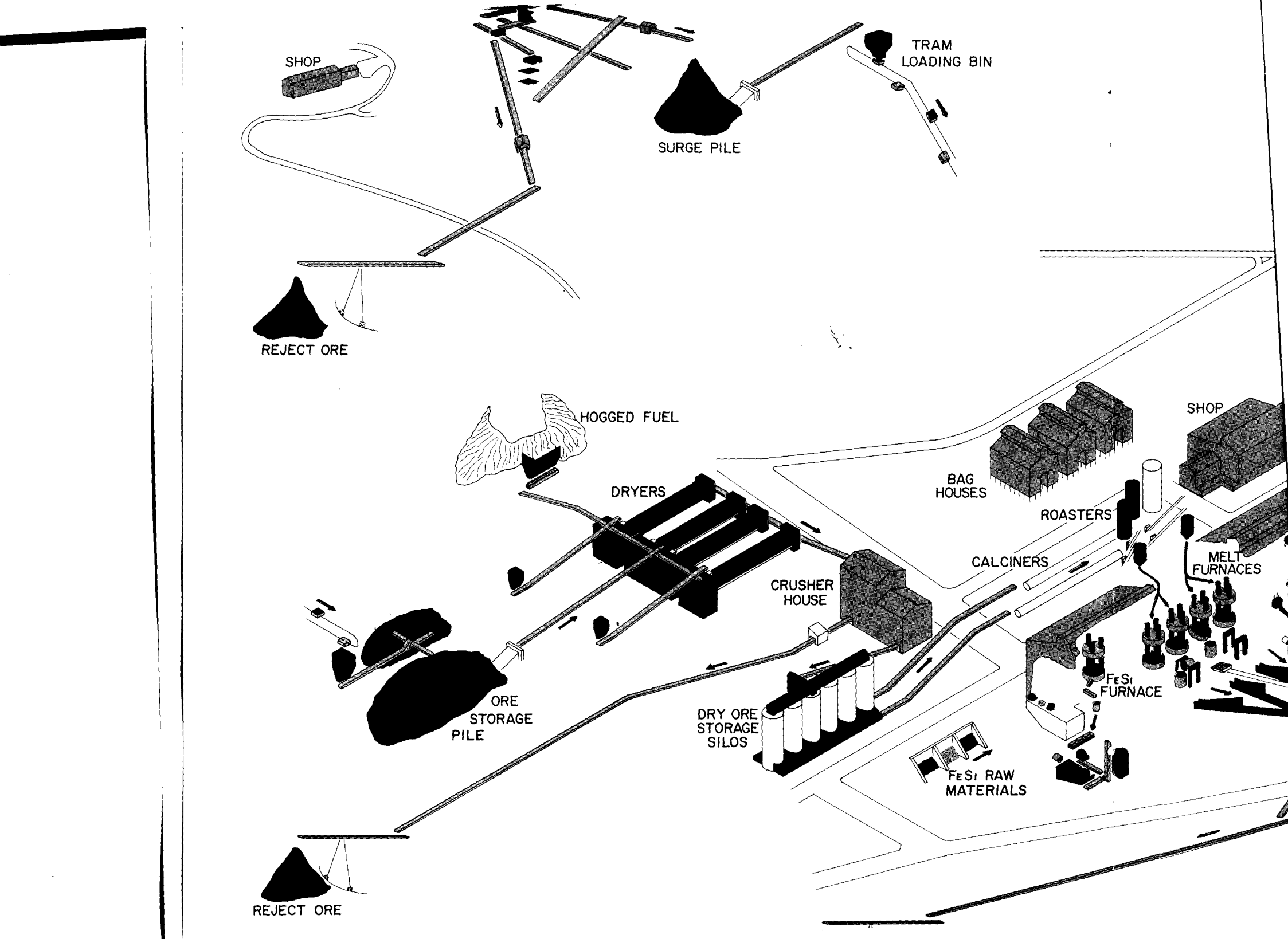
At the tramway the ore is fed to the loading terminal where it is loaded automatically into 50-cubic foot tram cars. It is conveyed downhill to the smelter storage stockpile.

The tramway runs continuously, carrying ore in the upright tram cars and returning the empty cars in an inverted position. The ore is discharged by inverting the cars at the lower end of the tramway where it is stockpiled. A speed of 600 feet per minute is maintained by the braking action of the two 300-horsepower generators driven by the weight of the loaded tram cars. The braking action of the generators produces approximately 500 horsepower, which is used in the generating of electricity for the operation of the mine facilities.

The tramway is 8,300 feet long and drops a vertical distance of 2,000 feet in its length.

Smelter

Ore from the stockpile is processed at the smelter to produce ferronickel, containing approximately 50 percent nickel. Steps in the process include reclaiming ore, drying, fines screening, rejection of lean rock by screening, crushing, sampling, calcining, melting, reducing to ferronickel, refining, casting, and skull metallics recovery.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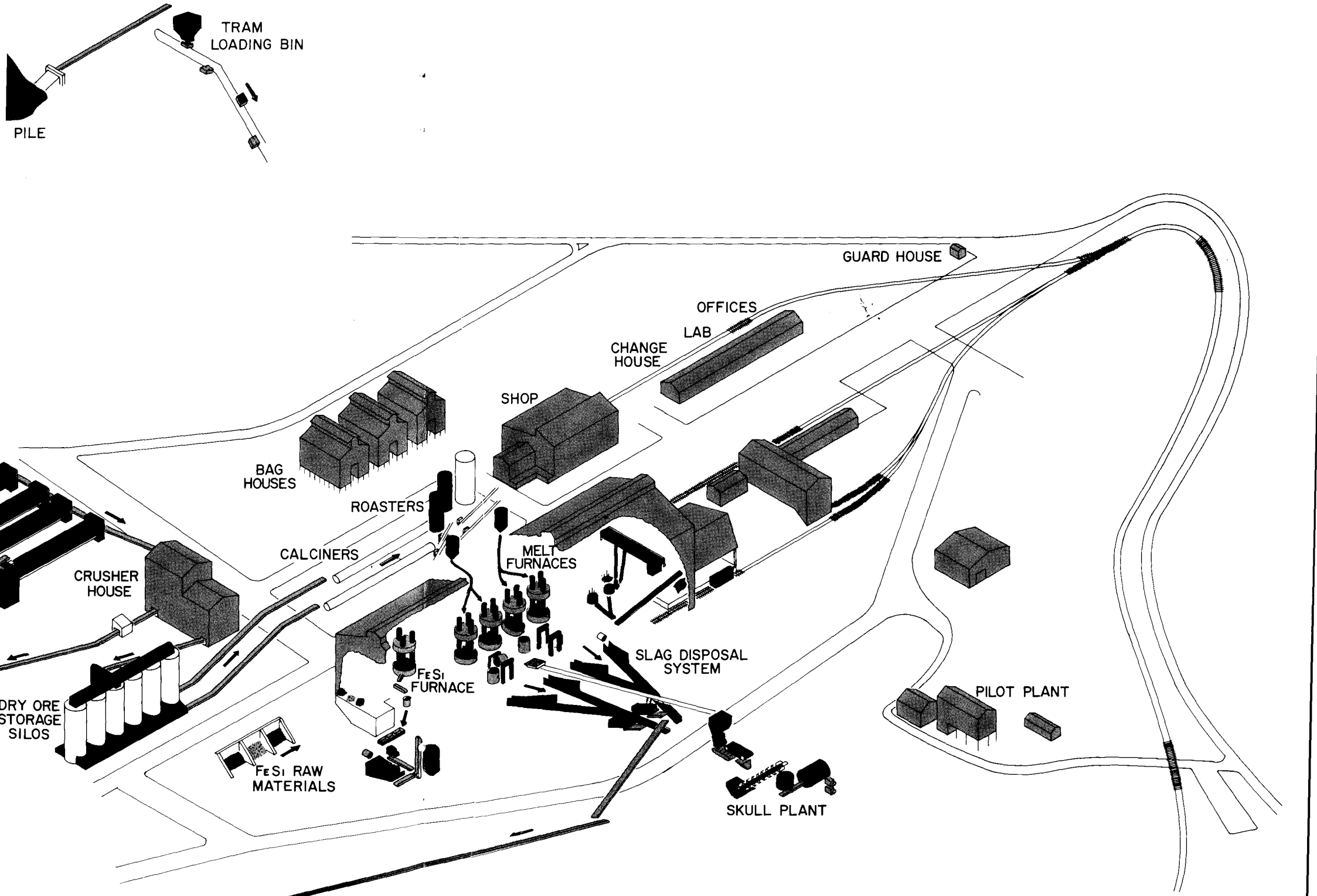
SURGE PILE
REJECT ORE
HOGGED FUEL
DRYERS
BAG
HOUSES
SHOP
ROASTERS
CALCINERS
MELT
FURNACES
CRUSHER
HOUSE
FeSi
FURNACE
ORE
STORAGE
PILE
DRY ORE
STORAGE
SILOS
FeSi RAW
MATERIALS
REJECT ORE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LAB
CHANGE
HOUSE
SHOP
BAG
HOUSES
ROASTERS
CALCINERS
MELT
FURNACES
CRUSHER
HOUSE
SLAG DISPOSAL
SYSTEM
FeSi
FURNACE
PILOT PLANT
DRY ORE
STORAGE
SILOS
FeSi RAW
MATERIALS
SKULL PLANT

Form PR. 1-W

FEDERAL WORKS AGENCY
PUBLIC ROADS ADMINISTRATION

State OREGON

(Corps area or engineer division)

Nickel Mountain Mine
(Army reservation or defense industry site)

Project No. DA-RM-27

PROJECT STATEMENT
DEFENSE HIGHWAY ACT OF 1941

THE COMMISSIONER OF PUBLIC ROADS,
Washington, D. C.

Date December 30, 1942

Sir: War Production Board

The [redacted] having indicated that the construction or improvement of access roads to the Nickel Mountain Mine is important to the national defense, the undersigned considers that the project described below as to general character of road work (including bridges thereon) and delineated as to location and termini in diagrammatic form on the accompanying sketch map, will provide a reasonable access road improvement for the above-named establishment, and recommends the construction thereof, under the provisions of the Defense Highway Act of 1941.

1. Description: Nickel Mountain Road from county road to the summit vicinity of Nickel Mountain
(Local name of road and points of beginning and ending)

2. Length in miles 3.0

3. General character of improvement Grading, draining and surfacing.

4. Preliminary estimate of cost: Total, $ 12,000.00

Respectfully submitted,

W. H. LYNCH
District Engineer, P. R. A.

Approval recommended:

By L. J. Caufield, Sr. Highway Engineer

(Title *)

* Corps area commander or his representative for stations under corps area control, U. S. Division Engineer for Industrial Establishments, and military stations exempt from corps area control.

16—24602-2 U. S. GOVERNMENT PRINTING OFFICE

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JAN 13 1943
STATE DEPT OF GEOLOGY
& MINERAL INDS.

MONTHLY REPORT OF PURCHASES

Machinery, Supplies, Maintenance Items and Repairs
under Preference Rating Order P-56

NAME OF MINE OPERATOR OR AUTHORIZED AGENT FOR SUCH OPERATOR Freeport Sulphur Co.

ADDRESS Box 160, Riddle, Oregon MINE SERIAL NO. 33-65

PURCHASES MADE IN MONTH OF December, 19 42.

I. PURCHASES TO WHICH RATING A-8 HAS BEEN APPLIED DURING MONTH:
Material None
Quantity _____ W.P.B. Authorization No. _____
Supplier _____

II. PURCHASES TO WHICH RATING A-3 HAS BEEN APPLIED DURING MONTH:
Material None
Quantity _____ W.P.B. Authorization No. _____
Supplier _____

III. PURCHASES TO WHICH RATING A-1-c HAS BEEN APPLIED DURING MONTH:
Material None
Quantity _____ W.P.B. Authorization No. _____
Supplier _____

IV. PURCHASES TO WHICH RATING A-1-a HAS BEEN APPLIED DURING MONTH:
Material 3/4-ton pull lift chain hoist; solid rubber stoppers; 12-inch stroke drilling jars
Quantity 1; 1 pound; 1 set W. P. B. Authorization No. _____
Supplier Rogue River Hdwre, Grants Pass; Braun-Knecht-Heimann Co., San Francisco; Star Drilling Machine Co., Portland

V. PURCHASES TO WHICH RATING AA-2X HAS BEEN APPLIED DURING MONTH:
Material underreamer; drive casing, casing couplings, shoes, head; sheets black metal; chainomatic balance, stainless steel weights;
Quantity 1; 31 joints, 10 joints, 41, 8, 1; 16; 1, 1 set.
W.P.B. Authorization No. _____
Supplier Oil Well Supply Co., Los Angeles; A. M. Jannsen Drilling Co., Portland; Brill Metal Works, Medford; Braun-Knecht-Heimann Co., San Francisco.

CERTIFICATION

The undersigned hereby certifies to the War Production Board, that

(1) he executed the foregoing statement on behalf of and by authority of the above-named Mine Operator;

(2) the above-named Mine Operator has, during the period covered by this report, complied with all the provisions of Preference Rating Order P-56, and has applied ratings only in accordance therewith;

(3) during such period the Mine Operator's inventory of operating supplies and other material has not been greater than the minimum necessary for the efficient operation of his business, and the ratio of inventory (quantity) to current production has not exceeded the ratio of average year-end inventory (quantity) to average production for the years 1938, 1939, and 1940;

(4) the facts stated herein are, to the best of his knowledge and belief, true and correct.

Freeport Sulphur Company

January 10, 1943 (Date)

By: _____ (Signature of Authorized Official)

Mgr., Western Office (Title)

MONTHLY REPORT OF PURCHASES

Machinery, Supplies, Maintenance Items and Repairs
under Preference Rating Order P-56

RECEIVED
DEC 18 1942
STATE DEPT OF GEOLOGY & MINERAL INDS.

NAME OF MINE OPERATOR OR AUTHORIZED AGENT FOR SUCH OPERATOR Freeport Sulphur Co.

ADDRESS Box 160, Riddle, Oregon MINE SERIAL NO. 33-65

PURCHASES MADE IN MONTH OF November, 19 42.

I. PURCHASES TO WHICH RATING A-8 HAS BEEN APPLIED DURING MONTH:
Material none
Quantity _____ W.P.B. Authorization No. _____
Supplier _____

II. PURCHASES TO WHICH RATING A-3 HAS BEEN APPLIED DURING MONTH:
Material none
Quantity _____ W.P.B. Authorization No. _____
Supplier _____

III. PURCHASES TO WHICH RATING A-1-c HAS BEEN APPLIED DURING MONTH:
Material none
Quantity _____ W.P.B. Authorization No. _____
Supplier _____

IV. PURCHASES TO WHICH RATING A-1-a HAS BEEN APPLIED DURING MONTH:
Material Brass clott sieve, sieve bottom pan, triangular files
Quantity 1, 1, 3 W.P.B. Authorization No. _____
Supplier Braun-Knecht-Heimann Co., 1400 16th St., San Francisco, Calif.

V. PURCHASES TO WHICH RATING AA-2X HAS BEEN APPLIED DURING MONTH:
Material 4 x 8 ft. 14-gauge black metal
Quantity 16 sheets W.P.B. Authorization No. _____
Supplier Lorenz Company, Medford, Oregon

CERTIFICATION

The undersigned hereby certifies to the War Production Board, that

(1) he executed the foregoing statement on behalf of and by authority of the above-named Mine Operator;

(2) the above-named Mine Operator has, during the period covered by this report, complied with all the provisions of Preference Rating Order P-56, and has applied ratings only in accordance therewith;

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(4) the facts stated herein are, to the best of his knowledge and belief, true and correct.

Freeport Sulphur Company

December 10, 1942 (Date) By: _____ (Signature of Authorized Official) Mgr., Western Office (Title)

MONTHLY REPORT OF PURCHASES

Machinery, Supplies, Maintenance Items and Repairs
under Preference Rating Order P-56

NAME OF MINE OPERATOR OR AUTHORIZED AGENT FOR SUCH OPERATOR Freeport Sulphur Co.

ADDRESS Box 190, Grants Pass, Oregon MINE SERIAL NO. 33-65

PURCHASES MADE IN MONTH OF October, 19 42.

I. PURCHASES TO WHICH RATING A-8 HAS BEEN APPLIED DURING MONTH:
Material none
Quantity _____ W.P.B. Authorization No. _____
Supplier _____

II. PURCHASES TO WHICH RATING A-3 HAS BEEN APPLIED DURING MONTH:
Material none
Quantity _____ W.P.B. Authorization No. _____
Supplier _____

III. PURCHASES TO WHICH RATING A-1-c HAS BEEN APPLIED DURING MONTH:
Material none
Quantity _____ W.P.B. Authorization No. _____
Supplier _____

IV. PURCHASES TO WHICH RATING A-1-a HAS BEEN APPLIED DURING MONTH:
Material _____
Quantity _____ W.P.B. Authorization No. _____
Supplier none

CERTIFICATION

The undersigned hereby certifies to the War Production Board, that

(1) he executed the foregoing statement on behalf of and by authority of the above-named Mine Operator;

(2) the above-named Mine Operator has, during the period covered by this report, complied with all the provisions of Preference Rating Order P-56, and has applied Ratings only in accordance therewith;

(3) during such period the Mine Operator's inventory of operating supplies and other material has not been greater than the minimum necessary for the efficient operation of his business, and the ratio of inventory (quantity) to current production has not exceeded the ratio of average year-end inventory (quantity) to average production for the years 1938, 1939, and 1940;

(4) the facts stated herein are, to the best of his knowledge and belief, true and correct.

Freeport Sulphur Company

November 4, 1942 (Date) By: David S. Clair (Signature of Authorized Official) Mgr., Western Office (Title)

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& MINERAL INDS.

MONTHLY REPORT OF PURCHASES

Machinery, Supplies, Maintenance Items and Repairs
under Preference Rating Order P-56

NAME OF MINE OPERATOR OR AUTHORIZED AGENT FOR SUCH OPERATOR Freeport Sulphur Co.

ADDRESS Box 190, Grants Pass, Oregon MINE SERIAL NO. 33-65

PURCHASES MADE IN MONTH OF September, 19 42.

I. PURCHASES TO WHICH RATING A-8 HAS BEEN APPLIED DURING MONTH:
Material none
Quantity _____ W.P.B. Authorization No. _____
Supplier _____

II. PURCHASES TO WHICH RATING A-3 HAS BEEN APPLIED DURING MONTH:
Material none
Quantity _____ W.P.B. Authorization No. _____
Supplier _____

III. PURCHASES TO WHICH RATING A-1-c HAS BEEN APPLIED DURING MONTH:
Material snatch block
Quantity one W.P.B. Authorization No. _____
Supplier James Trimble, 515 I Street, Grants Pass, Oregon

IV. PURCHASES TO WHICH RATING A-1-a HAS BEEN APPLIED DURING MONTH:
Material none
Quantity _____ W.P.B. Authorization No. _____
Supplier _____

CERTIFICATION

The undersigned hereby certifies to the War Production Board, that

(1) he executed the foregoing statement on behalf of and by authority of the above-named Mine Operator;

(2) the above-named Mine Operator has, during the period covered by this report, complied with all the provisions of Preference Rating Order P-56, and has applied Ratings only in accordance therewith;

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(4) the facts stated herein are, to the best of his knowledge and belief, true and correct.

Freeport Sulphur Company

October 10, 1942 (Date) By: _____ (Signature of Authorized Official) Mgr., Western Office (Title)

MONTHLY REPORT OF PURCHASES

Machinery, Supplies, Maintenance Items and Repairs
under Preference Rating Order P-56

NAME OF MINE OPERATOR OR AUTHORIZED AGENT FOR SUCH OPERATOR Freeport Sulphur Co.

ADDRESS Box 190, Grants Pass, Oregon MINE SERIAL NO. 33-65

PURCHASES MADE IN MONTH OF August, 19 42.

I. PURCHASES TO WHICH RATING A-8 HAS BEEN APPLIED DURING MONTH:
Material none
Quantity _____ W.P.B. Authorization No. _____
Supplier _____

II. PURCHASES TO WHICH RATING A-3 HAS BEEN APPLIED DURING MONTH:
Material none
Quantity _____ W.P.B. Authorization No. _____
Supplier _____

III. PURCHASES TO WHICH RATING A-1-c HAS BEEN APPLIED DURING MONTH:
Material none
Quantity _____ W.P.B. Authorization No. _____
Supplier _____

IV. PURCHASES TO WHICH RATING A-1-a HAS BEEN APPLIED DURING MONTH:
Material none
Quantity _____ W.P.B. Authorization No. _____
Supplier _____

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(2) the above-named Mine Operator has, during the period covered by this report, complied with all the provisions of Preference Rating Order P-56, and has applied Ratings only in accordance therewith;

(3) during such period the Mine Operator's inventory of operating supplies and other material has not been greater than the minimum necessary for the efficient operation of his business, and the ratio of inventory (quantity) to current production has not exceeded the ratio of average year-end inventory (quantity) to average production for the years 1938, 1939, and 1940;

(4) the facts stated herein are, to the best of his knowledge and belief, true and correct.

Freeport Sulphur Company

September 10, 1942 (Date) By: _____ (Signature of Authorized Official) Mgr., Western Office (Title)

With my compliments
J. T. Cumberlidge.

GEOLOGY OF THE NICKEL MOUNTAIN MINE

RIDDLE, OREGON

John T. Cumberlidge

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- Saprolite Group

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- Faults
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ABSTRACT

Nickel-bearing saprolite developed during the early Tertiary over a north-east trending ultramafic body of Jurassic age near Riddle in southwestern Oregon. The principal nickel mineral is garnierite, but other complex nickel minerals may be present. There are two main orebodies, an upper (older) one associated with the Klamath peneplain, and a lower (younger) one on the Sherwood peneplain.

Saprolite constitutes the bulk of the ore, and was probably derived from peridotite and dunite through chemical decomposition by downward percolating meteoric groundwater. Decomposition took place by net loss of MgO, SiO_2, and Fe without a change in volume. Faults and joints provided permeable zones which localized saprolite development, and faulting may have helped preserve some ore from loss by erosion.

Garnierite-chalcedony boxwork ore was deposited by meteoric groundwater along faults, joints, and at the level of former water tables. Boxwork ore is entirely supergene, the chemical constituents having been derived from higher in the soil profile. The saprolites show evidence of both supergene and residual enrichment in nickel. Red and yellow soil occurs as a capping over saprolite and boxwork, and was derived from them by chemical and mechanical decomposition.

The present deposits are probably truncated remnants of a formerly thicker and much more extensive deposit which probably included laterite at the surface. The deposits started to form in the early Teriary due to deep chemical weathering under sub-tropical to warm temperate conditions. Early Tertiary erosion surfaces of low relief probably contributed to the predominance of chemical weathering over mechanical erosion. Alteration under present climatic conditions favors the formation of soil from saprolite rather than the formation of new saprolite from peridotite.

INTRODUCTION

The Nickel Mountain deposit occupies a unique position in the metal economy of the United States. Although the deposit is quite small, it produces seven per cent of domestic nickel requirements, and is the only producing nickel mine in the United States. Moreover, it is the only operation currently utilizing nickel silicate ore on the North American continent.

The deposit is located in southwestern Douglas County, about four miles west of the small town of Riddle (figure 1). (Figure 1 near here). The deposit covers much of the upper part of Nickel Mountain, including parts of Sections 8, 9, 16, 17, 18, 20, and 21, T30S, R6W, Willamette meridian.

The ore is mined by open pit methods by The Hanna Mining Company. After preliminary screening at the mine, ore is conveyed by an 8300 foot long aerial tramway to a smelter located at the foot of Nickel Mountain. The smelter, 2000 feet below mine level, is owned and operated by the Hanna Nickel Smelting Company.

Ore is smelted by an adaptation of the Ugine process (11) in which ferrosilicon is used to reduce iron and nickel oxides in molten ore to ferronickel containing about 48 per cent nickel. Production statistics over the life of the property are given in table 1. Expansion of the smelter facilities should increase the annual production in 1965. Present knowledge of ore reserves indicates a life of approximately 16 years, although technological innovation could change this somewhat.

Figure 1. Location of Nickel Mountain

Table 1. Production of Ore and Metal, 1954 - 1964

YEAR	Lbs. Ni. Produced	Ore Shipped Dry Short Tons	% Ni
1954	318,489	98,583	1.58
1955	6,505,329	284,416	1.47
1956	11,382,984	408,961	1.53
1957	18,121,452	813,842	1.51
1958	21,233,634	846,489	1.51
1959	20,794,091	819,501	1.51
1960	22,228,720	874,318	1.50
1961	20,650,142	863,110	1.49
1962	21,138,893	874,646	1.50
1963	21,447,986	892,903	1.50
1964	22,472,891	1,070,866	1.44
Total	186,294,611	7,847,635	1.50

PREVIOUS WORK

An interesting description of early settlement in the area and exploration of the deposit can be found in an article written by the staff of the Oregon State Department of Geology and Mineral Industries (33). The nickel deposit was first discovered by shepherds in 1865, not long after the area was first settled, but it lay dormant until 1954 when production began.

The nickel deposit has been described by a number of writers. Geological aspects have been covered by Clarke (10), Von Foullon (15), Austin (3), Ledoux (26), Kay (23), Diller and Kay (13), Pecora and Hobbs (34 and 35), Schoenike (38), and most recently by Hotz (19). Mining and exploration methods were described by Foster (14), Van Voorhis (40), Walker (41), and Gustafson (16). The smelter and smelting operations were fully described by Coleman and Vedensky (11).

Many of these papers were written before or shortly after mining commenced in 1954. The additional information revealed by over ten years of mining and development drilling has given a better insight into the geology of the deposit than was formerly available from surface trenching and a limited amount of drilling.

This paper is intended to describe the geology of the Nickel Mountain deposits; to classify the types of ore which occur; to show the influence of climate, topography, and structure on ore development; and to investigate some of the effects of residual and supergene nickel enrichment. The factual data were obtained from study of the Riddle deposit. The conclusions may be applicable to other lateritic nickel deposits, but this is not necessarily assumed to be true.

GENERAL GEOLOGY

Nickel Mountain is situated at the northern end of the Klamath mountains (figure 2) (Figure 2 near here) which extend south into northern California. The Klamath mountains are composed of rocks older than the Tertiary volcanic rocks forming the Cascade Range to the east, and the Tertiary sedimentary rocks of the Coast Range to the west and north. The peridotite on which the orebody is located is one of several north to northeast trending ultramafic intrusions which traverse the area.

The Orebodies

The laterite-type ore on Nickel Mountain occurs as a discontinuous mantle of residual material covering approximately 500 acres with an average depth of only 50 feet. However, the apparent simplicity of the deposits is misleading. Jointing and faulting cause considerable variation in ore thickness (5 - 200 feet), and in ore type over relatively short distances.

There are two main orebodies, one coinciding roughly with the top of Nickel Mountain (3535 feet), and the other on a terrace on the south side of the mountain (figure 3). (Figure 3 near here). The lower terrace, known as the Lower orebody, slopes to the south at about 13 per cent. It ranges in elevation from 2000 to 2550 feet and is separated from ore above by a steep slope of barren peridotite. The south side of the terrace coincides essentially with the serpentinized and faulted contact of the ultramafic body with the Riddle formation (figure 4). (Figure 4 near here).

The Upper orebody includes the highest erosion level and a narrow discontinuous step in the topography at approximately 2900 feet. Ore associated with the two erosion levels merges, and is not distinguished in figure 3. The Upper orebody has a mean slope to the south of 31 per cent, but ore is preserved on slopes as steep as 47 per cent.

Figure 2. Geologic Map of Southwestern Oregon

Figure 3. Geologic Map of Nickel Mountain

Figure 4. North-South Profile Through the Lower and Upper Orebodies

Stratigraphy

The geology of the Riddle Quadrangle was first described by Diller and Kay (13). Since that time, the work of Imlay, Dole, Wells, and Peck (20) has further clarified the Jurassic-Cretaceous sequence in this part of Oregon. A recent compilation of Oregon geology west of the 121st meridian by Wells and Peck (42), and the succession given by Imlay et al. (20, p. 2777) have been used as a base for the stratigraphic sequence given in table 2.

Part of the Jurassic sequence is represented on Nickel Mountain. Rocks assigned to the Dothan formation outcrop mainly on the north side of the mountain (figure 3). In addition, faulted remnants of Dothan sediments have been preserved within the peridotite mass. The Dothan formation consists essentially of graywacke, but includes shale, conglomerate, and chert. As a rule, the fine grained members are thinly bedded, while the graywackes are thick and massive. In places, some of the sediments are schistose and are cut by thin quartz veinlets. No fossils were found in the Dothan formation.

The Dothan formation is intruded by rocks of basaltic, andesitic, and gabbroic composition, locally altered to greenstones. Thin chert lenses are associated spatially with the greenstones.

Riddle formation rocks are found on the south side of Nickel Mountain. Typically, the Riddle formation consists of thinly bedded fossiliferous siltstone with sandstone and shale, and includes conglomerate lenses. The siltstone and sandstones contain the pelecypod Buchia piochii (Gabb) considered diagnostic of the Riddle formation, while lenses of sandstone and grit within the conglomerate contain wood fragments and carbonaceous layers up to 5mm thick.

Table 2. Stratigraphic Column in the Riddle Area

SYSTEM	GROUP	FORMATION	INTRUSIVE ROCKS
Lower Cretaceous	Myrtle	Days Creek	
		Riddle	
Upper Jurassic			Ultramafic Intrusions?
		Dothan	

Ultramafic Rocks

The Nickel Mountain ultramafic rocks include peridotite (saxonite), dunite, and serpentinite. Peridotite is the predominant rock type and underlies most of the orebodies. Dunite accounts for perhaps ten percent of the ultramafic area and appears to grade into peridotite. Serpentinite occurs mainly close to contacts with Jurassic sediments.

The peridotite is a coarse grained rock containing approximately 80 percent olivine ($Fo_{90}Fa_{10}$) and 20 per cent enstatite ($En_{90}Fs_{10}$). Enstatite grains range up to 5mm in diameter, while the olivine grains are generally somewhat smaller. Minute grains of accessory chromite are found in both peridotite and dunite, and account for 0.3 - 1.0 per cent of the rock by weight. The magnesium content of olivine tends to be slightly higher in dunite than in peridotite.

Serpentinized peridotite and dunite are variable in composition, depending on the degree of serpentinization. Generally, peridotite and dunite contain from five to ten per cent of serpentinized olivine grains. Enstatite tends to remain unaltered until serpentinization has advanced towards completion. Secondary magnetite in microscopic layers and grains occurs with the serpentine minerals.

Contacts of the peridotite with the sedimentary formations on Nickel Mountain are faulted and the age relationships are uncertain. Faulted remnants of the Dothan formation are found within the peridotite suggesting that the intrusion may be of post Dothan age. Imlay et. al. (20, p. 2776) noted that the basal conglomerate of the Riddle formation contains some "limestone or serpentine" pebbles. In addition, Ramp (36, p. 5) reports cobbles of serpentine and partly serpentinized peridotite in conglomerates which also contain fossils of Portlandian (Riddle formation equivalent) age at Otter Point near Gold Beach in Curry County, Oregon. The two lines of reasoning, though not conclusive, indicate that the ultramafic intrusion and the serpentinization may be of post Dothan - pre Riddle formation age

Chemical Analyses

Chemical analyses of Nickel Mountain peridotite are given in table 3. Analyses by B. J. Grimm were made by standard wet chemical methods at the Hanna Nickel Smelting Company laboratory.

Loss on ignition, plus silica, magnesia, and the oxides of nickel, chrome, and iron account for approximately 97 - 98 per cent of the chemical constituents of peridotite and normal ore. Rapid routine analysis is accomplished by arcing a pulverized sample and reading the intensity of Mg, Fe, Cr, and Ni spectral emission on a quantometer. Loss on ignition varies with iron and nickel content, and can be estimated closely by reference to the analyses of these elements. Minor constituents such as Al, Ca, K, Na, Ti, P, and Mn average 2.5 per cent. The amount of SiO_2 can thus be found by subtraction from 100 per cent. Check chemical assays usually agree with calculated silica values to within ± 2 per cent SiO_2.

A colorimetric method is also used to obtain accurate nickel analyses. Accuracy is $\pm$ .02 per cent Ni in normal ore. Unless otherwise stated, all analyses given in this paper are colorimetric or quantometric.

Table 3. Analyses of Fresh Peridotite and Serpentinite from Nickel Mountain. In Per Cent.

	1	2	3	4	5
SiO_2	42.7	43.2	43.7	42.8	42.4
Al_2O_3	1.0	1.10		1.1	1.05
Fe_2O_3	* 0.87	0.83	* 0.94	0.8	2.49
FeO	* 7.06	7.80	* 7.64	6.8	3.94
MgO	44.2	44.0	43.2	45.7	41.50
CaO	0.9	0.48		0.9	0.35
Na_2O	NR	NR		0.03	NR
K_2O	NR	NR		0.01	NR
H_2O^+	NR	1.47		1.6	7.18
L.O.I.**	1.42	NR		NR	NR
TiO_2	NR	0.01		0.02	0.01
P_2O_5	NR	0.01		0.02	0.005
MnO	0.15	0.12		0.12	0.09
CO_2	NR	0.05		0.12	0.15
Cr_2O_3	0.38	0.43	0.47	0.45	0.39
NiO	0.52	0.34	0.32	0.36	0.29
CoO	0.01	0.01	____	0.02	0.013
Total	99.98	99.85	96.27	100.85	99.85

NR = Not Run. *90% Total Fe converted to FeO, remainder to Fe_2O_3.

**L.O.I. = Loss on ignition, includes H_2O^+ and CO_2.

Sample Description

1. Single sample fresh peridotite. Analyst B. J. Grimm.
2. Composite sample fresh peridotite. Analyst B. J. Grimm.
3. Same sample as No. 2, but analyzed by quantometer and colorimeter.
4. Saxonite from Nickel Mountain. From Hotz (19, Table 2, p. 363).
5. Single sample of serpentinite. Analyst B. J. Grimm.

PHYSIOGRAPHIC HISTORY

Concordant summit levels at approximately 3500 feet are a conspicuous feature of the landscape around Nickel Mountain and throughout the Klamath mountains, although the precise elevation is variable. This surface was named the Klamath peneplain by Diller (12), who concluded that the long cycle of erosion and uplift was initiated at the close of the Eocene. Diller considered that marine sediments (Wimer formation) were forming on the western margin of the developing peneplain. These marine sediments are preserved in patches at an elevation of about 2000 feet along the western edge of the Klamath mountains in Del Norte County, California (21). Diller, and later Maxson (30, p. 135), assigned a late Miocene age to the Wimer formation, but Diller also considered the Wimer sediments to be erosional remnants of marine deposits found 10 to 15 miles westward at Point St. George, which Allen and Baldwin (2) have since concluded are of Pliocene age.

Cater and Wells (5), in considering the topography of the Gasquet quadrangle in northwestern California, emphasize that the surface on which the Wimer beds were deposited is separated from the Klamath peneplain by a distinct break in slope. They concluded that (p. 114) "the Klamath cycle of peneplanation ended with moderate regional uplift before the upper Miocene beds were deposited." Later subsidence allowed the Wimer sea to deposit upper Miocene sediments in the lower ends of the river valleys and along the coast bordering the land mass.

The Weaverville formation was considered by Diller (12, p. 12) to be associated with the development of a second major cycle of erosion which he named the Sherwood peneplain. Unfortunately, there is some doubt as to the age of the Weaverville formation. Diller thought the Weaverville was of Miocene age, but Hinds (18) and Jenkins (22) both thought it was chiefly Eocene. MacGinitie (29) did a considerable amount of work on fossil floras of the Weaverville formation and concluded that it was of Oligocene age. If the later is true, the Sherwood stage is Oligocene, and the Klamath peneplain is of pre-Oligocene age.

There appears to be no reason why the sequence of events discussed above cannot be applied to Nickel Mountain. If this is so, the Upper orebody (Diller's Klamath peneplain) is of pre upper Miocene age, and could be as old as the Eocene, while the Lower orebody, (possibly Diller's Sherwood stage) is of pre-Pliocene age. This dating, though not as close as one might wish, probably serves the present purpose of assigning an approximate age to the distinct ore levels on Nickel Mountain.

Other erosion levels in the Riddle area are considerably younger than the Klamath and Sherwood peneplains, and are found at lower elevations on the mountain side and in the present river valleys. Ore has not been developed where the younger terraces cut ultramafic rocks, and in fact, low level ore is conspicuously absent throughout the Klamath Mountain province.

Indirect evidence of the age of laterization is provided by the Cle Elum nickeliferous iron deposits in Kittitas County, Washington. These deposits are generally considered to be residual laterites, although portions of the ore appear to have been reworked (25). The deposits rest upon serpentinized peridotite and are overlain by continental sandstones of the Swauk formation. The age of the Swauk formation is uncertain, but Lupher (28, p. 8) concluded that "the Swauk Creek flora is suggestive of a time near the Mesozoic-Cenozoic boundary".

TERTIARY CLIMATE

Direct evidence of the early Tertiary climate is not preserved in sedimentary rocks on Nickel Mountain, but some indication of the prevailing climatic conditions at this time can be gained by study of continental Tertiary sediments and fossil bearing volcanic rocks in other parts of Oregon, Washington, and California. A fairly complete sequence of Tertiary terestrial deposits containing moderately abundant plant and tree flora has been preserved in the John Day Basin of eastern Oregon, and floral assemblages from other isolated areas in Oregon, Washington, and California can be given a stratigraphic position by reference to this sequence. The basin deposits have been described by a number of writers including Merriam (31), Knowlton (24), and Buwalda (4).

In a comprehensive survey of early Tertiary climate, Chaney (8) used two distinct floras to trace migration of climate. The two floras, one dominated by redwood, and the other by avocado, fig, and palmetto, indicate temperate and subtropical conditions respectively. Study of the distribution of the two floras has shown that during Eocene time, there was a lowland area extending from Washington to California which supported a subtropical vegetation. The similarity of floras west and east of the present Cascade axis indicates that this range was probably not in existence in the Eocene.

Subtropical conditions continued into the Oligocene, as shown by the Weaverville flora of California (29), but by the end of the Oligocene, the subtropical forests were migrating southwards and being replaced by redwoods. This is particularly well shown by the upper Oligocene flora from Bridge Creek near Mitchell in central Oregon (6). The flora indicates a redwood forest somewhat more diversified than modern Californian forests, but generally of the same type. By early Miocene, the redwood and other broadleaf deciduous genera were dominating the forests of middle latitudes in western North America. The Mascall flora of Miocene age is widely distributed through western Oregon, Washington, and California and, according to Chaney (7), indicates a climate comparable with that of modern oak - madrono forests which have about 39 inches of rainfall. The progressive change in climate culminated in the Pleistocene glaciation.

At the onset of the Pliocene, differences between the flora east and west of the Cascade axis can be seen. A redwood flora is known from western Oregon but is absent from Pliocene assemblages east of the Cascades. Thus it seems reasonable to conclude that the Cascade barrier came into existence in late Miocene or Pliocene time.

Coal swamps figure prominently in the Tertiary history of Oregon and Washington. Snavely (39), shows that they existed from early Eocene time to as late as the middle Miocene. Thick beds of partly carbonized wood are typical of the upper Miocene but are not recorded from Pliocene strata. The existence of coal swamps suggests a warm, humid climate at least until the middle of the Miocene in the coastal regions. By the start of the Pliocene these conditions had changed to a distinctly cooler climate.

Ferruginous bauxites are found in northwestern Oregon. According to Libbey et al. (27), laterization took place following extrusion of the Miocene basalts, from which the bauxites were derived, but prior to their folding in the Pliocene. Allen (1, p. 625) further states that the formation of bauxite was completed before the deposition of an overlying silt, probably of Pliocene age. The formation of bauxite strongly suggests at least a humid, warm temperate climate in the Miocene, although as Reiche (37, p. 81) points out, laterization is not always confined to tropical climates and may occur under temperate or even sub-polar climates.

The gradual change from a humid subtropical climate in the Eocene and Oligocene, to more temperate conditions in the Miocene and Pliocene appears to be well established. The coincidence of subtropical climate and low relief in the early Tertiary may have been responsible for the favorable conditions which allowed widespread development of nickeliferous deposits over ultramafic bodies in Oregon, California, and Washington.

ORE CLASSIFICATION

Ore grade is an important economic factor, and is significant in other ways, but classifying Nickel Mountain ore according to nickel grade tends to group together ores which otherwise are quite dissimilar. Instead of Ni, differences in texture and structure have been used to subdivide the ore into three main groups and six ore types, as shown in table 4.

The primary division between soil and saprolite is based on the presence or absence of joint planes, the appearance of residual rock boulders, and the granularity of interstitial decomposed material. The soil group is subdivided on color, while the saprolites are further subdivided according to the amount of fresh rock they contain. Boxwork ore is quite distinct, as it occurs in veins, and is composed of chalcedony and a number of hydrous Ni-Mg silicates, including garnierite. The term saprolite is used in its original sense to describe a decomposed but untransported rock, and to distinguish the high MgO - low Fe ore preserved on Nickel Mountain from typical low MgO - high Fe laterite which is not present.

Soil Group

The orebody is mantled by a cover of brick red soil which grades downward locally into a yellow soil. The soils account for approximately 20 per cent of the ore reserve, and their general distribution is shown in figure 3. The thickness averages ten feet, but soil may be virtually absent or up to 40 feet thick. The soil is a porous, incoherent material composed of pulverulent aggregates rich in hydrous iron oxides and clay minerals, and scattered fresh peridotite boulders, ranging in size from a few inches to over 20 feet in diameter. In some areas, irregular fragments of leached honeycomb chalcedony boxwork and chalcedony vein fragments are abundant. Soils developed over serpentinite are brown in color rather than brick red, and normally contain a smaller amount of nickel than red soil.

Table 4. Ore Classification

GROUP	ORE TYPE
Soil	Red Soil
	Yellow Soil
Saprolite	Soft Saprolite
	Hard Saprolite
	Saprolized Peridotite
Boxwork	Boxwork

The brick red color is caused by iron minerals and iron staining. The transitional change to yellow soil takes place over about one foot and reflects the change from predominantly ferric to predominantly ferrous compounds. Compared with saprolite ore, the soils are higher in Fe, and tend to be rather high in silica where the underlying ore is boxwork. The soils have a variable magnesia content, and are generally lower in nickel content than the ore which underlies them. Soils in the Lower orebody are higher in Fe and SiO_2, and lower in Ni and MgO than soils in the Upper orebody.

The top few inches of soil contains moderately abundant grains of magnetite approximately .3mm in size, and the whole soil thickness is slightly enriched in chromite and enstatite grains. The soils show no trace of original joint planes, and peridotite boulders are randomly distributed.

Where soil occurs over fresh peridotite, the soil contains abundant peridotite boulders, some of which may be quite large. Where soil occurs over a thick saprolite sequence, fresh peridotite boulders are either absent or few in number. No exotic rock float has been found in the soil, which probably means that the orebody was never capped by younger rocks.

One of the most distinctive features of the soils is the appearance of the peridotite boulders. These tend to be somewhat rounded and completely fresh except for a thin rusty skin which is never more than 5mm thick. This feature, combined with a total lack of relict joint planes in the soil portion, is in marked contrast with the physical appearance of saprolite.

The base of the soil cover may be thought of as an "unconformity" separating ores which differ both chemically and physically. Planar features in the underlying ore, such as boxwork veins and faults, do not penetrate the soil. The contrast between soil and saprolite is stressed because the differences probably imply somewhat different modes of origin. This will be discussed in a later section.

Boxwork Group

Some of the richest and most colorful ore on Nickel Mountain occurs as rather thick veins of garnierite, chalcedony, and serpentine, often showing typical boxwork texture. Boxwork ore from Nickel Mountain and other localities has been described in many publications, consequently only the major features of interest will be outlined here.

Pecora and Hobbs (34), in describing the ores on Nickel Mountain, used the term "boxwork layer" in a broader sense than it is presently being used. They distinguished between the peridotite basement and the red soil cover, and called the ore lying in between "the boxwork layer". Thus they included in the term material which is classified here as saprolite as well as boxwork sensu stricto.

There is some merit in the grouping used by Pecora and Hobbs. Thin garnierite-chalcedony-serpentine veinlets are very widely distributed in saprolite and coat most joint planes. However, these veinlets rarely exceed five per cent of the total weight of the material, the bulk of which is fresh and decomposed peridotite. On the other hand, zones of predominantly garnierite-chalcedony boxwork occur, some as much as 40 feet thick, and it is to these zones that the term "boxwork ore" is restricted here. Boxwork ore, so defined, accounts for approximately ten per cent of the total ore reserve. Saprolite ore with minor garnierite-chalcedony veinlets may grade into boxwork ore, but more often than not the transition is rather sharp, and the two should be considered separately. The separation may have genetic as well as economic significance.

The term boxwork ore, as presently used, covers a variety of textures, not all of which are true boxworks. Three main varieties can be distinguished:

(1) True boxwork veins. These vary in thickness from a few inches to more than fifteen feet, and are composed of thin-walled chalcedony boxes, 1-5cm square, commonly filled or partly filled with hydrous Ni-Mg silicates including garnierite, and minor amounts of limonitic earth.

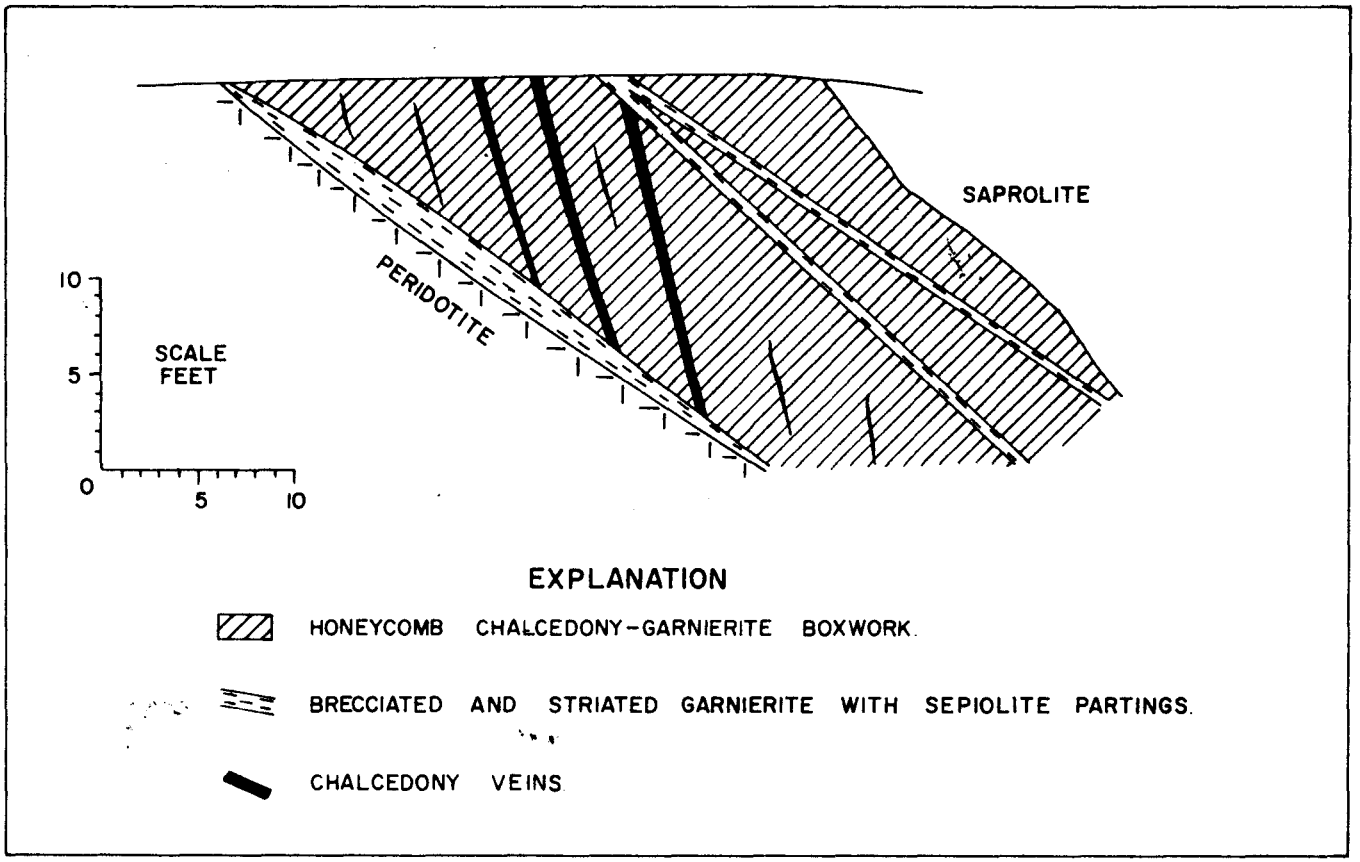
(2) Chalcedony veins, massive or banded. These are up to ten feet thick, are composed essentially of chalcedony in shades of white, gray, and brown and may contain up to 75% per cent SiO_2. Occasional bands or partings of garnierite are common, and some green chalcedony (chrysoprase) is also found. However, this ore is generally of lower grade than other types of boxwork.

(3) Breccia veins. These consist of fragments of peridotite, saprolite, serpentine, early chalcedony, or early garnierite, cemented by later chalcedony, serpentine and garnierite. Fault grooving and striae, often coated with later garnierite and chalcedony, are very common. Thin partings of soft, plastic, white or greenish sepiolite also occur with the breccia veins and may represent a fault gouge or mylonite.

True boxwork veins and breccia veins are nearly always vuggy or even cavernous. The openings typically are lined with garnierite and chalcedony, often showing bilateral symmetry. Thick boxwork zones are usually compound and often include representatives of all three varieties of boxwork. A normal sequence would be a brecciated and striated footwall, with an overlying true boxwork cut by thinner chalcedony veins as shown in figure 5. (Figure 5 near here).

Most boxwork ore in the Upper orebody is found along structural controls (faults, joints), but some boxwork along the south side of the orebody is in layers more or less parallel to the present surface and possibly represents fossil water tables. In contrast, most of the boxwork in the Lower orebody is flat lying and is believed to be related to fossil water tables.

Figure 5. Geologic Sketch Section Through Typical Compound Boxwork


SAPROLITE
PERIDOTITE
10
5
0
SCALE
FEET
5
10
EXPLANATION
HONEYCOMB CHALCEDONY-GARNIERITE BOXWORK.
BRECCIATED AND STRIATED GARNIERITE WITH SEPIOLITE PARTINGS.
CHALCEDONY VEINS.

Average analyses given in table 5 show that boxwork is notably high in silica and nickel, but relatively low in magnesia and iron. Boxwork in the Upper orebody carries appreciably more nickel and slightly less iron than in the Lower orebody, thus contributing to the pattern of differences between the two orebodies.

Changes in the character of some boxwork veins with depth have been observed. Most boxworks extend to the top of the saprolite zone and leached fragments are found in the overlying soil cover. However, some boxworks are capped by high grade soft saprolite which grades downward into high grade boxwork, then into lean boxwork. Figure 6 shows a sequence which has been pieced together from a number of scattered drill hole intersections and bank samples. (Figure 6 near here). The analyses and depths given are intended only as a guide to the scale and type of changes, and to show the relative mobility of some of the major chemical constituents.

Iron is concentrated in the soft saprolite, and the nickel content is highest in the upper part of the vein. Silica increases to a maximum at about the middle of the high grade zone and decreases below this level. Magnesia is present in the soft saprolite as both hydrous and anhydrous silicates and tends to be moderate in amount. The richest portion of the boxwork vein is low in MgO, while the leanest part of the vein is high in MgO due to the abundance of hydrous silicates.

The sequence suggests that Ni and Fe are either relatively immobile or are easily re-deposited, silica is moderately mobile, and magnesia is highly mobile. Conceivably, veins of this kind could grade downward into material composed of only hydrous Mg-silicates, although this has never been proven by drilling.

Figure 6. Depth Zoning in a Hypothetical Boxwork Vein

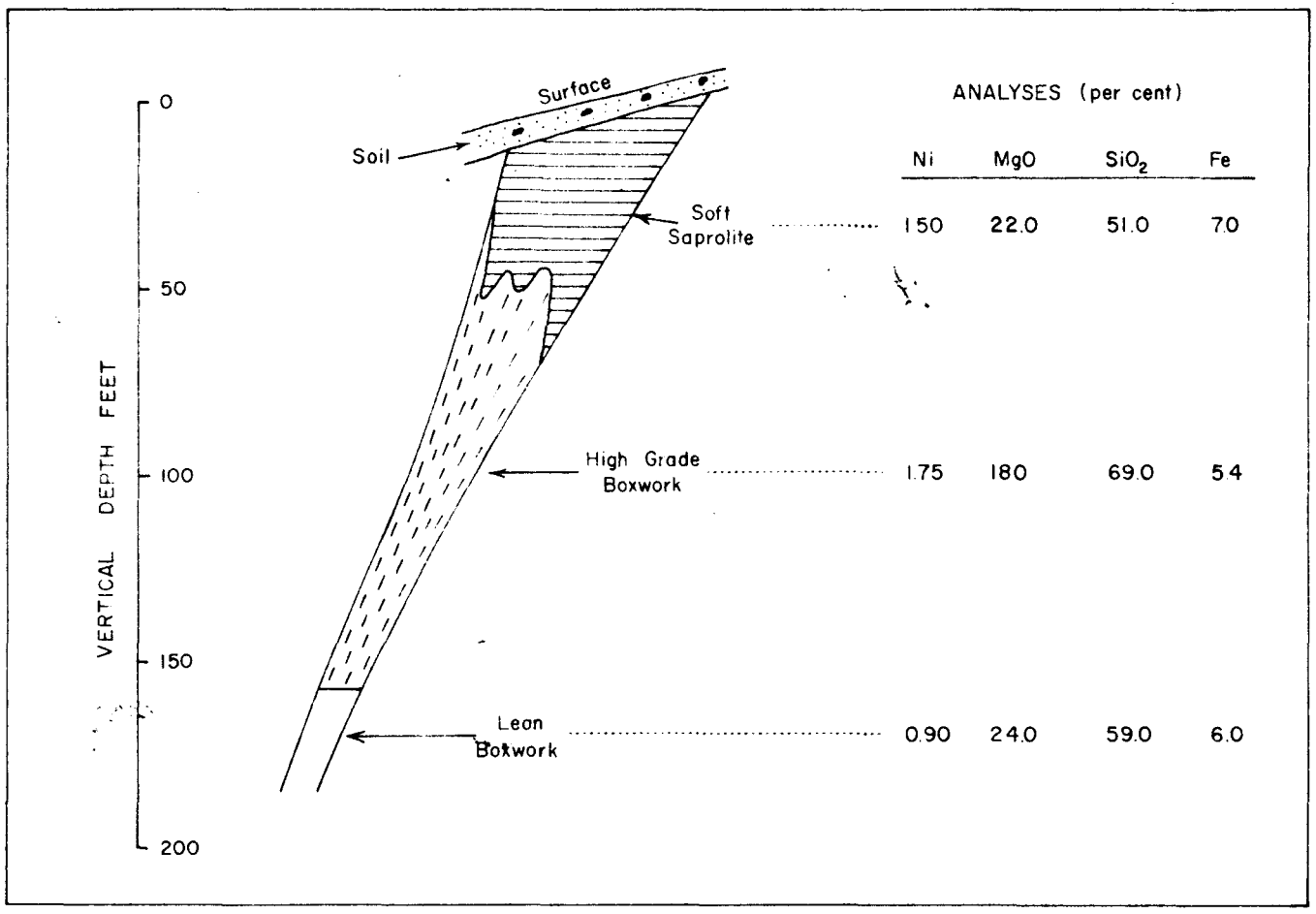

VERTICAL DEPTH FEET
0
50
100
150
200
Surface
Soil
Soft Saprolite
High Grade Boxwork
Lean Boxwork
ANALYSES (per cent)
Ni MgO SiO2 Fe
1.50 22.0 51.0 7.0
1.75 18.0 69.0 5.4
0.90 24.0 59.0 6.0

Table 5. Average Analyses of Boxwork Ore (per cent)

Orebody	Ni	MgO	SiO_2	Total Fe	L.O.I.
Upper	1.78	22.0	59.3	7.5	7.3
Lower	1.49	18.9	59.7	8.5	7.8

Boxwork ore marks the locations of major "plumbing" zones down which groundwater containing Ni, MgO, Fe, and SiO_2 migrated. Drill holes have penetrated boxwork ore as much as 260 feet vertically below the present surface. The thick compound boxworks in particular must have had a long history of use as channelways judging from the tonnage of deposited minerals.

Saprolite Group

Saprolite ore underlies most of the red soil areas and accounts for almost 70 per cent of the ore reserve. Because of their economic importance, they will be discussed in some detail. The saprolite group has been divided into three ore types based on the content of fresh, unaltered peridotite or dunite as follows:

Soft Saprolite	0 - 20% fresh rock by weight
Hard Saprolite	20 - 50%
Saprolized Peridotite	50 - 75%

Material containing more than 75 per cent fresh peridotite is classified as Peridotite or Bedrock and is generally not ore. The saprolite ore types represent a continuous sequence of rock decomposition in which peridotite, or dunite, was the starting point. Thus content of fresh rock is an index to the degree of alteration, and is used in this sense in the discussion which follows.

The classification based on fresh peridotite content is useful in that it can be applied to mine mapping, to bulk samples, and to heavy liquid and microscopic studies. However, it is not completely satisfactory when dealing with drill hole samples. This results from the fact that the ore can only be sucessfully drilled at present with a churn drill, and the sludge samples are difficult to classify visually. Some indication of the type of ore being drilled may be obtained by close inspection of the larger chips after washing out the mud, but most of the altered material and some of the peridotite is pulverized by the action of the drill bit.

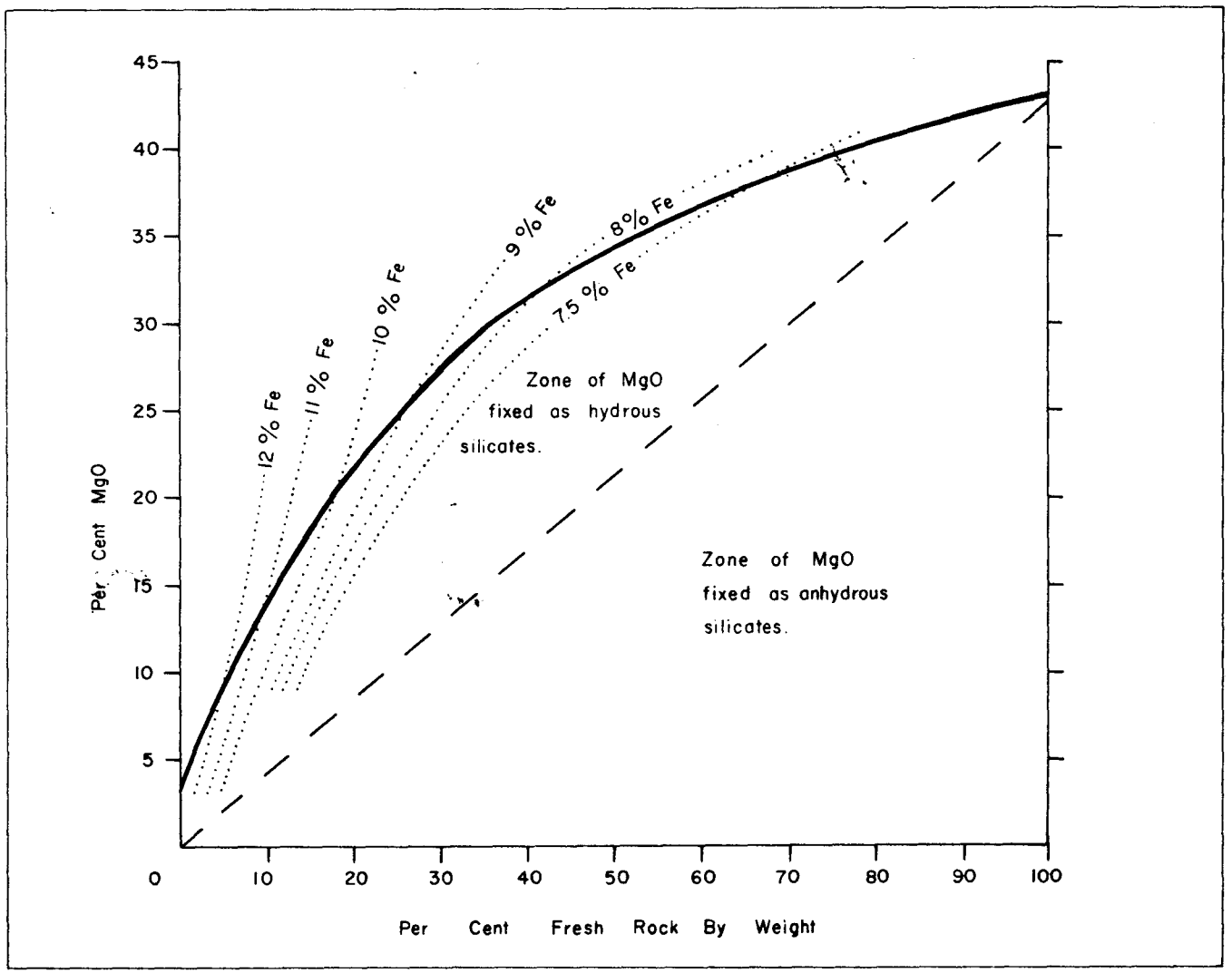
The most reliable indication of the fresh rock content of drill samples is obtained from chemical analyses. Pure peridotite contains approximately 44 per cent MgO, and using this as a basis, a relationship between MgO and rock content has been established. This correlation is not simple because several minerals in the ore contain MgO, the principal ones being primary anhydrous silicates such as olivine and enstatite, and secondary hydrous silicates such as garnierite, serpentine, and sepiolite. Study of mineral suites prepared by heavy liquid separation has shown that the ratio of hydrous to anhydrous Mg-silicates is fairly constant for a given content of fresh peridotite. Thus the MgO due to anhydrous silicates can be separated from MgO in hydrous silicates as shown by the dashed line in figure 7. (Figure 7 near here). The solid curved line in figure 7 represents the average rock content, and allows prediction of rock content from MgO analysis to within $\pm$ 10 per cent.

As a further refinement, an empirical relationship between iron and rock content has been developed. This relationship is used to correct the figure derived by the MgO method, thereby increasing the accuracy of prediction of rock content to $\pm$ 3 per cent. The correction due to iron content is also shown in figure 7.

Both MgO analysis and the amount of fresh rock may be used interchangeably; they vary together and both indicate the degree of saprolization. Where possible, rock content is estimated directly, but in the many places where only drill samples are available, the MgO - rock relationship is used.

The saprolites show the same kind of jointing as the peridotite from which they were derived, namely three or more sets of joint planes intersecting approximately at right angles and forming irregular blocks or rhombs. The joint planes are nearly always marked by thin films of garnierite, chalcedony, or serpentine, and the films are preserved with no sign of collapse or deformation even when all peridotite has been completely decomposed.

Figure 7. Relationship of MgO and Fe to the Amount of Fresh Rock in Crude Ore.


45
40
35
30
25
20
15
10
5
0
10
20
30
40
50
60
70
80
90
100
Per Cent MgO
Per Cent Fresh Rock By Weight
12 % Fe
11 % Fe
10 % Fe
9 % Fe
8% Fe
7.5 % Fe
Zone of MgO fixed as hydrous silicates.
Zone of MgO fixed as anhydrous silicates.

Normally, each joint rhomb contains a core of fresh peridotite surrounded by concentric layers of saprolitic material. A progressive chemical change can be traced from the core to the joint planes. Compared with the rock core, the outermost layers are lower in MgO and higher in SiO_2, Fe, and Ni, indicating that decomposition took place from the joint surfaces inwards. Joint frequency must therefore have been an important factor controlling degree of saprolization.

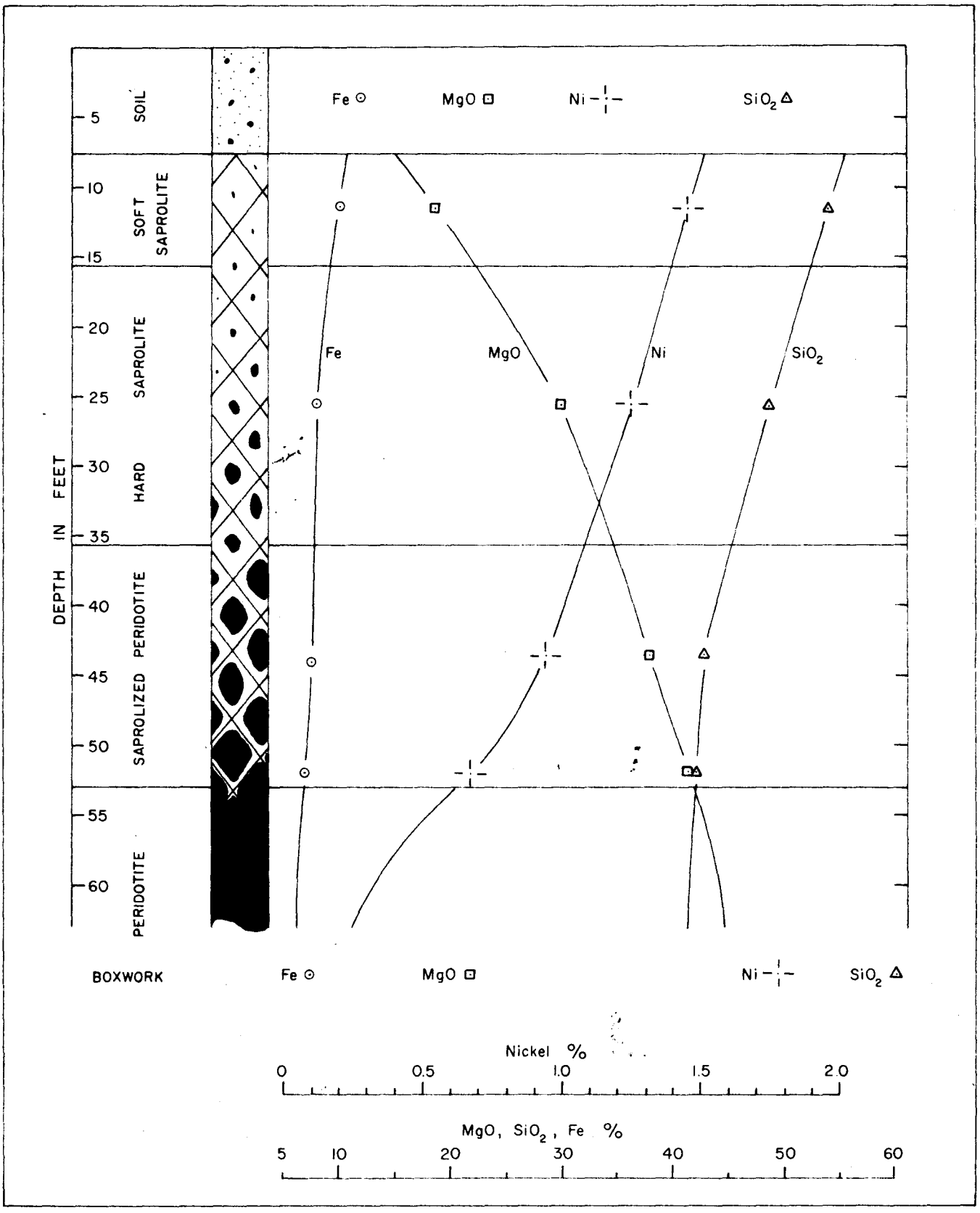
Decrease in the total amount of fresh rock is paralleled in general by a decrease in size of the fresh rock residuals. This would be expected if alteration was initiated along joint surfaces. However, the size of the residuals also depends on the closeness of joint spacing in the parent rock. A highly fractured or jointed parent rock produces small sized residual fragments regardless of the degree of saprolization.

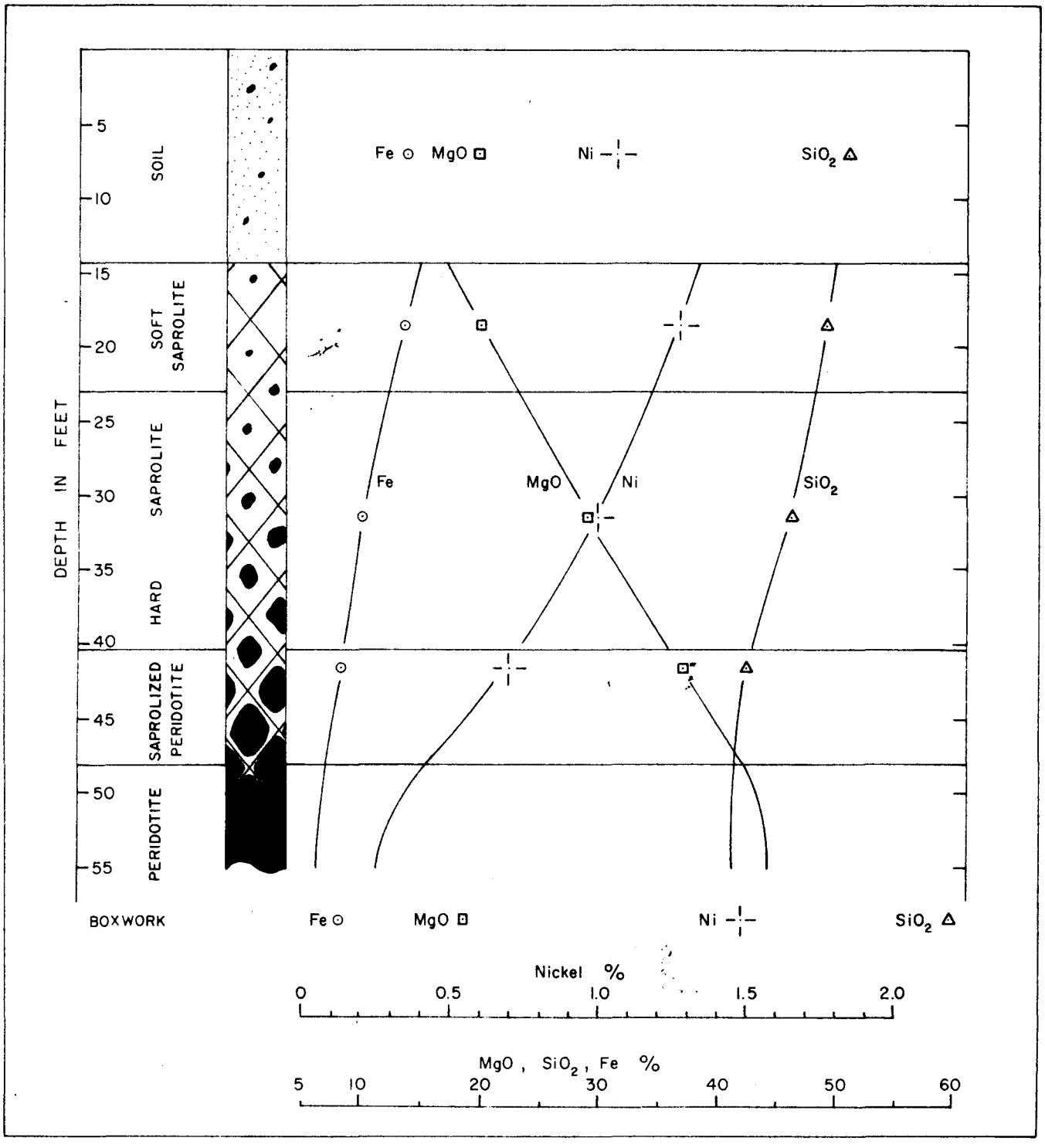
The chemistry of the saprolite sequence is shown graphically in figures 8 and 9 where grades of Ni, MgO, SiO_2, and Fe are plotted against thickness of each ore type. (Figures 8 and 9 near here). These profiles are not true vertical cross sections. Irregularities due to structure have been eliminated, and the resulting profile is an ideal section through a perfectly gradational sequence. Although this situation does not in fact obtain, the general sequence of chemical change attending saprolization is illustrated.

The two profiles are generally similar. Both show a systematic increase in MgO, and a decrease in Ni, SiO_2, and Fe as bedrock is approached. Differences between the two orebodies are also apparent. The total thickness of ore in the Upper orebody is about five feet greater than in the Lower orebody. Comparing ore type with ore type, the Upper orebody saprolites are uniformly higher in Ni, and lower in Fe than those in the Lower orebody. The SiO_2 and MgO contents tend to be variable but considering the saprolites as a whole, both orebodies have about the same SiO_2, while the Upper orebody is higher in MgO than the Lower orebody.

Figure 8. Chemistry and Thickness of Ore Types in the Upper Orebody

Figure 9. Chemistry and Thickness of Ore Types in the Lower Orebody


Fe ⊙
MgO ⊡
Ni
SiO2 △
5
SOIL
10
SOFT SAPROLITE
15
20
SAPROLITE
25
HARD
30
35
SAPROLIZED PERIDOTITE
40
45
50
55
PERIDOTITE
60
DEPTH IN FEET
Fe
MgO
Ni
SiO2
BOXWORK
Nickel %
0
0.5
1.0
1.5
2.0
MgO, SiO2, Fe %
5
10
20
30
40
50
60


DEPTH IN FEET
5
10
15
20
25
30
35
40
45
50
55
SOIL
SOFT SAPROLITE
HARD SAPROLITE
SAPROLIZED PERIDOTITE
PERIDOTITE
Fe ⊙ MgO ⊡ Ni ⊣⊢ SiO2 △
Fe
MgO
Ni
SiO2
BOXWORK
Fe ⊙ MgO ⊡ Ni ⊣⊢ SiO2 △
Nickel %
0 0.5 1.0 1.5 2.0
MgO , SiO2 , Fe %
5 10 20 30 40 50 60

The density of saprolite varies considerably, the most decomposed material being the least dense. As this is an important factor in making accurate ore reserve estimates, a series of bulk samples of about 200 tons each were collected to determine in-place tonnage factors. These samples were supplemented by a series of smaller samples obtained from hand dug test pits. The results of the sampling program are shown in figure 10 where tonnage factor (cu. ft/short ton) is plotted against MgO and ore type of the sample. (figure 10 near here). The dry in-place tonnage factor is controlled by mineral specific gravities and by porosity; the wet tonnage factor is further complicated by the degree of saturation.

The close relationship between in-place tonnage factor and degree of alteration reflects the large increase in porosity which is achieved without change in volume. Due to the incoherent nature of the material, direct measurements of porosity are difficult to make and usually inaccurate. However, porosity can be calculated from the dry in-place tonnage factor (Fd) if the true mineral specific gravity (Gm) is also known. Dry in-place tonnage factor is converted to dry in-place specific gravity (Gi) as follows:

$$Gi = \frac{2000}{Fd. \; 62.4}$$

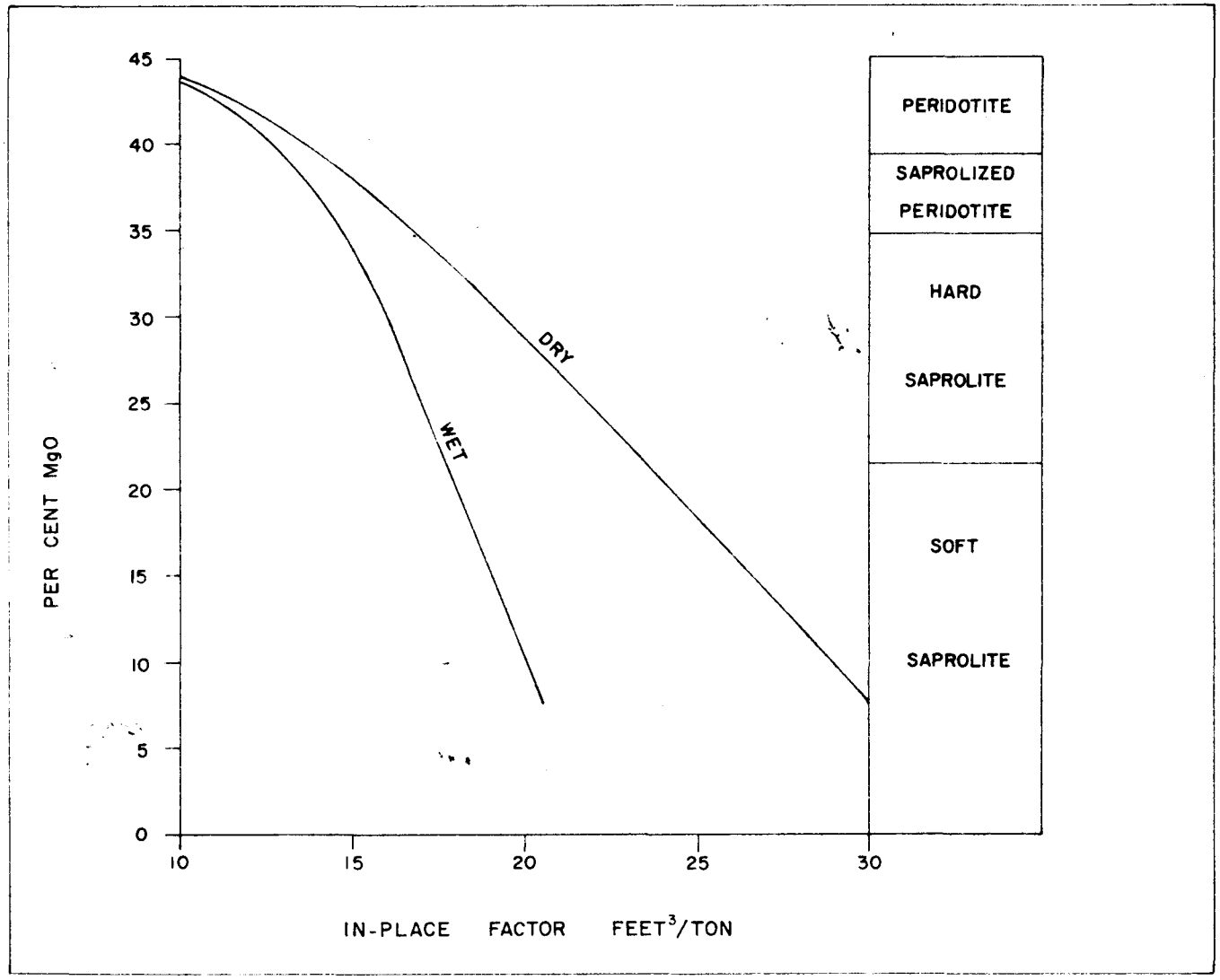
Porosity (P) is then obtained from

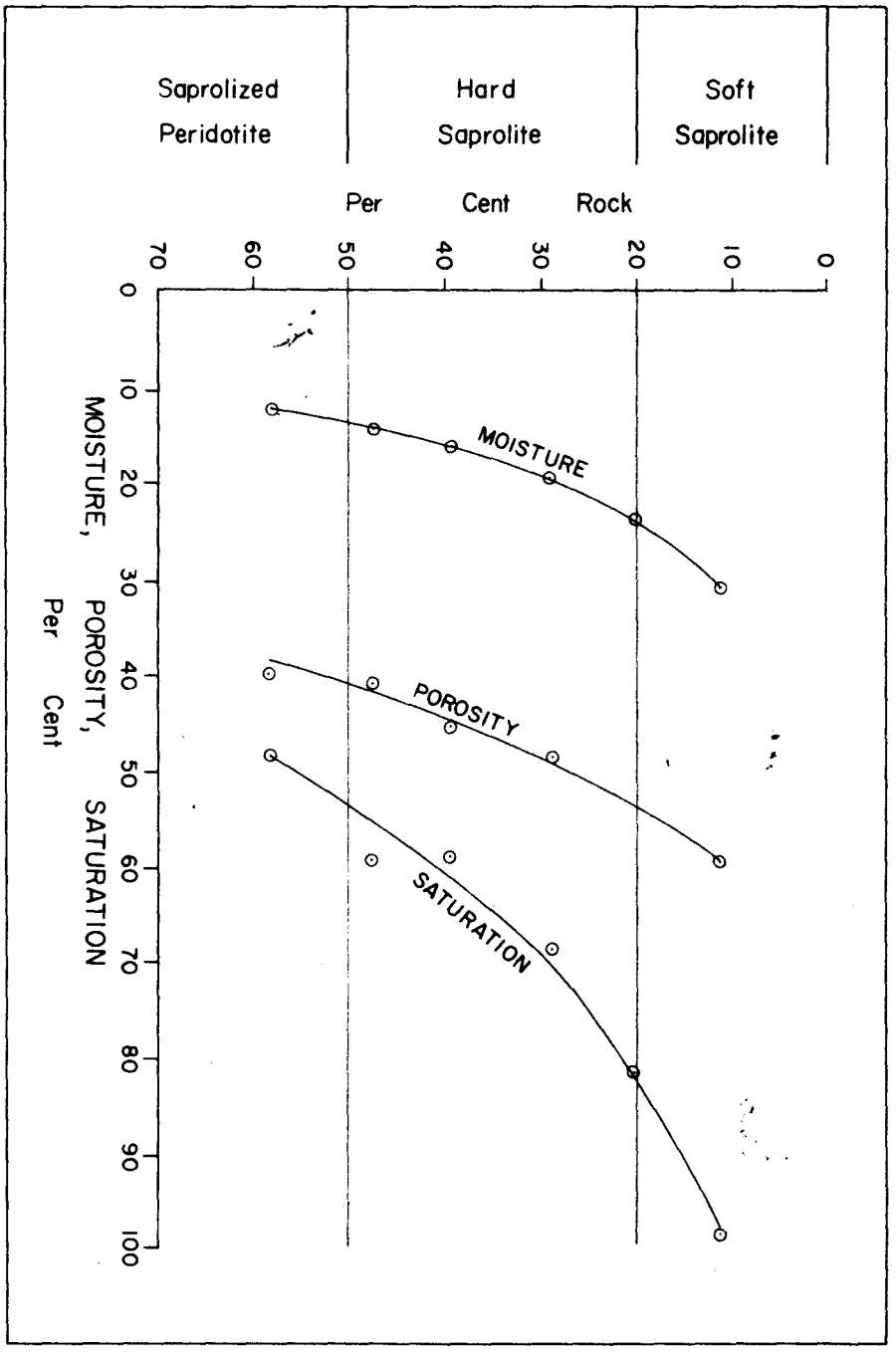
$$P = \frac{(Gm - Gi)}{Gm} \times 100$$

A clear relationship between porosity and degree of alteration is indicated by the six samples plotted in figure 11. (Figure 11 near here). The highest observed porosity is about 60 per cent, expressed as the ratio of void volume to total volume.

Figure 10. In-Place Tonnage Factors of Saprolite Ore Plotted Against MgO and Ore Type

Figure 11. Moisture Content, Porosity, and Degree of Saturation of the Ore Types


45
40
35
30
25
20
15
10
5
0
PER CENT MgO
DRY
WET
10
15
20
25
30
IN-PLACE FACTOR FEET³/TON
PERIDOTITE
SAPROLIZED PERIDOTITE
HARD SAPROLITE
SOFT SAPROLITE


Saprolized Peridotite
Hard Saprolite
Soft Saprolite
Per Cent Rock
70 60 50 40 30 20 10 0
0 10 20 30 40 50 60 70 80 90 100
MOISTURE, POROSITY, SATURATION
Per Cent
MOISTURE
POROSITY
SATURATION

Given the moisture content and porosity of a sample, the degree of saturation (per cent volume of voids filled by water) can be calculated.

$$\% \text{ vol. water} = \% \text{ weight water} \times \text{wet in-place S. G.}$$

$$\% \text{ saturation} = \frac{\text{vol. water}}{\text{porosity}} \times 100$$

Figure 11 also shows the results of this calculation plotted against fresh rock content of the samples used. Although the data points are few, the trend seems to be clear. As peridotite is decomposed, the in-place density decreases due to an increase in pore space. As pore space is made available, the resulting rock becomes increasingly saturated with water due to increased permeability. The increase in surface area available to chemical weathering, and the increase in permeability, may have had an important affect on the rate of saprolization.

The importance of the saprolite group is twofold. First, the saprolites account for a large part of the ore reserve and are valuable in their own right. Secondly, the saprolites have been preserved in place with a few, if any, physical changes so that their origin from peridotite can be demonstrated almost beyond doubt. This provides a stable foundation for theories regarding the origin not only of the saprolites, but also of boxwork and soil. The saprolites are secondary after peridotite. Boxworks were derived from the chemical breakdown of both peridotite and saprolite, and are also secondary. However, the soils were derived from saprolite and boxwork, and are therefore tertiary.

STRUCTURE

Depth and intensity of saprolization follows a pattern which is complex in detail but fairly simple in its broader aspects. The pattern is influenced by three structural elements, namely, former water tables, two sets of faults, and zones of intense jointing. These three elements make up the large scale structural framework which controlled ore distribution and the degree of saprolization.

Water Tables

A discontinuous zone of boxwork ore, more or less flat lying and sub-parallel to the present surface, is found at the eastern end of the Lower orebody and along the southern margin of the Upper orebody. The boxwork ore lies just below the base of the red soil and tends to drape over the underlying structures rather than conform to them. The location of this ore in the regolith is consistent with deposition of boxwork elements at a former water table or similar boundary surface. Apart from the two areas mentioned above, this type of boxwork ore is either absent or insignificant in amount.

Faults

Faulting and jointing controlled the localization of the saprolite ore. Two major faults show a relationship to existing ore. One of these, known as Rock Fault, strikes approximately east-west through the Upper orebody and dips to the south at 35-45° (figure 3). The fault has been exposed by mining operations for a strike length of 2800 feet and can be traced through surface mapping and drilling for an additional 3300 feet. At least two other sub-parallel faults have been mapped above Rock Fault. These faults branch from and converge with Rock Fault forming a fault zone which in places is 50 feet thick.

The low dip of Rock Fault suggests reverse movement, but ore thickness is greatest on the south or hanging wall side, implying that a greater thickness of ore was preserved as a result of normal movement. However, this is not necessarily true; thicker ore could have developed as a result of greater shattering in the hanging wall member regardless of the sense of movement. Striations on the several planes of movement pitch steeply (75°-90°) both west and east, indicating a strong component of dip slip. Striae are perfectly preserved in many places but, contrary to expectation, do not provide unequivocal proof of the direction of movement.

Rock Fault is overlain in many places by a remarkably thick boxwork which is invariably vuggy and in places cavernous. This implies that the boxwork was deposited in an open fracture, a condition not likely to be encountered under thrust fault conditions. In addition, the massive boxwork is cut by steeply dipping tension cracks filled with later barren chalcedony (figure 5). These too are consistent with normal movement, and the balance of evidence suggest that movement on Rock Fault was normal dip slip.

The footwall of Rock Fault is usually fresh peridotite, hence the name of the fault. Boxwork ore along the plane of Rock Fault is known to continue locally to a vertical depth of 260 feet below the present surface, indicating that the fault zone acted as a major artery for the escape of mineralized groundwater. Downward migrating groundwater would have impinged on the footwall, but clearly had little or no effect on the footwall peridotite, indicating that the footwall was sealed in some way.

The second major fault, known as Spring Fault, strikes approximately east-west through the Lower orebody. The fault dips 28°-60° to the north, and can be traced for approximately 10,000 feet. Reverse movement on Spring Fault is suggested by the fact that barren peridotite occurs at a higher level on the north (hanging wall) side of the fault. The plane of the fault is not marked by boxwork despite the fact that boxwork is prevalent in the Lower orebody. This contrasts markedly with Rock Fault, and suggests that the fault was not an "open" fracture. However, saprolite ore has been developed adjacent to Spring Fault to depths of 230 feet below the present surface.

Rock Fault and Spring Fault are both cut by north-south trending, steeply dipping, normal faults. Mining has exposed three cross faults cutting Rock Fault, and the existence of at least two other is suspected from drilling. Striations on the exposed cross faults pitch steeply, indicating essentially dip slip movement which resulted in horizontal offsets in Rock Fault of 10-220 feet. The structure of the Lower orebody is not as well known as that of the Upper orebody, and only one fault cutting Spring Fault has been recognized. The cross fault dips to the west, and the offset of Spring Fault is consistent with normal movement on the cross fault.

The relationship of faulting to the age of saprolization and boxwork formation is complex. Some of the factors having a bearing on age are as follows:

1. Rock adjacent to the known faults has been saprolized, and boxwork ore was deposited along many of the faults. Some saprolite and boxwork is therefore post-faulting.

2. The average thickness of saprolite south of Rock fault is much greater than on the north (footwall) side. This may mean that saprolization started before Rock fault came into existence, and that saprolite was preserved from erosion by downfaulting.

3. Striated and brecciated garnierite is common, thus some garnierite is pre-latest fault movement. Some garnierite cements brecciated garnierite fragments showing that there is more than one generation of garnierite, and that some garnierite is post-faulting.

These facts indicate that the processes of saprolization and boxwork formation started before the last period of fault movement, and continued for some time afterwards. Whether the period of saprolization synchronized exactly with the period of boxwork formation is not clear. The fact that many boxworks penetrate deeper into the peridotite basement than saprolite ore suggests that deposition of boxwork continued after saprolite had stopped forming, or that the rates of formation were different in different parts of the regolith. The two major faults were probably in existence long before ore started to form. Renewed movement in the early Tertiary cut some early-formed ore, but ore continued to develop after movement finally ceased.

Joints

Joint intensity exerted a considerable amount of control on both the depth and degree of saprolization by providing permeable avenues through an otherwise relatively impermeable rock. A relationship between joint spacing and degree of alteration can be recognized in the field. Massive blocky peridotite with a joint spacing of about 24 inches is little altered except along the joint planes, which are usually coated with films of garnierite and serpentine. On the other hand, relict joint planes in exposures of soft saprolite show a joint spacing of the order of two to six inches.

Although this is the general rule, a few exceptions are found, particularly close to major fault zones. In these zones, joint spacing may be less than two inches but the degree of alteration is often small. Where this is the case, the well jointed area has often been extensively mineralized by garnierite and chalcedony. This may have effectively sealed the rock against circulating groundwater, thereby preventing further decomposition to a typical saprolite.

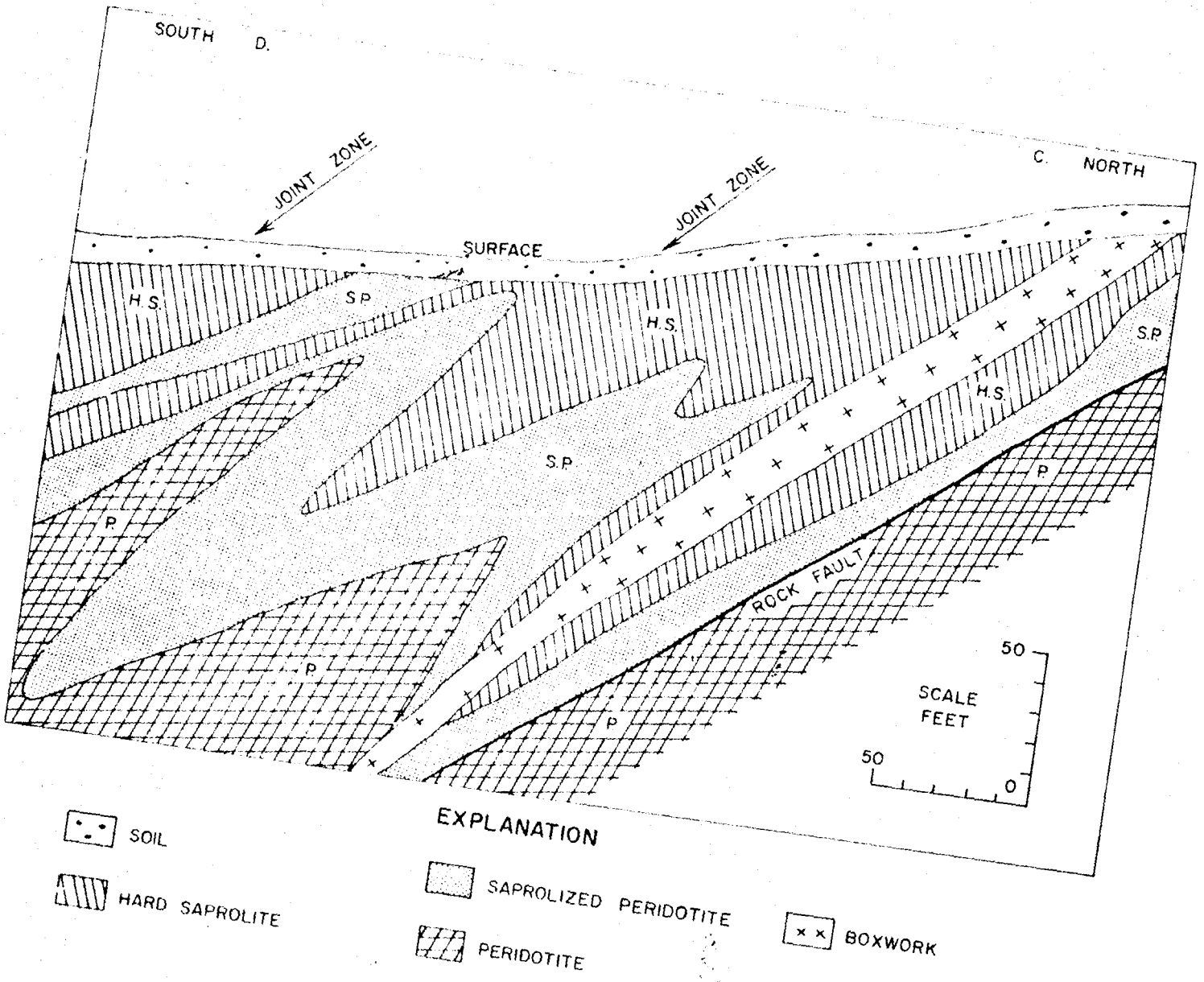
Irregularities in the bedrock togography can be related to permeable zones produced by faulting and jointing. This is shown in plan in figure 12, (Figure 12 near here) which reproduces a portion of the 3200 foot level of the Upper orebody. In this area, the major joint zones strike north-south and dip 50°-60° to the east. They are truncated by Rock Fault on the north, and cut by a "Y" shaped fault system in the southwestern part of the area. The pattern is similar in other parts of both orebodies, and results in a series of "ribs" of peridotite elongated in a north-south direction, and dipping steeply to the east. Saprolite ore types are not shown in the illustration because of scale limitations, but the centres of the large saprolite areas tend to be soft saprolite which grades outward into hard saprolite and saprolized peridotite. Boxwork ore is closely related to the faults.

A typical pattern of ore distribution in vertical cross section is shown in figure 13. (Figure 13 near here). In this example, two joint zones striking northeast and dipping to the southeast are cut by Rock Fault. Saprolite ore types are developed symmetrically around the joint zones. A layer of boxwork lies slightly above, but parallel to the plane of Rock Fault.

In detail, the distribution of ore types is more complex than shown in figures 12 and 13, and day to day mining operations have to be carefully controlled in order to provide an optimum product and to reduce stripping. The complex bedrock topography increases the problems of pit design, haulage road location, and equipment utilization.

Figure 12. Level Map Through a Portion of the Upper Orebody, 3200 Foot Elevation

Figure 13. Geologic Cross Section C-D, Showing the Intersection of Joint Zones and Rock Fault


SOUTH
D.
C.
NORTH
JOINT ZONE
JOINT ZONE
SURFACE
H.S.
S.P.
H.S.
S.P.
H.S.
S.P.
P.
P.
P.
ROCK FAULT
50
SCALE
FEET
50
0
EXPLANATION
SOIL
HARD SAPROLITE
SAPROLIZED PERIDOTITE
PERIDOTITE
BOXWORK

NET CHEMICAL GAINS AND LOSSES

Detailed mapping shows that saprolization involved no change in volume. As already noted, undeformed joint planes are preserved in the saprolites even when all vestiges of peridotite have disappeared. If saprolization truly involves no change in volume, net changes in chemistry can be followed by comparing the metal contents of equal volumes of peridotite and saprolite. The principles underlying the method are shown in table 6. The results of similar calculations on saprolites in the Lower and Upper orebodies are shown in figures 14 and 15. (Figures 14 and 15 near here).

The two graphs are generally similar in shape and to some extent in amount. Both show a net gain of Ni, and net losses of MgO, SiO_2, and Fe. Nickel enrichment is less in the Lower orebody, and the "nickel bulge," shown at the base of the hard saprolite in the Upper orebody, is probably in the soft saprolite horizon in the Lower orebody. The net gain in nickel can only be explained by the addition of nickel, presumably from higher in the profile. This is perhaps the best chemical proof of supergene enrichment as opposed to purely residual enrichment.

The net loss of iron, amounting in some cases to one third of the original iron in peridotite, appears to be at variance with residual iron enrichment which often accompanies laterization. In fact no conflict need exist. If magnesia and silica are lost at a greater rate than iron, the residual material will be enriched in iron.

Table 6. Calculation of Net Chemical Changes

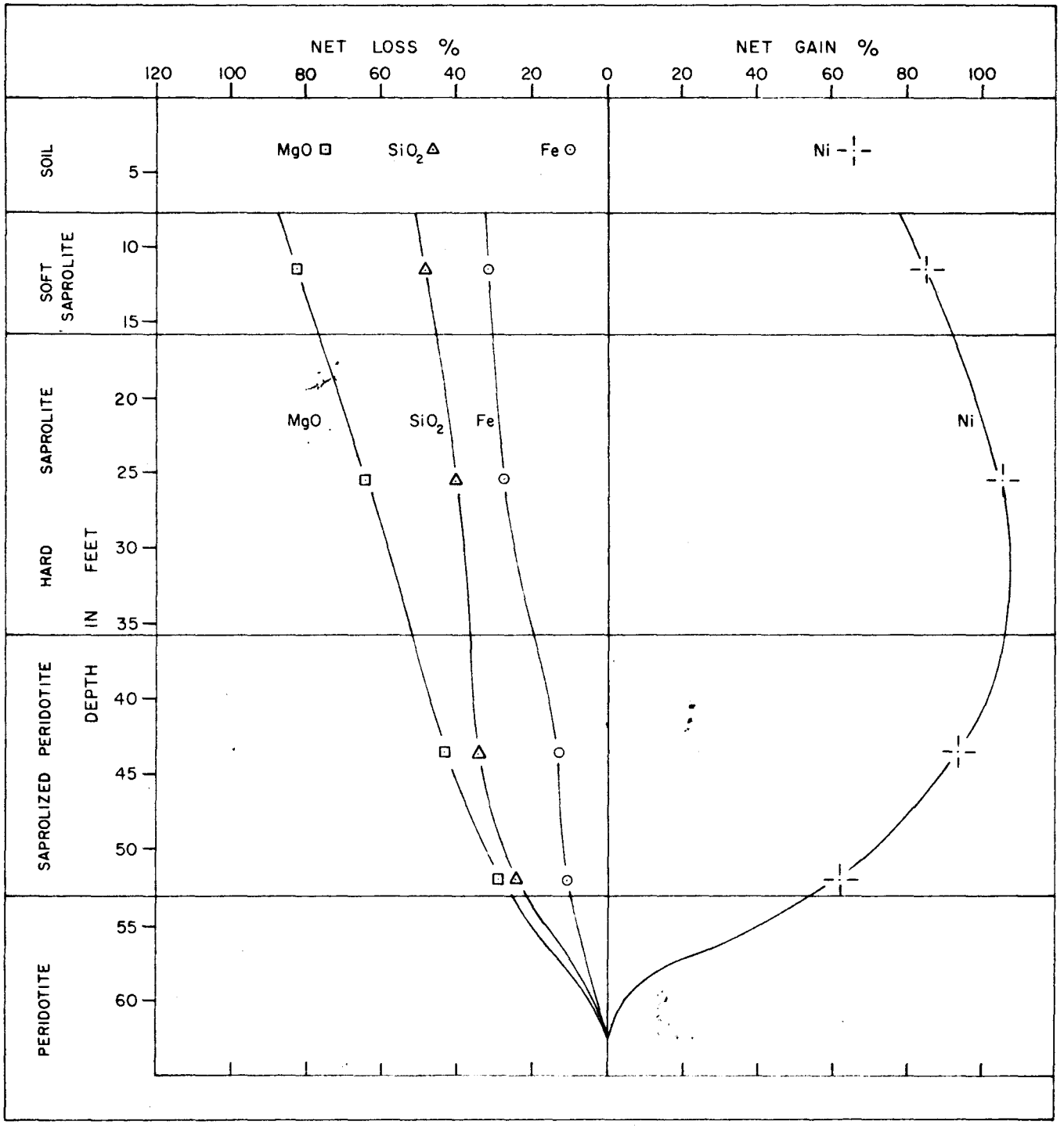
	Peridotite	Saprolite
Weight 1 Ft.^{3}	200 lbs.	104.2 lbs.
Ni Assay	0.32%	1.26%
Lbs. Ni/Ft.^{3}	0.64	1.32

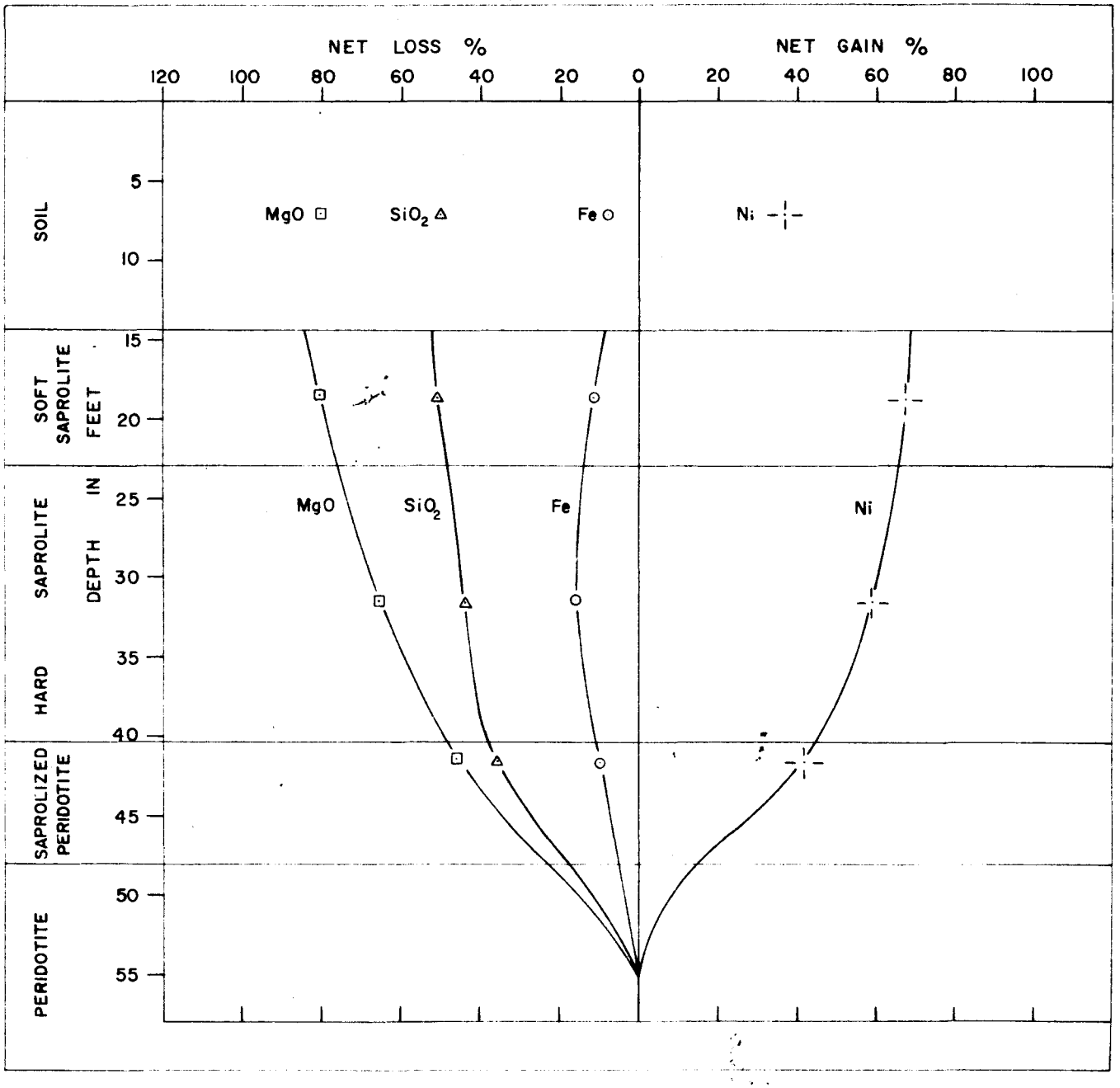
Difference + 0.68 lbs. Ni

Net Change + 106%

Figure 14. Net Chemical Changes in the Upper Orebody Plotted Against Depth

Figure 15. Net Chemical Changes in the Lower Orebody Plotted Against Depth


NET LOSS %
120
100
80
60
40
20
0
NET GAIN %
20
40
60
80
100
SOIL
SOFT SAPROLITE
HARD SAPROLITE
SAPROLIZED PERIDOTITE
PERIDOTITE
DEPTH IN FEET
5
10
15
20
25
30
35
40
45
50
55
60
MgO
SiO2
Fe
Ni


NET LOSS %
120
100
80
60
40
20
0
NET GAIN %
20
40
60
80
100
SOIL
SOFT SAPROLITE
SAPROLITE
HARD
SAPROLIZED PERIDOTITE
PERIDOTITE
DEPTH IN FEET
5
10
15
20
25
30
35
40
45
50
55
MgO
SiO2
Fe
Ni
MgO
SiO2
Fe
Ni

The results included in figures 14 and 15 for the soils are of doubtful value. The total lack of relict jointing, the presence of boxwork fragments, and the eroded appearance of peridotite boulders in the soil, all point to movement and therefore to some volume change. A change in volume invalidates the calculation. However, if there has been a change in soil volume, it probably tended towards decrease in volume, and increase in density. Hence the values given are maximum gains and minimum losses. Thus, the soils show a net loss of silica, magnesia, and total iron. The change in nickel content was small - probably a net gain.

Using alumina as a constant, Hotz (19, p. 380) calculated the net chemical changes shown by four near surface samples of Nickel Mountain ore. The chemical analyses of the samples show that they are not representative of typical soil, and the net changes are difficult to compare with the results presented here, which are based on the weighted averages of the two orebodies. It is perhaps sufficient to conclude that, so far as the soil is concerned, MgO always shows a net loss and that silica frequently does. The net changes in nickel and iron are probably small.

Hotz' samples are not at all representative of the saprolites proper, and for this reason the results cannot be compared with those given for saprolites in figures 14 and 15.

Because boxwork ore does not show relict jointing, the "equal volume" method cannot be used to follow net changes in chemistry. The vuggy texture of the boxwork shows that some or most boxwork was deposited in open fractures. The presence of angular fragments of fresh peridotite in some boxworks suggests further that the supergene solutions did not notably attack peridotite, and that replacement did not take place. Clearly, if boxwork was deposited in open fractures, the host saprolite would gain in all boxwork elements: it would be valid to correct the net chemical changes shown by the saprolites alone by adding the chemical contribution made by the boxwork veins.

Unfortunately, the amount of boxwork ore in each saprolite type has not been measured, so that ore types cannot be corrected individually. However, the saprolites as a group can be corrected as shown in table 7. The soils are not cut by boxwork veins and are therefore excluded from the tabulation. The figures given in table 7 agree in direction with the trends shown by saprolite ore alone indicating that the shapes of figures 14 and 15 are substantially correct.

The present amount of nickel in saprolite exceeds the total amount available from an equal volume of peridotite. The excess nickel is supergene, and if added to the supergene nickel represented by boxwork ore, the total excess amounts to approximately 52 per cent of the nickel in the Upper orebody, and 47 per cent of the nickel in the Lower orebody. If some nickel has been lost from the system, as is probable, supergene enrichment accounts for even more of the present nickel reserve.

It is extremely doubtful whether the present soil cover could have provided all the supergene nickel, and one is left with the presumption that the nickel was derived from a thicker sequence of ore, now lost by erosion, which existed on Nickel Mountain at some time during the evolution of the deposit.

Table 7. Net Chemical Changes in Saprolite and Boxwork Compared with a Volume of Peridotite Equal to the Volume of Saprolite Only

	Upper Orebody		Lower Orebody	
	Saprolite Only	Saprolite and Boxwork	Saprolite Only	Saprolite and Boxwork
Ni	+95.1	+110.9	+57.8	+90.0
MgO	-59.3	- 57.8	-68.5	-65.6
SiO_2	-39.8	- 35.8	-45.7	-36.2
Fe	-24.8	- 21.8	-15.6	- 5.9

+ Net Gain - Net Loss Values in Per Cent

ORE MINERALOGY

The large and small scale chemical variations in ore reflect the progressive mineralogical changes due to saprolization and supergene enrichment. These changes are difficult to follow microscopically because most of the minerals are fine grained and stained with iron oxides. Moreover, many of the secondary minerals belong to little understood and poorly classified mineral groups.

The ultramafic rocks on Nickel Mountain lack sulfides of any kind. This supports the generally accepted view that the presence of nickel in peridotite usually can be explained by the substitution of Ni^{2+} for Mg^{2+} in the olivine lattice. Most of the nickel in the orebody occurs in a number of secondary minerals or mineral groups, one of which is garnierite.

Garnierite

The existence of garnierite as a distinct mineral has been questioned by many workers. Pecora et al. (35, p. 22) concluded from a study of eight Nickel Mountain specimens that garnierite "is not a single mineral but a mixture of at least two and possibly three hydrosilicates analogous in structure to serpentine, deweylite, and saponite (pimelite)". They suggested retaining the name garnierite as a field term. Hotz (19, p. 385) concluded that his X-Ray diffraction data of the specimens of garnierite from Nickel Mountain could be interpreted as "mixtures of serpentine and a 10Å layered mineral".

Garnierite varies in color from a pale greenish yellow (1-Y 8/2)___/ through shades of moderate yellowish green (109Y 6/4) to a brilliant green (5G 6/6). The colors are more intense in wet specimens. Pecora et al. (35) showed a close relationship between color, refractive index, specific gravity, and tenor of nickel. Low grade samples are pale in color, have a low specific gravity (~2.55), and low refractive index (1.56 - 1.57).

___/Color terms and designation from rock color chart, published by the Geological Society of America, 1963.

Garnierite is megascopically homogeneous. It appears to be amorphous, and when dry it is brittle and soft (H=2-3). It has a white streak, and fracture surfaces are earthy and dull. Garnierite frequently shows a colloform texture. Dendritic manganese can be seen along fracture surfaces. Thin sections and grain mounts frequently show two or more generations of garnierite which can be distinguished by differences in grain size and color. Under crossed nicols, garnierite is crypto-crystalline and fibrous with low birefringence.

Occasional pieces of moderate yellow green (5GY 7/4), clay-like mineral having a sub conchoidal fracture are found, mainly along joint surfaces. The material adheres to the tongue and is megascopically homogeneous. It is brittle, has a white streak, a hardness of 3, and a greasy feel. One sample assayed 1.3 per cent nickel. Under the microscope it has a speckled mosaic texture. The mineral is feebly anisotropic and fibrous, has a mean refractive index of ~1.58, and a low birefringence (~.004). The mineral is probably a clay-like form of garnierite.

Chalcedony

Chalcedony occurs in a variety of pastel colors, including white, gray, yellow, brown, pink, and green. It is brittle and has a hackly fracture. Openings and vugs are commonly lined with chalcedony which has a sugary appearance due to light reflections from minute prism terminations. Some vugs, however, are lined with colloform chalcedony. Shrinkage cracks are typical of thinly layered chalcedony. Under crossed nicols, chalcedony appears as a distinctive mosaic of small particles, about .01 mm in diameter, each of which extinguishes separately. Thin sections of chalcedony cut normal to the walls of vugs sometimes show several curved, colored bands of mosaic chalcedony ending in a layer of slightly larger (.04mm) crystals of clear silica.

Garnierite and chalcedony are intimately associated both on a megascopic and microscopic scale, and exhibit a variety of textural relationships. The association and textures make it clear that they were deposited essentially at the same time. Colloform banding indicates that both garnierite and chalcedony were deposited partly as colloidal precipitates.

Sepiolite

Thin veins of a white to very pale green (10G 8/2) mineral are found occasionally in massive compound boxworks along Rock Fault. Hotz (19) identified this material as sepiolite. When wet, sepiolite is highly plastic but it dries to a semi-plastic or brittle material with a hardness of about 2 and a smooth or greasy feel. The vein material is foliated parallel to the vein walls. Microscopically, each mineral plate appears to be fibrous. The mean index of refraction is close to 1.53 and the birefringence is low ($\sim$.01). Sepiolite is not an important ore mineral, as it has been found only in places along the plane of Rock fault.

Chlorite

In the eastern part of the mine area, a micaceous, pale blue green (5 BG 7/2) mineral occurs in veins up to 2 inches thick along joints and fractures. The mineral has one strongly developed cleavage and two other partings at about 77° to each other, consequently the mineral crumbles to triangular or rhombic plates. The mineral is soft (H=2), has a white streak, and the specific gravity is about 2.43. One sample had the following partial chemical analysis.

NiO	SiO_2	R_2O_3	MgO	L.O.I.	Total
36.3	42.6	3.8	7.3	9.5	99.5

Analyst - E. J. Grimm

Under the microscope, this sample has a small (-) 2V, and low birefringence (~.04). Dr. M. A. Kays___/ notes that the X-ray diffraction pattern of

___/ Personal communication April 5, 1963.

this sample compares favorably with the A.S.T.M. index reference to penninite. The optical properties suggest that this may be a nickeloan chlorite in the schuchardite-nepouite series. The mineral has been found only at the east end of the present open pit in the Upper orebody on the 3160 foot level. It is not an important ore mineral.

Saprolite Minerals

Fresh olivine crystals decompose to a hard, brown, compact material known colloquially as "hard oxide". This in turn decomposes to a brownish yellow, soft, incoherent material termed "soft oxide". Alteration starts along fractures in the olivine crystals and continues until no trace of fresh olivine can be seen, and the material is completely opaque. Fine seams of serpentine and garnierite cut the altered material but do not appear to have controlled or influenced the formation of the "oxides".

The brown color of "hard oxide" may be due to the development of poorly crystalline goethite and limonite, while the brownish yellow color of "soft oxide" may be due to an increase in the amount of limonite. Hotz (19, p. 369) reports that montmorillonite, chlorite, and talc constitute the clay fraction of the laterite at Eight Dollar Mountain in Josephine County, Oregon, about 50 miles southwest of Riddle. Because the geologic environments are similar, these minerals may also be present in the clay fraction on Nickel Mountain.

Clay sized fractions from crushed "hard oxide" were prepared by washing and decantation. Fine fragments of garnierite and serpentine were hand picked until the resulting clay fraction was microscopically free of green nickel-bearing minerals. Assays of this material show that it still contains between 1.0 and 2.0 per cent nickel. The form in which the nickel occurs is not known. It is likely that Ni^{2+} released from olivine would proxy for Mg^{2+} in montmorillonite, chlorite, serpentine, and talc. It is also likely that Ni^{2+} would be adsorbed on nearby limonite. If the conclusions drawn from the study of net chemical changes are accepted, nickel in this form could be a substantial portion of the total nickel reserve.

ORE GENESIS

Ore on Nickel Mountain is related to high level erosion surfaces which provided a gently sloping terrane suited to prolonged chemical weathering. The oldest peneplain, the Klamath, may date back to the Eocene, and all the erosion levels are pre-Pliocene in age. The climate in Oregon changed slowly from subtropical in the Eocene and Oligocene, through warm temperate conditions in the Miocene, and culminated in the Pleistocene glaciation. The present climate is temperate with a marked seasonal rainfall.

It has been shown that the present morphology of saprolite ore is consistent with weathering of peridotite by meteoric groundwater migrating down joints and other planes of weakness. The close relationship of ore to permeable zones indicates that drainage was an important factor in ore formation.

Although the preserved amount of saprolite derived from serpentinite is small, this may be due more to selective erosion than to serpentinite being an unfavorable parent rock. However, serpentinization is not a necessary stage in the formation of saprolite.

The thickness of saprolite in the Lower (younger) orebody is less than in the Upper (older) orebody. This may be a reflection of the amount of time each orebody was under the influence of a relatively favorable subtropical climate. Further confirmation of this may be found in the higher degree and greater depth of nickel enrichment in the Upper orebody profile.

Table 8 lists analyses of three selected samples representing 70,000 tons of soft saprolite containing little or no visible fresh peridotite. If the trend of chemical weathering were to continue towards a lower MgO, the resulting material might properly be classified as nickel laterite, and would be similar to some of the New Caledonian laterites described by Chételat (9). Nickel laterite may, therefore have overlain the saprolites at some time during the evolution of the deposit, and have been lost through subsequent erosion. Part of the present soil cover may be a reworked and leached residue from the laterite.

Table 8. Analyses of Selected Samples of Soft Saprolite (per cent).

Sample	Ni	MgO	SiO_2	Fe
1	1.11	15.5	56.0	11.7
2	1.46	13.2	50.5	9.9
3	1.36	14.0	50.5	15.3
Weighted Average	1.23	14.7	53.8	11.8

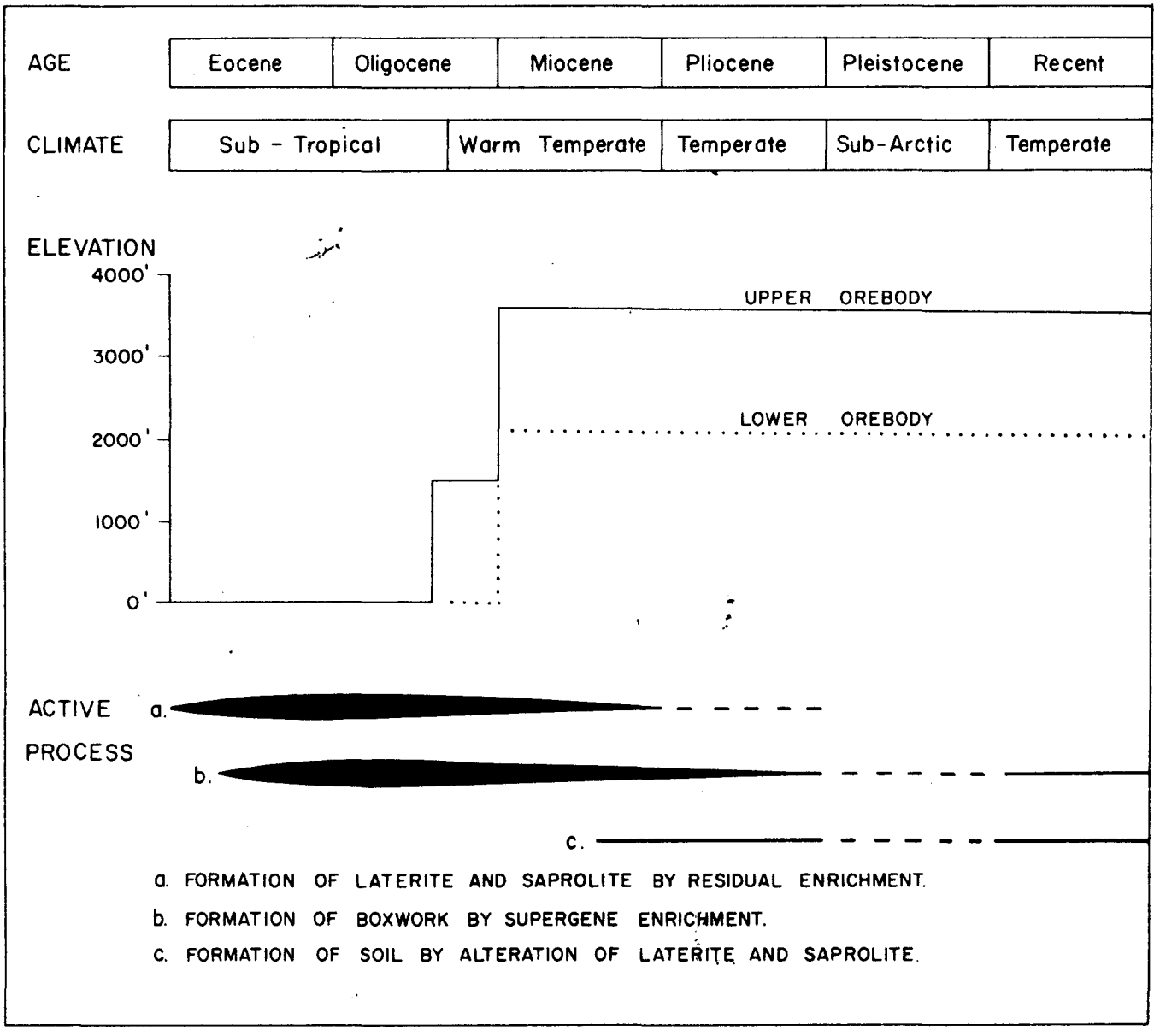
A distinction has been drawn between residual and supergene nickel enrichment. These processes overlapped, and it is likely that supergene enrichment took place partly as a result of residual enrichment, and perhaps continued long after residual enrichment of the saprolites had ceased. Successive stages in the genesis of the Nickel Mountain orebodies are summarized in figure 16, where changes in climate and elevation with time are related to the predominant ore forming process. (Figure 16 near here).

Residual enrichment of saprolite by selective leaching can be inferred from the data presented on net chemical changes, where large net losses of MgO and SiO_2, and smaller net losses of total Fe were shown. The large net gain of nickel does not preclude absolute loss of nickel; simply that more nickel was introduced than was lost.

The intimate association of garnierite and chalcedony indicates that they were deposited essentially at the same time. The physical and chemical conditions at various horizons within the saprolite profile at the time of formation are not known, hence it is difficult to postulate the mechanism of supergene enrichment. Precipitation from solution, and deposition as colloids are both possible mechanisms.

Experimental work by Mueller (32) and others has shown that nickel rich hydrous Mg-silicates can be synthesized at essentially atmospheric temperature and pressure. Mueller has also shown that ionic exchange of Ni^{+2} for Mg^{+2} can take place in a much more acidic environment than precipitation of nickel, suggesting that ionic exchange could occur at higher levels in the saprolite profile than precipitation. Whether this in fact took place is not known.

Figure 16. Stages in the Genesis of Ore on Nickel Mountain


AGE
Eocene
Oligocene
Miocene
Pliocene
Pleistocene
Recent
CLIMATE
Sub - Tropical
Warm Temperate
Temperate
Sub-Arctic
Temperate
ELEVATION
4000'
3000'
2000'
1000'
0'
UPPER OREBODY
LOWER OREBODY
ACTIVE PROCESS
a.
b.
c.
a. FORMATION OF LATERITE AND SAPROLITE BY RESIDUAL ENRICHMENT.
b. FORMATION OF BOXWORK BY SUPERGENE ENRICHMENT.
c. FORMATION OF SOIL BY ALTERATION OF LATERITE AND SAPROLITE.

The source of the supergene nickel and silica was probably the missing lateritic portion of the profile. Successive stages of uplift would tend to activate the drainage, thus enhancing the role played by supergene enrichment. Although the exact mechanism of boxwork deposition is not known, it was probably dependent on a gradual change in pH with depth. Erosion of the laterite cover would cause the pH zonation to shift downwards, thereby increasing the chance of early garnierite being redeposited lower in the profile.

Austin (3) was of the opinion that some of the quartz veins (garnierite-chalcedony boxwork veins) were deposited by hydrothermal solutions, but the field and chemical evidence does not support this point of view.

Some difference in the mode of origin accounts for the textural and chemical differences between soil and saprolite. If one assumes that soil was derived from saprolite (or a pre-existing laterite), then it is necessary to find a process whereby joint planes were obliterated, saprolitic skins were removed from residual rock fragments, boxwork veins were truncated and fragmented, the total Fe was increased, and Ni was decreased. Movement in the form of downhill creep, landslides, frost heave, and the like would tend to accomplish the textural changes involved. It is unlikely that the small amount of movement which did take place would completely destroy the former textures, but remnants of these textures are not found, suggesting that a chemical agency was also involved in the transformation.

If chemical transformation took place, the environment was not the same as the environment of saprolite formation. This is deduced from the fact that peridotite boulders in soil are not saprolized. It appears that the soil-forming environment was effective in altering previously formed saprolite, but not peridotite. Further confirmation of this can be seen in old test pits and older mining cuts in rocky ore which show evidence of decomposition under prevailing climatic conditions. In these cuts, the saprolite crusts are weathering to soil, but the peridotite at the cores of the joint rhombs is not being altered. If this were to continue, the end product would be similar in appearance to typical soil.

Neither soil nor saprolite are found on erosion levels below 1900 feet in the Riddle area. From this it may be concluded that saprolite is not forming under modern climatic conditions. The fact that soil appears to be forming over saprolite at higher levels, but does not form directly over peridotite at low levels, further confirms that soil does not originate directly from peridotite.Where soil is found directly overlying peridotite above 1900 feet, it is reasonable to assume that the saprolite once present has been changed to soil.

The soil/saprolite thickness ratio is appreciably greater in the Lower orebody suggesting that the thickness of soil in the Lower orebody may have been enhanced by erosion of the Upper orebody. Transported soil, probably overlying the Riddle formation, has been found in the NW¼ Sec. 21, and was derived from the Lower orebody.

For these reasons, it is likely that the soil cover originated from saprolite by a combination of mechanical movement accompanied by chemical weathering under more temperate conditions than were needed to produce saprolite.

Honeycomb boxwork fragments in the soil have been partly leached of their garnierite content and tend to be barren. When the larger fragments are broken, garnierite can often be seen enclosed by chalcedony septa. Some of this leaching is Recent as shown by thin coatings of a pale, whitish green nickeliferous material on modern tree roots. Other roots are partly replaced by the same whitish green material, and one of these assayed 1.83 per cent Ni. The wood fibers in this particular sample were still visible, showing that movement of nickel took place quite recently, certainly within the last 150 years.

Analyses of mine waters also shows modern movement of some of the major ore forming elements. Table 9 gives analyses of two water samples. Sample 1 was taken from a drillhole at a depth of 150 feet in the Upper orebody. The hole was stopped at Rock Fault and the sample is of water draining down the plane of the fault. Sample 2 was taken from a drillhole in the Lower orebody which was drilled into Spring Fault. The sample was collected at surface, approximately one year after the hole was completed.

Hawkes and Webb (17, p. 115) indicate that fresh water may contain from .02 - 10 ppb nickel. The nickel content of the two samples in table 9 is appreciably higher than the high end of the range (.01 p.p.m.). Modern groundwater is apparently continuing the process of supergene enrichment, but not the process of saprolization.

Table 9. Analyses of Natural Waters on Nickel Mountain (in p.p.m.)

Sample	Ni	MgO	SiO_2	Fe	Total Solids	pH
1	0.06	67.0	42.0	0.7	180.0	7.9
2	0.02	65.0	16.0	0.24	166.0	8.0

Analyst E. G. Wilson, Hanna Nickel Smelting Company

CONCLUSIONS

Sub-tropical to warm temperate conditions during the early Tertiary were responsible for the development of nickel laterite-saprolite profiles over peneplaned ultramafic bodies of Jurassic age. A series of mid-Tertiary tectonic events, which included at least one other major stage of terrace cutting and laterite-saprolite formation, lifted these deposits to approximately their present elevation. Active erosion due to uplift reduced the nickel deposits to their present thickness and areal extent.

Nickel Mountain ore was enriched in nickel by residual and supergene processes. Downward percolating meteoric groundwater selectively leached MgO, SiO_2, Fe, and Ni from the peridotite. The depth and degree of alteration was largely controlled by the intensity of jointing and faulting.

Saprolite is quantitatively the most important ore, and is recognizably residual after peridotite. Enrichment of nickel in the saprolites took place by selective loss of MgO, SiO_2, and to a lesser extent of Fe. In addition, nickel leached from overlying ore was redeposited in underlying saprolites by substitution for Mg or adsorbtion on limonite and clay minerals. Formation of saprolite was at a maximum in the early Tertiary due to favorable climate and topography.

Solutions or sols containing Ni, MgO, SiO_2, and some Fe migrated down major fracture zones, depositing some of the contained elements as chalcedony-garnierite boxwork ore. Colloform garnierite and chalcedony indicate that some of the material was carried and deposited in colloidal form. Supergene enrichment is probably still taking place today, although at a much reduced rate.

A thin layer of nickel bearing soil was derived from and blankets the saprolite and boxwork ores. The original ore textures have been lost, in part by movement, but also by chemical weathering under temperate conditions. Soil is probably still forming from saprolite ore, but is not forming directly from peridotite. The stability of anhydrous magnesium silicates under present climatic conditions is apparently much greater than the stability of hydrous silicates. Soil is generally of lower grade than the ore which underlies it due to leaching, which is still taking place.

Chemical and mineralogical trends in the preserved saprolites indicate that a laterite capping may once have covered the orebody, and that the full profile may have been very similar to some New Caledonian orebodies. If allowance is made for the physical and chemical differences between serpentinite and peridotite, many of the features of Cuban and Phillipine ores derived from serpentinite can also be matched. Nickel Mountain is the preserved remnant of a deposit which originated under conditions now prevailing in the tropics, modified by effects due to later temperate conditions, and presents an excellent opportunity of studying the root zone geology of a nickel laterite deposit.

ACKNOWLEDGMENTS

The writer would like to thank Dr. F. M. Chace, Chief Geologist of The Hanna Mining Company, for permission to publish this paper, and for reviewing the manuscript. B. N. Webber, V. M. Mejia, W. L. Cameron, R. M. Slipp, J. G. Stone, and members of the mine and smelter staffs contributed to the study but are not necessarily in full agreement with the conclusions. D. L. Foster drafted the illustrations.

The Hanna Mining Company,
Riddle, Oregon.
November, 1965

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State Department of Geology and Mineral Industries

702 Woodlark Building
Portland, Oregon

Report by: Ray C. Treasher

Date: Aug. 10, 1943

Nickel Mountain (nickel) Riddle area

Douglas Co.

Mr. O. D. Rohlfs, Principal Mining Engineer, Ferro-Alloys Branch, W.P.B., Washington, D. C. had requested that I take him to visit the Freeport Sulphur Co. property at Nickel Mtn. He arrived at 12:39 p.m. Sat., July 31st, with Mrs. Rohlfs, and they were taken to Nickel Mtn. and to Roseburg at 11:58 pm.

The access road is open about half way between the Discovery area and the West area. We went to the West area, looked at the shaft and entered the 900 foot adit. Rohlfs secured some excellent specimens. Note was made of garnierite in a narrow shear zone on the N. side near the floor, and as thin crusts along joint planes. We next visited the Discovery area, entered the adit and the shaft.

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Rohlfs had Climax Moly. drilling data, but no Freeport data. In the West adit, about 2% for 100 ft. and then less than 1%, after fairly solid rock is encountered. At Discovery adit, 3% for 75 feet and then 1 to 1.5% in harder rock. Discovery shaft, up to 4% for 20 feet, and then the grade drops. Climax drill holes show erratic values but little below 30 ft.

Nickel seems confined to brown, soft zone and to depths of 30 feet. Even this will be erratic. The limonitic material of the "boxwork" may carry 1½ %. The red soil may carry up to

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3/4 % Mineralization is spotty. I'd be interested in Freeport's drilling results.

Some geologists prefer a hydrothermal origin for the garnierite, which theory I cannot see at all. Neither can I see laterization, with all the silica that is obviously present. Ralph Taylor (Freeport) collected silica gel, in the process of formation in the West area adit. I believe the silica, nickel, etc., came from the decomposition of the peridotite, in situ.

Rohlfs said that W.P.B. is interested in New Caledonian ores. Three furnaces are in operation. W.P.B. plans on a fourth furnace either at the mines, or in San Francisco. In event S. F. is chosen, domestic garnierite of plus 3% grade will be acceptable. Rohlfs idea is that if Freeport gives up their lease, W.P.B. might be interested in High-grading the deposit.

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NICKEL MOUNTAIN

Riddle Area
Douglas Co

Freeport Sulphur is exploring the nickel deposits here. Old workings have been cleaned out, particularly the adit and shaft at the "Discovery" and the 80 foot shaft and the lower adit at the "West area". In addition drilling has been started.

Climax Molybdenum drilled a north-south line of holes through the "Discovery" area on 400 foot centers, about 1938 or 1939. Hobbs and Pecora did not mention this work and it is doubtful if they knew of it. Freeport has started a line of holes 400 feet west, on 400' centers, and will continue to explore on that basis. The Climax work consisted of three holes, the deepest being 130 feet. The weighted average assay was 1.87 percent nickel.

Recent Freeport drilling proved nickel in this peridotite at a depth of 125 feet, - a zone 5 feet thick. Minor showings were found at 155 feet.

Certain observations were made at the time of the visit. They are recorded here for what they are worth, in an effort to evaluate Hobbs and Pecore's (H & P) observations and conclusions. A study of their paper is advisable.

Red soil seems to average remarkably uniform in nickel when nickel is present; both in the cover over the terraces and in "wash" at lower elevations according to H. & P. What does this indicate relative to supergene enrichment? Perhaps the present nickel showings represent a once continuous blanket that covered the Mountain, - later eroded into present terraces. (suggested by Dave Evans). H. & P., 42:214 state that the limonite enclosed in the boxwork assays about 1% nickel. This is very similar to the percent of nickel in the red soil. They also say that the abundance of quartz in garnierite decreases downward, yet we found silica being deposited, right now, in the lower rock.

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On p. 213 H. & P. mention a progression of paler varieties of garnierite to darker varieties toward the surfaces and that the darker colors represent richer material. In the lower adit, "West area", this is not true as dark garnierite is abundant in seams in the peridotite.

On p. 214, H. & P. state that brown cherty silica is more abundant nearer the surface, but I found abundant brown cherty silica in the lower adit, "West area", and have some beautiful specimens to prove it.

The above observations suggest difficulties with the H. & P. theory of origin and the apparent "upward" movement of silica and nickel in the second stage. Another suggestive feature is the similarity in nickel assays of the red soil and of the limonite between the boxwork. If the second stage is a re-concentration it is odd that that "matrix" should be so uniform in nickel content.

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Some observations about silica were made. There is little silica in the red soil, except cellular masses that probably have worked up from the limonite zone like large rocks work upward in a gravelled road. Silica is abundant as box work in the limonite zone. Silica gel is being deposited at the present time in the peridotite, as evidenced by the gel on mine timbers and along joint cracks in the lower adit, "West area". Whether nickel is being deposited with the gel is not known.

The points of the above discussion is that silica apparently is moving downward. If the overlying limonite and red soil is true laterite, it should be deficient in silica Might there be a possibility that both silica and nickel are being leached from the peridotite at the present time.

A factor overlooked by H. & P. was the flat top of a portion of Nickel Mountain. This area is covered with a red soil of unknown depth. Outcropping peridotite frequently has cellular quartz on its surfaces. Some of this quartz shows garnierite.

Reference: H. & P. = Hobbs, S. Warren, and Pecora, William T., Nickel deposits near Riddle, Douglas County, Oregon: U.S.G.S. Bull. 931-I.

Informant: Ray C. Treasher, trip of July 30, 1942.

CONFIDENTIAL

MAS DEPOSIT RECORD CODING & MATRIX ASSEMBLY COOK BOOK

This cookbook was assembled with the idea of being supplemental to the MAS MANUAL. It was designed to "ease the pain" in getting started in MAS in two areas:

1. Coding the MAS Record forms.
2. Assembling the Grade-Quantity matrix.

The deposit exemplified herein is the Nickel Mountain nickel orebody at Riddle, Oregon. Time did not permit the assembly of a complete backup file with substantiating data for all quantities and grades entered into the Resource Matrix; some of the numbers used are assumed to help complete the example.

All entries designated "E" are data items considered essential to the system, and must be entered. In instances where the available coding is not adequate to cover a particular situation, then the References and Comments Records are used in explanation.

Entries designated "O" are optional data items not absolutely essential to operation of the system, but represent good information that should be included.

Most mineral commodities entered into MAS require completion of a Beneficiation Record describing and costing out the beneficiation process, and a Transportation Record describing the path of the beneficiation product to the first market point. The residual nickel deposits are unique in that a direct ore reduction process is employed, and the ore itself is a marketable product, therefore these two Records are not used, and may be omitted.

Leading zeros required when so coded

U. S. BUREAU OF MINES

MINERALS AVAILABILITY SYSTEM

IDENTIFICATION

Enter in pencil, as sequence numbers may be changed

Leave blank when entering initial data on a deposit

Record Reference - E

1 2	3 5	6 9	10 12	13
4 1	0 1 9	0 0 0 1	0 1 0	

State coded INDEX 001 — Oregon; County coded INDEX 002 — Douglas; Sequence Number; Record Identification; Action Code - E coded INDEX 006

Last 2 digits of year of entry - does not change on updating

14 C Type of Deposit Description - E coded INDEX 007

Letter "C" signifies a complete, all record description.

Letter "L" indicates a location description with no resource determinations and no mine or process costing. Can include up to the first 9 records.

15 16 7 4 Year of Initial Information Entry - E

17 4 Field Center Maintaining Backup File - E coded INDEX 008

Code "4" = WFOC, to be used on all Oregon & California entries.

Commodity Description - E

	Commodity Name coded INDEX 009	Grade Units coded INDEX 010
Commodity 1	18 20 4 2 0 ← Nickel	21 1 ← Weight percent
Commodity 2	22 24 3 2 1 ← Iron	25 1 ← Weight percent
Commodity 3	26 28 [illegible]	29
Commodity 4	30 32	33
Commodity 5	34 36	37
Commodity 6	38 40	41

42 1 Current Operational Status - E coded INDEX 011 — Producer

43 1 Type of Mining - E coded INDEX 012 — Surface

Patented claims

44 2 45 9 46 9 Type of Minerals Holdings - E coded INDEX 013

Entered in order of importance, starting with Col. 44

No entry, space not used

47 7 Resource Quantity Units - E coded INDEX 014 — Metric tons of crude ore, containing the commodities listed above

48 55 File Link - 0

Do not use - intended for possible BuMines statistical file linkage at some future time.

U. S. BUREAU OF MINES

MINERALS AVAILABILITY SYSTEM

DEPOSIT NAME

Record Reference - E

columns 1-9 and 13 comprise the Reference Number, and appear on all records

1 2	3 5	6 9	10 12	13
41 State coded INDEX 001	019 County coded INDEX 002	0001 Sequence Number	011 Record Identification	Action Code - E coded INDEX 006

commonly accepted current name

Primary Name - E

14 20 30 40 46

RIDDLE NICKEL MINE

Additional Names - 0 (Single space between words)

47 50 60 70 79

RIDDLE NICKEL LATERITE DEPOSIT

(A total of 10 property names may be entered)

Additional Names - 0 — 10 12: 012 Record Identification — 13: Action Code - E

14 20 30 40 46

HANNA NICKEL MINE

47 50 60 70 79

NICKEL MOUNTAIN MINE

Additional Names - 0 — 10 12: 013 Record Identification — 13: Action Code - E

14 20 30 40 46

47 50 60 70 79

Additional Names - 0 — 10 12: 014 Record Identification — 13: Action Code - E

14 20 30 40 46

47 50 60 70 79

Additional Names - 0 — 10 12: 015 Record Identification — 13: Action code - E

14 20 30 40 46

47 50 60 70 79

U. S. BUREAU OF MINES

MINERALS AVAILABILITY SYSTEM

OWNER/OPERATOR

First record. Up to 5 records may be used to describe complex ownership

Record Reference - E

1 2	3 5	6 9	10 12	13
41	019	0001	020	
State coded INDEX 001	County coded INDEX 002	Sequence Number	Record Identification	Action Code - E coded INDEX 006

14	15 16	17
0	74	3
Confidentiality - E coded INDEX 015	Date of Information - E	Status of Owner/Operator - E coded INDEX 016

No confidentiality

can be changed on updating

Owner/Operator Name - 0

single space between words

18 20	30	40	51
HANNA NICKEL MINING COMPANY			

52	60	70	73

74 75	76 78	79 80
39	199	99
State - 0 coded INDEX 001	Country - 0 coded INDEX 005	Percent of Ownership - 0

United States

Equivalent to 100 percent

Corporate headquarters: Ohio

Note: Detailed address of company, with both local operating and corporate addresses, should be incorporated in backup files.

10 12	13
02	
Record Identification	Action Code - E coded INDEX 006

14	15 16	17
Confidentiality - E coded INDEX 015	Date of Information - E	Status of Owner/Operator - E coded INDEX 016

Owner/Operator Name - 0

18 20	30	40	51

52	60	70	73

74 75	76 78	79 80
State - 0 coded INDEX 001	Country - 0 coded INDEX 005	Percent of Ownership - 0

Latitude - Longitude Calculation
From Seconds & Minutes to Fractional Degrees

Latitude

42°57'40"

$\frac{40''}{60''\text{ per }'} = 0.67'$

$\frac{57.67'}{60'\text{ per }^\circ} = 0.96117^\circ$

42.96117°

Longitude

123°26'32"

$\frac{32''}{60''\text{ per }'} = 0.53'$

$\frac{26.53'}{60'\text{ per }^\circ} = 0.44217^\circ$

123.44217°

Latitude

42°57'40" 40. ÷
60. =
.66666666666667 *

57.67 ÷
60. =
.96116666666667 *

= 42.96117°

Longitude

123°26'32" 32. ÷
60. =
.53333333333333 *

26.53 ÷
60. =
.44216666666667 *

= 123.44217°

U. S. BUREAU OF MINES
MINERALS AVAILABILITY SYSTEM

LOCATION

Record Reference - E

1 2	3 5	6 9	10 12	13
41	019	0001	030	
State coded INDEX 001	County coded INDEX 002	Sequence Number	Record Identification	Action Code - E coded INDEX 006

Latitude - Longitude Location (see attached calculation sheet)

Latitude - E

14 15 16 20
42°96117

21 [1] Direction - E (North latitude) coded INDEX 017

Calculated to 5 place fractional degree

Longitude - E

22 24 25 29
123°44217

30 [4] Direction - E (West Longitude) coded INDEX 017

Universal Transverse Mercator Location

31 32 [ ] Zone - E

33 [ ] Hemisphere - E coded INDEX 018

34 40 [ ] Northing - E

41 46 [ ] Easting - E

47 [2] Reference Point - E (Trench or pit) coded INDEX 019

48 [2] Precision of Point Location Measurement - E (To 100 meters - considering map scale and accuracy of measuring instrument) coded INDEX 020

Public Land Survey Location

49 50 [33] Principal Meridian - E (Willamette) coded INDEX 021

51 53 54 [030 . 0] Township - E (None) fraction coded INDEX 022

55 [2] Direction - E (South) coded INDEX 017

Township 30, right justified, w/ leading zeros

56 58 59 [006 . 0] Range - E (None) fraction coded INDEX 022

60 [4] Direction - E (West) coded INDEX 017

Range 6, right justified, w/ leading zeros

61 62 [17] Section - E

63 64 65 [9] [7] [3] Section Subdivision - E (SWY4 NWY4 S½) coded INDEX 023 *

66 [2] Survey Status - E (Surveyed) coded INDEX 024

* Method of entry is reverse of standard CHO procedure.

67 71 [00994] Elevation - E (Elevation of reference point, converted to meters; Right justified, leading zeros)

72 [1] Datum for Elevation Measurement - E (Above mean sea level) coded INDEX 025

73 [1] Precision of Elevation Measurement - E (To 10 meters) coded INDEX 020

74 76 [168] U. S. G. S. 1:250,000 Quadrangle - E (Medford) coded INDEX 003

RECORD 040, Columns 34-37

Publication used in coding: 1970 Edition, USGS Office of Water Data Coordination, Catalog of Information on Water Data:

MAPS SHOWING LOCATIONS OF WATER QUALITY STATIONS

Example: South Umpqua River Drainage Basin, containing the Riddle Nickel deposit.

Method of coding: Code is a four digit one. The first two digits are the map number where the drainage is generally located, in this case 73 for Map 73; the last two digits represent the numerical position in the alphabet of the letter designating the specific location of the drainage, in this case the letter is M, and the numerical equivalent is 13 — — The total Drainage Basin code is therefore 7313.

U. S. BUREAU OF MINES
MINERALS AVAILABILITY SYSTEM

GEOGRAPHICAL AND ENVIRONMENTAL CHARACTERISTICS

Record Reference - E

1 2 [41] State coded INDEX 001
3 5 [019] County coded INDEX 002
6 9 [0001] Sequence Number
10 12 [040] Record Identification
13 [ ] Action Code - E coded INDEX 006

On site

14 [1] Distance of Road Needed - E coded INDEX 026
15 [1] Distance to Adequate Water Supply - E coded INDEX 027
16 [1] Distance to Adequate Electrical Power Supply - E coded INDEX 026

Mining District - 0 space
17 [RIDDLE DISTRICT] 31
↑ Right Justified

O & C lands - BLM administered
32 33 [49] Domain - E coded INDEX 028

34 37 [7313] Drainage Basin - E coded - see manual
see attached sheet

Very rugged - over 450 meters local relief
38 [6] Topography - E coded INDEX 029

Approximate, from USGS atlas
39 42 [0170] Annual Precipitation - E (cm)
leading zero

43 [3] Distribution of Precipitation - E coded INDEX 030
winter maximum

44 [2] Temperate Temperature - E coded INDEX 031

45 [5] Coniferous or deciduous forest Vegetation - E coded INDEX 032

46 [7] Clay Soil Texture - 0 coded INDEX 033

47 [4] commercial forestry Primary Land Use - E coded INDEX 034

48 [4] All year Working Season - E coded INDEX 035

49 [2] Available locally Labor Supply - E coded INDEX 036

Environmental Sensitivity to Mineral Extraction - E coded INDEX 037

	Land	Vegetation	Wildlife	Water	Air	Aesthetics	Sound	Overall
Short Term	50 [4]	52 [2]	54 [2]	56 [2]	58 [4]	60 [4]	62 [3]	63 [3]
Long Term	51 [3]	53 [2]	55 [2]	57 [2]	59 [1]	61 [2]		64 [2]

Average of all factors

640 ~~acres~~ (estimated) × 0.4047 hectares/~~acre~~ = 259.008, or 259 hectares

65 69 [00259] Maximum Surface Area Potentially Disturbed - E (hectares)
leading zeros

70 [2] Map Series - E coded INDEX 038
15 minute

71 80 [CANYONVLLE] Map Name - E
shortened to 10 characters by omitting vowels.

U. S. BUREAU OF MINES
MINERALS AVAILABILITY SYSTEM

EXPLORATION

First exploration record. Up to 10 exploration records, numbered 0 to 9, may be used.

Record Reference - E

1 2	3 5	6 9	10 12	13
41 State	019 County	0001 Sequence Number	050 Record Identification	Action Code - E
coded INDEX 001	coded INDEX 002			coded INDEX 006

14 **0** Confidentiality - E (All material herein is published; no confidentiality considerations.)
coded INDEX 015

15 16 **74** Date of Information - E (Date entered into the system. To be changed upon updating)

17 **1** Mode of Discovery - 0 (Ore mineral, exposed in place)
coded INDEX 039

18 21 **1864** Year of Discovery - 0

22 25 **1954** Year of First Significant Production - 0

26 29 **9999** Year of Last Production - 0 (signifies ongoing production)

Description of Exploration Methods Employed - 0

	Method Employed coded INDEX 040	Extent Employed coded INDEX 041	Extent Method Supports Resource Evaluation coded INDEX 041	Year of Work
Geologic mapping	Method 1 30 31 **11**	32 **3** Extensive	33 **1** Little	34 37 **1941**
Core drilling	Method 2 38 39 **51**	40 **1** Little	41 **1**	42 45 **1942**
Churn drilling	Method 3 46 47 **52**	48 **2** Moderate	49 **1**	50 53 **1942**
Bedrock sampling	Method 4 54 55 **90**	56 **2**	57 **1**	58 61 **1942**
Test shaft	Method 5 62 63 **61**	64 **1**	65 **1**	66 69 **1942**
Test adit	Method 6 70 71 **71**	72 **1**	73 **1**	74 77 **1942**

U. S. BUREAU OF MINES
MINERALS AVAILABILITY SYSTEM

EXPLORATION

Second exploration record

Record Reference - E

1 2	3 5	6 9	10 12	13
41	019	0001	051	
State coded INDEX 001	County coded INDEX 002	Sequence Number	Record Identification	Action Code - E coded INDEX 006

14	15 16
0	74
Confidentiality - E coded INDEX 015	Date of Information - E

17	18 21
1	1864
Mode of Discovery - 0 coded INDEX 039	Year of Discovery - 0

22 25	26 29
1954	9999
Year of First Significant Production - 0	Year of Last Production -0

Description of Exploration Methods Employed - 0

	Method Employed coded INDEX 040	Extent Employed coded INDEX 041	Extent Method Supports Resource Evaluation coded INDEX 041	Year of Work
Trenching	Method 1 30 31: 81	32: 3 Extensive	33: 1 Little	34 37: 1952
Bedrock sampling	Method 2 38 39: 90	40: 3	41: 1	42 45: 1952
Geologic mapping	Method 3 46 47: 11	48: 3	49: 3 ongoing exploration →	50 53: 9974
Churn drilling	Method 4 54 55: 52	56: 3	57: 3	58 61: 9974
	Method 5 62 63:	64:	65:	66 69:
	Method 6 70 71:	72:	73:	74 77:

U. S. BUREAU OF MINES

MINERALS AVAILABILITY SYSTEM

ROCK DESCRIPTION — First rock description record. Up to 10 such records, numbered 0 to 9, may be used

Record Reference - E

1 2	3 5	6 9	10 12	13
41	019	0001	060	
State coded INDEX 001	County coded INDEX 002	Sequence Number	Record Identification	Action Code - E coded INDEX 006

14 — ULTRAMAFIC INTRUSIVES — 36 — Formation or Group Name - 0

37 39 — 221 — Upper Jurassic — Geologic Age of the Formation or Group - 0 coded INDEX 042

40 Folding, 41 Faulting, 42, 43 — 12 — Deformation of the Formation or Group - 0 coded INDEX 043

Left justified entries

44 46 — 219 — Post Cretaceous — Geologic Age of Deformation - 0 coded INDEX 042

47 — 4 — Relationship of Mineralization to Deformation - 0 coded INDEX 044

Mineralization following event.

* 48 50 — 1.9 — In Situ Rock Density - E (gm/cm^3)

Leading zero not necessary

Refers to density of rock being mined, or to be mined

Rock Types - 0

	Rock Name coded INDEX 045	Relationship to Ore coded INDEX 046
Rock Type 1	51 53: 163 — Saxonite ?	54 55: 59 — Is ore; Replaced by ore
Rock Type 2	56 58: 123 — Dunite	59 60: 59 — Is ore
Rock Type 3	61 63: 222 — Serpentinite	64 65: 6 — Encloses ore
Rock Type 4	66 68:	69 70:
Rock Type 5	71 73:	74 75:
Rock Type 6	76 78:	79 80:

Note: If two codes are used, the most important is in the first column

* See attached sheet

In Situ Rock Density

(conversion from standard tonnage - volume factor to gm/cm³)

Hanna Mining Co. published conservative factor is 17 cubic feet per short ton in place.

$$\frac{2000\ (1\ \text{lb} \times 453.59\ \text{gm/lb})}{17\ \text{ft}^3 \times 28{,}317\ \text{cm}^3/\text{ft}^3} = 1.8845\ \text{gm/cm}^3$$

rounded off to 1.9 gm/cm³

```
2,000. X
453.59 =
907,180. *

17. X
28,317. =
481,389. *

907,180. ÷
481,389. =
1.8845050468540 *
```

U. S. BUREAU OF MINES
MINERALS AVAILABILITY SYSTEM

ROCK DESCRIPTION

Second Rock Description record

Record Reference - E

1 2	3 5	6 9	10 12	13
41	019	0001	061	

State coded INDEX 001 — County coded INDEX 002 — Sequence Number — Record Identification — Action Code - E coded INDEX 006

14 36
DOTHAN FORMATION
Formation or Group Name - 0

37 39
221
Upper Jurassic
Geologic Age of the Formation or Group - 0
coded INDEX 042

Folding — Faulting

40 41 42 43
1 2
Deformation of the Formation or Group - 0
coded INDEX 043

44 46
219
Post Cretaceous
Geologic Age of Deformation - 0
coded INDEX 042

Not required, as rock will not be mined or processed

47
4
Relationship of Mineralization to Deformation - 0
coded INDEX 044
Following event

48 50
In Situ Rock Density - E
(gm/cm^3)

Rock Types - 0

	Rock Name coded INDEX 045		Relationship to Ore coded INDEX 046	
Rock Type 1	51 53: 312	Sandstone	54: 2	55:
Rock Type 2	56 58: 315	Shale	59: 2	60:
Rock Type 3	61 63: 311	Conglomerate	64: 2	65:
Rock Type 4	66 68: 355	Chert	69: 2	70:
Rock Type 5	71 73: 219	Greenstone	74: 2	75:
Rock Type 6	76 78:		79:	80:

Lies along ore

U. S. BUREAU OF MINES
MINERALS AVAILABILITY SYSTEM

ROCK DESCRIPTION

Record Reference - E

Third Rock Description record

1 2	3 5	6 9	10 12	13
41	019	0001	062	

1 2 State coded INDEX 001 — 3 5 County coded INDEX 002 — 6 9 Sequence Number — 10 12 Record Identification — 13 Action Code - E coded INDEX 006

14 RIDDLE FORMATION 36 Formation or Group Name - O

37 39 221 Upper Jurassic Geologic Age of the Formation or Group - O coded INDEX 042

Folding 40: 1 — Faulting 41: 2 — 42 — 43 Deformation of the Formation or Group - O coded INDEX 043

44 46 219 Post Cretaceous Geologic Age of Deformation - O coded INDEX 042

47 4 Relationship of Mineralization to Deformation - O coded INDEX 044

Mineralization following event

48 50 In Situ Rock Density - E (gm/cm^3)

Not required, as rock will not be mined or processed

Rock Types - O

	Rock Name coded INDEX 045		Relationship to Ore coded INDEX 046	
Rock Type 1	51 53: 313	Siltstone	54: 8	55
Rock Type 2	56 58: 312	Sandstone	59: 8	60
Rock Type 3	61 63: 315	Shale	64: 8	65
Rock Type 4	66 68: 311	Conglomerate	69: 2	70 — Lies along ore
Rock Type 5	71 73		74	75
Rock Type 6	76 78		79	80

Near ore, but never in contact

U. S. BUREAU OF MINES
MINERALS AVAILABILITY SYSTEM
ECONOMIC AND GANGUE MINERALS

First Economic & Gangue Minerals record. Up to 10 such records, numbered 0 to 9, may be used.

Record Reference - E

1 2	3 5	6 9	10 12	13
41	019	0001	070	
State coded INDEX 001	County coded INDEX 002	Sequence Number	Record Identification	Action Code - E coded INDEX 006

14 16	17
122	6
Geologic Age of Mineralization - 0 coded INDEX 042	Overall Grain Size - 0 coded INDEX 047

Miocene

variable

Mineral Description - 0 optional information - to be completed to the best of the evaluator's ability. If the data is not readily available, then omit.

Mineral Name coded INDEX 048	Mineral Class coded INDEX 049	Grain Size coded INDEX 047	Amount	Units coded INDEX 050
18 20: 210 garnierite	21 22: 16 silicate	23: 6	24 27:	28: 1
29 31: 299 limonite	32 33: 04 oxide	34: 6	35 38:	39: 1
40 42: 105 chalcedony	43 44: 15 silicate	45: 6	46 49:	50: 1
51 53: 442 sepiolite	54 55: 16 silicate	56: 6	57 60:	61: 1
62 64: 444 serpentine	65 66: 16 silicate	67: 6	68 71:	72: 1

leading zero

no data

weight percent

At Nickel Mountain, nickel-bearing soil and saprolite constitute a significant part of the ore reserve. This record has no way to adequately describe such "ore materials", so a description should be given in the REFERENCES and COMMENTS Records.

U. S. BUREAU OF MINES
MINERALS AVAILABILITY SYSTEM

DEPOSIT CHARACTERISTICS

Record Reference - E

1 2 [4 1] State coded INDEX 001
3 5 [0 1 9] County coded INDEX 002
6 9 [0 0 0 1] Sequence Number
10 12 [0 8 0] Record Identification
13 [ ] Action Code - E coded INDEX 006

14 [0] Confidentiality - E coded INDEX 015 — No confidential information

15 16 [0 1] Fissure veins, leading zeros
17 18 [0 2] shear zones
19 20 [1 0] Type of Ore Body - E coded INDEX 051 — other - takes into account the soil and saprolite ores

21 [7] Residual concentration
22 [3] Supergene enrichment — Mode of Origin - E coded INDEX 052

23 [3] Irregular
24 [ ]
25 [ ] Shape of Ore Body - E coded INDEX 053 — Left justified, in order of importance

26 [3] Faulting
27 [2] Fracturing (jointing) — Ore Controls - E coded INDEX 054

28 [0] Undetermined (none) — Degree of Wallrock Alteration - E coded INDEX 055

29 30 [0 0] Undetermined (does not apply)
31 32 [ ]
33 34 [ ] Type of Wallrock Alteration - E coded INDEX 056 — Left justified

Mineralized Zone Orientation and Dimensions

35 39 [0 0 0 0 0] Average Depth to the Mineralized Zone - E (meters)

40 44 [0 0 0 0 0] Minimum Depth to the Mineralized Zone - E (meters)

45 48 [0 0 0 0] Leading zeros — Average Thickness of the Unconsolidated Material - E (meters)

49 52 [0 0 0 0] Minimum Thickness of the Unconsolidated Material - E (meters)

53 58 [0 0 1 8 3 0] Leading zeros — Average Length of the Mineralized Zone - E (meters)

59 [1] North
60 61 [4 5] Degrees
62 [3] East — Strike of the Mineralized Zone - E direction coded INDEX 017

63 68 [0 0 0 9 1 5] Average Width of the Mineralized Zone - E (meters)

69 70 [3 5] Degrees
71 [2] South * — Dip of the Mineralized Zone - E direction coded INDEX 017

72 75 [0 0 1 5] Average Thickness of the Mineralized Zone - E (meters)

* In the case of a flat-lying deposit, code strike as 1 00 2 (North - South), and dip as 00 0

U. S. BUREAU OF MINES
MINERALS AVAILABILITY SYSTEM

SURFACE MINING

Mining Records are keyed to Resource Matrix Records. "1" signifies this Record is matched to the first Resource Matrix

Record Reference - E

1 2 [4][1] State coded INDEX 001
3 5 [0][1][9] County coded INDEX 002
6 9 [0][0][0][1] Sequence Number
10 12 [1][3][0] Record Identification
13 [ ] Action Code - E coded INDEX 006

could be coded confidential, if Company cost data are used.

14 [0] Confidentiality - E coded INDEX 015
In this case, BuMines derived costs were used - no confidentiality.

15 16 [7][4] Year this Evaluation Enters the System - E ← To be changed on update

17 [2] System Status - E coded INDEX 057
Operating system, estimated costs

18 19 [5][5] Swell Factor - E
Estimated - need loose density for calculation (see manual for method)

20 22 [9][9][9] Percent Waste Rock - E ← Undetermined

23 24 [1][3] Surface Mining Method - E coded INDEX 063
Bench mining

25 28 [0][0][0][0] Average Cover Thickness - E (m)
None - not applicable

Cover Description - E

Hardness coded INDEX 064

29 [ ] Horizon 1
32 [ ] Horizon 2
35 [ ] Horizon 3

Percent of Specified Thickness
30 31 [ ][ ]
33 34 [ ][ ]
36 37 [ ][ ]

This section not applicable to Nickel Mountain and possibly to other "nickel laterites" where no cover is stripped and wasted prior to mining

38 [4] Ore Body Hardness - E coded INDEX 064 ← see manual

500 acres × 0.4047 hectares/acre = 202.35

39 43 [0][0][2][0][2] Surface Area - 0 (hectares) = 202 hectares
Leading zeros

44 46 [0][0][6] Bench Height - 0 (m) ← 20' benches
Leading zeros

47 48 [ ][ ] Maximum Pit Slope - 0 (degrees) ← determined from field visit

49 54 [0][0][4][4][6][7] Estimated Mine Capacity - E (resource quantity units / day) ← From 1972 production data, in metric tons of crude ore.

55 60 [0][0][0][0][0][0] Estimated Preproduction Stripping Volume - E (1000 m³) ← None

Derived from BuMines cost curves, escalated to 1974 costs

61 65 [0][1][.][2][5] Estimated Unit Production Cost - E (dollars / resource quantity unit)
Decimal occupies a full column

66 71 [0][0][1][0][0][0] Estimated Mine Capital Cost - E (1000 dollars) ← $1000/100

72 73 [2][0] Estimated Production Period - E
years

U. S. BUREAU OF MINES
MINERALS AVAILABILITY SYSTEM

BENEFICIATION

Record Reference - E

1 2 [ ] State coded INDEX 001

3 5 [ ] County coded INDEX 002

6 9 [ ] Sequence Number

10 12 [5] Record Identification

13 [ ] Action Code - E coded INDEX 006

14 [ ] Confidentiality - E coded INDEX 015

15 16 [ ] Year this Evaluation Enters the System - E

17 [ ] System Status - E coded INDEX 065

Omit - not used for residual nickel deposits

Product Description - E

	Process Feed Grade	Percent Recovery in this Beneficiation Product
Commodity 1	18 21 [ ]	22 23 [ ]
Commodity 2	24 27 [ ]	28 29 [ ]
Commodity 3	30 33 [ ]	34 35 [ ]
Commodity 4	36 39 [ ]	40 41 [ ]
Commodity 5	42 45 [ ]	46 47 [ ]
Commodity 6	48 51 [ ]	52 53 [ ]

54 [ ] Beneficiation Method Used - E coded INDEX 066

55 60 [ ] Amount of this Beneficiation Product Shipped - E

61 [ ] Units for Amount Shipped - E coded INDEX 067

62 [ ] Costing Option - E coded INDEX 068

63 [ ] Quantity Units for Capacity and Production Cost - E coded INDEX 014

64 69 [ ] Estimated Plant Capacity - E

70 74 [ ] Estimated Unit Production Cost - E

75 80 [ ] Estimated Capital Cost - E (1000 dollars)

First Comment Record. Up to 200 records can be used, numbered from 800 to 999

U. S. BUREAU OF MINES
MINERALS AVAILABILITY SYSTEM
REFERENCES AND COMMENTS

Record Reference - E

1 2	3 5	6 9	10 12	13
41	019	0001	800	
State coded INDEX 001	County coded INDEX 002	Sequence Number	Record Identification	Action Code - E coded INDEX 006

Reference or Comment - 0

14 20 30 40 46
RECORD 070 NI BEARING SOIL AND

47 50 60 70 80
SAPROLITE ARE SIGNIFICANT PART OF

Second Comment Record

Additional Reference or Comment - 0

10 12 Record Identification: 801 | 13 Action Code - E

14 20 30 40 46
ORE RESERVE BUT CANT BE CODED.

47 50 60 70 80
RECORD 130 COVER DESCRIPTION DOES

Third Comment Record

Additional Reference or Comment - 0

10 12 Record Identification: 802 | 13 Action Code - E

14 20 30 40 46
NOT APPLY TO THIS TYPE OF DEPOSIT

47 50 60 70 80
.

Additional Reference or Comment - 0

10 12 Record Identification | 13 Action Code - E

14 20 30 40 46

47 50 60 70 80

Additional Reference or Comment - 0

10 12 Record Identification | 13 Action Code - E

14 20 30 40 46

47 50 60 70 80

past projected "life of the ore body" figures an additional 6,000,000 mt was assigned totaling 30,000,000 mt at 75 percent probability (3 chances out of 4 that that tonnage is present) at the 1.38 percent grade. On the same reasoning, it was thought that an additional 4,000,000 mt would be present at 50 percent probability (2 chances out of 4) at the same grade, for a total of 34,000,000 metric tons.

The lower grade figures of 1.25 percent nickel and 1.0 percent nickel were obtained by including areas of lower-grade material that diluted the grade and increased tonnages. Probability levels were obtained by proportion from the basic mining grade tonnage numbers.

The higher grade figures of 2.0 percent nickel and 3.0 percent nickel were obtained from USGS data and represent small minable blocks of ground that would have to be selectively mined.

In an actual deposit the existence of the minable blocks of ground at certain tonnage and grade figures must be backed up by data of some kind, varying from company reserve figures to geological inference, with the validity of the data and the weight placed on it being reflected by the probability.

Length = 1830 meters, width 915 meters,
Thickness = 15 meters (all average figures)

1830 m x 915 m x 15 m = 25, 116,750 meters^3

Tonnage-volume factor is derived:
1.9 gm/cm^3 (in situ rock density) is equivalent to: 1.9 metric tons/meter^3

25,116,750 meters^3 x 1.9 metric tons/meter^3 = 47,721,825 metric tons, so the maximum matrix tonnage figure of 42,499,000 metric tons will "fit" within the dimensions established.

IV. A general approach completion of the Grade-Quantity matrix is given on page 5 of the yellow manual, and page 15 of the blue manual.

For the Nickel Mountain deposit, the procedure was as follows:

1. Ore body was defined as an irregular block of ground 1830 meters long, 915 meters wide, and 15 meters thick (all average dimensions)

2. Minable grades were determined as

   a. 1.38 percent nickel (company data)

   b. 2.0 percent nickel (USGS data, for a much smaller tonnage)

   c. 3.0 percent nickel (USGS data, for a still smaller tonnage)

   d. 1.25 percent nickel (assumed grade for a larger tonnage than "a")

   e. 1.0 percent nickel (assumed lowest average minable grade)

3. Tonnage figures were determined thusly:

   The basic tonnage figure (at 90 percent probability) of 24,000,000 metric tons, at an average mining grade of 1.38 percent nickel was derived from company information giving a mine life of 20 years at a production of 1,200,000 mty. On the basis of past production that has exceeded

Matrix Assembly

I. Tonnages are cumulative: (1) From right to left within a specified probability level, and (2) Downward, within a specified Average Minable Grade. For example, the 1.0 percent Nickel tonnages represent a summation of all the higher grade range material plus enough material of a lower grade to make up a minable entity of 1.0 percent nickel ore. Material at a 50 percent probability level (for any average minable grade) contains all the ore at 75 percent and 90 percent probability, plus the additional tonnage of 50 percent certainty.

II. The Nickel Mountain deposit was taken down only to the 50 percent probability level, largely because sufficient data were available to set fairly definite spatial and confidence limits to the ore body, hence the lower probability levels do not apply. However, the system requires that the 25 percent and 10 percent probability entries be made (since all tonnages having a 50 percent probability of being there are obviously at least 25 percent or 10 percent "sure", then the 50 percent quantities are carried the rest of the way through the matrix).

III. For the Nickel Mountain deposit, the maximum tonnage established is 42,499,000 metric tons at an Average Minable Grade of 1.0 percent nickel, at the 50 percent probability level. In all cases, the maximum matrix tonnage recorded must be compatible with the maximum possible tonnage established by the dimensions of the mineralized zone, as entered on Record 080 (Deposit Characteristics) For Nickel Mountain, dimensions are:

U. S. BUREAU OF MINES

MINERALS AVAILABILITY SYSTEM

PROBABILISTIC GRADE - QUANTITY MATRIX

Reference Number - E

1 2	3 5	6 9	10
41 State	019 County	0001 Sequence Number	1 Record Identification (1st digit)

Number of matrix being developed. More than one may be used, if alternative methods of developing the deposit are considered.

Commodity numbers from Identification Record (Record 010)

Present average mining grade

Average Minable Grades

Record Identification / Action Code

11 12	13	Commodity	14	15 19	20 24	25 29	30 34	35 39
01		Nickel	1	001.0	01.25	01.38	002.0	003.0
02		Iron	2	010.0	011.8	014.2	007.5	006.2
03								
04								
05								
06								

Tonnages are cumulative in two directions

Resource Quantity (thousands)

Company "proven ore" reserve at 1.38% Ni

Record Identification / Action Code

11 12	13	Probability	14 15	16 24	25 33	34 42	43 52	53 60
11		P 1	90	30000	27500	24000	10000	100
12		P 2	75	37500	34375	30000	12500	125
13		P 3	50	42499	38958	34000	14160	142
14		P 4	25	42499	38958	34000	14160	142
15		P 5	10	42499	38958	34000	14160	142

Maximum tonnage shown

61 62 Year of this Evaulation - E 74

U. S. BUREAU OF MINES
MINERALS AVAILABILITY SYSTEM

REFERENCES AND COMMENTS

First References Record. Up to 100 records can be used, numbered from 700 to 799

Record Reference - E

1 2	3 5	6 9	10 12	13
41	019	0001	700	
State coded INDEX 001	County coded INDEX 002	Sequence Number	Record Identification	Action Code - E coded INDEX 006

Reference or Comment - 0

14 20 30 40 46
USGS BULL 931 I P 205 226

47 50 60 70 80

Second reference record

Additional Reference or Comment - 0

10 12 Record Identification: 701 | 13 Action Code - E

14 20 30 40 46
AIME ORE DEPOSITS OF US VOL R

47 50 60 70 80
CHAP 79 P 1650 1672

Third reference record

Additional Reference or Comment - 0

10 12 Record Identification: 702 | 13 Action Code - E

14 20 30 40 46
MIN ENG V 9 NO 9 P 903 904

47 50 60 70 80

---

dditional Reference or Comment - 0

10 12 Record Identification | 13 Action Code - E

20 30 40 46

50 60 70 80

---

nal Reference or Comment - 0

10 12 Record Identification | 13 Action Code - E

20 30 40 46

50 60 70 80

U. S. BUREAU OF MINES
MINERALS AVAILABILITY SYSTEM

TRANSPORTATION

Record Reference - E

1 2 State coded INDEX 001

3 5 County coded INDEX 002

6 9 Sequence Number

10 12 Record Identification

13 Action Code - E coded INDEX 006

14 15 Year this Evaluation Enters the System - E

16 21 Shipping Point - E Standard Point Location Code

22 Product Number of Material Shipped - E

23 24 Percent of Produced Material Shipped through this Alternative - E

Destination Description - E

25 30 Standard Point Location Code

31 35 Zip Code

36 Type of Facility coded INDEX 069

Omit - not used for residual nickel deposits

Transportation Description - E

	Mode coded INDEX 070	Distance (km)
Component 1	37	38 42
Component 2	43	44 48
Component 3	49	50 54
Component 4	55	56 60
Component 5	61	62 66
Component 6	67	68 72
Component 7	73	74 78

Chromite Reserves

Alaska 132 subeconomic Podiform-type deposits and 1 placer deposit are estimated to contain 3.4 million to 4.3 million st chromic oxide (Cr_2O_3) in high-Cr and high-Fe chromite. Most of the deposits contain between 5 and 10 % chromite and would require mine site beneficiation (See USBu Mines IC 9087)

SW Oregon Low grade disseminated

Youngs Dailey Dozen - 30,000 long tons 15 % Ch

3 or 4 other sites could possibly be developed to produce low grade disseminated chromite (Illinois River district) Together they may match the amount of Youngs mine.

N. California:

Del Norte Browns High Plateau, massive high-grade metallurgical ~~[illegible]~~ lump Chromite. — 60,000 MT of 50 % Cr_2O_3 and Cr:Fe ratio of 2.8 To 3.7

NICKEL MOUNTAIN MINE

Table 1

WEST SLOPE — JUNE 1 , 1968

DEPTH	Drill Hole No. 1	2	3	4	5	6	7	8	9	10
0 - 5	1.14	0.97	1.07	0.86	0.56	0.92	0.88	1.07	1.10	1.44
5 -10	1.14	1.13	1.33	1.19	0.60	0.89	0.85	1.61	1.01	1.62
10 -15	1.69	1.84	1.65	0.91	0.45	0.98	0.77	1.16		1.71
15 -20	1.41	1.82	1.61	0.96		1.01	0.94	1.06		
20 -25	1.46	1.78	1.09	1.00		1.00	1.04	1.00		
25 -30	1.31	2.05		0.83		1.07	1.19			
30 -35	1.33	1.94				1.01				
35 -40	1.58	1.88				0.88				
40 -45						0.70				
45 -50						0.60				

EAST SLOPE

DEPTH	Drill Hole No. 1	2	3	4	5	6	7	8	9	10	11	12
0 - 5	1.35	0.93	0.94	0.76	1.63	0.62	1.33	0.80	0.74	0.65	0.63	0.57
5 - 10	1.21	1.15	1.23	0.93	2.25	0.66	1.11	0.35	0.87	0.58	0.65	0.59
10 - 15	0.49	1.12	1.15	0.90	2.13	0.56	1.95		0.73	0.56	0.70	0.58
15 - 20		1.41	1.00	0.86		0.36	1.49		0.83		0.62	0.64
20 - 25			0.99			0.28	1.09		0.73		0.64	
25 - 30			0.88			0.26	1.86		0.59		0.62	
30 - 35						0.25	1.86					
35 - 40						0.41	1.57					
40 - 45							1.60					
45 - 50							1.52					

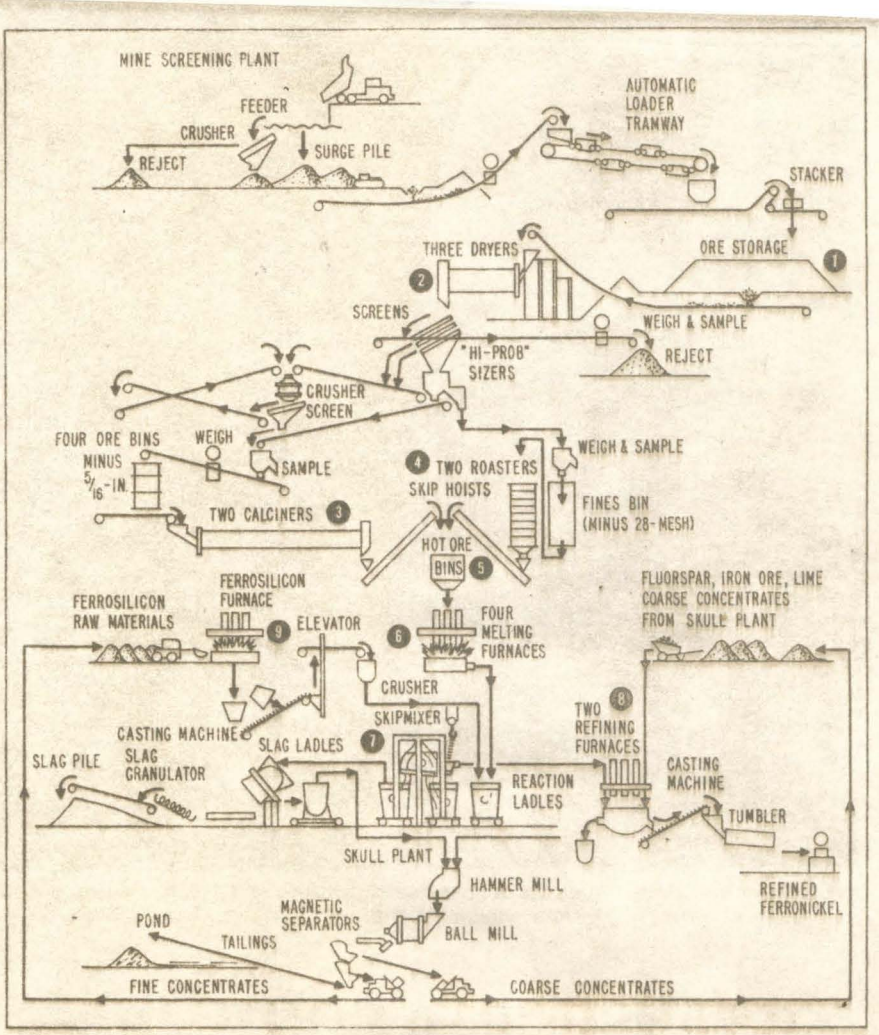
-EN —

The Red colored portion of the map is the main
nd lower Ore bodys, which is public knowledge - The
reen represents our satellite ore zones which are
to some extent confidential as we aren't sure of
the outlines of the geology. You can use your own
~~discretion~~ discretion as to the extent you wish to
use this information.

Hope this helps a little -

Regards
Ted

Continuous tramway delivers ore to smelter and produces a 500 hp credit.



Ferronickel builds-up at 800-900 lb per reaction at skip mixer in Hanna smelter.

Smelter Legend

1. Stockpile; to 100,000 tons.
2. Three dryers; two, 10 x 100 ft, one, 11 x 100 ft.
3. Two 9 x 250-ft rotary kilns, counter-current firing.
4. Two multiple hearth roasters.
5. Four 50-ton bins.
6. Four 20,000 kva tilting furnaces.
7. Skip mixer; handles 14.3-ton pours.
8. Two covered arc 2,500 kva furnaces.
9. One submerged arc 12,500 kva furnace.

2-in. track cables. At the discharge they are inverted and return to the mine in that position on a pair of 1½-in. cables. This system pumps a credit of some 500 hp through induction generators and the power is consumed at the mine. At the smelter the ore is bedded outside by an overhead conveyor and travelling wing trippers.

Making 50% nickel pigs

Unit smelter operations include: (1) Bedding, reclaiming and blending; (2) drying natural water of 21% to the 3 or 4% level; (3) screening to manipulate the basicity index at its best level, to also reject roughly 15% of low nickel-bearing oversize, and to split out by sizers minus 20-mesh fines; (4) calcining of minus 5/16-in. plus 20-mesh ore and roasting of fines to drive off water of crystallization and to adjust the tri-valent and di-valent iron ratios; (5) melting the ore in electric furnaces equipped with three self-baking Soderberg electrodes; (6) reducing the melt by means of ladling molten ore, the ferrosilicon reductant, and seed ferronickel back and forth seven times to promote the reduction reaction; (7) periodically thieving ferronickel from the reaction ladle after slag has been decanted; (8) refining thieved metal to dephosphorize it; and (9) casting pigs in 28-lb shapes.

Hanna makes its own ferrosilicon from local quartz, iron turnings, coke and wood chips in a 12,500 kva submerged arc furnace. It is crushed to minus ⅝-in. for addition to the process. Four tilting melting furnaces are arranged in two pairs of 20,000 kva each for each furnace. One roaster and one calciner feed each pair. They melt at 25 to 28 tph and are operated with open arcs.

The reactions proceed in three overlapping sequences as follows. (1) Fe_2O_3 to FeO; (2) nickel oxide to metal; and (3) FeO to the metallic state. To cut the consumption of ferrosilicon, carbon as sawdust (a product of local lumber industries) is added to the roasters and calciners to gain partial reduction of ferric iron to the ferrous state before melting. When the contents of a melting furnace is poured into a ladle in the skip mixer, a ladle of 9 to 14 tons of seed ferronickel is waiting on the other side. The latter is hoisted and poured into the ladle containing the freshly melted ore.

The nickel picture in 1967

Description	Dry tons (millions)	% Ni	lb nickel (millions)
Ore from stockpile	1.123	1.43	32.193
Hard rock rejected	0.175	0.77	2.686
Ore to process	0.948	1.56	29.478
Molten ore	0.859	1.69	29.053
Slag and tailing loss	—	—	2.474
Dust	—	—	0.424
Ferronickel produced	—	50.18	26.070

Recovery from ore to process (%)	88.44
Power consumption per pound of nickel produced (kwh)	29.49
Electrode paste (pounds per ton of ore poured)	7.3
Ferrosilicon (52% Si, per pound of Ni in molten ore)	1.45

TABLE II NICKEL PRODUCTION

Year	Pounds of contained nickel in ferro nickel produced	Average U.S. price per pound f.o.b. Port Colborne, Ontario	$ Approxima gross value
1954	318,489	$ .79 *	258,848
1955	6,505,329	.74 *	4,840,061
1956	11,382,984	.605 *	6,886,705
1957	18,121,452	.605 *	10,963,478
1958	21,233,634	.605 *	12,846,000
1959	20,794,091	.605 *	12,580,000
1960	22,228,720	.605 *	13,448,000
1961	20,650,142	.736	15,199,000
1962	21,238,893	.774	16,362,000
1963	21,447,986	.8275	17,748,000
1964	22,472,891	.8275	18,596,000
1965	25,333,000	.8275	20,963,000
1966	24,533,000	.8275	20,301,000
1967	26,070,000	.849	22,134,000
1968	26,252,000	.915	24,020,000
1969	26,172,000	1.028	26,905,000
1970	25,349,000	1.284	32,548,000
1971	25,934,000	1.305	33,843,000

* Contract agreement price with Government 79.39 cents for the first 5 million pounds and 60.5 cents a pound thereafter until contract completed in 1961.

ANALYSIS REPORT

HANNA NICKEL SMELTING CO.

Riddle, Oregon

To. H. W. Hard

Chemical ✓

Quantometer

Lab. No.	Sample Description	~~Note~~				
107069	7/20 Quarry Mt.		3-38	—	W. A. Foster	
	SiO_2	97.99				
	Fe_2O_3	1.48				
	Al_2O_3	0.13				
	TiO_2	0.27				
	CaO	<0.03				
	Phos	<0.005				
	L.O.I	0.06				
107070	7/20 Quarry Mt.		3-39	—	W. A. Foster	
	SiO_2	97.34				
	Fe_2O_3	1.92				
	Al_2O_3	0.20				
	TiO_2	0.25				
	CaO	0.06				
	Phos	<0.005				
	L.O.I.	0.20				

Date 7-24-59

Signed Eric Wilson

FM No. 602 RPCo.

CRIB MINERAL RESOURCES FILE 12

RECORD IDENTIFICATION
RECORD NO..... W000690
RECORD TYPE..... X1M
COUNTRY/ORGANIZATION. USGS
DEPOSIT NO..... 4102
MAP CODE NO. OF REC..

REPORTER
NAME..... COURY, ANNY B.
DATE..... 72 08
UPDATED..... 79 02
BY..... BRADLEY, ROBIN; WALKER, G. W.

NAME AND LOCATION
DEPOSIT NAME..... HANNA NICKEL MINE
SYNONYM NAME..... NICKEL MOUNTAIN

MINING DISTRICT/AREA/SUBDIST. RIDDLE

COUNTRY CODE..... US
COUNTRY NAME: UNITED STATES

STATE CODE..... OR
STATE NAME: OREGON

COUNTY..... DOUGLAS
DRAINAGE AREA..... 17100302 PACIFIC NORTHWEST
PHYSIOGRAPHIC PROV..... 13 KLAMATH MOUNTAINS

QUAD SCALE	QUAD NO OR NAME
1: 62500	CANYONVILLE

LATITUDE	LONGITUDE
42-57-40N	123-26-20W

UTM NORTHING	UTM EASTING	UTM ZONE NO
4756374.7	464203.3	+10

POSITION FROM NEAREST PROMINENT LOCALITY: 8 MILES WEST OF CANYONVILLE

LOCATION COMMENTS: DEPOSIT COVERS UPPER PART OF NICKEL MTN. INCLUDES PARTS OF SECTIONS, 8 , 9 , 16 , 17 , 18 , 2
AND 21 OF T 30 S, R 6 W.

COMMODITY INFORMATION
COMMODITIES PRESENT..... NI CO PGM

PRODUCER(PAST OR PRESENT):
MAJOR PRODUCTS.. NI

COMMODITY SPECIALIST INFORMATION:
PGM PDT

ORE MATERIALS (MINERALS,ROCKS,ETC.):
GARNIERITE, PERIDOTITE

MAIN ORE MINERALS:
GARNIERITE

MINOR ORE MINERALS:
SEPIOLITE, CHLORITE

COMMODITY COMMENTS:
ORES ARE CLASSIFIED INTO GROUPS: SOIL (RED AND YELLOW), SAPROLITE (SOFT, HARD SAPROLIZED PERIDOTITE), AND BOXWORK. SOILS ACCOUNT FOR 20 % OF ORE RESERVE AVERAGING 10 FT. THICK, VARYING FROM ZERO TO 40 FT. SAPROLITE ACCOUNTS FOR 70 % OF RESERVES. BOXWORK GROUP ACCOUNTS FOR REST OF RESERVE WITH AVERAGE GRADE OF 1.78 % NICKEL I UPPER DEPOSIT AND 1.49 % IN UPPER DEPOSIT. PGM BASED ON ANALYSIS, HOTZ AND EDUCATED GUESS, NEEDS TO BE CHECKED.

ANALYTICAL DATA(GENERAL)
PARENT ROCKS RANGE FROM 0.52 TO 0.29 % NICKEL

EXPLORATION AND DEVELOPMENT

STATUS OF EXPLOR. OR DEV.	7
	PROPERTY IS ACTIVE ACTIVE
YEAR OF DISCOVERY.....	1864
BY WHOM.....	SHEEPHERDERS
NATURE OF DISCOVERY.....	B
YEAR OF FIRST PRODUCTION.	1882
PRESENT/LAST OPERATOR....	HANNA MINING CO

DESCRIPTION OF DEPOSIT

DEPOSIT TYPES:
LATERITE
FORM/SHAPE OF DEPOSIT: STRATIFIED BLANKET

SIZE/DIRECTIONAL DATA

SIZE OF DEPOSIT.....	LARGE	
DEPTH TO TOP	3	FEET
MAX LENGTH.....	6000	FT
MAX WIDTH.....	3000	FT
MAX THICKNESS.....	220	FEET

COMMENTS(DESCRIPTION OF DEPOSIT):
500 ACRES OF DISCONTINUOUS MANTLE, AVERAGING 50 FT. THICK BUT VARYING FROM 5 TO 200 FT. TWO MAIN ORE BODIES ONE ON TOP OF NICKEL MTN. CALLED UPPER DEPOSIT, AND ONE ON TERRACE ON SOUTH SIDE OF MTN. CALLED LOWER DEPOSIT.

DESCRIPTION OF WORKINGS
SURFACE

COMMENTS(DESCRIP. OF WORKINGS):

PRODUCTION
YES
LARGE PRODUCTION

ANNUAL PRODUCTION (ORE,COMMOD.,CONC.,OVERBURD.)

	ITEM		ACC	AMOUNT	THOUS.UNITS	YEAR	GRADE,REMARKS
1	NI	ACC		000011.8	MET TONS	1971	NI IN ORE
2	NI		ACC	000018.3	TONS	1979	
3	ORE	EST		00000860	MET TONS	1974	;1.38% NI

CUMULATIVE PRODUCTION (ORE,COMMOD.,CONC.,OVERBUR.)

	ITEM	ACC	AMOUNT	THOUS.UNITS	YEAR	GRADE,REMARKS
15	NI	ACC	000247.7	TONS	1953-1979	

PRODUCTION YEARS..... 1971

SOURCE OF INFORMATION (PRODUCTION).. CORNWALL, H.R., 1966, NICKEL DEPOSITS OF NORTH AMERICA: U.S.GEOL. SURVEY BUL
1223

PRODUCTION COMMENTS.... AVERAGE GRADE OF ORE: 1.4% ONLY DOMESTIC NICKEL PRODUCTION. SINCE 1957, ANNUAL PRODUCTI
HAS BEEN 10 TO 13 THOUSAND TONS; 1972 PRODUCTION FIGURES NOT AVAILABLE CORNWALL, H.R., 1966, REPORTS, 'PRODUCTI
RECORDS FOR THE FIRST 10 YEARS OF OPERATION, PLUS CONSIDERATION OF PRESENT CAPACITY AND MINIMAL REQUIREMENTS FR
PROFITABLE EXPLORATION OF A METAL DEPOSIT, INDICATE THAT THE DEPOSIT IS LARGE ENOUGH TO SUPPORT A PRODUCTION RA
OF 12,000 MET TONS PER YEAR FOR A MINIMUM OF 30 YEARS.' 1964 PRODUCTION WAS 12,700 M.T. OF NICKEL...1973 MINE A
SMELTER OUTPUT WAS 11,735 M.T. NICKEL, 1972 OUTPUT WAS 11,900 M.T. NICKEL.

RESERVES AND POTENTIAL RESOURCES

	ITEM		ACC	AMOUNT	THOUS.UNITS	YEAR	GRADE OR USE
1	NI		EST	00000240	MET TONS	1973	NI IN ORE RESERVES
2	CO		EST	00000008	MET TONS	1973	; CALCULATED
4	ORE	NI CO	EST	00016000	MET TONS	1973	; 1.50% NI, 0.05% CO
5						1973	1.50% NI, (AVERAGE)
6							

SOURCE OF INFORMATION (RESERVES/POT RESOURCES).. VHAY, JOHN S., ET AL, 1973, COBALT: (IN US MINERAL RESOURCES,
GEOL. SURVEY PROF. PAPER 820, P. 148).

RESERVES ONLY

	ITEM	ACC	AMOUNT	THOUS.UNITS	YEAR	GRADE OR USE
1	NI	EST	00000136	MET TONS	1973	NI IN ORE
5	NI-ORE	EST	00009070	MET TONS	1973	1.50% NI

COMMENTS (RESERVES).. CORNWALL, H.R., 1966, REPORTS SEVERAL OTHER DEPOSITS IN SOUTHWESTERN OREGON AND NORTHWES

SOURCE OF INFORMATION (RESERVES).. CORNWALL, H.R., SEE REF. 1.

GEOLOGY AND MINERALOGY

AGE OF HOST ROCKS..... MIO PLIO
HOST ROCK TYPES..... LATERITE
IGNEOUS ROCK TYPES..... PERIDOTITE, DUNITE, SERPENTINITE

AGE OF MINERALIZATION..... TERT

PERTINENT MINERALOGY..... CHALCEDONY

IMPORTANT ORE CONTROL/LOCUS.. THE LATERITE OCCURS IN TWO AREAS, THE FIRST AND LARGEST AREA COVERS THE TOP OF TH MOUNTAIN AND IS THE ONE THAT HAS BEEN MINED; A SECOND DEPOSIT, CONSIDERABLY SMALLER, OCCURS IN A BENCH ON THE SOUTHEASTERN SLOPE OF THE MOUNTAIN. BOTH DEPOSITS OVERLIE FRESH PERIDOTITE AND HAVE A WELL-DEVELOPED QUARTZ-GARNIERITE BOXWORK ZONE.

GEOLOGICAL DESCRIPTIVE NOTES. SURFACE BLANKET DEPOSIT, FORMED BY TWO-STAGE LATERITIC WEATHERING OF PERIDOTITE O FLATTER UPPER SURFACES OF MOUNTAIN. THE NICKEL(AND COBALT?)ORIGINALLY IN THE OLIVINE. AMOUNT OF CO IN OLIVIN AND ORE NOT REPORTED

GEOLOGY (SUPPLEMENTARY INFORMATION)
REGIONAL GEOLOGY
MAJOR REGIONAL STRUCTURES.. THE LATERITES OCCUR ON FLAT-LYING TO GENTLY SLOPING EROSIONAL SURFACES, INCLUDING BROAD PLATEAU-LIKE SUMMITS, SADDLES, AND TERRACES. THE HIGHEST CONCORDANT EROSIONAL SURFACES FORM THE MOUNTA TOPS AND REPRESENT THE OLDEST PENEPLAINS, PROBABLY MIDDLE TERTIARY IN AGE. THE SURFACES ON THE FLANKS OF THE MOUNTAINS AND ON LOWER TERRACES OF THE MOUNTAINS ARE, FOR THE MOST PART, YOUNGER EROSION SURFACES, BUT AT A PLACES THE TERRACES REPRESENT OLDER, HIGHER EROSION SURFACES THAT HAVE BEEN DOWNFAULTED BY GRAVITATIONAL SLUMPING. CONTACTS OF PERIDOTITE AND RIDDLE AND DOTHAN FAULT CONTACTS REGIONAL; ROCK FAULT AND SPRING FAULT RELATED TO SAPROLITE FORMATION; JOINTS RELATED TO DEPTH OF SAPROLITE; FORMER WATER TABLE RELATED TO BOXWOR ORE

LOCAL GEOLOGY
NAMES/AGE OF FORMATIONS,UNITS,OR ROCK TYPES
1) NAME: RIDDLE FORMATION, SILTSTONE, SANDSTONE, SHALE
AGE: JUR
2) NAME: DOTHAN FORMATION, GRAYWACKE, SHALE, CONGLOMERATE, CHERT
AGE: JUR

GENERAL COMMENTS
THREE LAYERS IN SOIL ZONE:(1) BRICK RED SOIL(MOST CO HERE?); (2)YELLOW LIMONITIC LAYER WITH SOME QUARTZ GARNIERI BOXWORK; (3)BOXWORK OF QUARTZ AND GARNIERITE IN NEARLY FRESH PERIDOTITE. ALL ZONES HAVE SOME NICKEL AND ARE MIN LAYER(3) HAS HIGHEST GRADE: UPDATE BY GLENN L. SHAFFER-1/75, GEOLOGIC DESCRIPTION, PRODUCTION DATA, RESERVES AN POTENTIAL RESOURCES. SMELTER ANNUAL CAPACITY 11,800 M.T. SEE CUMBERLIDGE AND CHACE FOR GEOLOGIC MAPS AND ASSAY DATA. USGS RECORD (M046850) MERGED WITH THIS RECORD AND DELETED FROM THE OREGON FILE

GENERAL REFERENCES
1) PECORA, W.T., AND HOBBS, S.W., 1941, USGS BULL. 931-I, P. 205-226
2) BOGERT, J.R., 1960, MINING WORLD, VOL. 22, NO. 11, P. 33-37
3) HOTZ, P.E., 1964, ECONOMIC GEOLOGY, VOL. 59, NO. 3, P. 356-396

CRIB MINERAL RESOURCES FILE 12

RECORD IDENTIFICATION
RECORD NO..... M061616
RECORD TYPE..... XIM
COUNTRY/ORGANIZATION. USGS
DEPOSIT NO..... 030
MAP CODE NO. OF REC..

REPORTER
NAME..... JOHNSON, MAUREEN G.
DATE..... 76 05
UPDATED..... 81 03
BY..... FERNS, MARK L. (BROOKS, HOWARD C.)

NAME AND LOCATION
DEPOSIT NAME..... NICKEL MOUNTAIN GROUP
SYNONYM NAME..... UPPER OCCURRENCE

MINING DISTRICT/AREA/SUBDIST. RIDDLE

COUNTRY CODE..... US
COUNTRY NAME: UNITED STATES

STATE CODE..... OR
STATE NAME: OREGON

COUNTY..... DOUGLAS
DRAINAGE AREA..... 17100302 PACIFIC NORTHWEST
PHYSIOGRAPHIC PROV..... 13 KLAMATH MOUNTAINS

QUAD SCALE	QUAD NO OR NAME
1: 62500	CANYONVILLE

LATITUDE	LONGITUDE
42-57-37N	123-26-37W

UTM NORTHING	UTM EASTING	UTM ZONE NO
4756275.	463820.	+10

TWP..... 30S
RANGE.... 06W
SECTION.. 17
MERIDIAN. W.M.

ALTITUDE.. 3240 FT

POSITION FROM NEAREST PROMINENT LOCALITY: ON HANNA NICKEL PROPERTY

POTENTIAL.....
OCCURRENCE..... CR RH

COMMODITY SPECIALIST INFORMATION:
PGM OCCUR

ORE MATERIALS (MINERALS,ROCKS,ETC.):
CHROMITE

ANALYTICAL DATA(GENERAL)
FRESH DUNITE WITH ABOUT 15% DISSEMINATED CHROMITE ASSAYED 50.60% CR2O3, 19.52% FE, 6.63% SIO2 ; RH 0.025 PPM

EXPLORATION AND DEVELOPMENT
STATUS OF EXPLOR. OR DEV. 1

DESCRIPTION OF DEPOSIT

DEPOSIT TYPES:
DISSEMINATED
FORM/SHAPE OF DEPOSIT: LENS

SIZE/DIRECTIONAL DATA
SIZE OF DEPOSIT..... SMALL
MAX LENGTH..... 12 FT
MAX WIDTH..... 4 FT
STRIKE OF OREBODY.... N20E
DIP OF OREBODY..... 55SE

PRODUCTION
NO PRODUCTION

GEOLOGY AND MINERALOGY

AGE OF HOST ROCKS..... JUR

GENERAL REFERENCES
1) RAMP, LEN, 1972, GEOLOGY AND MINERAL RESOURCES OF DOUGLAS COUNTY, OREGON: OREGON DEPT. GEOLOGY AND MINERAL IND
BULL. 75, 106 P.
2) RAMP, LEN, 1961, CHROMITE IN SOUTHWESTERN OREGON: OREGON DEPT. GEOLOGY AND MINERAL IND. BULL. 52, 169 P.
3) PAGE, N.J, JOHNSON, M.G., HAFFTY, JOSEPH, AND RAMP, LEN, 1975, OCCURRENCE OF PLATINUM GROUP METALS IN
ULTRAMAFIC ROCKS OF THE MEDFORD-COOS BAY 2 DEGREE QUADRANGLE, SOUTHWESTERN OREGON: U.S. GEOL. SURVEY MISC. FIEL
STUDIES MAP MF-694

CRIB MINERAL RESOURCES FILE 12

RECORD IDENTIFICATION
RECORD NO..... M061218
RECORD TYPE..... M
COUNTRY/ORGANIZATION. USGS
MAP CODE NO. OF REC..

REPORTER
UPDATED..... 81 03
BY..... FERNS, MARK L. (BROOKS, HOWARD C.)

NAME AND LOCATION
DEPOSIT NAME..... NICKEL MOUNTAIN GROUP
SYNONYM NAME..... LOWER OCCURRENCE

MINING DISTRICT/AREA/SUBDIST. RIDDLE

COUNTRY CODE..... US
COUNTRY NAME: UNITED STATES

STATE CODE..... OR
STATE NAME: OREGON

COUNTY..... DOUGLAS
DRAINAGE AREA..... 17100302 PACIFIC NORTHWEST
PHYSIOGRAPHIC PROV..... 13 KLAMATH MOUNTAINS
LAND CLASSIFICATION..... 20

QUAD SCALE	QUAD NO OR NAME
1: 62500	CANYONVILLE

LATITUDE	LONGITUDE
42-57-11N	123-26-07W

UTM NORTHING	UTM EASTING	UTM ZONE NO
4755492.2	464495.2	+10

TWP..... 030S
RANGE.... 006W
SECTION.. 20
MERIDIAN. W.M.

ALTITUDE.. 2550

COMMODITY INFORMATION
COMMODITIES PRESENT..... CR

PRODUCER(PAST OR PRESENT):
MAJOR PRODUCTS.. CR

ANALYTICAL DATA(GENERAL)
MASSIVE FLOAT: 54.60% CR2O3, 10.08% FE; SIMILIAR ORE 51.60% CR2O3, 10.75% FE.

EXPLORATION AND DEVELOPMENT
STATUS OF EXPLOR. OR DEV. 8

DESCRIPTION OF DEPOSIT

DEPOSIT TYPES:
MASSIVE CHROMITE
FORM/SHAPE OF DEPOSIT: LENS, PODS

SIZE/DIRECTIONAL DATA
SIZE OF DEPOSIT..... SMALL

DESCRIPTION OF WORKINGS
SURFACE

PRODUCTION
YES
SMALL PRODUCTION

CUMULATIVE PRODUCTION (ORE,COMMOD.,CONC.,OVERBUR.)

ITEM	ACC	AMOUNT	THOUS.UNITS	YEAR	GRADE,REMARKS
15 ORE	EST	0000.241	TONS	1916-1918	HIGH GRADE (1917= 55% CR2O3)
16 ORE	EST	0000.199	TONS	1952-1958	42% CR2O3 TO 48% CR2O3
21 TOTAL		.440	TONS	50.23 % CR2O3	(WEIGHTED AVERAGE GRADE)

GEOLOGY AND MINERALOGY

AGE OF HOST ROCKS..... JUR

GENERAL REFERENCES
1) RAMP, LEN, 1972, GEOLOGY AND MINERAL RESOURCES OF DOUGLAS COUNTY, OREGON: OREGON DEPT. GEOLOGY AND MINERAL IND. BULL. 75, 106 P.
2) RAMP, LEN, 1961, CHROMITE IN SOUTHWESTERN OREGON: OREGON DEPT. GEOLOGY AND MINERAL IND. BULL. 52, 169 P.
3) THAYER, T. P., 1974, UNPUBL. DATA

State Department of Geology and Mineral Industries

702 Woodlark Building
Portland 5, Oregon

Reconnaissance geology of secs. 18, 19, 30, and 31, T. 30 S., R. 6 W., and secs. 13, 23, 24, 25, 26, 35, and 36, T. 30 S., R. 7 W., Douglas County, Oregon

By

Hollis M. Dole and David J. White

ABSTRACT

A geologic reconnaissance of a twelve square mile area in the southwestern part of T. 30 S., R. 6 W., and the southeastern part of T. 30 S., R. 7 W., does not show anything that would indicate this to be a better prospecting area than areas of similar rocks found elsewhere in southwestern Oregon. The metavolcanic and serpentine rocks are recommended as the most likely sites of ore deposits but it is emphasized that intensive prospecting will be necessary to determine the economic possibilities of these areas. The present price of chromite and its insecure future suggests that immediate encouragement should be given for prospecting in the rocks in which this ore might occur.

The geologic map shows the distribution of the various formations found. The formations include both sedimentary and igneous rocks and range in age from late Mesozoic to early Tertiary.

GEOLOGY

Introduction

The area covered by this geologic reconnaissance consists of sedimentary and igneous rocks of the late Mesozoic and early Cenozoic periods. The surficial deposits of Quaternary age were not mapped and will not be discussed.

Igneous Rocks

Jurassic metavolcanics. All rocks in this category show some metamorphism and in most instances their original character is deciphered with difficulty. Probably most were originally flow rocks, as determined by their fine-grained character, and most are of an intermediate composition.

The more resistant rocks of this series form sharp cliffs and the less resistant have slopes covered with considerable rubble. Outcrops are numerous but due to jointing and metamorphism their structure is masked. Generally, these rocks trend NE with high dips to the SE. Their contact with the sediments of the Dothan formation appears to be conformable and for this reason they are thought to be of similar geologic age, that is, late Jurassic. The serpentine is intrusive into the metavolcanics and the contact of the metavolcanics with the Cretaceous sediments in the northwestern part of the area is marked by a series of faults.

Serpentine. Included in the areas mapped as serpentine is considerable peridotite but as it has been serpentinized to varying degrees no attempt was made to distinguish the serpentine from the serpentinized peridotite. Blocky outcrops in the area generally indicate peridotite. Zones of shearing within the serpentine are shown by a "backbone" or a "fish scale" type serpentine. These zones show lineation which undoubtedly is a result of the forces that produced the shearing. The lineation varies in strike from N 35° E to N 65° E and has steep dips to the NW or SE.

All contacts of the serpentine with the other formations show cross cutting relations. The serpentine has invaded the Dothan formation and the metavolcanics and is in fault contact with the younger sedimentary formations. From evidence found elsewhere the age of the serpentine is established as very latest Jurassic or early Cretaceous.

Dikes. Several dikes are noted on the map and float found in the field suggests that they are probably more common than indicated. The dikes are variable in composition, even over a short distance, but all have high percentages of feldspar; quartz was noted in some hand specimens but generally the rocks tend to be fairly basic. The dikes are intrusive into

the serpentine or are found in the volcanics a short distance from the serpentine. Their association in zones of shearing near the volcanics or near the sediments may indicate that they are the products of reaction between the sediments or volcanics and the serpentine or that they are the more mobile constituents of the invaded rocks which formed upon intrusion of the serpentine or upon faulting. However, a magmatic origin should not be disregarded.

Sedimentary Rocks

Dothan formation. The Dothan formation in this area is very similar to its type locality in Cow Creek Canyon, a short distance to the southwest. Graywackes and shales predominate; chert and conglomerate occur in minor quantities.

The general NE strike and high dip to the SE which is so common in the Dothan formation of the Dutchman Butte and Riddle quadrangles is still the dominant attitude in this area.

The age of the Dothan formation is late Jurassic.

Knoxville formation. A fairly large area of Knoxville age rocks is found at the eastern edge of the map area. This series continues eastward below Nickel Mountain and forms a fairly regular band that crosses the Umpqua River at the U. S. Highway 99 bridge just northwest of the town of Myrtle Creek. Small inliers of Knoxville conglomerate are found in the serpentine in the Beatty Creek area. From this evidence it appears that in this area the Knoxville formation has been engulfed by the serpentine. The contacts of the Knoxville formation with the Umpqua formation are faults.

The Knoxville formation is dominantly a pebble conglomerate. The pebbles are almost entirely of chert and are well rounded. Sphericity of

the pebbles is fair. Cementation is mainly silica. Jointing has sheared the pebbles so that a joint surface presents a very smooth face - cutting through pebbles and matrix with very little difference. The composition of the pebbles and the shearing are the main criteria for distinguishing this formation from the other sediments.

Little structure is evident in the Knoxville conglomerates and so their attitude is poorly known. Fossils found in similar-appearing rocks in the Dutchman Butte area indicate a very late Jurassic age for this formation.

A small patch of shale striking N 20° E and dipping 85° SE surrounded by serpentine was found in sec. 35, T. 30 S., R. 7 W. It is thought this shale belongs to the Knoxville formation.

Cretaceous undifferentiated. The rocks mapped as "Cretaceous undifferentiated" include the sedimentary rocks deposited during the Cretaceous period. No effort was made to distinguish the subdivisions of the period. These rocks are largely medium-grained sandstones but minor amounts of shale and conglomerate are found. Leaf impressions and invertebrate fossils are occasionally found but they are not common.

The structure of the sediments indicates two basins of deposition: one in Cow Creek Valley and the other in the upper Buck Creek and Thompson Creek area in the Dutchman Butte quadrangle. The contact between these rocks and the younger Umpqua formation is a sedimentary one but the contact with the older formations is faulted. Faults are common in the Cretaceous rocks but the strong jointing and slight metamorphism which marks the Knoxville and Dothan formations is lacking. In this respect, these rocks are more similar to the younger Eocene rocks than the older Jurassic rocks. This indicates that most of the severe orogenic movements and serpentine intrusion took place before these rocks were deposited.

Umpqua formation. The sedimentary rocks of Eocene age in this and the surrounding locality are termed the Umpqua formation. In the map area the Umpqua formation is largely massive boulder conglomerate but on the valley floor near Riddle, shale and sandstone predominate. The conglomerate forms bold cliffs and in Cow Creek it produces rapids.

In the cliffs above the Riddle "swimming hole" the rocks of the conglomerate have an average size of approximately 4 inches and a maximum size of 8-10 inches. The matrix, which makes up around 60 percent of the mass, is dominantly clay size material. The pebbles and boulders are mainly graywacke and metavolcanics. The strata of the cliffs in this area have a strike of N 45° E and a dip of 22° to the SE.

ECONOMICS

The serpentine, dikes, and metavolcanics are thought to be the only rocks which offer likely areas for prospecting. Many minor prospects have been found in all of these rocks but no known production to amount to anything has been recorded. Veins which contain minor amounts of gold and copper have been prospected in the metavolcanics and dikes. Disseminated chromite and small pods of chromite have been found in the serpentine. Minor amounts of asbestos were observed in the same rocks. Practically all drainages have been worked for placer gold but from the extent of the workings they do not appear to have been very productive.

For almost 100 years prospectors have been in southwestern Oregon and it is unlikely that any large metallic mineral deposit outcropping at the surface would have escaped their attention. Inasmuch as no large deposits have been discovered in the area of this map it is assumed that if deposits

of value are to be found it will be the result of extensive prospecting or that minerals which have recently become of importance will be recognized.

Because of the present favorable price of chromite it is suggested that the areas of serpentine receive the greatest attention in prospecting, for it is only in ultrabasic rocks that lode chromite occurs. As there is no assurance that the Federal Government will continue to buy chromite at the present price after June 30, 1957, it would appear prudent to encourage prospecting.

During the course of this investigation nothing was found that indicated this area to be a better prospecting area than any other place in southwestern Oregon in which rocks of a similar character are found.

Table II

~~RIDDLE PROPERTY~~ - MINE & SMELTER PRODUCTION SUMMARY

Year	Crude Tons Mined	Nickel Production (pounds)
1954	129,000	319,000
1955	423,000	~~8,464,000~~ 6,505,000
1956	614,000	11,383,000
1957	1,087,000	18,122,000
1958	1,243,000	21,234,000
1959	1,287,000	20,794,000
1960	1,426,000	22,229,000
1961	1,422,000	20,650,000
1962	1,395,000	21,139,000
1963	1,480,000	21,448,000
1964	1,813,000	22,473,000
1965	1,898,000	25,333,000
1966	1,691,000	24,533,000
1967	1,672,000	26,070,000
1968	1,898,000	26,252,000
1969	1,781,000	26,172,000
1970	2,137,000	25,349,000
1971	2,215,000	25,934,000
TOTAL	25,611,000	~~367,898,000~~ 365,939,000

EJM:7/11/72

TABLE II NICKEL PRODUCTION

Year	Pounds of contained nickel in ferro nickel produced	Average U.S. price per pound f.o.b. Port Colborne, Ontario	$ Approximat gross value
1954	318,489	$ .79 *	258,848
1955	6,505,329	.74 *	4,840,061
1956	11,382,984	.605 *	6,886,705
1957	18,121,452	.605 *	10,963,478
1958	21,233,634	.605 *	12,846,000
1959	20,794,091	.605 *	12,580,000
1960	22,228,720	.605 *	13,448,000
1961	20,650,142	.736	15,199,000
1962	21,138,893	.774	16,362,000
1963	21,447,986	.8275	17,748,000
1964	22,472,891	.8275	18,596,000
1965	25,333,000	.8275	20,963,000
1966	24,533,000	.8275	20,301,000
1967	26,070,000	.849	22,134,000
1968	26,252,000	.915	24,020,000
1969	26,172,000	1.028	26,905,000
1970	25,349,000	1.284	32,548,000
1971	25,934,000	1.305	33,843,000

* Contract agreement price with Government 79.39 cents for the first 5 million pounds and 60.5 cents a pound thereafter until contract completed in 1961.

OREGON NICKEL PROJECT

One of the most important events in Oregon mining history took place January 16 in Washington, D.C., when the Defense Materials Procurement Agency signed a contract with Hanna Coal and Ore Corporation and the Hanna Nickel Smelting Company, both subsidiaries of the M. A. Hanna Company, Cleveland, Ohio, for the production of nickel from Nickel Mountain near Riddle, Douglas County, southwestern Oregon. The contract calls for the production of from 95,000,000 to 124,000,000 pounds of nickel in ferronickel which will contain at least 25 percent nickel and not more than 75 percent iron. The Hanna Coal and Ore Corporation agrees to develop the mine on Nickel Mountain at its own expense to cost approximately $4,300,000. Ore from the deposit will be sold to the Government at $6 a ton. In turn, the Government will sell the ore to the Hanna Nickel Smelting Company at the same price and the smelting company will treat the ore in an electric furnace plant to produce the ferronickel. This plant will be located about 2 miles down the mountain from the mine and will consist reportedly of four primary furnaces, one refining furnace, and two auxiliary furnaces.

It was announced in the press on February 3 that according to H. L. Pierce, Vice President of Hanna Coal and Ore Corporation and of Hanna Nickel Smelting Company, a contract has been awarded to the Bechtel Corporation, San Francisco, to handle the design, engineering, and construction of the nickel smelting plant at Riddle.

The Hanna Smelting Company will use a patented process developed in France by the Societe D'Electro-Chimi, D'Electro Metallurgie et des Acieries Electrique D'Ugine. This process has been used in treating New Caledonia ores having characteristics similar to the nickel silicate ore on Nickel Mountain. The contract price is 79.39 cents per pound for the first 5,000,000 pounds of nickel produced in the ferroalloy and 60.5 cents per pound thereafter.

The Government agrees to advance $24,800,000 for construction of the smelter and related expenses. The contract includes rapid amortization of the facilities installed.

The importance of this development to Oregon cannot be overemphasized. Nickel is one of the most strategic of metals needed in national defense and Nickel Mountain contains by far the largest deposit of nickel ore known in the United States. Moreover, the economy of the State will be greatly benefited by this large production of new wealth.

F.W.L.

****

OREGON

● A prediction that ferronickel will be produced by next June at the M. A. Hanna Co. development at Riddle was heard on the mining and smelting project site by a Portland Chamber of Commerce group which spent a day as company guests inspecting facilities under construction.

Earl S. Mollard, general manager for Hanna Nickel Smelting Co. told the 35 industrialists the installation of four electric furnaces should begin in January and initial ingots should be poured five months later.

Steel for the smelter structure, which along with other units of the multi-million dollar project is under contract to Bechtel Corp., San Francisco, was beyond 100 ft. in height the shop building completed, and four ore bins of 900 tons capacity erected.

Clearing of the slopes of Nickel Mountain, source of the ore, is well advanced on the area where initial bench mining is planned. In the smeltering structure area, concrete nests for furnaces have been poured. This building is 400 ft. long and 120 ft. wide.

Company engineers explained the two-ton bucket cable tramway, to drop 2,400 ft. from ridge to operation site, is expected to have a capacity of 3,000 tons a day of wet ore. Wing belts will convey the ore from dumps, feed underground from the storage areas to driers which will burn oil or wood sawmill wastes, the latter plentiful in the lumber area industries. Dried and crushed ore will move from the four bins into a pair of rotating calciners, each 250 ft. long, from which it will feed at 700 deg. C into bins above the furnaces. Officials reported they are trying to determine what uses they might find for the slag. Tests indicate it is not usable for highway surfacing or aggregate.

The government contract for mining and smelting of the defense stockpiling program metal calls for quantities indicating an 8 yr. operating cycle. But on the basis of planned capacity and ore reserves a 30- to 40-yr. operation is indicated, assuming an economic operation after the government contract is completed. In this respect, *The Portland Oregonian* reported amortization is so arranged that Hanna can acquire the smelting facility, financed by government advance, for $2.8-million at the end of the stockpiling contract.

Mollard is a veteran of 35 years with Hanna and predecessor companies. Plant superintendent will be Emmons Coleman, who joined Hanna in May after 10 years with Bradley Mining Co., Stibnite, Idaho, and 15 years with Idaho Power Co.

FEDERALLY BACKED OREGON OPERATION TO GIVE NATION NEEDED NICKEL

Green rock first noted in southern Oregon by sheepherders nearly 90 years ago appears destined to provide the state with its biggest mining enterprise to date--and the United States its first real source of nickel.

Thickly forested Nickel mountain, five miles west of Riddle in Douglas county, is marked for decapitation in yielding thousands of tons of a critical metal needed in the nation's defense.

Nickel is vital in toughening armor plate and making stainless steel, yet only a small fraction is mined domestically.

Action in Washington, D. C., has cleared most of the way for a start this summer on mining and smelting facilities to cost between $25,000,000 and $30,000,000. The mine is scheduled to be in operation by summer of 1954 and the smelter by the following October.

Subsidiaries of the M.A. Hanna company, Cleveland, O., a top-flight outfit handling millions of tons of coal and iron ore in this country and developing huge iron deposits in eastern Canada, will take on the Oregon nickel task.

Project State's Biggest

The Hanna Coal and Ore corporation will develop the mining operation at its own expense at a cost estimated close to $4,300,000. The defense procurement administration will advance up to $24,800,000 to the Hanna Nickel Smelting company to construct crusher and smelter.

That's the biggest thing that's ever come to Oregon mining. Riddle's development won't loom large against the huge nickel operations near Sudbury in Canada, but it will be of respectable size.

Hanna has agreed to produce for Uncle Sam at least 95,000,000 pounds of nickel contained in ferronickel. That's regarded as a minimum. Drillings have pretty well proved that two deposits on the prominence which also has long been known as Piney mountain, contain 20,000,000 tons of nickel ore, perhaps considerably more.

It's the largest known nickel deposit in this country, and the richest despite its low content of 1 to 3 per cent of the pale, hard metal. The nickel is locked in the silicate mineral, garnierite, with an approximate 6 per cent of iron.

Alloy to Rate High

That combination is why smelting will yield ferronickel, instead of nearly pure nickel as in Canada. Most nickel goes into nickel steel, anyhow, so the mixture is quite acceptable to industry.

Most nickel steels contain only 1 or 2 per cent of the toughening

metal, though they range up to more than 25 per cent. The alloy produced at Riddle is expected to run around 25 per cent nickel. Enough chromite exists in the ore to bring the product closer to actual stainless steel, though its use in stainless is rated unlikely.

Cost Factor Reduced

Oregon mining men have dreamed for decades of a going nickel operation, but economics long had them beat. Ore removal appeared feasible. The best deposits on Nickel mountain lie on terraces and slopes from 2000 feet elevation upward toward the summit of 3533 feet. Power shovels can scrape off the red earth overburden, permitting open pit mining.

But a new, cheap process for treating nickel silicate ores was needed--or a big boost in the price of nickel--to make an operation at Riddle feasible. The key has been found for the lock, with government aid to make an admittedly marginal venture attractive to a private company.

Cheaper methods for producing the ferro-nickel have come out of years of intensive research. The Albany laboratory of the U.S. Bureau of mines has come up with a smelting process peculiarly adaptable to Oregon's timber economy--it uses two tons of hog fuel to one ton of ore as a substitute for coke in the furnaces.

But the Hanna interests have adopted a closely-guarded French process, it is reported in mining circles. Developed by the French Societe d'Ugine, the process is being used on nickel ore from New Caledonia. Hanna reportedly will pay a royalty for its use.

What the advantage of the Ugine process may be is unclear to mineralogy men locally. It may utilize ferrosilicon as a reducing agent, one surmised.

Financing of the Riddle development is something of a riddle in itself, but apparently John Q. Taxpayer will be nipped to help boost strategic nickel supplies.

The mining subsidiary has contracted to sell the government enough ore to produce 95,000,000 pounds of nickel at $6 per dry ton of ore with 1.5 per cent of nickel, the average grade shown in test drillings. This is for the books, as the government then will turn around and sell the ore to the smelting company at the same figure.

Price Schedule Set

Hanna Nickel Smelting will produce ferronickel ingots at a price not to exceed 79.39 cents a pound for the first 5,000,000 pounds of nickel--a price not far from the current market figure of about 60 cents.

However, amortization provisions constitute a heavy subsidy. All but $2,800,000 of the federal advance to the smelting firm can be written off during the term of the contract, which runs to June 30, 1962, if the com-

pany fulfills its production commitment.

If Hanna wishes to retain the smelting facility at that time, it will owe the government only the $2,800,000. Continuation after 1962 is considered dubious unless new technical improvements arise or the nickel market climbs.

The Riddle smelter, it is reported, will have four primary furnaces, one refining furnace and two auxiliary furnaces. These will be electrically heated. Bonneville power administration has given the operation a commitment for 65,000 kilowatts of firm power, part of it for 1954 and the full amount by 1955.

The ore will go through a primary crusher at the mine site, then move between two and three miles down the slope of Nickel mountain, probably by conveyor either of the bucket or rubber belt type. The ore then will be recrushed and dried before smelting.

Other Deposits Known

Other deposits of nickel are known in the Northwest, but the Riddle body is the only one giving promise of production. All are at a disadvantage against Canadian ores, because the latter's sulphide combination yields nearly pure nickel through a relatively inexpensive process.

In southern Oregon two other deposits have been sampled and partially explored. A 4000-acre area at Red Flats in Curry county is being studied by the U.S. Bureau of Mines. Surface ore there contains 1.5 per cent nickel, said Regional Director Stephen Shelton; about in line with 1948 findings of a less intensive check by the state department of geology and mineral industries.

Size of this deposit has not been determined, but its location 20 miles in from the ocean and far from a railroad is discouraging. The third deposit in the region is at Woodcock mountain between Kerby and O'Brien in Josephine county, also far from a railroad.

A few sulphide deposits containing nickel, a little copper and a tiny amount of cobalt also are known in southern Oregon. But generally the hauling of the ore from other sites to Riddle is regarded as not feasible.

Second largest known nickel deposit in the Northwest, however, is in central Washington, 26 miles north of Cle Elum, and contains an estimated 5,500,000 tons smelting about 1 per cent nickel, 45 per cent iron and 1.7 per cent chromium. The deposit is regarded as not sufficient to justify a smelting operation under present conditions.

Oregon's story goes clear back to 1864 with the discovery on Nickel mountain. First to do much exploring and treating of

TREASURY SECRETARY HEADS HANNA CONCERN

The M. A. Hanna company name has become familiar to the nation's readers largely in recent months, not because of the nickel project, but because its shrewd boss, George M. Humphrey, has just become secretary of the treasury.

The $250,000,000 corporation dominates coal and iron mines, a steel corporation, ships, chemical plants, banks and a rayon factory. Its biggest new undertaking is a $200,000,000 iron ore development in remote Labrador, with private funds.

---

ore was W. Q. Brown of Riddle, between 1880 and 1900. He owned a large part of the mountain, which rises slightly higher than others around it.

But recurrent testing made little progress until World War II and its impetus for stockpiling of strategic metals. A geological survey report of 1942 estimated the deposit at something more than 6,000,000 tons on about 162 acres. Then the Freeport Sulphur company made 50 to 60 diamond drillings and boosted estimates to 20,000,000 tons in two ore bodies.

Freeport Sulphur abandoned Oregon to build the Nicaro plant in Cuba, another of the three foreign sources available to the United States. This nickel operation fell idle at war's end but was revived in late 1951.

Work at Nickel mountain was resumed in 1949 when the Hanna company leased mineral rights, with option to buy. For many years the site belonged to the Edson F. Adams estate, Oakland, Cal.

Hanna has sent ore samples to many laboratories for help in working out a refining process, including those of the federal bureau of mines, its own in the east and some in Europe.

Compared to the normal U.S. nickel consumption of more than 130,000 tons a year, the potential at Riddle is small, but defense production leaders consider the Oregon deposit well worth developing.

By: Merlin Blais, Staff Writer
The Oregonian--1-25-53

UNITED STATES DEPARTMENT OF THE INTERIOR
Harold L. Ickes, Secretary
GEOLOGICAL SURVEY
W. C. Mendenhall, Director

Bulletin 931–I

NICKEL DEPOSIT NEAR RIDDLE DOUGLAS COUNTY, OREGON

BY

WILLIAM T. PECORA

AND

S. WARREN HOBBS

Strategic Minerals Investigations, 1941
(Pages 205–226)

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NICKEL DEPOSIT NEAR RIDDLE,

DOUGLAS COUNTY, OREGON

By William T. Pecora and S. Warren Hobbs

ABSTRACT

The Riddle nickel deposit, on the slopes of Nickel Mountain about 5 miles northwest of Riddle, Douglas County, Oreg., was discovered in 1864. Since then much prospecting and preliminary development work has been done, but no ore has been shipped except small lots used for metallurgical tests.

The deposit is a layered blanket, containing the nickel silicate garnierite, which rests upon unserpentinized peridotite. This blanket ranges in thickness from a few feet to a maximum of 60 or 70, but with an average of about 20 feet. It is best developed on terraces, flats, and gentle mountain slopes above an elevation of 2,000 feet. It consists of three layers, a top brick-red soil layer, an intermediate thick yellow limonitic layer with some quartz-garnierite boxwork, and a root layer composed of quartz-garnierite boxwork in nearly fresh bedrock that is a transitional phase between weathered material and fresh peridotite. The disposition of the boxwork veins was controlled by original blocky jointing in the peridotite. Nickel occurs in all three layers of the blanket but is most abundant in the boxwork veins carrying garnierite. The darker green varieties of the garnierite contain the highest percentage of nickel.

The nickel is believed to have been derived from olivine in the peridotite by decomposition during lateritic weathering, which probably took place during late Tertiary time, before the present regional surface at an elevation of 2,000 feet was dissected. This process formed limonite and nickel-poor garnierite. Under present climatic conditions the original laterite has undergone a change resulting chiefly in a boxwork of quartz and nickel-rich garnierite.

About 162 acres of ground are underlain by a blanket containing over 6,000,000 tons of material, 1 to 2 percent of which is probably nickel. Eighty thousand tons have been proved to contain 2 to 3 percent of nickel, and 75,000 tons have been proved to contain 1 to 2 percent of nickel. A new method of treating low-grade silicate material would have to be devised before this large deposit could be utilized.

INTRODUCTION

The Riddle nickel deposit is on Nickel Mountain, also called Piney Mountain, about 5 miles northwest of Riddle, Douglas

County, Oreg. (fig. 20). The deposit is an unevenly distributed surficial blanket, containing the nickel silicate garnierite, which rests upon peridotitic rocks on the western, southern, and southeastern slopes of the mountain above an elevation of 2,000 feet.

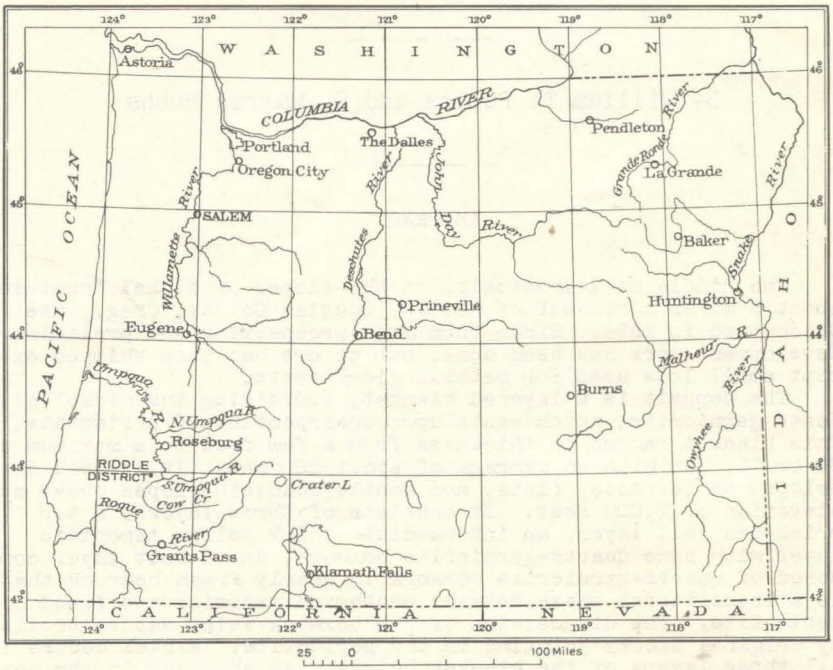


Figure 20.—Index map showing location of the Riddle nickel deposit.

Riddle, which has a population of about 200, is at an elevation of about 700 feet on the north side of Cow Creek a mile west of its junction with the South Umpqua River. It is on the Southern Pacific Railroad, and it is about 230 miles by highway south of Portland. A poorly conditioned dirt road about 5 miles long connects the town with the nickel deposit.

History and development

Since the discovery of the deposit by sheepherders in 1864, much prospecting and exploration has been done on Nickel Mountain, but up to the present no nickel ore has been shipped ex-

cept small lots used for experimental metallurgical tests. From 1880 to 1900, Mr. W. Q. Brown of Riddle owned a large portion of the deposit, and under his direction it was actively explored. Mr. Brown also experimented with concentration and treatment of the ore. The property that contains most of the deposit is now owned by Mr. Edson F. Adams of Oakland, Calif.

The accessible workings include 75 small pits and trenches, 6 adits, 3 shafts, and about 5 large open cuts. The longest adit is 300 feet long and the deepest shaft is 83 feet deep. The dump piles contain about 4,000 tons of material--practically all that has been excavated from the workings--in which the nickel content ranges from 1/2 to 3 percent. If garnierite ore of this low grade could be successfully concentrated or treated, there would be a huge potential reserve of nickel in the deposit. Mining of the deposit would involve no unusual problems; the principal obstacle to operation is the difficulty of profitably treating such low-grade ore.

Field work and previous investigations

During September and October 1940, the writers made a detailed study of the mode of occurrence of the nickel and prepared a map of the deposit. The geology of the Riddle quadrangle, in which the deposit is situated, has been described by Diller and Kay,[1] and the nickel deposit has been described by Clarke,[2] Von Foullon,[3] Austin,[4] Ledoux,[5] and Kay.[6]

1/ Diller, J. S., and Kay, G. F., U. S. Geol. Survey Geol. Atlas, Riddle folio (No. 218), 1924.

2/ Clarke, F. W., Some nickel ores from Oregon: Am. Jour. Sci., 3d ser., vol. 35, pp. 483-488, 1888; U. S. Geol. Survey Bull. 60, pp. 21-26, 1890.

3/ Von Foullon, H. B., On Riddle, Oregon: K. K. Geologische Reichsanstalt, Jahrb., vol. 42, pp. 224-234, Vienna, 1892.

4/ Austin, W. L., The nickel deposits near Riddle's, Oregon: Colorado Sci. Soc. Proc., vol. 5, pp. 173-196, 1896.

5/ Ledoux, A. R., Notes on Oregon nickel prospects: Canadian Min. Inst. Jour., vol. 4, pp. 184-189, 1901.

6/ Kay, G. F., Nickel deposits of Nickel Mountain, Oregon: U. S. Geol. Survey Bull. 315, pp. 120-128, 1906.

The authors are indebted to F. C. Calkins and H. G. Ferguson, of the Geological Survey, for many helpful suggestions during the preparation of this report. The chemical analyses were made by Victor North, also of the Geological Survey.

Topography

The topography of the Riddle quadrangle is typical of a large part of the Pacific Coast Ranges. The relief is about 3,000 feet. The summit of Nickel Mountain has an altitude of 3,533 feet and rises a few hundred feet above the neighboring ridges. The ridge crests are fairly uniform in altitude and were believed by Diller [7] to represent the widespread Klamath peneplain of late Tertiary age. Dissected erosion surfaces, the chief of which has an elevation of about 2,000 feet, are also recognizable at lower altitudes. In a detailed analysis of the topography of Nickel Mountain, given in a later section, the distribution of the ore is correlated with the topography. The physiographic history of the region has been an important factor in the formation and localization of the nickel deposit.

GEOLOGY

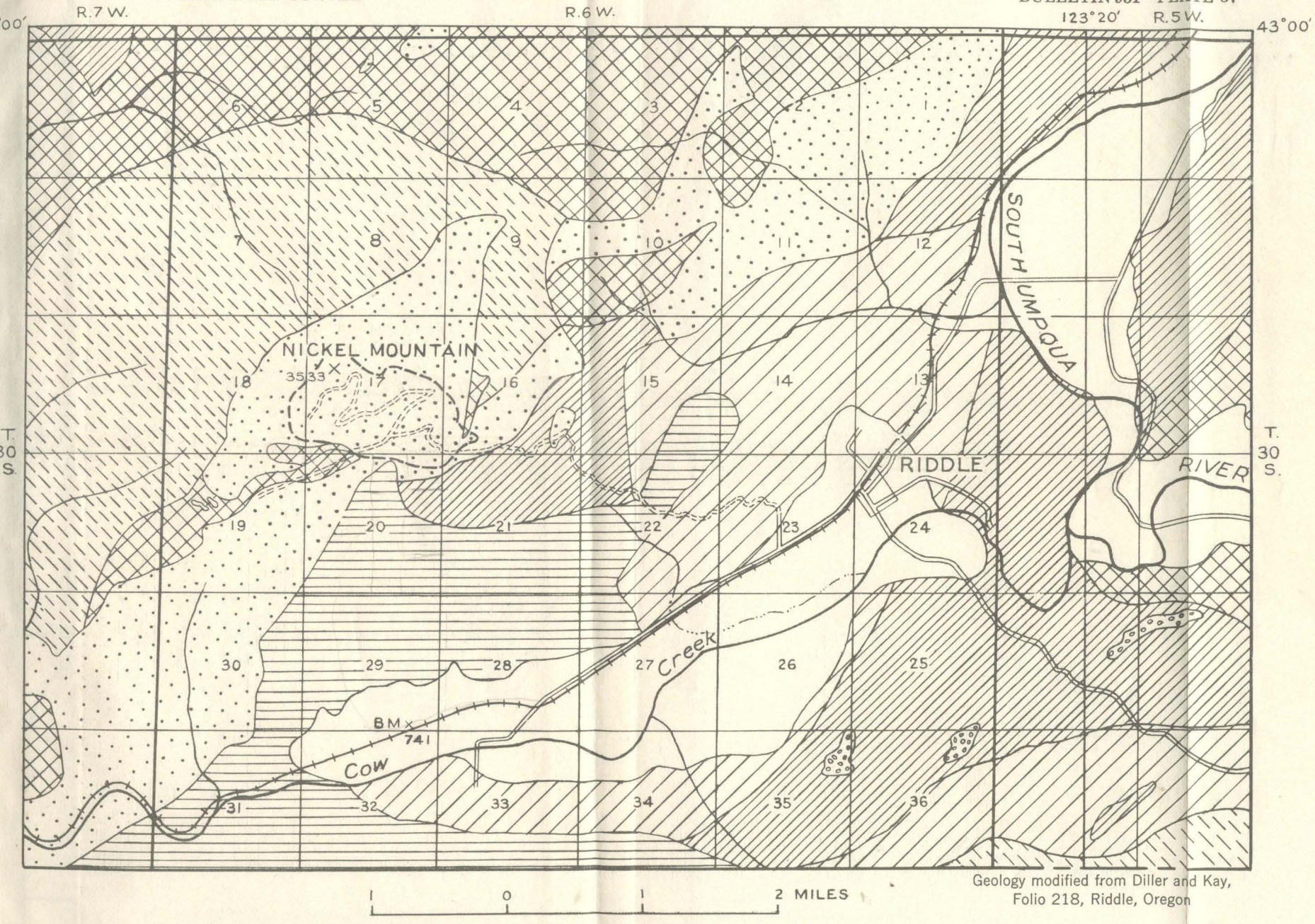
The areal distribution of the rocks in the vicinity of Nickel Mountain is shown on plate 37.[8] A large irregular body of peridotite and serpentine, which extends northeast and southwest from Nickel Mountain, is of principal interest, because the nickel deposits are related to the peridotite. The peridotite and serpentine body is intrusive into Jurassic sandstone and late Jurassic greenstone and related rocks, and is probably late Jurassic. The structure of these older rocks has a predominant northeasterly trend. They are unconformably overlain by the Knoxville formation and younger sedimentary rocks.

7/ Diller, J. S., Mineral resources of southwestern Oregon: U. S. Geol. Survey Bull. 546, pp. 12-14, 1914.

8/ The geology shown on plate 37 is modified from Diller and Kay, op. cit.

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

BULLETIN 931 PLATE 37



EXPLANATION

SEDIMENTARY ROCK

Alluvium

High terrace grave

Umpqua formatio
(Sandstone and sha

UNCONFORMITY

Horsetown format
(Shale)

UNCONFORMITY

Knoxville formati
(Sandstone and sha

UNCONFORMITY

Dothan formatio
(Sandstone)

IGNEOUS ROCKS

Serpentine and peridotite

Greenstone, gabb and related rock

Boundary of are mapped in deta

Geology modified from Diller and Kay, Folio 218, Riddle, Oregon

GEOLOGIC MAP OF THE VICINITY OF NICKEL MOUNTAIN, DOUGLAS COUNTY, OREGON

U. S. GOVERNMENT PRINTING OFFICE: 1942 O - 430320

(Faces p. 208)

Peridotite

In the ultrabasic intrusive mass of Nickel Mountain, peridotite is far more abundant than its derivative, serpentine. This is true of the entire intrusive body as well as the small part shown on plate 38, with which the nickel deposits are associated. In previous geologic reports on this region, "serpentine" is commonly used as a collective term for all the ultrabasic intrusive rocks, but as the nickel ore is associated only with the unserpentinized peridotite, it is essential to discriminate in this report between true serpentine and the peridotite from which the serpentine is derived. The name serpentine is therefore applied only to the serpentinized ultrabasic rocks, and the unaltered rock is called peridotite.

The peridotite is partly dunite and partly saxonite. Dunite contains more than 90 percent of olivine, $((Mg,Fe)_2SiO_4)$, and saxonite contains, with its dominant olivine, as much as 40 percent of the orthorhombic pyroxene enstatite, $((Mg,Fe)SiO_3)$. Dunite and saxonite are not shown separately on the geologic map (pl. 38). Field study revealed no system in the distribution or structural orientation of masses of the two rocks. Although no fine-grained or chilled varieties were seen, large irregular masses of saxonite appear in places to be intrusive into dunite. Probably both rocks were formed in the same intrusive episode, but the saxonite crystallized later than the dunite.

The saxonite and dunite are coarse-grained and hard, and both contain a little scattered chromite, $(FeCr_2O_4)$, but the few segregations of chromite are always associated with the dunite. Both rocks are dark yellow green on unweathered surfaces. In weathered outcrops the dunite is brownish green and exhibits a fine-textured lattice-work of joints. The weathered saxonite is dark reddish brown and has a coarse blocky jointing that makes it more resistant to weathering than the dunite, and it is further distinguished by a pitted surface, because the pyroxene in

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it is more resistant to weathering than the olivine. This feature is especially noticeable where decay of the rock is far advanced, the olivine being completely changed to yellow limonite whereas the pyroxene remains in recognizable crystals.

As the nickel content of olivine is greater than that of enstatite (see table on p. 211), unweathered dunite has a higher nickel content than unweathered saxonite. Under certain conditions of weathering the nickel originally contained in the olivine became concentrated in the nickel-magnesium silicate garnierite, which, together with quartz, forms veinlets in both rocks. These veinlets are more abundant in the dunite than in the saxonite, as the dunite is the more closely jointed. The ratio of garnierite to quartz is also higher in the veins cutting dunite, as the larger olivine content affords a larger supply of nickel.

A brick-red soil which is developed on the surface of the nickel deposits is described in the section that deals with the deposits.

Serpentine

A band of partly or completely serpentinized peridotite, from 10 to several hundred feet in width, separates the unaltered parts of the intrusive body from the older rocks wherever the contact was observed. This border facies of the ultrabasic intrusive rock consists mainly of a black, fine-grained serpentine. In many specimens the pyroxene is unaltered although the olivine is completely serpentinized, but commonly the pyroxene also is serpentinized, being altered to lustrous bronze-colored pseudomorphs of bastite. Some of the partly altered peridotite contains veins of serpentine.

In places within the border zone of the intrusive there are masses of green slickensided serpentine. This material encloses rounded blocks of the black, fine-grained serpentine, from which

it evidently was derived. A similar association was observed by Palache [9] in the serpentine of the California Coast Ranges.

Analyses of two samples of serpentine show that it contains more nickel than the olivine samples that have been analyzed (see table below). However, no nickel deposit has been found in serpentine. Both varieties of serpentine weather to a gray-brown soil that is conspicuously different from the soil over peridotite.

Analyses of rocks and minerals from Nickel Mountain

	1	2	3	4	5	6
SiO_2	41.43	42.81	....	....	....	....
Al_2O_3	.04	Not det.	....	....	....	....
Fe_2O_3	2.52	2.61	....	....	....	....
FeO	6.25	7.20	....	....	....	....
CaO	.55	None	....	....	....	....
MgO	43.74	45.12	....	....	....	....
NiO	.10	.26	0.32	0.05	0.45	0.33
Cr_2O_3	.76	.79	....	....	....	....
Loss on ignition	4.41	.57	....	....	....	....
	99.80	99.36	....	....	....	....
Ni	.08	.20	.25	.04	.35	.26

1. Peridotite (saxonite) with more than two-thirds olivine. Clarke, F. W., op. cit. (1888), p. 485.
2. Olivine, not entirely free from enstatite and chromite. Clarke, F. W., op. cit. (1888), p. 485.
3. Olivine. Von Foullon, H. B., op. cit., p. 226.
4. Orthorhombic pyroxene ("bronzite"). Von Foullon, H. B., op. cit., p. 226.
5. Serpentine from locality near border east of stock. Von Foullon, H. G., op. cit., p. 233.
6. Serpentine from locality northeast of Nickel Mountain. Kay, G. F., op. cit., p. 126. George Steiger, analyst.

THE NICKEL DEPOSIT

The typical ore [10] of the nickel deposit is a blanket of deeply weathered peridotite, now almost entirely altered to limonite, which is host to an intricate lattice boxwork of quartz-garnierite veins. The deposit was formed during the weathering

9/ Palache, Charles, Lherzolite and associated rocks of the Potrero, San Francisco: California Univ., Dept. Geology, Bull. 1, pp. 161-180, 1894.

10/ The term "ore" is not used here in the strict sense, being applied for convenience to material not rich enough to be worked profitably, in place of such cumbersome phrases as "potential ore", "nickel-bearing material".

of the unserpentinized peridotite upon which it rests, by a two-fold supergene process which involved the release of nickel from the primary minerals and its combination in nickel-poor secondary minerals under a humid tropical climate, and its subsequent concentration in nickel-rich garnierite under a humid temperate climate. The deposits are the remains of a once more extensive blanket, which probably at one time covered most or all of the peridotite in the area. Landsliding, rill wash, and slope wash have stripped parts of the deposit from the unweathered peridotite. The weathered blanket is constantly undergoing further chemical change, so that in small areas further enrichment in nickel is being effected, apparently by the breaking down of early formed garnierite that contains relatively little nickel and the formation of nickel-rich garnierite and quartz. Garnierite does not seem to be forming directly from the peridotite under present climatic conditions.

Mineralogy

The principal minerals of the nickel deposit are garnierite (hydrous nickel-magnesium silicate), quartz, chalcedony, and chert (three varieties of silica), and limonite (hydrated iron oxide). A small quantity of chromite ($FeCr_2O_4$) and manganese oxide are also present.

Garnierite.--The garnierite ranges in color, even in the same vein or hand specimen, from yellowish green through apple green to blue green. The darkest variety, which presumably has the highest nickel content, occurs in some places as veinlets in the yellowish-green variety. When the mineral is wet it is darker-colored than when it is dry. Some of it then crumbles under slight pressure, and some spreads like paste. The dry garnierite is soft but brittle, and will adhere to the tongue. Analyses of garnierite from Nickel Mountain are shown in the table on page 213.

Analyses of garnierite from Nickel Mountain

	1	2	3	4
SiO_2	44.73	48.21	40.55	48.82
$Al_2O_3 + Fe_2O_3$	1.18	1.38	1.33	.06
MgO	10.56	19.90	21.70	18.49
NiO	27.57	23.88	29.66	19.04
H_2O+	6.99	6.63	7.00	12.29
H_2O-	8.87			
	99.90	100.00	100.24	98.70
Ni	21.67	18.77	23.31	14.97

1. Clarke, F. W., op. cit. (1888), p. 484.
2 and 3. Blake, W. P., Nickel: Mineral Resources U. S., 1882, p. 404.
4. Von Foullon, H. B., op. cit., p. 272. (Apple-green garnierite.)

Enriched garnierite.--Much of the garnierite of the main ore zone shows evidence of recent enrichment in nickel through the breakdown of an earlier-formed, nickel-poor variety. Near the base of the decomposed mantle rock a greenish-yellow to colorless variety of garnierite has been found in partly weathered dunite. This material is always below the ore and is well-exposed along the road bed and road cuts in the southeastern part of the deposit, in some places on the steep slopes in fresh peridotite, and on the bed-rock areas of the summit of Nickel Mountain. Quartz and green garnierite are both absent or rare at these localities, but if one is present, the other is also. Both enriched garnierite and quartz may occur as veins in the pale garnierite, but the quantity of the enriched material increases toward the surface and develops a network of cross-cutting quartz-garnierite veins. This is well shown at the Discovery and West Workings. The order of formation in all places is from pale garnierite to deeper-colored garnierite, and a rude zoning indicates a progression from pale varieties at depth to deeper-colored varieties toward the surface. This indicates a process of supergene nickel enrichment in garnierite, and the pale, unenriched garnierite, which is accompanied by limonite, is believed to be the source of both the nickel and the silica concentrated by the recent enrichment process.

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Quartz.--The quartz which is persistently associated with the garnierite in the boxwork veins is commonly white and fine-grained. The quartz of the thin, flaky veinlets in the garnierite is porcellaneous, while that of the thicker veins is coarser and partly brownish. Brown chalcedony or cherty silica is common near the surface of the deposit. Quartz is generally more abundant than garnierite in the boxwork, but its relative abundance decreases downward from the surface.

Limonite.--Most of the limonite is soft and easily removed from the boxwork, but at a few places near the surface part of the limonite is silicified to a brown, chert-like mass. One sample of limonite from between the quartz-garnierite veins of the boxwork contained about 1 percent of nickel.

Layers of the deposit

The nickel deposit is layered, as is well shown in the vertical section exposed at the Discovery workings and represented in figure 21. A top layer of brick-red soil, 2 to 3 feet thick, covers the main layer, 40 feet thick, of quartz-garnierite boxwork in limonite. Locally the boxwork layer contains "boulders" of peridotite, which are incompletely altered residuals. The base of the boxwork layer is very irregular, but is approximately parallel to the hill slope. Below the boxwork layer is the basal or root layer. In it prongs of the peridotite project upward, and, conversely, roots of the boxwork project downward into fresh peridotite. The maximum depth of boxwork roots in peridotite is not known but is estimated to be about 150 feet.

Brick-red soil layer

The top layer of the deposit averages 2 to 3 feet in thickness and ranges from a thin veneer up to 9 feet. It consists of brick-red soil, soft and incoherent, containing small round pellets of red iron oxide and, at the surface in a few places,

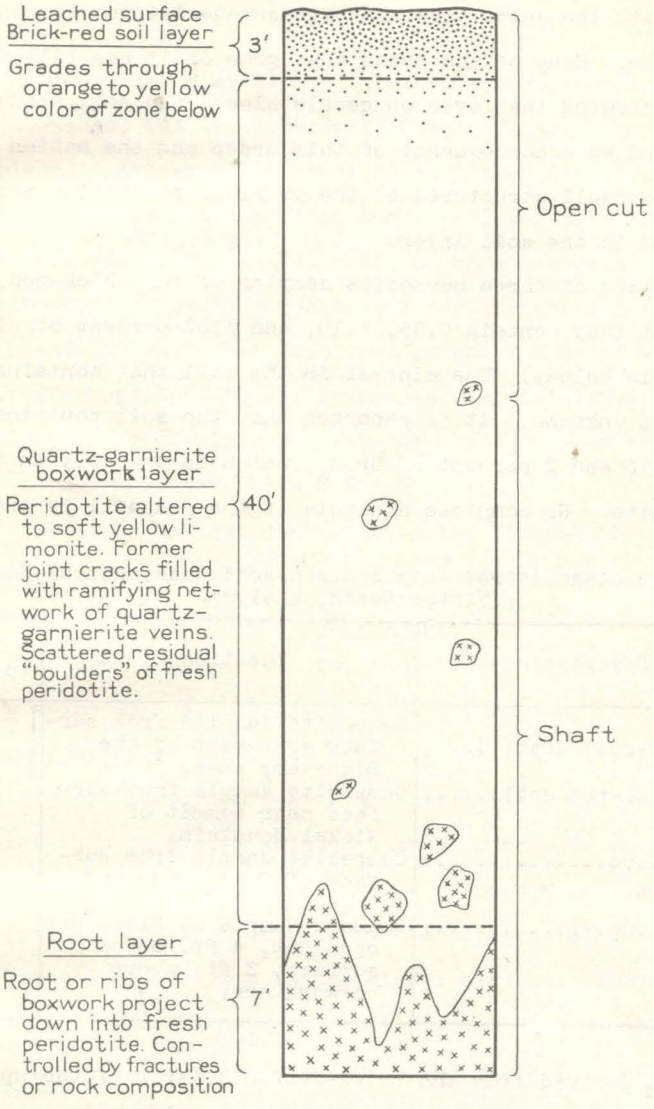

Figure 21.--Diagrammatic sketch of a vertical section of the mineral deposit at the Discovery workings.

small pieces of dull quartz or larger fragments of spongy quartz. The quartz, which is commonly stained with much manganese oxide, is a residue of weathered boxwork, and hence may be an excellent guide to unexposed boxwork ore.

The brick-red soil layer, originally derived from peridotite, supports a moderately heavy growth of vegetation, which con-

trasts with the scant growth on areas underlain by serpentinized peridotite. Many of the trees that grow on it are tilted and curved, showing that even on gentle slopes the soil tends to creep, and as a consequence of this creep and the action of plant roots all structures of the original peridotite are obliterated in the soil layer.

Analyses of three composite samples of the brick-red soil show that they contain 0.95, 1.10, and 1.02 percent of nickel. (See table below.) The mineral in the soil that contains the nickel is unknown. It is reported that the soil contains between 0.75 and 2 percent of Cr_2O_3, which is probably in the form of chromite. No complete analysis of the red soil is available.

Nickel content of red soil and red-soil wash, Nickel Mountain
[Victor North, analyst]

Sample No.	Description	Location	Ni (percent)
1	Red-soil wash.....	Composite samples from surface southeast of the Discovery area.	0.61
2			.71
3	Brick-red soil.....	Composite sample from surface near summit of Nickel Mountain.	.95
4	....do.....	Composite sample from surface of 2 acres around Discovery shaft.	1.10
5	....do.....	Channel sample at Discovery open cut, 4 ft. below surface, 3 ft. above boxwork ore.	1.02

Wash derived from the brick-red soil layer of the upper slopes partly covers terraces and the bottoms of small valleys on the lower slopes of Nickel Mountain. Analyses of two composite samples of this wash material collected southeast of the Discovery area (see pl. 38 and fig. 22) show that they contain 0.61 and 0.71 percent of nickel. The wash also contains very small grains of chromite.

Quartz-garnierite boxwork layer

The boxwork layer attains a thickness of 40 feet at the Discovery workings, but it is between 10 and 20 feet thick in most other places. At several places, boxwork ore can be seen to project downward like roots into the underlying peridotite. This is well shown at the West shaft where a narrow irregular root of boxwork extends downward from the surface for at least 85 and possibly 100 feet. Scattered patches of boxwork ore in areas of fresh peridotite are common in the vicinity of the main ore bodies, and probably represent the lower ends of the root zone of a once more extensive boxwork layer.

Two striking features characterize the boxwork in both the boxwork layer and the roots: (1) The intimate quartz-garnierite veins form a honeycomb in yellowish, hard or soft limonitic material weathered from peridotite, and (2) local fractures and fracture veins with slickensided walls are common.

Boxwork veins.--Individual veins in the boxwork layer consist mainly of intergrown quartz and garnierite, and they range from paper-thin sheets to veins 2 inches or more in thickness. Quartz commonly forms the walls of the veins and encloses the garnierite, but it also forms intricate networks of very thin, white, porcellaneous veins in the nickel mineral. The relative proportions of the two minerals in the veins vary greatly from place to place. The boxwork layer on the north face of the Discovery open pit, which is exceptionally rich in garnierite, is estimated to contain 5 percent of garnierite, 15 percent of quartz, and 80 percent of limonite. Here, the boxwork layer averages between 3 and 4 percent of nickel. Elsewhere, garnierite commonly makes up 5 to 10 percent of the individual boxwork veins, but less in the veins near the surface in which leaching or rain wash have been active. Below the surface the veins are compact, but near and at the surface they contain open spaces

whose walls are coated with brown-stained quartz. Brown quartz locally replaces the white quartz.

The garnierite varies in color and composition in the same vein. Green is the predominant color, and the shade of green is darker when the boxwork is wet. Both the percentage of garnierite in the veins and the nickel content of the mineral itself must be estimated before any evaluation of a boxwork exposure can be made by inspection in the field.

In some places the boxwork, naturally exposed on the surface, is almost entirely leached of its garnierite, and there remains a heavy, spongy mass of brown and white quartz. When this leached outcrop material is broken, small angular or rounded fragments of garnierite are frequently found within the protective quartz. Much of the boxwork ore of the dump piles also shows this feature. The exposed garnierite is more easily washed from the boxwork by rain than leached by the chemical activity of the water. Large masses of the sponge-quartz outcrops are exposed on the surface of the gentle slope immediately below the summit. Prospect pits prove conclusively that such leached outcrops can be used as guides for location of unexposed boxwork ore, but it is reported that the boxwork ore exposed beneath such leached outcrops contains less than 2 percent of nickel.

Joints and fractures in the fresh peridotite have been the main factor in controlling the pattern as well as the thickness of the veins. The coarse rectangular joint plan of the saxonite supports a very coarse boxwork. The largest observed joint block of saxonite is about 4 feet in diameter, many are 1 to 2 feet, but most of the blocks are only a few inches across. The thickness of the individual veins of the boxwork varies in proportion to the size of the joint blocks that the veins enclose. The thickest of the veins of the boxwork are about 2 inches; the thinnest are mere films a fraction of an inch across. The in-

dividual cells of the boxwork frequently contain a core of unweathered peridotite in a soft limonitic matrix, and this relationship is evidence of the process by which the peridotite was altered to form the ore. The closely spaced joints of the dunite, on the other hand, support a finer-textured boxwork of thinner septa; the joint blocks are rarely more than an inch across, are completely weathered, and are enclosed in a lacework of quartz and garnierite.

The limonite interstitial to the boxwork veins is soft and crumbly in the boxwork layer but is hard and compact at some places in the boxwork roots. A carefully collected sample, weighing about an ounce, of soft limonite from the boxwork deposit at the portal of the Discovery adit contained 1.3 percent of nickel (see table on p. 220).

Fracture veins.--Open fractures are numerous in the boxwork ore and also in the peridotite that contains the boxwork root. Brown and white quartz and light- to dark-green garnierite form veins along these fractures, and both minerals show slickensides. The thickest vein, observed at the West shaft, ranges in thickness from 6 inches to a foot in a distance of 30 feet. Some fragments of the vein on the dump are 14 inches wide and consist predominantly of white and brown quartz, which encloses scattered small pellets of garnierite. The brown quartz is banded and flinty and clearly replaces the white quartz. Some cavities in quartz are lined with mamillary crusts of dark-green garnierite and brown quartz.

Along some parts of the veins apple-green to blue-green garnierite has been deposited. The thickest vein of garnierite was observed on the south wall of the West open cut, where it ranged in thickness from 1 to 3 inches in a distance of 15 feet. The veins are not persistant in depth and commonly extend less than 20 feet along the strike. Boxwork is characteristically present in the wall rock and at the edges of the fracture veins.

The attitude of the veins in the deposit is not systematic. Low dips are commoner than high ones for veins near the surface, but high dips are most characteristic for fracture veins in the roots. Where slickensides are present, movement is indicated in a direction down the present slopes of Nickel Mountain. The fractures that contain the fracture veins are possibly results of slumping, landsliding, or local collapse of the mineral deposit.

Nickel content of samples from boxwork and root zone, Nickel Mountain
[Victor North, analyst]

Sample No.	Description and Location	Ni (percent)
1	Limonite between boxwork, portal of Discovery adit.	1.31
2	Rich pocket of garnierite ore from fracture vein in west wall of Discovery shaft.	8.09
3	Composite of five channel samples of boxwork ore from walls of Discovery open pit, representative of upper 15 ft. of boxwork.	2.07
4	Composite sample from 30 ft. of boxwork ore in Discovery shaft.	2.81
5	From bottom 5 ft. of Discovery shaft; part boxwork ore and part peridotite.	1.84
6	Composite sample from outer 150 ft. of Discovery adit; part boxwork ore and part peridotite.	2.06
7	From breast of Discovery adit, 175 ft. from portal; part boxwork ore and part peridotite.	1.35
8	Composite sample from upper 35 ft. of West shaft; mostly boxwork ore.	1.94
9	From bottom 4 ft. of West shaft (84-88 ft. below surface); mostly peridotite with films of garnierite and glassy quartz along fractures in rock.	.83
10	Composite sample from outer 155 ft. of West adit; mostly boxwork.	1.04
11	Composite sample from inner 145 ft. of West adit (to face at 300 ft. from portal); mostly peridotite.	.34

Root layer

The lowermost part of the blanket of ore is a zone in which root-like extensions of the boxwork material above penetrate the underlying fresh peridotite. The zone is very irregular and marks the transition from ore to bedrock. The boxwork roots project downward into the fresh peridotite to an unknown depth.

In the boxwork deposits of the West area and of the steep slope northwest of the Discovery deposit, which are interpreted as parts of the root zone, the greatest known depth of the roots is about 85 feet. This figure depends on the fact that the breast of the West adit, which lies about 40 feet directly below the bottom of the West shaft, is in partly weathered peridotite with thin flakes of quartz and garnierite.

Only the boxwork roots need be explored in the root zone. Except where enrichment has taken place, the boxwork roots reportedly contain less than 1 percent of nickel.

Origin

Relation to slopes

It is generally recognized that the best deposits of garnierite lie on terraces and gentle slopes at altitudes above 2,000 feet, and such ground therefore has been the most thoroughly prospected. (See fig. 22.) Some terraces cut on fresh peridotite below 2,000 feet, are mantled with wash, consisting partly of boxwork and partly of red soil derived from upper slopes. The West area and the steep slope northwest of the Discovery area contain root deposits of a former gentle surface of higher elevation which, before erosion to the present slope, was probably rich in boxwork ore. Debris from the West area boxwork is abundant on a 2,500-foot terrace west of the mapped area of plate 38.

The dissected terrace at 2,000 feet is part of a widespread erosion surface, and it is evidently much older than the stream terraces, at least 500 feet lower, from which Pleistocene vertebrate remains have reportedly been collected. The deposits are probably not much younger than the 2,000-foot terrace, for no garnierite and limonite layer is known to have formed on any terrace cut on peridotite below the 2,000-foot terrace level. All local terraces in peridotite between 2,000 feet and the

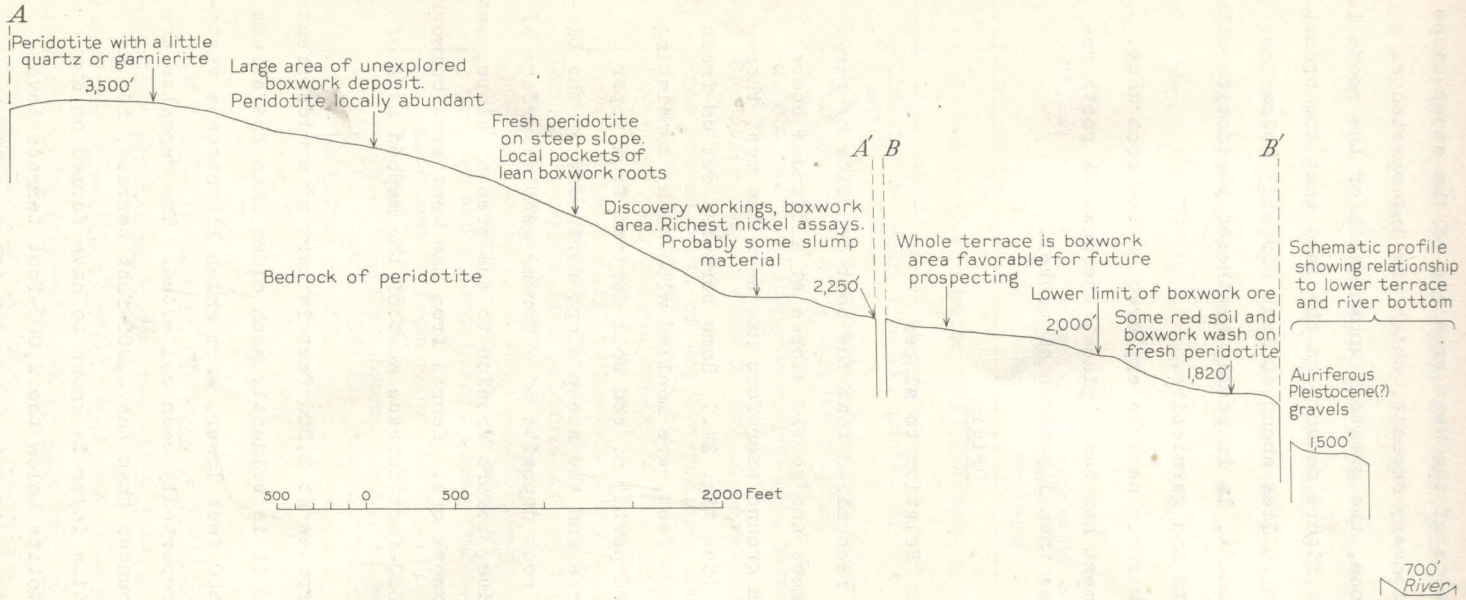

Figure 22.—Composite and schematic profile of the southeast side of Nickel Mountain and the adjacent area, showing relationship of ore to topography.

summit of Nickel Mountain, on the other hand, have deep roots of boxwork ore. The writers therefore believe that the weathering of peridotite to a lateritic soil made up chiefly of limonite and nickel-poor garnierite took place during the time interval, probably late Tertiary, in which the Klamath Upland Surface was uplifted and dissected, to form ultimately a widespread mature erosion surface whose base level in the area near Nickel Mountain is now represented by the 2,000-foot terrace. According to this interpretation, the present nickel deposit is largely a partially reworked remnant of a lateritic soil blanket, which originated in late Tertiary time, and no further weathering of this kind occurred in the peridotite that was later exposed by dissection of the 2,000-foot terrace.

Formation of boxwork

Either of two conditions may have produced a deeply weathered limonitic blanket on the peridotite during the formation of the late Tertiary 2,000-foot erosion level: (1) climatic conditions differing from that of later, presumably Quaternary time, or (2) longer weathering under the same climatic conditions. The writers favor the first alternative, and believe that the late Tertiary weathering was lateritic. A humid and tropical to subtropical climate would produce laterite on a peridotite surface of low relief. While the olivine was decomposing under these conditions, magnesium, nickel, and silica combined with water to form nickel-poor garnierite, and iron oxidized to form limonite. In true laterites, quartz is not precipitated within the deposit.

Under Recent humid-temperate climatic conditions new laterite did not form, but the laterite already formed became further altered. Decomposition of garnierite at the surface released silica, magnesium, and nickel. Much of the silica was precipitated as quartz, some magnesium was leached and lost, and much

nickel was redeposited lower down to form green nickel-rich garnierite associated with quartz. In the root zone the nickel-poor garnierite has been partly decomposed and enriched in place.

The quartz-garnierite boxwork is therefore attributed to Recent weathering of the lateritic product of Tertiary weathering. Garnierite and quartz are being deposited at the present time along fractures in peridotite below the boxwork.

Both Von Foullon [11] and Kay [12] have argued that garnierite was formed by the weathering of serpentine derived from peridotite; and Austin [13] believed that the quartz-garnierite veins were of hydrothermal origin. In the writers' opinion, on the contrary, field evidence strongly indicates that the garnierite was derived from peridotite rather than serpentine and deposited, together with quartz, by a secondary supergene rather than hydrothermal action.

Reserves

Grade

Under present conditions, garnierite ore containing less than 5 percent of nickel cannot be worked profitably. Most of the deposit at Nickel Mountain contains only 1 or 2 percent of nickel, and only a relatively small part, reckoned in minable tonnages, contains as much as 2 to 3 percent.

Calculations from samples totaling a few hundred pounds indicate that the boxwork ore at the Discovery workings contains between 2 and 3 percent of nickel, but representative samples of boxwork ore from other parts of the deposit contain less than 2 percent of nickel. Samples weighing a few pounds and containing 3 to 5 percent or more of nickel can indeed be collected--one taken by the writers from the richest pocket of garnierite ob-

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11/ Von Foullon, H. B., op. cit.
12/ Kay, G. F., op. cit.
13/ Austin, W. L., op. cit.

served contains 8.09 percent of nickel--but these samples are not representative. The results of the writers' sampling indicate that the nickel content of the deposit is lower than has been reported. Kay,[14] for example, states that two specimens, collected as representing average boxwork ore, contained 5.35 and 4.94 percent of nickel, and that about 20 tons of ore, shipped by the Oregon Nickel Mines Co. for experimental purposes, was reported by the company to contain between 5 and 8 percent of nickel.

Estimates of tonnage

At the Discovery shaft, adit, open cut, and adjacent trenches there is a proved minimum of 80,000 tons[15] of boxwork ore in which the nickel content is estimated to be at least 2

Estimated tonnage of nickel ore at Nickel Mountain

Location	Proved ore (tons)	Probable ore (tons)	Estimated Ni content (percent)
Boxwork:[1]			
Discovery workings	80,000	200,000	2 to 3
West workings	50,000	.....	1 to 2
Miscellaneous trenches, pits, short adits, dumps	25,000	.....	1 to 2
Discovery area	.....	2,000,000	1 to 2
West area	.....	500,000	1 to 2
Upper area	.....	3,000,000	1 to 2
Brick-red soil:[2]			
Discovery area	.....	240,000	½ to 1½
West area	.....	48,000	½ to 1½
Upper area	.....	300,000	½ to 1½

[1] Boxwork calculations based on 20 cu. ft. per ton.
[2] Red soil calculations based on 25 cu. ft. per ton.

but not more than 3 percent. In the area surrounding the Discovery open cut there is probably at least 200,000 tons of the same grade. The exposures over a wider area about the Discovery workings indicate that there is probably about 2,000,000 tons

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[14] Kay, G. F., op. cit., p. 124.
[15] Calculations of boxwork ore are based on an estimate of 20 cubic feet per ton.

more material with a nickel content of 1 to 2 percent. Further prospecting within this promising area might justify a higher estimate.

At the West workings, the shaft, open cuts, and adit develop a proved minimum of 40,000 tons of boxwork ore, and at the open cuts north of the West adit there is at least 10,000 tons of proved ore, having a nickel content between 1 and 2 percent. The probable ore in the area about the West workings amounts to about 500,000 tons, of the same grade.

Scattered pits, trenches, short adits and dump piles partly block out about 25,000 tons of boxwork ore containing between 1 and 2 percent; this also may be regarded as proved ore.

For the large area east of the West workings, the estimate of probable ore is 3,000,000 tons with a grade of 1 to 2 percent. Much of this area is as yet unexplored, so that a larger tonnage is possible. In some places, however, the boxwork ore may contain less than 1 percent and in others more than 2 percent.

In all, the Nickel Mountain deposit contains more than 6,000,000 tons of boxwork ore, composed of limonite, quartz, garnierite, and chromite, with a nickel content of 1 percent or more. There is, in addition, over 600,000 tons of brick-red soil containing 1/2 to 1½ percent of nickel.

The deposit can be mined by power shovels at low cost, but a new method of treating nickel silicate ores or a great increase in the price of nickel would be required to make mining of the deposit profitable.

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NICKEL MOUNTAIN

Riddle Area

Freeport Sulphur is exploring the nickel deposits here. Old workings have been cleaned out, particularly the adit and shaft at the "Discovery" and the 80 foot shaft and the lower adit at the "West area". In addition drilling has been started.

Climax Molybdenum drilled a north-south line of holes through the "Discovery" area on 400 foot centers, about 1938 or 1939. Hobbs and Pecora did not mention this work and it is doubtful if they knew of it. Freeport has started a line of holes 400 feet west, on 400' centers, and will continue to explore on that basis. The Climax work consisted of three holes, the deepest being 130 feet. The weighted average assay was 1.87 percent nickel.

Recent Freeport drilling proved nickel in this peridotite at a depth of 125 feet, - a zone 5 feet thick. Minor showings were found at 155 feet.

Certain observations were made at the time of the visit. They are recorded here for what they are worth, in an effort to evaluate Hobbs and Pecore's (H & P) observations and conclusions. A study of their paper is advisable.

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Red soil seems to average remarkably uniform in nickel when nickel is present; both in the cover over the terraces and in "wash" at lower elevations according to H. & P. What does this indicate relative to supergene enrichment? Perhaps the present nickel showings represent a once continuous blanket that covered the Mountain, - later eroded into present terraces. (suggested by Dave Evans). H. & P., 42:214 state that the limonite enclosed in the boxwork assays about 1% nickel. This is very similar to the percent of nickel in the red soil. They also say that the abundance of quartz in garnierite decreases downward, yet we found silica being deposited, right now, in the lower rock.

On p. 213 H. & P. mention a progression of paler varieties of garnierite to darker varieties toward the surfaces and that the darker colors represent richer material. In the lower adit, "West area", this is not true as dark garnierite is abundant in seams in the peridotite.

On p. 214, H. & P. state that brown cherty silica is more abundant nearer the surface, but I found abundant brown cherty silica in the lower adit, "West area", and have some beautiful specimens to prove it.

The above observations suggest difficulties with the H. & P. theory of origin and the apparent "upward" movement of silica and nickel in the second stage. Another suggestive feature is the similarity in nickel assays of the red soil and of the limonite between the boxwork. If the second stage is a re-concentration it is odd that that "matrix" should be so uniform in nickel content.

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Some observations about silica were made. There is little silica in the red soil, except cellular masses that probably have worked up from the limonite zone like large rocks work upward in a gravelled road. Silica is abundant as box work in the limonite zone. Silica gel is being deposited at the present time in the peridotite, as evidenced by the gel on mine timbers and along joint cracks in the lower adit, "West area". Whether nickel is being deposited with the gel is not known.

The points of the above discussion is that silica apparently is moving downward. If the overlying limonite and red soil is true laterite it should be deficient in silica. Might there be a possibility that both silica and nickel are being leached from the peridotite at the present time.

A factor overlooked by H. & P. was the flat top of a portion of Nickel Mountain. This area is covered with a red soil of unknown depth. Outcropping peridotite frequently has cellular quartz on its surfaces. Some of this quartz shows garnierite.

Reference: H. & P. = Hobbs, S. Warren, and Pecora, William T., Nickel deposits near Riddle, Douglas County, Oregon: U.S.G.S. Bull. 931-I.

Informant: Ray C. Treasher, trip of July 30, 1942.

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OREGON NICKEL MINES — Riddle Area.

Owner: CONFIDENTIAL.

Location: sec. 17, T. 30 S., R. 6 W., with the main nickel deposits in the south half of sec. 17, covering the summit and south side of Nickel Mountain, plus two mining claims that lie partly in SW¼, sec. 17 and SE¼ sec.18.

Area: 640 acres, plus fractions of two mining claims.

History: see Bulletin No. 14-C, Vol. 1, under Nickel Mountain.

Development: A great number of test pits, trenches, etc. There are two main sets of workings; a lower pit at elev. about 2600' and an upper pit at an elev. of about 3200' on the north side.

Lower Pit: consists of a 100' adit and a 35' shaft as well as a quantity of surface pit around the group. (see photographs)

Upper Pits: a series of test trenches, an 80' shaft, a 300' adit now caved about 100' from the portal. There is another group of pits and trenches about 600' E-NE of the upper pit.

Smelter: Foundations were laid for a smelter well below the workings. Remains of the foundations may still be seen. It is reported that the brick were burned from the red soil "and that nickel sweated out of the bricks during burning". The smelter was never completed. Most of the workings were done by the former company. The present holders are sampling all workings and adding data from drill holes and new locations.

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Geology: The area is underlain by ultra basics, probably peridotite, with a small amount of serpentine. A mahogany-red soil develops above the peridotite. In many cases the red soil is underlain by an ocherous mass, similar to gossan, that is cut by the light green genthite. Time spent did not permit any conclusions as to structure.

At the "lower pit", genthite is found in the ocherous gossanoid material, where it occurs as narrow, discontinuous veinlets and small to larger masses. Apparently, nickel silicates penetrated the ocheroid masses along fracture planes and, in part, replaced the iron oxide. In the 35' shaft, and at the portal of the adit, the concentration of genthite is greater and is classed as "high-grade".

In the "upper pit", the siliceous nature of the genthite is more pronounced. Large masses of "opal", or chalcedony stained by genthite, are common. These masses are quite resistant and weather out of the ocher; their surfaces are quite rough and reflect all the fine irregularities of the ocher in which it occurs. There are masses of "high-grade" genthite, grading into chalcedony which may have a greenish to pinkish cast. In addition, there are the narrow veinlets and smaller masses seen at the "lower pit".

Brevity of the inspection does not justify definite conclusions. However, my impressions are given, subject to change with additional work:

It is reported that the peridotite carries 0.05% Ni. The peridotite weathered and produced a gossan (this doesn't sound right, I know) which in turn weathered to

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Geology (continued)

a mahogany-red soil. The weathering process released silica, which picked up nickel and deposited it through the ocher, or gossan, as genthite. When sufficient nickel was absent, the silica was deposited as chalcedony. The mahogany-red soil did not permit penetration of silicates, and the residual nickel is left in it. Just why and how all these things happened is not at all clear, if they did happen this way.

Reported analyses by new company: The peridotite contains 0.05% Ni on the average. The mahogany-red soil contains an average of 0.75-1.25% Ni. The light greenish genthite averages 1.25-3.25% Ni. On the assay map I saw only one assay less than 0.7% Ni. In the "lower pit", the 35' shaft averages 3+% and the rest of the area in the pit from 1.25-3%. Three drill holes show a depth of around 100 ft. (?) to peridotite bedrock, and the average is 2+%. In the "upper pit" the 80' shaft is in ore and, as I remember it, averages 2+% with the best ore at 35'. Other assays in the area are also good. The two "pits" have 700' difference in elevation and are ½ mile apart (2.4 miles by road.)

An area E-NE of the upper pit was tested at the surface and all went above 1%.

According to A. E. Hepburn, their company figures an ore reserve of a quarter million tons. I can't quite see that they've proven this much ore, but it may well be that it is indicated. Hepburn states that 2% ore can go directly to the furnace without concentration. However, his story didn't always check on this point. He claims that their big problem is to concentrate the red soil low grade and the genthite low grade so it can all be mined open pit and shovel. He says that electrostatics and leaching are being tried. If a concentrating process can be devised, their company is ready to shoot.

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Informant: Ray C. Treasher with A. E. Hepburn, Sept. 16, 1941.

Report by: R.C.T.

State Department of Geology and Mineral Industries

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Report by: Ray C. Treasher

Date: Aug. 10, 1943

Nickel Mountain (nickel) Riddle area

Douglas Co.

Mr. O. D. Rohlfs, Principal Mining Engineer, Ferro-Alloys Branch, W.P.B., Washington, D. C. had requested that I take him to visit the Freeport Sulphur Co. property at Nickel Mtn. He arrived at 12:39 p.m. Sat., July 31st, with Mrs. Rohlfs, and they were taken to Nickel Mtn. and to Roseburg at 11:58 pm.

The access road is open about half way between the Discovery area and the West area. We went to the West area, looked at the shaft and entered the 300 foot adit. Rohlfs secured some excellent specimens. Note was made of garnierite in a narrow shear zone on the N. side near the floor, and as thin crusts along joint planes. We next visited the Discovery area, entered the adit and the shaft.

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Rohlfs had Climax Moly. drilling data, but no Freeport data. In the West adit, about 2% for 100 ft. and then less than 1%, after fairly solid rock is encountered. At Discovery adit, 3% for 75 feet and then 1 to 1.5% in harder rock. Discovery shaft, up to 4% for 20 feet, and then the grade drops. Climax drill holes show erratic values but little below 30 ft.

Nickel seems confined to brown, soft zone and to depths of 30 feet. Even this will be erratic. The limonitic material of the "boxwork" may carry 1⅛ %. The red soil may carry up to

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3/4 % Mineralization is spotty. I'd be interested in Freeport's drilling results.

Some geologists prefer a hydrothermal origin for the garnierite, which theory I cannot see at all. Neither can I see laterization, with all the silica that is obviously present. Ralph Taylor (Freeport) collected silica gel, in the process of formation in the West area adit. I believe the silica, nickel, etc., came from the decomposition of the peridotite, in situ.

Rohlfs said that W.P.B. is interested in New Caledonian ores. Three furnaces are in operation. W.P.B. plans on a fourth furnace either at the mines, or in San Francisco. In event S. F. is chosen, domestic garnierite of plus 3% grade will be acceptable. Rohlfs idea is that if Freeport gives up their lease, W.P.B. might be interested in High-grading the deposit.

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Informant: Ray C. Treasher with A. E. Hepburn, Sept. 16, 1941.

Report by: R.C.T.

Mining Journal Aug 15, 1941

NICKEL NEAR RIDDLE, OREGON, INVESTIGATED BY SURVEY

AS A PART of the investigation of domestic deposits of strategic minerals by the Geological Survey, two of the survey's geologists, W. T. Pecora and S. W. Hobbs, have examined a nickel deposit about five miles northwest of Riddle, Douglas County, Oregon. The town is 230 miles south of Portland by highway and is on the Southern Pacific railroad.

The nickel deposit is a rather irregular blanket on the western, southern, and southeastern slopes of Nickel Mountain. It was formed as a result of the concentration by weathering agencies of the small quantities of nickel originally present in the silicate minerals that compose the peridotite underlying the mountain. The peridotite is a dark igneous rock made up largely of the minerals olivine and pyroxene; it is commonly altered to serpentine along its contact with the sandstones and greenstones into which it was intruded. The concentrations of nickel, however, appear to be limited to the ores underlain by the peridotite and not to overlie the serpentinized masses.

The nickel-bearing blanket is best developed on terraces and gentle slopes above an altitude of 2,000 feet, where its thickness reaches a maximum of 60 to 70 feet. Within the blanket, nickel is present chiefly in the mineral garnierite, a hydrous silicate of nickel and magnesium. The garnierite varies in nickel content, the darker varieties having the larger amounts. Three layers or zones may be distinguished in the blanket; a thin upper brick-red soil layer at the surface, which is relatively low in nickel; a thick intermediate layer, richer in nickel and composed of limonite cut by a network of quartz and garnierite veinlets; and a bottom layer in which thin veinlets of quartz and garnierite occur in unaltered peridotite. The network of veinlets in the second and third layers is thought to have formed along the blocky jointing in the unaltered peridotite.

Pecora and Hobbs believe that the concentration of the nickel originally present in the peridotite, which is in the order of 0.2 per cent, into the higher grade garnierite-bearing material of the blanket deposit was the result of two successive long-continued climatic cycles. During the earlier cycle the minerals of the peridotite were decomposed, forming an aggregate of hydrous iron oxides and nickel-poor garnierite. The more recent temperate and humid cycle resulted in the solution of the nickel-poor garnierite and its redisposition in veinlets as quartz and nickel-rich garnierite.

No comprehensive sampling program of the entire deposit has been undertaken; such sampling as has been done indicates that the great bulk of the deposit contains from 1 to 2 per cent of nickel and a much smaller part contains from 2 to 3 per cent of nickel. Should emergency conditions result in a substantially higher price for nickel or stimulate the development of a practicable method of treatment for low-grade nickel silicate ores, the deposits on Nickel Mountain would provide a reserve of some 6,000,000 tons of material with an average nickel content of 1 to 2 per cent and in addition possibly 250,000 to 300,000 tons that contain 2 to 3 per cent nickel, of which 80,000 tons in the vicinity of the discovery workings can be regarded as proved ore.

ECONOMIC GEOLOGY

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Applied Geology at the Nickel Mountain Mine, Riddle, Oregon

F. M. CHACE, J. T. CUMBERLIDGE, W. L. CAMERON, AND S. D. VAN NORT

Abstract

Applied geology at the Nickel Mountain nickel-silicate mine, the only producing nickel mine in the United States, in its broader aspects is little different from that where mining geology is used extensively in mining metallic mineral deposits. Important differences arise, however, because of the nature of the ore deposit, its general geology, mineralogy, structure, rock alteration, chemistry, and origin, all of which are unique in North America.

The Riddle ore bodies are nickel-silicate or nickel-bearing saprolite deposits that probably represent the erosional remnants of original nickel-laterites that formed on old erosion surfaces by weathering and supergene enrichment. Much of the initial, deep, residual products of weathering now have been removed by erosion, leaving a complex blanket of decomposed, leached, and enriched saprolite that grades laterally and downward into fresh peridotite and dunite. The ore mineralization extends downward along a rather definite fracture and fault system forming nickel silicate-chalcedony (or boxwork) veins in depth.

Applied geology consists of (1) the collection of geologic facts by open pit mine mapping, drilling and laboratory work, and (2) the use of geologic data in ore reserve computations, mine planning, grade control and study of special problems relating to mining, beneficiation, and smelter operation. Each of these pursuits has important and interesting ramifications owing to the characteristics of the ore deposits and the reliance that must be placed on the geological work for successful mine operation. Grade control, which includes not only the control of nickel grade but also the selection of ores to be blended for optimum smelter performance, is perhaps the single most important aspect of applied geology and essential to the successful operation of the mine.

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Introduction

FROM a casual point of view, applied geology at the Nickel Mountain ore deposit at Riddle, Oregon, is little different from that in other mines where geology is used extensively. The geologist's duties include: (1) geological mine mapping, (2) supervision of drilling and mine development, and the interpretation of sampling results, (3) preparation and maintenance of geological maps, sections, and other records, (4) estimation of ore reserves, (5) assistance in mine planning, (6) supervision and scheduling of grade control during mining operations, and (7) study of special problems relating to the mining and smelting operations.

Only when the geology of the Riddle ore deposit

is examined in detail does it become apparent that these rather routine and prosaic assignments have considerably more significance and importance at Riddle than at the usual underground or open pit sulfide ore deposit. The differences arise from the unique nature of the ore deposit itself, its unusual geology, mineralogy, structure, rock alteration, and chemistry; and the reliance that is placed on the mine geologist to guide successful mining and smelting operations. The geological features that must be observed, mapped, interpreted, and translated into usable advice and instructions to the operating departments present new challenges and problems in the use of applied geology and are unusual on the North American continent.

The Riddle ore bodies are nickel-bearing saprolite or nickel-silicate deposits that probably represent the erosional remnants of original nickel-laterites that formed on old erosion surfaces by weathering and supergene enrichment processes. Much of the initial, deep, residual products of weathering now have been removed by erosion, leaving a complex blanket of decomposed, leached, and enriched saprolite that grades laterally and downward into fresh peridotite and dunite. The ore mineralization extends downward along a rather definite fracture and fault system forming nickel silicate-chalcedony (or boxwork) veins in depth.

The purpose of this paper is to describe briefly the geologic techniques applied at Riddle and to discuss the various aspects of the work done by the mine geologist. Although an understanding of the paper requires a rather thorough knowledge of the geology of the nickel deposit itself, a distinction must be made between the geological mapping and detailed research that was done to achieve an understanding of the geology and origin of the deposit, and the techniques that are now used in applying that knowledge to mining. It is only the applied geology that we are concerned with here.

Effective application of mining geology to this type of deposit is possible only when the geology is rather thoroughly known in three dimensions well in advance of mining. In addition to the surface geology and the geology exposed in the upper benches of the mine, the characteristics of the deposit in depth must also be known and understood in considerable detail. To attain this knowledge in deposits of this type, substantial deep drilling must be done before mining starts, and it must be done to the extreme bottom of the ore deposit and into solid bedrock. This is necessary to determine geological and chemical conditions at depth that are not observable in the upper parts of the ore body, but which, when projected upward, reveal important bedrock and structural features, such as rock ribs and fault zones, that otherwise would not be suspected. Knowledge of these features is essential for an accurate interpretation of the upper part of the ore bodies.

The importance of drilling cannot be emphasized too strongly. Where necessary, drilling is continued into uneconomic material solely to obtain structural and petrological information. Mine operating staffs are rarely sympathetic toward this point of view, and usually are unwilling to approve the cost unless convinced of its necessity. The mine geologist must have the wit and courage to insist on having, in advance, as complete information on the ore deposit as possible. At the Nickel Mountain mine considerable success has been achieved along this line as a result of the utmost cooperation of mining, smelting, and geological departments.

Geology of the Ore Deposit

The geology of the Nickel Mountain ore deposit has been described by a number of authors, including Cumberlidge and Chace (1967), Hotz (1964), and Pecora and Hobbs (1942). A more complete bibliography is given in the paper by Cumberlidge and Chace (1967). Only a brief summary of the geology is given here to provide sufficient geological setting for an understanding of the application of geology to the mining of the deposits.

The nickel-silicate deposits are located on Nickel Mountain, 4 miles west of Riddle in southwestern Oregon, and are residually enriched cappings over a peridotite intrusive body, which is one of several similar Jurassic ultrabasic rock masses that underlie the Klamath Mountains in northwestern California and southwestern Oregon. Two nickel-silicate (or nickel saprolite) ore bodies are present. The larger, Upper Ore Body, occurs at the crest of Nickel Mountain at an elevation of 3,535 feet and conforms to the Klamath Peneplain; the smaller, Lower Ore Body, formed on a topographic terrace, the Sherwood Level, at a lower elevation (2,000 to 2,550 feet) on the south side of the mountain. The ore bodies originated at different times during periods of prolonged stability in the erosion cycle and now undoubtedly represent the eroded remnants of previously more extensive nickel-bearing laterite-saprolite deposits that formed over the ultrabasic rocks. The laterite cappings that were undoubtedly present over the original deposits have now been eroded, leaving exposed the underlying saprolitic material, enriched in nickel, that forms the present ore bodies. A thin mantle of red and yellow soil overlies the saprolitic ore and probably originated by later weathering of the saprolite. The saprolite itself formed by progressive chemical decomposition of peridotite and dunite through the selective removal of iron, magnesia, and silica and the residual concentration and enrichment

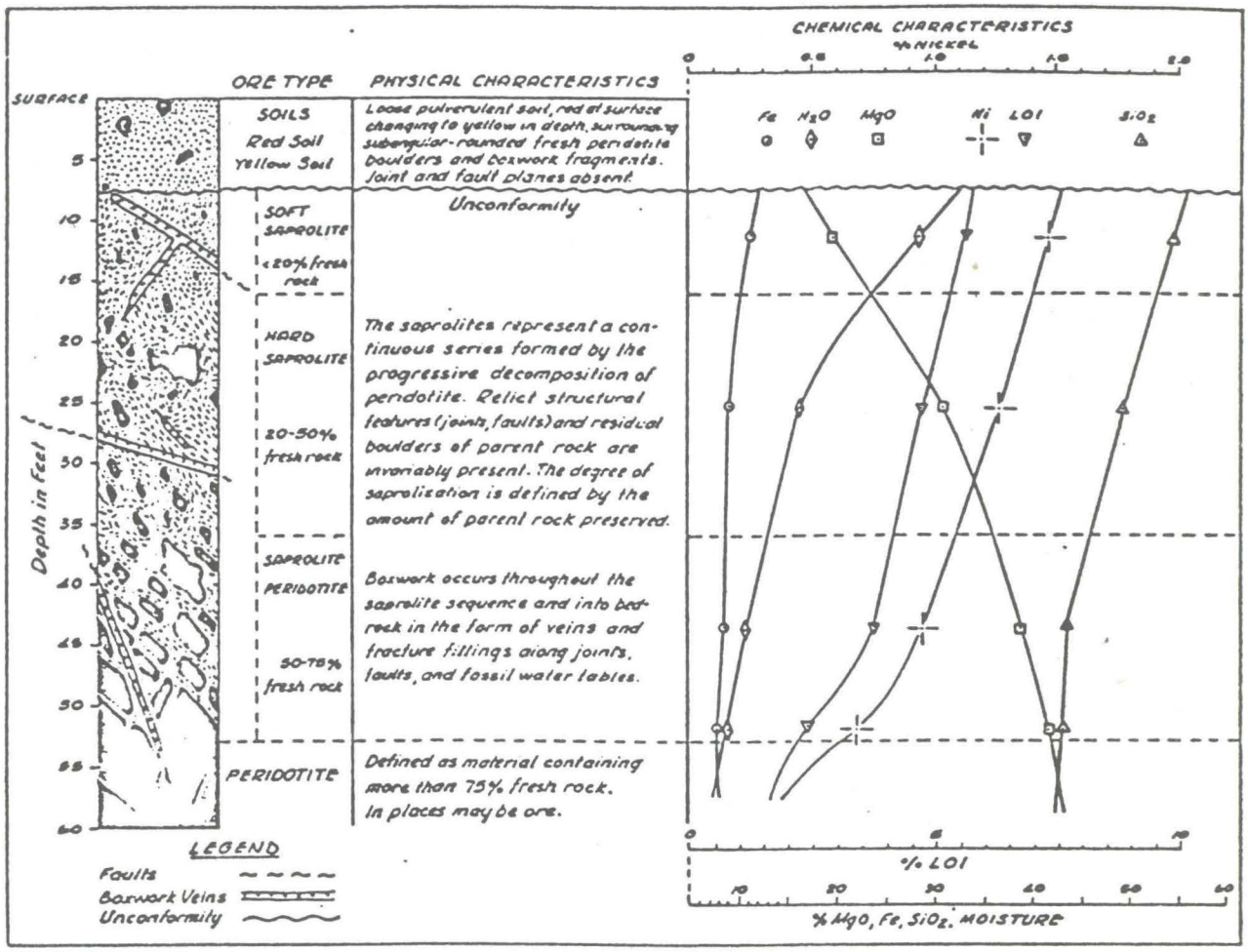

FIG. 1. Columnar Section, showing physical and chemical characteristics of ore types.

of nickel. The relative losses and gains of these constituents took place without reduction in volume, and with the preservation of the original rock textures, joints, and fractures of the peridotite bedrock. Figure 1 is a generalized columnar section of the Upper Ore Body showing (1) the relative positions of soil, soft saprolite, hard saprolite, saprolitized peridotite, and bedrock peridotite and (2) the chemical and physical changes with depth of silica, iron, nickel, and magnesia. This profile has considerable genetic significance and an understanding of it is essential for the successful application of mining geology at Riddle.

As mining progressed in depth it became apparent that the Upper Ore Body had a definite structural control by faults, fractures, and joints. The major controlling structures were pre-ore (with some post-ore movement) and consist of Rock Fault, which forms the footwall of the Upper Ore Body, and a series of subparallel diagonal cross faults roughly at right angles to Rock Fault (Figs. 2, 3). These faults controlled the downward weathering and leaching of the bedrock and provided the loci for deposition of nickel and silica in the form of garnierite-bearing chalcedony veins that locally are called "boxworks." The deep ore channels follow the downward extensions of the stronger cross-faults.

Figure 2, reproduced from Cumberlidge and Chace (1967), is a part of the 3,200-foot level, Upper Ore Body, and illustrates the principal geologic features of the mine, including distribution and structural relations of bedrock, ore types, soil, silica boxwork veins, and faults. A typical cross section of the Upper Ore Body is given in Figure 3.

Ore Types

In the application of geology at Riddle, considerable importance is given to the recognition and classification of ore into definite types that have a direct influence on mining and smelting operations and, therefore, are important in ore grading and ore blending during mining. Nickel content of the ore, of course, is the most important economic factor, but a classification of the Nickel Mountain ore solely ac-

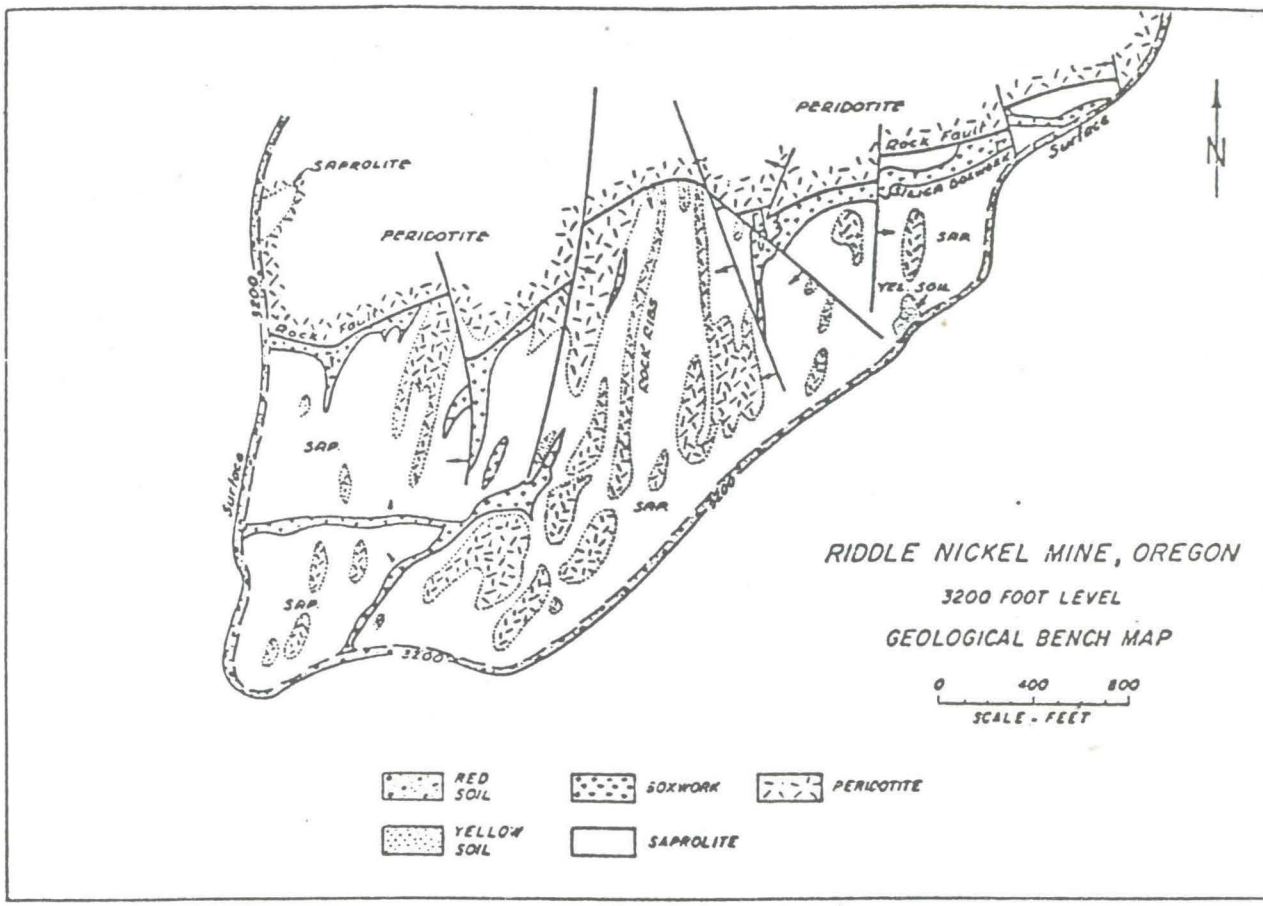

FIG. 2. Geological map, 3,200-foot level.

cording to nickel grade would group together ores that otherwise are quite dissimilar. Instead of nickel content, differences in texture and structure are used to subdivide the ore into three main groups, soil, saprolite, and boxwork with six subordinate ore types. These are illustrated on the columnar section, Figure 1.

The distinction between soil and saprolite is based on the presence or absence of joint planes, the characteristics of residual rock boulders, and the granularity of interstitial decomposed material. The soil group is subdivided on the basis of color, while the saprolites are further subdivided according to the quality and quantity of parent rock present, particularly its hardness and freshness. The term "saprolite" is used in its original sense, as defined by Becker (1895) to describe a rock that has been decomposed chemically but has not been transported and which preserves the original textures and structures of the parent rock. The term also serves to distinguish the high magnesia-low iron material preserved on Nickel Mountain from typical low magnesia-high iron laterite which is not present but is commonly associated with nickel-silicate deposits elsewhere. Boxwork o is quite distinctive, as it occurs in veins and is co posed of chalcedony with several hydrous nickel-ma nesia silicates, predominantly of the garnierite grou

Soils.—Red and yellow soils form an unconfor able surface mantle overlying the saprolitic ore. T soils are composed of loose pulverulent aggregates hydrous iron oxides and clay containing scatte boulders of fresh peridotite. The high proportion hydrous iron oxides in the soil is indicated by hig iron analyses. The boulders in the soil are mos rounded or subangular and are surprisingly fresh cept for a thin, rusty skin of decomposed rock. T red and yellow soils simply indicate the oxidat state of the iron oxides and are readily distinguish by color. Nickel content of the soils averages percent, but locally may range up to 1.7 percent.

The soils account for about 20 percent of the reserve. The thickness averages 10 feet, but may be virtually absent or up to 40 feet thick. So over serpentinite are brown in color, rather than br red or yellow, and normally have a lower nickel co tent than red soil. Scattered fragments of boxwo ore are found in the soil.

Planar structures in the underlying ore, such as boxwork veins, joints, and faults, do not extend into the soil. Clearly much of the soil had a different origin than the saprolite.

Saprolites.—Nickel-bearing saprolite underlies most of the red soil areas on Nickel Mountain and accounts for 70 percent of the ore reserves. The saprolites formed in place with a minimum of textural and structural change; hardness and density do change. Chemical decomposition is rather complete. The saprolites form a continuous transitional zone from soft saprolite immediately below the soils, through hard saprolite and saprolitized peridotite into fresh peridotite or dunite in depth. Their derivation from the fresh ultrabasic rocks can be demonstrated beyond a reasonable doubt. The profile of ore types (Fig. 1) illustrates the chemical and physical changes in the ore body from the surface downward into fresh rock.

The content of fresh, undecomposed peridotite in the saprolite is an indication of the degree of chemical decay of the original fresh rock and to some extent the grade of the ore. The varieties of saprolite ore distinguished on the basis of rock content are:

Soft saprolite	0– 20% Rock
Hard saprolite	20– 50% Rock
Saprolitized peridotite	50– 75% Rock
Peridotite	75–100% Rock

Material containing 75 to 100 percent peridotite boulders, classed as bedrock, generally is not ore. This classification, based on fresh peridotite rock content, is useful in mine mapping, in bulk sampling, and in heavy liquid and microscopic studies. Moreover, it is an important factor in mining.

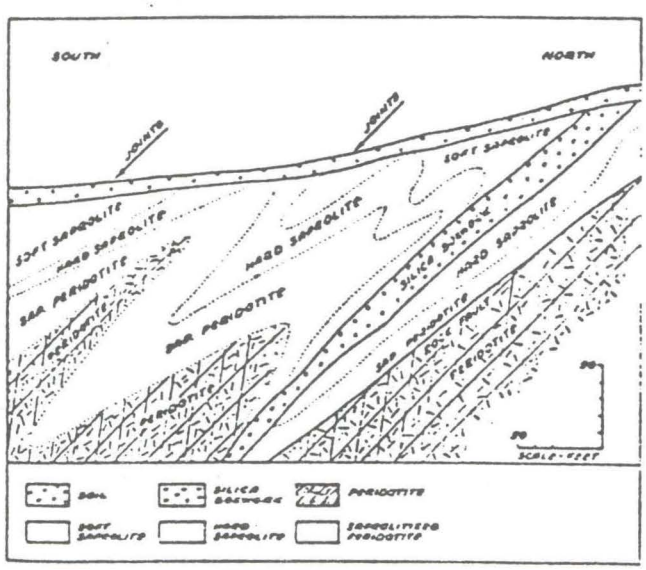

FIG. 3. Geological cross-section North-South, across Nickel Mountain Mine.

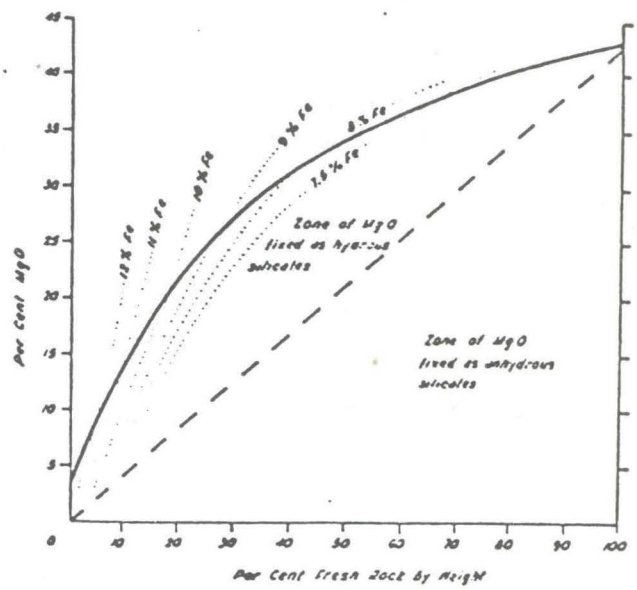

FIG. 4. Relationship of MgO and Fe to amount of fresh rock (peridotite) in crude ore.

The following pertinent details concerning the saprolite ore are largely quoted from the paper by Cumberlidge and Chace (1967).

The most reliable indication of the fresh rock content of drill samples is obtained from chemical analyses. Pure peridotite contains approximately 40% MgO and, using this as a basis, a relationship between MgO and rock content has been established. This correlation is not simple because several minerals in the ore contain MgO; the principal ones are primary anhydrous silicates such as olivine and enstatite, and secondary hydrous silicates such as garnierite, serpentine, and sepiolite. Study of mineral suites prepared by heavy liquid separation has shown that the ratio of hydrous to anhydrous Mg-silicates is fairly constant for a given content of fresh peridotite. Thus, the MgO due to anhydrous silicates can be separated from MgO in hydrous silicates as shown by the dashed line in Figure 4. The solid curved line in this figure represents the average rock content, and allows prediction of rock content from MgO analysis to within ±10 percent.

As a further refinement, an empirical relationship between iron and rock content has been developed. This relationship is used to correct the figure derived by the MgO method, thereby increasing the accuracy of prediction of rock content to ±3 percent. The correction owing to iron content is also shown in Figure 4.

Both MgO analysis and the amount of fresh rock may be used interchangeably; they vary together and both indicate the degree of saprolitization. Where possible, rock content is estimated directly, but in

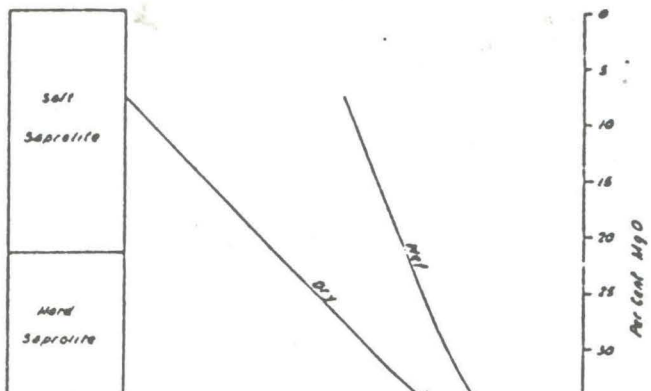

FIG. 5. "In-Place" tonnage factors of ore and rock types and relationship to MgO content.

the many places where only drill samples are available, the MgO-rock relationship is used.

The saprolites show the same kind of jointing as the peridotite from which they were derived, namely three or more sets of joint planes intersecting approximately at right angles and forming irregular blocks or rhombs. The joint planes are nearly always marked by thin films of garnierite, chalcedony, or serpentine, and the films are preserved with no sign of collapse or deformation even when all peridotite has been completely decomposed.

Normally, each joint rhomb contains a core of fresh peridotite surrounded by concentric layers of saprolitic material. A progressive chemical change can be traced from the core to the joint planes. Compared with the rock core, the outermost layers are lower in MgO and higher in SiO_2, Fe, and Ni, indicating that decomposition took place from the joint surfaces inward. Joint spacing and frequency must therefore have been important factors controlling degree of saprolitization.

Decrease in the total amount of fresh rock is paralleled in general by a decrease in size of the fresh rock residuals. This would be expected if alteration was initiated along joint surfaces. However, the size of the residuals also depends on the closeness of joint spacing in the parent rock. A highly fractured or jointed parent rock produces small-sized residual fragments regardless of the degree of saprolitization.

The density of saprolite varies considerably; the more decomposed material is less dense. As this is an important factor in making accurate ore reser estimates, a series of bulk samples of about 200 to each were collected to determine in-place tonna factors. These samples were supplemented by series of smaller samples obtained from hand du test pits. The results of the sampling program a shown in Figure 5 where tonnage factor (cu ft p short ton) is plotted against MgO and ore type the sample. The dry, in-place tonnage factor is co trolled by mineral specific gravities and by porosit the wet tonnage factor is further complicated by t degree of water saturation.

The close relationship between in-place tonna factor and the degree of decomposition reflects t large increase in porosity which is achieved witho change in volume. Owing to the incoherent natu of the material, direct measurements of porosity a difficult to make and are usually inaccurate. Ho ever, porosity can be calculated from the dry, in-pla tonnage factor (Fd) if the true mineral specific gra ity (Gm) is also known. Dry in-place tonnage fact is converted to dry, in-place specific gravity (Gi) follows:

$$Gi = \frac{2.000}{Fd.\ 62.4}$$

Porosity (P) is then obtained from

$$P = \frac{(Gm-Gi)}{Gm} \times 100$$

A clear relationship between porosity and degree alteration is indicated by the six samples plotted Figure 6. The highest observed porosity is about percent, expressed as the ratio of void volume to to volume.

Given the moisture content and porosity of a sa ple, the degree of saturation (percent volume of voi filled by water) can be calculated.

$$\%\ \text{volume water} = \%\ \text{weight water} \times \text{wet in-place S.}$$

$$\%\ \text{saturation} = \frac{\text{volume water}}{\text{porosity}} \times 100$$

Figure 6 also shows the results of this calculati plotted against fresh rock content of the sampl used. Although the data points are few, the tre seems to be clear. As peridotite is decomposed, t in-place density decreases owing to an increase pore space. As pore space is made available, t resulting rock becomes increasingly saturated wi water because of increased permeability. The crease in surface area available to chemical weath ing, and the increase in permeability, may have h an important effect on the rate of saprolitization.

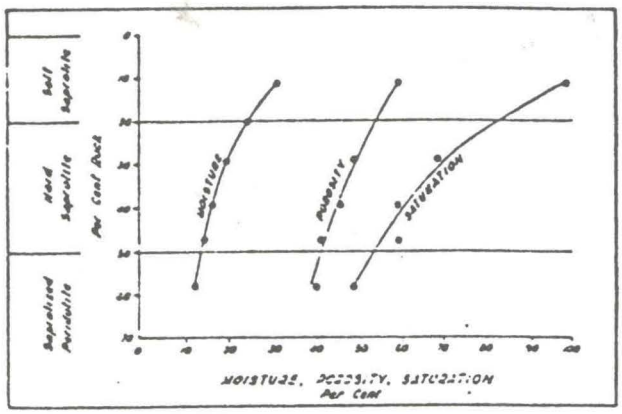

FIG. 6. Moisture content, porosity, and degree of saturation of each ore type.

Boxwork Ore.—This ore is quite distinctive as it occurs in prominent veins composed of chalcedony and garnierite group minerals, many with typical thin-walled boxwork textures. This is the highest grade, most colorful ore, and makes up about 10 percent of the ore reserve.

Boxwork ore is widely distributed throughout the saprolite ores, usually with evident structural control, as veins following joints, fractures, and faults. It is particularly prominent as the 40-foot thick vein along Rock Fault. Some of the boxwork ore, however, is in layers roughly parallel to present surface and possibly represents fossil water tables.

Not all boxwork ore has the typical boxwork texture; in places it is made up of massive or banded chalcedony veins up to 10 feet thick; breccia veins with fragments of peridotite, saprolite, and serpentine, and early chalcedony or early garnierite cemented by later chalcedony, serpentine, and garnierite are locally prominent. Polished fault planes, fault grooving, and striae also are common.

Boxwork ore is important not only because it makes up 10 percent of the ore reserve of relatively high nickel content, but also because the high silica content creates smelting problems.

Structure

Depth and intensity of saprolitization follows a pattern complex in detail but fairly simple in its broader aspects. The pattern is influenced by three structural elements, namely, former water tables, two sets of faults, and zones of intense jointing. These three elements make up the large-scale structural framework that controlled ore distribution and the degree of saprolitization.

Water Tables.—A discontinuous zone of boxwork ore, more or less flatlying and subparallel to the present surface, is found at the eastern end of the Lower Ore Body and along the southern margin of the Upper Ore Body. The boxwork ore lies just below the base of the red soil and tends to drape over the underlying structures rather than conform to them. The location of this ore in the profile is consistent with deposition of boxwork elements at a former water table or similar boundary surface. Apart from the two areas mentioned above, this type of boxwork ore is either absent or insignificant in amount.

Faults.—Faulting and jointing controlled the localization of the saprolite ore. Two major faults show a relationship to existing ore. One of these, known as Rock Fault, strikes approximately east-west through the Upper Ore Body and dips to the south at 35 to 45 degrees. (Fig. 2) The fault has been exposed by mining operations for a strike length of 2,800 feet and can be traced through surface mapping and drilling for an additional 3,300 feet. At least two other subparallel faults have been mapped above Rock Fault. These faults branch from and converge with Rock Fault, forming a fault zone in places 50 feet thick.

Rock Fault is overlain in many places by a remarkably thick boxwork, which is invariably vuggy, and in places cavernous. This implies that the boxwork was deposited in an open fracture, a condition not likely to be encountered under thrust fault conditions. In addition, the massive boxwork is cut by steeply dipping tension cracks filled with later barren chalcedony. These, too, are consistent with normal movement, and the balance of evidence suggests that movement on Rock Fault was a normal dip slip.

The footwall of Rock Fault is generally fresh peridotite, hence the name of the fault. Boxwork ore along the plane of Rock Fault is known to continue locally to a vertical depth of 260 feet below the present surface, suggesting that the fault zone acted as a major artery for the escape of mineralized ground water. Downward migrating ground water would have impinged on the footwall but clearly had little or no effect on the footwall peridotite, indicating that the footwall was sealed in some way.

Rock Fault is cut by north-south trending, steeply dipping, normal faults. Mining has exposed three cross faults cutting Rock Fault, and the existence of at least two others is suspected from drilling. Striations on the exposed cross faults pitch steeply, indicating essentially dip slip movement which resulted in horizontal offsets in Rock Fault of 10 to 220 feet.

Joints.—Joint intensity exerted a considerable amount of control on both the depth and degree of saprolitization by providing permeable avenues through an otherwise relatively impermeable rock. A relationship between joint spacing and degree of alteration can be recognized in the field. Massive, blocky peridotite with a joint spacing of about 24

inches is little altered except along the joint planes, which are usually coated with films of garnierite and serpentine. On the other hand, relict joint planes in exposures of soft saprolite show a joint spacing of the order of 2 to 6 inches.

Irregularities in the bedrock topography can be related to permeable zones produced by faulting and jointing. This is shown in plan in Figure 2, which reproduces a portion of the 200-foot level of the Upper Ore Body. In this area, the major joint zones strike north-south and dip 50 to 60 degrees to the east. They are truncated by Rock Fault on the north, and cut by a "y"-shaped fault system in the southwestern part of the area. The pattern is similar in other parts of both ore bodies, and results in a series of "ribs" of peridotite elongated in a north-south direction, and dipping steeply to the east. Saprolite ore types are not shown in the illustration because of scale limitations, but the centers of the large saprolite areas tend to be soft saprolite that grades outward into hard saprolite and saprolitized peridotite. Boxwork ore is closely related to the faults.

A typical pattern of ore distribution in vertical cross section is shown in Figure 3. In this example, two joint zones striking northeast and dipping to the southeast are cut by Rock Fault. Saprolite ore types are developed symmetrically around the joint zones. A layer of boxwork lies slightly above, but parallel to the plane of Rock Fault.

In detail, the distribution of ore types is more complex than shown in Figures 2 and 3, and day-to-day mining operations must be carefully controlled in order to provide an optimum product and to reduce stripping. The complex bedrock topography increases the problems of pit design, haulage road location, and equipment utilization.

Collection of Geologic Facts

Mine Mapping

As in all mining geology, continual mapping of the faces exposed on the mine bench levels is essential at Riddle in order to keep up to date and not miss critical data. All pit mapping is done with a 2-man team consisting of a geologist and a surveyor-helper. Plane table or transit and stadia surveys along the toe of each bench, using established survey points, are made to locate geological contacts, ore types, and structures. These are projected to the toe of the face slope (bench level elevation) and are plotted directly on the individual 50-scale maps of each bench level. All mappable geology is shown clearly with this scale. Special effort is made to map soil, rock, and ore types, and contacts or transition zones, quantity and size of residual boulders in the ore, and the presence and attitude of faults, prominent fractures, and boxwork veins. Soils are readily recognizable in the mine and are easily mapped. Occasionally, a face with complicated or obscure geology is sketched in the field notebook, but usually all data are recorded in plan.

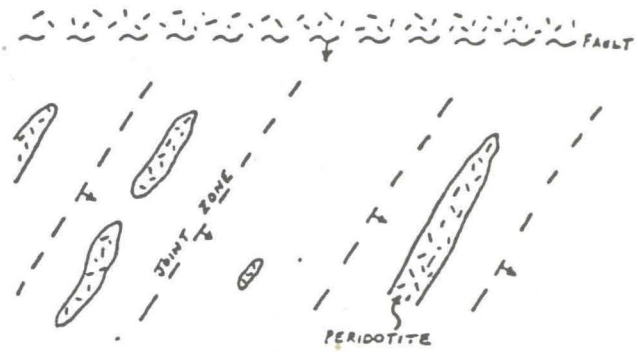

FIG. 7. Sketch map showing hypothetical pattern of rock distribution, faults, and channels of saprolitic ore as determined by drilling.

A numerical "shorthand" nomenclature is used for mapping saprolite ores to provide an accurate description of the continuous saprolite sequence. In this nomenclature the saprolite ores are recorded as a coupled number (e.g., 30/10) rather than as a rock name. The total amount of fresh rock is recorded as the first part of the number, and the amount of fresh rock greater than 6 inches in diameter is reported separately as the second part of the number.

Major boxwork veins are mapped directly by recording their location, dip, and strike. Minor garnierite joint coatings are noted symbolically. Faults, prominent fractures, and joints are mapped systematically in the usual way.

Because of the nature of the observed geology and because the technique of interpreting mappable elements differs from usual mining geology practices, the actual procedure used may be worth describing step by step in some detail.

Let us assume that before mining begins enough deep drilling has been done to determine the structural elements present. The structures are the "bones" around which the ore types are draped and they must be accurately recorded. Drilling has shown the general pattern portrayed in Figure 7.

Let us now examine in more detail a small area of the mine and illustrate the process of mapping a sequence of mining cuts on a bench level, which, though hypothetical, correspond to day-by-day operating practice at Riddle, and can be expected to approximate conditions in the root zone of nickel-laterite deposits elsewhere. The sequence of bench-level cuts is shown in Figure 8.

1st Cut.—At this stage very little direct evidence of structure is exposed in the bank. The geologist first decides where the boundaries of the various ore

type units are to be plotted. He then locates these points by stadia or by a set of previously surveyed pickets. When this has been done, he goes back over the bank and estimates the amount of peridotite boulders present and the amount of rock reject to be anticipated on the 6-inch screen at the plant. This involves noting the intensity of jointing and faulting, the attitude of all the structural features visible, and the degree of alteration of each joint rhomb. In training new geologists, high, medium, and low nickel contents are estimated visually to train the eye and at times to be used as a check against the bank samples. Otherwise nickel grade is only estimated where it is thought to be anomalous, e.g., in a saprolite that has escaped supergene enrichment.

In many instances, even when the observations have been carefully recorded, the structural data may be so confusing that confident projection of ore types is not possible. This is where drill hole data and mapping of the bench directly above are most important. These data help determine the projection of structure, and ore types, and aid in deciding where the mine shovel should be scheduled to dig next.

2nd Cut.—At this stage of mine development two structural features of importance have emerged. One is the major boxwork vein striking northeast, and the other is the peridotite rock rib that also appears to strike northeast. Hopefully, these two features can be identified in nearby drill holes or on maps of the bench above. If this information fits the drilling "pattern," projections can be made with some confidence. If not, caution and reinterpretation are indicated.

3rd Cut.—At this face, the trends or strikes of the boxwork vein and peridotite rib are clear, and one

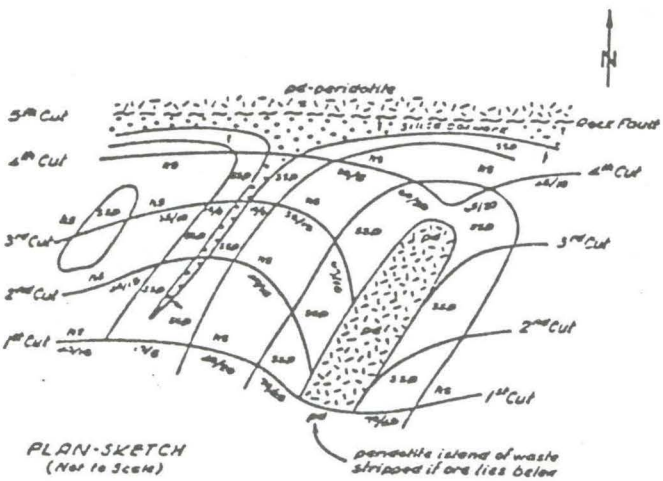

FIG. 8. Enlargement of small selected area of Fig. 7 illustrating geology as revealed by mapping of successive faces on a mine bench as mining proceeds in a series of cuts into the ore body.

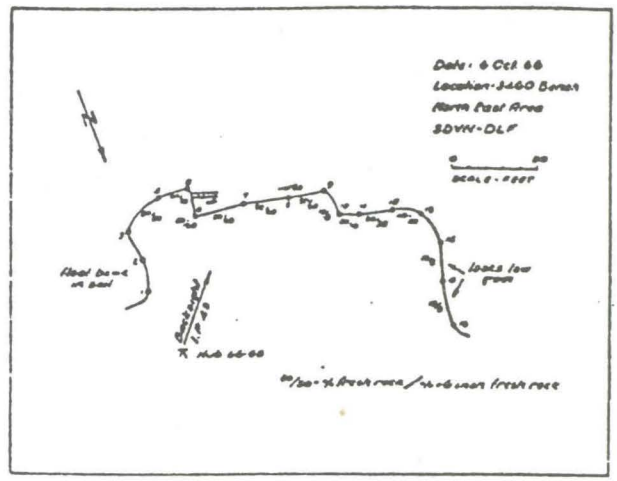

FIG. 9. Example of a typical work sheet from a mine notebook showing type of data recorded.

can assume that the ore channel continues to the northeast. However, at this stage, knowledge of the fault to the north is confined to drilling data. Moreover, it is not known whether the eastern rock rib is separated from the fault by enough room to allow mining machinery into the area and to swing a shovel boom.

4th Cut.—Completion of this cut clears up the problem of mining around the north side of the rock rib. Thus, the peridotite rib can be left as an island of waste, or it can be stripped at a later date.

This cut also confirms a tendency, noted in cuts 2 and 3, for the reject content and rock content to decrease. For example, successive cuts through the hard saprolite west of the peridotite rib show a numerical change from 40/20, 40/15, 35/15, to 30/5. This is due to increased fracturing as the fault plane is approached. The joint rhombs are smaller; therefore a higher specific surface was exposed to weathering.

The small island of saprolitized peridotite to the west of the boxwork vein is an indication of peridotite below and an advance warning for the next bench.

Note that the high-grade boxwork ore lying on the major fault has not yet been cut. Again, deep drilling and adequate mapping and sampling records from higher benches give advance warning.

5th Cut.—Ore is now cut back to the fault revealing high-grade boxwork ore along the fault plane, which in places is sufficiently rich to warrant cleaning the plane of the fault with a backhoe or bulldozer to recover all of the ore.

If good records have been kept of mining on this level, they will help explain conditions on the bench below when projected down dip.

With this illustrative sequence of "cuts" it is apparent that the mine faces are studied carefully in

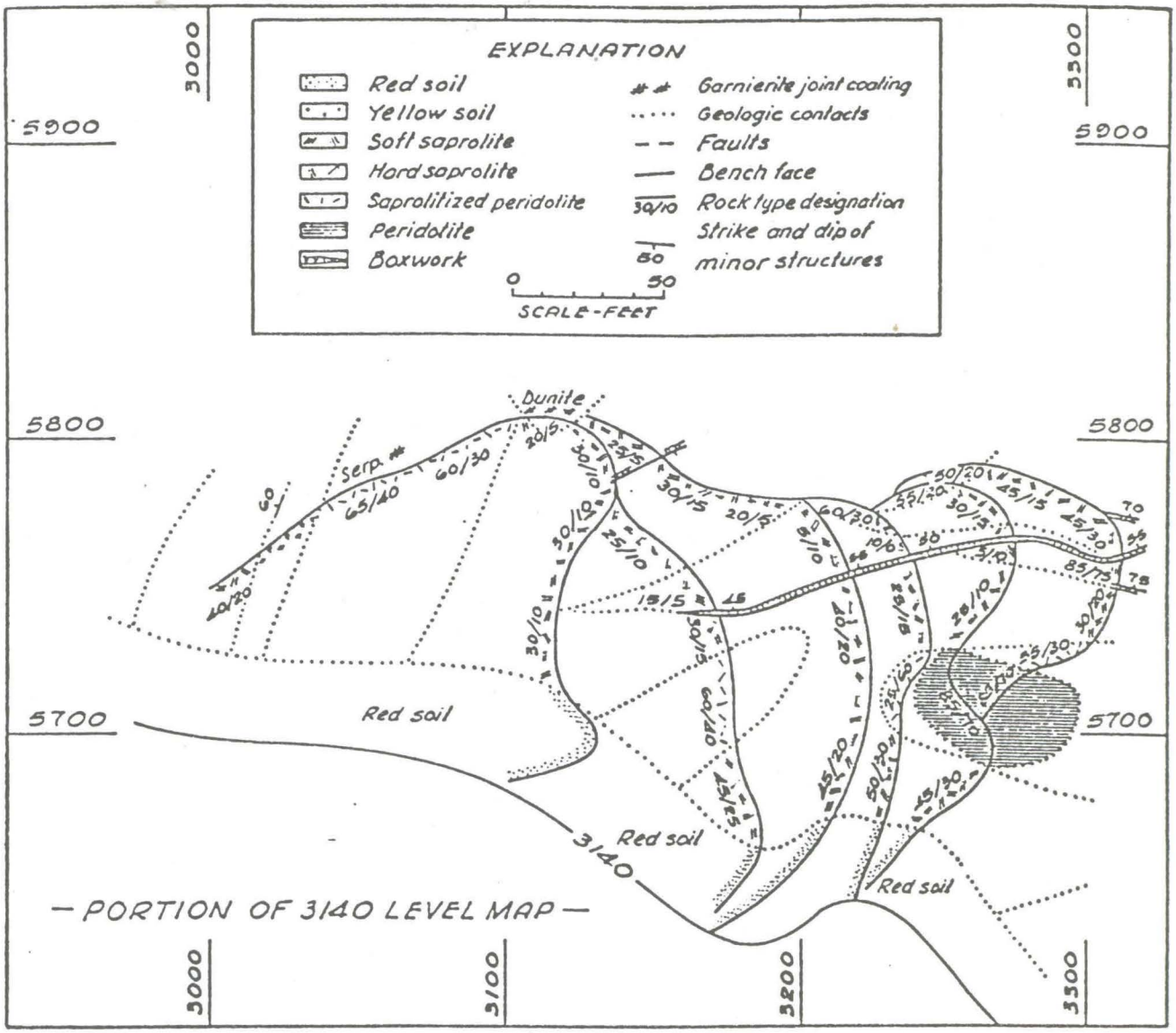

FIG. 10. Part of a typical bench map. 3,140-foot level, 50-scale.

advance of mapping, the mappable elements are selected, and preparations are made for actual recording of the important data. Figure 9 is an example of a typical mapping sheet. Note that mapping is done in plan and that it shows the type of data recorded and the side notes recorded. Figures 10 and 11 show portions of actual mapping sheets and illustrate further the method of recording ore types, the nomenclature used, and the trace of a series of mine faces or "cuts." In Figure 11, for example, at approximately 4150 East, 6725 North, the small differences in rock content that can be recorded are illustrated in the soft saprolite sequence 20/5, 15/5, 20/5, 10/0, and 10/5. All of this material is soft saprolite and the rock content varies considerably from 20 to 10 percent with the 6-inch rock content 5 percent or less.

Geological Maps and Sections

The geological mine data are plotted on a set of 50-scale level map sheets. Two sets of maps, 1 in. = 50 ft and 1 in. = 100 ft, and one set of sections, 1 in. = 50 ft, are maintained. Areal coverage of the ore body is provided by six 100-scale maps. The geological maps are constructed on 20-foot vertical intervals, corresponding to the mining benches. Detailed coverage in the active mining areas is provided by seven 50-scale base maps. On the 100-scale maps, 2 levels, each 100 vertical feet apart (5 mining benches), are plotted on the same sheet to conserve space and reduce the number of sheets.

A set of 50-scale vertical sections is used and is continually updated when new information or changes

are indicated from the field mapping. These sections coincide with the 100-foot north-south mine grid and complement the 50-scale geologic maps. The sections show the observed factual geology indicated by the mapping and the projected geology as indicated in the drill hole data. Reasonable geologic projections of the factual data are then sketched on the sections. The known and projected geology plotted on the sections is compiled on 100-scale maps.

The maps and sections are complementary. The 50-scale sheets are fact maps; only known or observed data are plotted on them. Interpretations and projections are sketched in pencil on the 50-scale sections and on the 100-scale maps. This method permits a clear differentiation between factual and inferred information. Past experience indicates that highly accurate geologic projections can be made only when the data appear to be consistent with the three-dimensional view of plan and section.

Mine Drilling

Both development churn drilling and blast hole drilling are carried on in the ore zone. Development churn drilling is used to provide information on ore grade, type of ore, and structures. Blast hole drilling is primarily used for mining purposes.

Development drilling is done with a Bucyrus-Erie Model 29T churn drill with a 6-inch bit. In the mine area, holes are drilled on a 100-foot grid, whereas in the peripheral area at the margins of the ore body, holes are spaced at 200-foot centers. In the early years of the mine development, drilling was done at closer intervals and the holes were stopped at arbitrary, shallow depths. The closely spaced holes were abandoned when the fundamental structural control of the ore body was recognized and it was found that fewer but deeper holes could be used to obtain the same or better factual information.

Samples are taken in the drill holes in 5-foot intervals. The holes are cased continuously behind the samples. As each 5-foot sample is bailed from a hole, it is split and a one-quarter split of the sample, amounting to about 2 gallons, is saved in 3- or 4-gallon water-tight cans. The sludge color and hardness of the material penetrated (hard or soft) are noted by the driller and reported on his daily drill report. At the same time, a small split of the cuttings is saved and washed. These "cuttings" are logged and provide a fairly accurate guide to the material being drilled.

Drill hole samples are not completely satisfactory because, with the churn drill currently in use, the sludge samples are difficult to classify visually. Close inspection of the drilling chips, after washing away the mud, is qualitatively useful but much of the altered rock and some of the fresh rock is pulverized in drilling and so quantitative data are not available.

Sludge color and the "cuttings" provide immediate information on the hole. Nickel analyses are usually available within 24 hours. Analyses are also run for MgO, SiO_2, Fe, and Cr; these are normally available within 2 to 5 days. The nickel analyses are run at the mine laboratory and the others at the smelter laboratory.

Churn drill holes are plotted on the 50-scale geologic sections as soon as the analyses are available. Because the ore type classification is based in part on chemical analyses, final assignment of the ore types cut in the hole is made at this time.

Blast hole drilling is a mining technique and produces very little additional geologic information. Blast holes are confined to the hard, less decomposed material which is generally of lower grade than the more saprolitized material. This drill produces an unreliable sample that cannot be used in determining accurate grades. Cuttings from the blast holes provide some material of geologic importance but the shallow depth of the holes limits the usefulness of this information.

Applied Geology: Use of Geologic Data

The factual data collected, recorded, and interpreted by the mine geologist are used routinely for three purposes: (1) for the estimate of ore reserves, (2) to aid in long-term mine planning, and (3) as a basis for daily grade control during mining.

Ore Reserves

Two types of estimates are made and kept up to date each year: (a) the usual tonnage-grade computation made in advance of mining and (b) a "cut estimate" which is a calculation of the amount and grade of ore actually mined each year.

a. The usual ore reserve estimates are made from the geologic cross sections using the grade data from the drill hole sample analyses after they have been factored to remove systematic bias in the data. Areas of the same ore type are planimetered and reduced to short tons by the usual weighted average method. Cutoff of 0.65% Ni and 0.90% Ni are used to determine true tonnage and grade figures.

Three reserve totals are calculated: (i) natural crude tons of unmined ore in place, (ii) crude dry tons of unmined ore in place using moisture correction factors and (iii) dry tons of tram product. The latter estimate is made by calculating or predicting the amount and grade of rock reject (+6 in. size) in each ore block that will be removed by the screening plant. The amount of rock reject is then subtracted from the crude ore reserve to determine a "tram product" reserve, which is an estimate of the amount and grade of ore that will actually

be moved down the mountain by aerial tram and delivered to the smelter.

b. *"Cut Estimate"*: This is an annual estimate of the ore that was mined during the previous year. It is measured by the same method that is used for the total "in-place" ore reserve estimate. The results of the "cut estimate" are compared with the actual production figures and provide a yearly check on the accuracy of the ore reserve computation technique including the crude ore estimates, the rock rejection predictions, and the "upgrading" data. The yearly reduction in total ore reserves by current mining is obtained by subtracting the "cut estimate" from the total reserve.

The yearly ore reserve estimates for both natural crude ore and dry crude ore are generally made following the completion of the "cut estimate." The new estimates thus incorporate the estimate of ore removed during the preceding year as well as taking into consideration new geologic and analytical data and interpretations made during the previous year.

Mine Planning

The mine geologist works with the mine engineer and mine superintendent in planning and scheduling pit development and mining sequence. Geologic sections, engineering level or slice maps, and the pit bottom maps are used in systematic planning. Bench development, haulage roads, and ore blocks to mine are controlled in a large measure by geologic structure, distribution of ore type and grade, and pit bottoms. Temporary access road locations and other engineering installations are located in accordance with geologic conditions to provide maximum usefulness and life span. The coordinated efforts of geologist, engineer, and operator, using the knowledge and experience of all three, result in an efficient mining operation.

Grade Control

The extreme variations in the nickel content of the ore body as a whole and within the individual ore types, coupled with the necessity of providing a uniform smelter feed, necessitate close grade control during the mining operation. Both nickel and silica are critical to the smelter. In controlling grade, the objective is to provide the smelter with ore of constant nickel content with silica held to close limits. In actual practice the ore grade is controlled by blending ores from the various mine faces in predetermined tonnages.

Projected or planned grades are set on an annual basis and normally are not changed during the course of the year. Every effort is made to achieve the projected grade during each day's mining. In practice, however, the basic grading standard is a unit of approximately 8,000 to 25,000 dry tons of screened ore. The degree of success achieved in attempting to mine the grade required improves as the tonnage

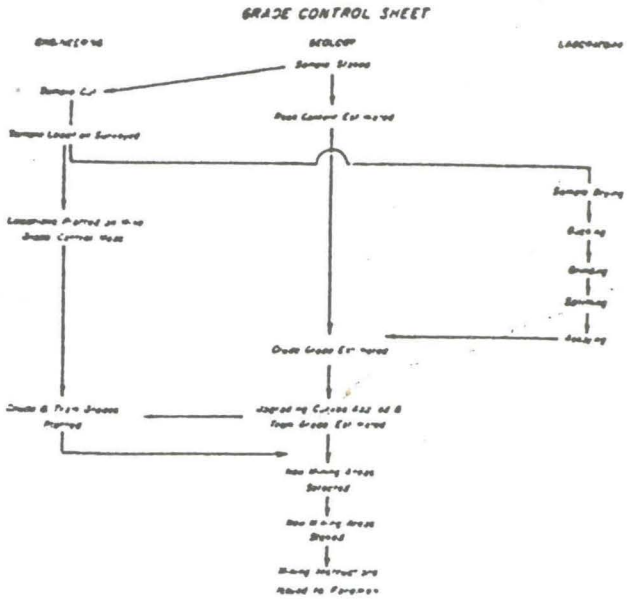

FIG. 12. Chart showing sequence of steps in grade control.

mined increases, so that, as a year progresses, the gap between the actual grades produced and the desired grade becomes progressively smaller.

The basic technique used in controlling grade is to mine small ore blocks that have been carefully sampled and examined visually for rock reject screening characteristics. A simplified flow sheet of the grade control procedure giving the different contributions and functions of each department is illustrated in Figure 12.

The bank sampling procedure used daily in obtaining the basic data for nickel grade control and estimated amount of rock rejects is given in the appendix.

Special Studies

Special studies of problems relating to the mine or to the smelter are undertaken periodically by the mine geologist in cooperation with the mine and smelter staffs. These studies have covered a wide range of subjects and have made important contributions to the success of the operation. Among the problems studied are (a) the correlation of chemical analyses by different methods and from different laboratories, (b) the feasibility of separating higher grade boxwork ore from peridotite and lean saprolite particles by various mechanical techniques, and (c) the chemical and physical properties that govern the smeltability of the ore.

The procedure followed to investigate ore smeltability is summarized below as an example of the type of research problems studied and the kind of results obtained. Parenthetically, this also illustrates the close cooperation between mine and smelter personnel needed to reach useful conclusions.

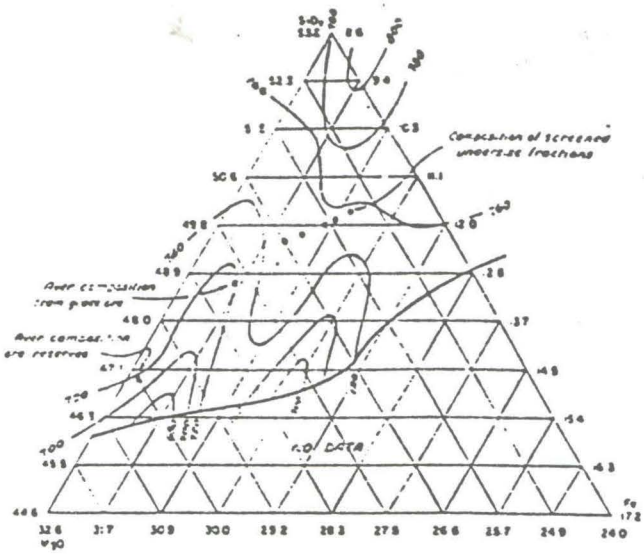

FIG. 13. Ternary diagram-system Fe-MgO-SiO_2, showing power consumption in kilowatt-hours per ton; 56 measurements contoured.

Cursory study of mine and smelter records showed that (1) smelter performance had been declining and (2) the decline was matched by a gradual change in mine product (screened ore) as mining advanced deeper into the ore body.

The primary objective of the study was to determine the smelter behavior of the various ore types and whether certain types of mine product gave better smelter results than others. It was hoped that a method of predicting and controlling smelter performance could be established.

The study interval of August, 1964, through September, 1966, was selected because of the uniformity of smelter procedures during that period. Individual tonnage units of mine product consisting of 12,000 to 25,000 dry tons each, which had been closely followed through the smelter, were used as a basis for study and comparison. One hundred and eight tonnage units that met the qualifications for testing were selected for study; all pertinent data concerning these units were tabulated from daily mine and smelter operation reports, and each unit was studied in detail as to chemical composition, power consumption (kwh per ton), ladle life, Ni losses in the slag, and normalcy of smelter operations.

When the information was assembled, a method of analyzing it was evolved. The mine product is composed essentially of three chemical components: MgO + Fe + SiO_2 = 85.8%. It seemed reasonable to assume that if smelter performance varied with changes in the ore, a systematic change must take place in the ratios of the three major chemical components.

To test and illustrate this hypothesis, a triangular diagram representing MgO, Fe, and SiO_2, recalculated to 100 percent, was drawn for kwh per ton (power consumption). Points representing kwh per ton for each unit were plotted on the triangular diagram according to their MgO, Fe, and SiO_2 contents. Contours developed from these points proved to be confusing; and it was necessary to smooth out the contour lines and simplify the overall results. This was achieved by breaking the triangular diagram into a series of binary graphs which actually represent cross sections of the ternary diagram and were constructed along constant Fe, MgO, and SiO_2 lines.

Lines that best fitted the points on each binary graph were drawn, and adjusted kwh-per-ton contours were replotted on the triangular diagram (Fig. 15). This plot gave clearer and more meaningful results by eliminating some analytical and measurement errors, and by reducing the effect of daily variations in smelter operating procedures.

In a similar manner, a triangular diagram was developed to show total nickel losses in the slag (Fig. 14).

The triangular diagram of power consumption (Fig. 13) shows a decrease in power consumption with a decrease in silica content of the ore. A "ridge" of higher power consumption divides the low silica field. This produces two favorable areas of low power consumption; one in which MgO is high, corresponding to saprolite ore, and one in which Fe is high, corresponding to surface soil. Mixtures of saprolite and soil are apparently unfavorable, perhaps due to the formation of a high heat-capacity phase.

The loss of nickel in the slag decreases with decreasing SiO_2 content (Fig. 14), and a ridge of high slag losses divides the low silica field. This

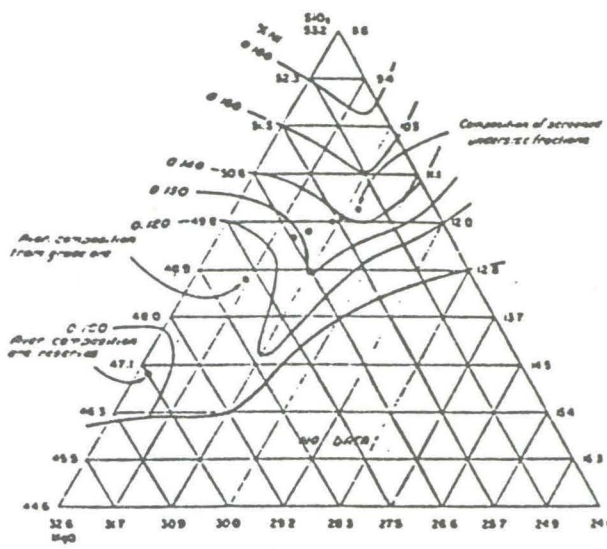

FIG. 14. Ternary diagram-system Fe-MgO-SiO_2, showing total nickel losses in slag; 87 measurements contoured.

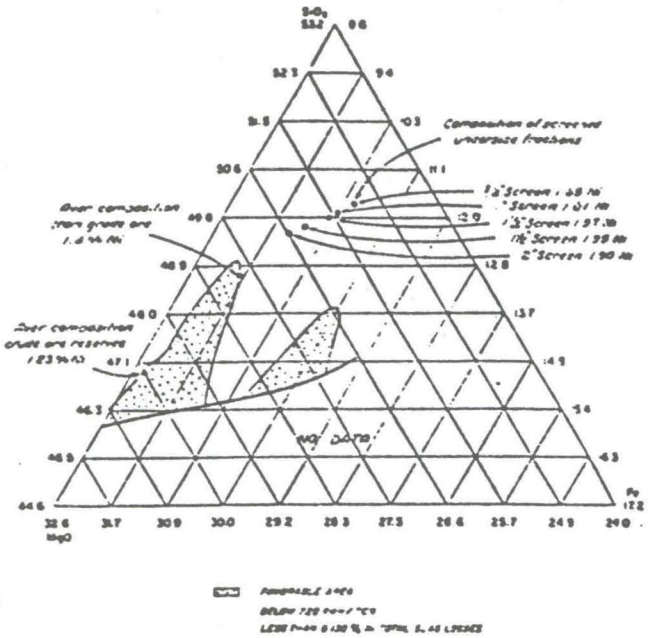

FIG. 15. Ternary diagram-system Fe-MgO-SiO_2, showing the two areas of optimum performance.

diagram is similar in shape to the power consumption diagram, but the underlying reason for nickel loss is probably the high viscosity of silica-rich melts.

With respect to power consumption and loss of nickel in the slag, two areas of optimum smelter performance were determined (Fig. 15). In these two areas, power requirements are low, and slag losses are low. Because these areas can be defined chemically, the production staff are now able to predict smelter performance within acceptable limits for any ore batch before it runs through the smelter. Trouble can be anticipated and minimized.

Neither of the two favorable areas corresponds exactly in composition with the remaining smelter feed as calculated from the current ore reserve estimates. Figure 15 shows the composition of crude ore and of ore screened on various screen sizes. Inspection shows that whereas crude ore is chemically favorable, it contains only 1.23 percent nickel. Screening on finer sizes produces an undersize product which is higher in nickel but has a less favorable chemistry. Obviously there is an economic balance point between the favorable economics of a higher nickel head grade and the benefits attending lower power costs and greater nickel recovery. When the optimum balance point had been defined, the mine geologist found ways and means of blending ore types to achieve optimum grade. The vagaries of geology, climate, and grade make this a difficult task, but the economic reward is commensurate with the effort involved.

Acknowledgments

We are indebted to Mr. E. E. Coleman, Consulting Engineer and formerly General Manager of the Nickel Mountain Mine, and to Mr. E. J. Maney, currently General Manager, and his staff for their cooperation and stimulating discussions during the work at Riddle. Mr. D. N. Vedensky, Senior Vice President of The Hanna Mining Company, has been a constant source of help, inspiration, and guidance. Dr. John G. Stone critically read the manuscript and made useful suggestions. Thanks are also due the officials of The Hanna Mining Company for permission to publish the results of our work. Our secretary, Mrs. R. E. Leibin, has patiently and efficiently typed and retyped various drafts of the manuscript.

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February 19, 1968

APPENDIX

Bulk Sampling for Nickel Grade Control

1. Shovels dig a 5-foot cut along face to be sampled.
2. A "fines" sample is collected along slough-face contact; only −3 in. material is collected. Samples are broken at 20-foot intervals or at geologic contacts. Location of sample breaks measured by transit and stadia.
3. "Fines" sample (−3 in.) is screened on a ¼-inch screen.
4. Minus ¼ in. material is sent to laboratory for analysis (Ni only).
5. Sample interval is inspected by grade control engineer who (a) estimates the amount of fresh rock within each sample interval and (b) estimates the percent of fresh rock that will be rejected by the screening plan (+5 − ¼ in. material).
6. Nickel analysis of −¼ in. "fines" plus estimate of fresh rock content and rock reject are used to calculate crude nickel grade and tram grade nickel for each sample interval.

A set of graphs which were developed over a long period of experience are used to determine the two grade estimates.

7. Crude grade of ore in place and tram grade are plotted on two 1 in. = 100 ft. daily grade control maps.
8. These maps are then used to schedule the next mining cuts. Location of cuts and amount to be taken from each face depends on the tonnage and nickel grade required for that day.

The first grade control sheet is a composite engineering map that shows the crude and tram grades for every bench face exposed in the pit. This map is posted daily so that current grade status of all exposed ore is always available.

The second grade control sheet is actually a set of engineering maps of the individual bench levels. These

show the analyses of all the samples taken previously on each level.

The first composite map shows only current data for 11 benches; the second set shows the results of all previous sampling and mining on each bench.

Daily mining schedules are made using the information on these maps. Each mining shift is divided into 3-hour intervals. The schedules are arranged so that the thin slice of ore mined at each face seldom exceeds 1,500 tons; this represents an advance of 8 to 10 feet in each of the scheduled mine faces. When the predetermined ore slice has been made at one face, the shovel is moved to the next previously selected face and the process is repeated.

A sample of the tram grade ore is taken every 30 minutes so that an almost continuous record of the mine production is available and the accuracy of the ore grade predictions can be checked. If discrepancies occur, as they do occasionally, corrections can be made in the tonnage of each grade mined, and the results taken into consideration for the next round of mining.

Past experience indicates that a systemati the tram samples occurs during the winter mo to the increased moisture content of the adjustment schedules have been evolved to this divergence.

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4-10-94

metamorphic water
slightly acidic

within in Nickel Mtn

reject this @ Nickel Mtn
New Caledonia 1.6% Ni

LATERITE soil
40% Fe
9% MgO

Topsoil

NC 2.6

SOFT SAPROLITE
15% FeO
22-24% MgO

flood & boulders

NC 1.8%

HARD SAPROLITE
10% Fe
33% MgO

Peridotite
3-5% Fe
45-48% MgO
.25% Ni

ferrosilicon is flux (reductant)

Terry Rennels died

Screen Ni-rich fines out

near ◻ bad no dust produced from sand blasting
MgO
SiO2
Fe

48% MgO = 100% reject

0.8

30% @ 0.25%
70% @ 1.3%
+ 0.8%

More affected by European & Japanese economies than U.S
Consumer products

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NICKEL IN DECEMBER 1994

Reported domestic nickel consumption in December, on a daily average basis, was almost identical to that of November, according to the U.S. Bureau of Mines (USBM). Production of austenitic stainless steel increased significantly, boosting demand for both scrap and ferronickel. Growing demand for pure metal in the steel sector, however, was offset by decreased consumption by (1) the electroplating industry and (2) producers of cupro-nickel and other non-ferrous nickel alloys. Daily use in electroplating dropped back to 34 metric tons (mt), the lowest level since July. Trade data for December will appear in a subsequent issue.

Glenbrook Plans To Resume Ferronickel Production in April

The Glenbrook Nickel Co. has told the USBM that it will restart its ferronickel smelter near Riddle, OR, in April. The mining and smelting complex had been on standby since August 1993. The Oregon operation is described in detail in the September 1993 issue of *Mining Engineering* (V. 45, No. 9, pp. 1139-1143). Glenbrook is a 50/50 venture of Cominco American Inc. and Cominco Resources International Ltd.

Glenbrook will continue to use lateritic ore from both New Caledonia and Nickel Mountain as feed. The New Caledonian ore imported in 1991-93 typically contained 2.2% to 2.4% Ni on a dry basis and was significantly richer than the 1.0% to 1.25% material being mined on Nickel Mountain. The first shipment of New Caledonian ore is expected to arrive in Coos Bay in late March.

The reopening of the smelter was made possible by the recent increase in the London Metal Exchange (LME) cash price. (See Table 9 of this MIS.) The LME cash price has been extremely volatile since the beginning of February and has been fluctuating between $3.24 and $4.45 per pound of nickel. Glenbrook's management decided to shut down the smelter 20 months ago when the cash price dropped below $2.50 per pound.

The company plans to produce about 8,200 mt of Ni in FeNi in 1995 and expects production to be at least 14,000 mt in 1996. (See *American Metal Market*, Jan. 23, 1995, p. 2.) The recently renovated smelter has a capacity of 16,000 metric tons per year (mt/yr). The ferronickel will contain 48% to 52% Ni and be available in both shot and ingot form.

Glenbrook is also considering reactivating its ferrosilicon

THIS ISSUE INCLUDES REVISED CONSUMPTION STATISTICS FOR 1990-92.

Prepared in the Branch of Metals and Branch of Data Collection and Coordination, March 6, 1995.
PRINTED ON RECYCLED PAPER.

furnace, instead of buying ferrosilicon on the open market as in recent years. Ferrosilicon prices have been gradually increasing since 1992.

The ferrosilicon is added to the molten nickel ore to promote rapid reduction of the nickel, while still keeping a large part of the iron in oxide form. Addition of ferrosilicon increases production costs, but improves nickel recovery, bringing the roughly 25% Ni content of the melt up to 50% Ni.

Falconbridge Moves To Develop The Raglan Deposit in Northern Quebec

Falconbridge Ltd. has decided to develop its Raglan deposit at the northern tip of the Ungava Peninsula. Work is to begin as soon as ongoing negotiations with the Provincial Government of Quebec are completed. A few issues involving infrastructure funding, environmental permitting, and taxation still need to be resolved. Falconbridge also has to finalize its agreement with the Makivik Corp., which represents the local Inuit people. (See Falconbridge news release sent via *Canada NewsWire* on Feb. 2, 1995.)

Falconbridge is planning to spend C$486 million to bring the deposit into production by mid-1998. A sulfide concentrate will be produced on site at Katinniq and trucked about 65 kilometers to Deception Bay, QUE, where it will be transshipped by vessel to the company's smelter at Sudbury, ONT. At Sudbury, the concentrate will be converted into matte. From Sudbury, the matte will go to the company's Nikkelverk refinery at Kristiansand, Norway. The capacity of the 64,000-mt/yr Nikkelverk operation is being increased to 80,000 mt Ni/yr at a cost of C$31 million to handle the increase.

According to company officials, the Raglan deposit has 18.1 million mt of reserves, averaging 3.13% Ni and 0.88% Cu. Falconbridge is planning to produce 20,000 mt/yr of Ni in concentrate over the first 15 years of operation. The deposit was discovered in the 1930's but has been passed over on several occasions because of its extreme northern location. Falconbridge has had control of the property since 1966. For additional information, see *The Northern Miner*, v. 80, No. 50, Feb. 13, 1995, pp. 1 and 12.

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L E A S E

THIS LEASE, made this 13th day of November, 1963, by and between DOUGLAS COUNTY, a body politic and corporate of the State of Oregon, party of the first part, hereinafter sometimes called "Lessor" and THE HANNA MINING COMPANY, a corporation duly organized and existing under and by virtue of the laws of the State of Delaware, party of the second party, hereinafter sometimes called "Lessee",

W I T N E S S E T H :

WHEREAS, Lessor is the owner in fee of the following described mineral rights on lands located in the County of Douglas, State of Oregon:

> All of the mines, minerals, ores and valuable substances (excluding timber) in, on or under the West half of the Southeast quarter of Section 18; Northeast quarter of the Northeast quarter of Section 19; West half of the Northwest quarter of Section 20; and Northwest quarter of the Southwest quarter of Section 20, all in Township 30 South, Range 6 West, Willamette Meridian,

hereinafter referred to as the "mineral rights"; and

WHEREAS, in accordance with Chapter 271, Oregon Revised Statutes, the County Court of Douglas County, Oregon, has determined that the mineral rights on the above-described property are not needed for public use and has further determined that the public interest would be furthered by leasing the mineral rights to the Lessee for the term and for the purpose hereinafter set forth and that the execution of this lease has been authorized by order of the County Court of Douglas County, Oregon, duly entered in its journal and dated November 13th, 1963, and

WHEREAS, it is expressly understood that the Lessor has deeded the rights to timber and other rights in and to said premises to the Roseburg Lumber Company as more particularly set forth in deed to Roseburg Lumber Company dated May 6, 1959, recorded in Vol. 284, page 223 and 228, Deed Records, Douglas County, Oregon, subject to all minerals and mineral rights in and to the same, said minerals and mineral rights having been retained by Douglas County.

NOW THEREFORE, In consideration of the sum of one dollar ($1) to it in hand paid, and in consideration of the agreements hereinafter set forth to be kept and performed by Lessee, Lessor has let, leased and demised and by these presents hereby does let, lease and demise to the Lessee the mineral rights for such period of time and upon such terms and conditions as are hereinafter set forth.

1. The term of this lease shall be ten (10) years from and after the date hereof, provided, however, that the Lessee shall have the sole and exclusive option to renew this lease for five (5) year periods for the next thirty-five (35) years by giving the Lessor written notice of its desire for each respective renewal at least thirty (30) days prior to the first day of such renewal period, and provided further, however, that Lessee shall have the right at any time to terminate this lease or any renewal thereof as a whole by giving sixty (60) days' written notice to the Lessor of its intention so to do. On the expiration of said sixty days, this lease shall terminate and all liabilities of the Lessee under this agreement, except such liabilities as shall have then accrued, whether or not then payable, shall cease and terminate.

2. The Lessee desires to acquire the rights of said Roseburg Lumber Company in and to the said above described premises in order that it may use the surface of the above described premises for roadways, power lines, pipe lines, stockpiles, and for any other uses and purposes which shall be necessary or convenient in connection with its mining and treating operations in or on other properties.

3. The mineral rights are leased to Lessee for the purpose of enabling the Lessee to construct, maintain and use on the above described premises any or all of the facilities described in Section 2 hereof.

4. While the parties hereto expect that there is not contained in the mineral rights, a merchantable ore body, it is the desire of the Lessor that the Lessee shall verify the non-existence of a merchantable ore body in the manner hereinafter set forth prior to the use of the mineral rights by the Lessee for the construction and use of facilities on the surface thereof. The geological representatives of the Lessee, as soon as possible after the execution and delivery of this agreement, shall submit to the State Geologist of the State of Oregon, a proposed program for the exploration of the mineral rights, and when the Lessee shall have obtained the approval of said State Geologist to such proposed program, it shall cause such exploration program to be carried out. During the course of such exploration, geological representatives of the Lessee shall confer with the said State Geologist with respect to the results being obtained,

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and at the completion of the exploration program, the geological representatives of the Lessee and the said State Geologist shall agree as to the existence or non-existence of a merchantable ore body on the mineral rights. The State Geologist shall thereupon make a report of such agreement to the Lessor, furnishing a copy of such report to the Lessee, and if such report shall indicate there is contained no merchantable ore body on the mineral rights, the Lessee shall thereafter, during the term of this lease or any renewal thereof, have the sole and exclusive right to use the mineral rights for the purposes herein set forth. If such report shall indicate that there is contained on the mineral rights a merchantable ore body, the said report shall also indicate the area covered by such merchantable ore body, and such area shall thereafter be excluded from the operation of this lease without any further action on the part of the parties hereto, but the Lessee shall thereafter during the term of this lease or any renewal thereof, have the sole and exclusive right to use all of the mineral rights, except the area so excluded, for the purposes herein set forth. The Lessee shall pay all costs and expenses incurred in connection with such exploration. For all purposes of this lease, a "merchantable ore body" shall be understood to be a concentration of minerals which could be mined and sold or mined, treated and sold on the market by the Lessee in the year in which such exploration is made.

5. In the event that the Lessor shall acquire at any time during the term of this lease or any renewal thereof, any interest or interests in the above described premises in addition to its ownership of the mineral or mineral rights therein, such additional interest or interests shall be automatically included herein and covered hereby with the same force and effect as if such interest or interests had been included herein on the date hereof.

6. Beginning with the date hereof and during the period this lease or any renewal thereof continues in force and effect, Lessee covenants and agrees to pay to Lessor, an annual rental, payable annually in advance, of the sum of twenty-five cents (25¢) for each acre of mineral rights covered by this lease at the time of each respective payment of rental.

7. The Lessor agrees that Lessee shall have the right to sub-lease the mineral rights or any part thereof and to contract with others to use the mineral rights or any part thereof for the purposes herein specified with the

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same rights, privileges, obligations and requirements as are herein granted to and required of the Lessee.

8. The Lessee agrees during the term of this lease to pay any and all taxes of every kind and all assessments duly and lawfully made against all improvements or use of the premises as may be provided by the laws and statutes of the State of Oregon and which may be levied against that part of the mineral rights covered by this lease at the time of each levy of said taxes and assessments (excluding all of the surface thereof except that part used by the Lessee in its operations) and any and all taxes which may be assessed against the improvements placed by Lessee thereon, provided that the Lessee shall have the right to bond, in the manner provided by law, any assessments levied against any such leased property for local improvements and to pay the same in installments in the manner provided by law; provided further that only such installments of any such assessments as shall become due during the lease term shall be paid by the Lessee; PROVIDED, however, the Lessee shall always have the right to contest in the courts, or otherwise, the validity of any such tax or assessment in case it shall deem the same unlawful, unjust, unequal, or excessive, before it shall be required to pay or discharge it, or any part thereof; but all such taxes and assessments, or so much thereof as shall not have been cancelled or set aside, shall be paid by Lessee in time to prevent any sale of the mineral rights, or property or any part thereof, for said taxes and assessments.

9. The use and occupancy of the above described premises by the Lessee, and all of its operations hereunder shall be conducted in strict compliance with all laws applicable thereto, and with all rules and regulations promulgated, adopted and published by any commission or other governmental body having jurisdiction in the matter.

10. Lessor reserves and shall have a lien upon all machinery, implements and personal property of Lessee that may be on mineral rights as security for the payment of any annual rental that may have accrued under this lease, and for all unpaid taxes and assessments on the mineral rights and for any and all liabilities of Lessee. Any such unpaid annual rental or taxes or liabilities shall be deemed to be and be treated as a balance or balances of unpaid accounts under this lease, and such lien thereof may be enforced under the laws of the State of

Oregon by action or otherwise. Such lien, however, shall not follow any of said property after it has been shipped or removed from within the boundaries of the State of Oregon, and nothing herein contained shall prevent the removal of any or all of said property at any time when the Lessee shall not be in default hereunder, and the above referred to lien shall not, in case of sale of such property to third parties, be deemed to follow the same as against said third parties.

11. The grants of Lessor as contained herein are subject, however, to the express condition, that in case, and as often as Lessee shall make default in the performance, or by the violation of, any of the several agreements expressed herein to be kept and performed on its part, and such default shall continue uncorrected or unsatisfied for the period of ninety (90) days after written notice specifying the default complained of shall be given to Lessee by Lessor, then and in such case Lessor shall have the right to enter in and upon the mineral rights and to have and possess them again as of its first and former estate, and to exclude Lessee and all parties claiming under it.

12. The Lessor hereby represents and covenants to and with the Lessee that, at the time of the execution hereof, it owns the mineral rights in fee simple, and that the same are free and clear from all encumbrances and that (the Lessee keeping, performing and carrying out all of the covenants, promises and agreements, on its part to be kept, performed and carried out) the Lessor will, during the term aforesaid or until the termination of this lease as herein provided, warrant and defend the Lessee in the quiet and peaceable possession of the mineral rights and privileges herein granted, against all persons and corporations whomsoever, and the Lessor further covenants that at the beginning of the term hereunder, it will turn over and deliver the mineral rights to the Lessee in such condition that nothing therein or thereon shall constitute a continuing nuisance, or a continuing menace to adjacent property.

13. Lessee agrees that whenever this lease is terminated, Lessee shall peacefully surrender the mineral rights to Lessor, provided that Lessee shall be entitled and permitted to remove within ninety (90) days after such termination all buildings, structures (including milling and treatment plants), engines, tools, machinery, railroad tracks, pipe and power lines, improvements, and other property

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which may be erected or placed or made on the mineral rights by the Lessee, either before or after the date hereof. It is expressly understood however, that Lessee shall leave all roads, complete with culverts and bridges necessary for their usefulness intact for the use of the Lessor upon expiration or termination of this lease.

Lessee further agrees to peaceably surrender the leased premises or the governmental descriptions affected thereby, as the case may be to the Lessor with all caves and openings properly fenced, filled or protected as may be required by any laws or proper regulations of any duly constituted governmental authority then in effect and in good order and condition, ordinary wear and tear in use and deterioration from and damage by the elements excepted.

Lessee agrees that when this lease terminates, it will, at the request of Lessor, enter or cause to be entered a certificate of that fact upon the proper books of record in said Douglas County, Oregon, provided this lease shall have been recorded there.

14. Any difference or controversy which may arise between Lessor and Lessee, as to the construction or carrying out of this lease, or the rights of Lessor or Lessee under it, shall not interrupt or suspend Lessee's right to use the mineral rights for the purposes herein set forth, provided Lessee shall duly pay the annual rental herein provided for at the time or times and in the manner stated in this lease.

15. It is mutually covenanted and agreed that in case any controversy or disagreement shall arise between the Lessor and the Lessee relative to the due observance and fulfillment of the terms and obligations hereof by either party, then such controversy or disagreement shall be determined by arbitration in the manner herein specified. Either Lessor or Lessee may within thirty (30) days after such controversy or disagreement arises demand arbitration thereof and the party or parties making such demand shall in writing to be served upon the other in the manner herein specified for the service of notice, specify the matter to be submitted to arbitration, and at the same time choose and nominate some competent and wholly disinterested person to act as an arbitrator; thereupon within ten (10) days after the receipt of such written notice, the other shall in writing choose

so chosen shall forthwith select a third arbitrator giving written notice to Lessor and Lessee of the choice so made and fixing a place and time for a meeting not later than ten (10) days thereafter, at which Lessor and Lessee may appear and be heard touching such controversy or disagreement. The arbitrators shall then make a decision as to the controversy or disagreement within thirty (30) days, which decision of said arbitrators shall be made in writing, and when signed by a majority of them, shall be final and conclusive upon all parties and the award so made shall be forthwith complied with. In case either Lessor or Lessee shall fail to choose and nominate an arbitrator, after notice as aforesaid from the other party, or in case the first two arbitrators selected fail to agree upon a third arbitrator within ten (10) days, then such arbitrator or arbitrators may, upon application made by either Lessor or Lessee, after ten (10) days written notice thereof given to the other, be appointed by any judge of the federal court having jurisdiction within the fede al judicial district in which the mine is located. The expense of any such arbitration, including reasonable compensation for the arbitrators, shall be paid by the party against which the award shall be made, unless otherwise provided in the award of the arbitrators.

16. Any request or notice which either party may desire to give hereunder shall be properly served on the other party or parties only when reduced to writing placed in an envelope, sealed, stamped, registered and deposited in any United States Post Office addressed as follows, to wit:

County Court, Douglas County
County Courthouse
Roseburg, Oregon

Hanna Mining Company
1300 Leader Building
Cleveland 14, Ohio

Either party hereto may upon written notice to the other party (which shall be served as herein provided for service of notices generally) change the address to which notices to such party may be sent, or designate a new party with the same or a different address to which such notices may be sent.

17. In the event Lessor, in any instance,shall waive any default by Lessee or waive any provision hereof, such waiver shall not constitute a waiver by Lessor of any other default or, as to any other instance, of any provision hereof.

If any provision of this Lease or the application of such provision to any circumstance shall be held unlawful, the remainder of this lease shall not be affected thereby.

18. It is further agreed that the covenants, terms and conditions of this Lease shall both bind and benefit the heirs, executors, administrators, successors and assigns of the Lessor and the Lessee.

IN WITNESS WHEREOF, the parties hereto have executed or cause this agreement to be duly executed as of the day and year first above written.

DOUGLAS COUNTY

By V T Jackson
County Judge

E R Metzger
County Commissioner

Ray E Downs
County Commissioner

_____
County Clerk

THE HANNA MINING COMPANY

By R. W. Whitney
President

S P Engel
Secretary

Signed AND sealed ~~, and acknowledged~~
in the presence of:

J. M. Cerbeit

Charlene T. Myers

LAW OFFICES
GEDDES, FELKER, WALTON & RICHMOND
435 S. E. KANE STREET
ROSEBURG, OREGON

THE HANNA MINING COMPANY
RIDDLE, OREGON

Mining Property Preliminary Questionnaire

Explanation - More mining prospects are being brought to our attention than we are, at present, able to examine. In order to determine whether your prospect warrants a field examination, it is essential that we have the most complete information possible on the prospect. If you will please fill out the following form as completely as possible, it will help to indicate what steps should be taken by our Company.

Date Questionnaire was sent_____

Name of Property_____

Mining District_____ County_____ State_____

Section_____ Range_____ Township_____ Meridian____

Principal Metals or Minerals_____

Owner or Representative_____

Address_____

CLAIMS:

How many claims_____ Lode or Placer_____ Where Recorded_____

When Located_____ Locater_____ Recorded At_____

Who owns Claims_____ Who represents Owner_____

TERMS:

Give your suggestions as to basis on which we might work out an agreement to lease or purchase the property.

_____

_____

_____

HISTORY OF PROPERTY:

Tell us what you can of the property's past history. (Use another sheet if necessary).

_____

_____

_____

_____

_____

PROSPECTING INFORMATION:

What is nearest town_____ Miles_____

Condition of road to property_____

Can property be examined at any season of year_____

What rock occurs mainly in region_____

Is property a vein, lode or blanket_____

Ore Minerals - what minerals are considered valuable_____

_____

Gangue Minerals - What minerals are considered worthless_____

What are the dimensions of the mineralized zone, Length_____

Width_____Thickness_____

What mine workings have been driven_____

_____Can they be entered_____

Have any exploration drill holes, trenches or pits been sunk in the prospect_____. Who did this work_____

_____ When_____

What were the results_____

_____

_____

If you have any assay or analytical returns list them, give length or height of sample_____

_____

Do you have any copies of maps or reports of Engineers' examinations

_____. Who made them_____ At what Date_____

A map or sketch, no matter how crudely drawn is always of value.

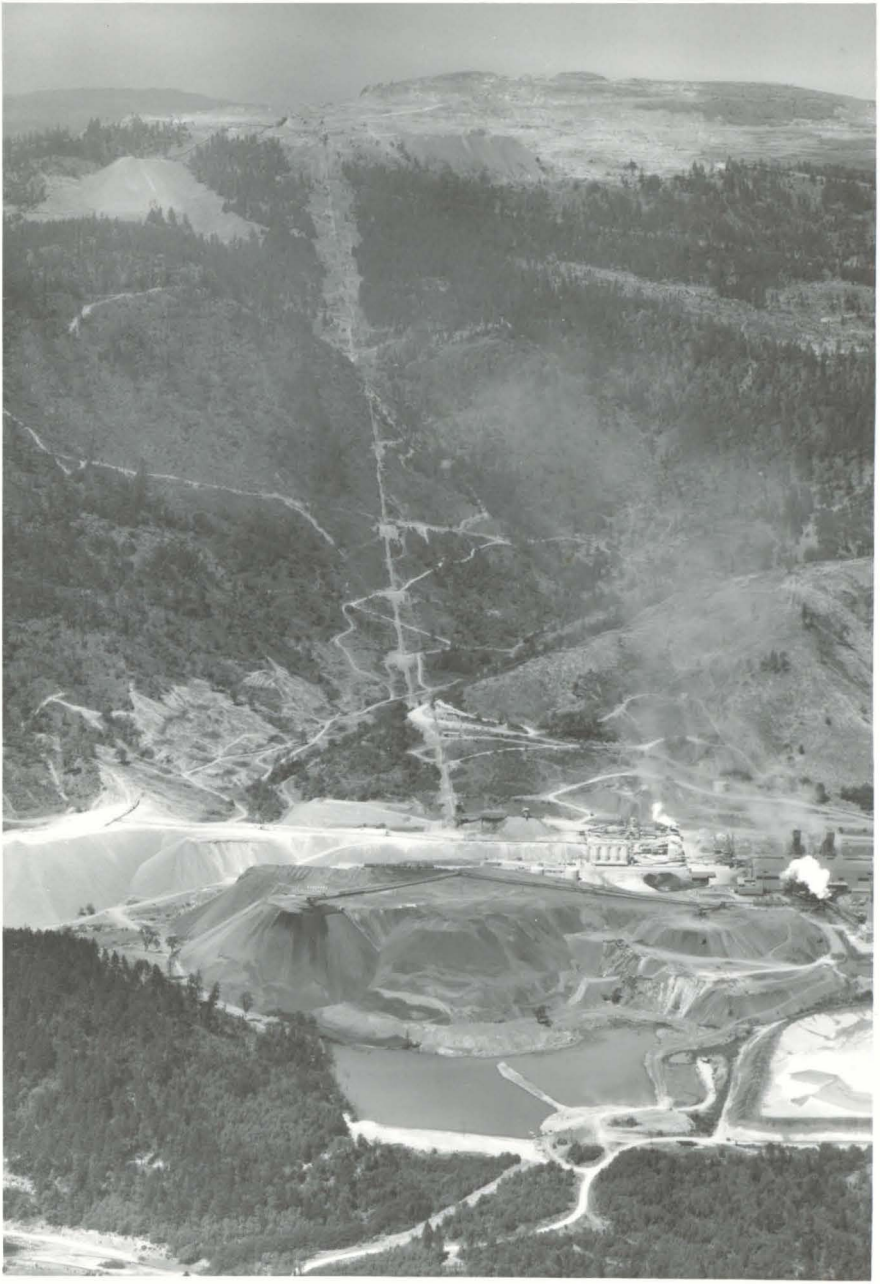
If none exist, try to draw a sketch of the property.

Your Name_____

Address _____

_____ _____

Date



'A Conspicuously Successful Case'

Statement by

George M. Humphrey

Honorary Chairman
The M. A. Hanna Company

Before the

Senate Armed Services Stockpiling Subcommittee

THE abrupt adjournment on August 17 of the Senate Stockpiling Subcommittee hearing left questions, and some degree of confusion, in the minds of many outside observers.

Since only partial reports of our initial testimony were published in the news media, we have printed Mr. Humphrey's opening statement before the Committee on August 16. This contains the basic information regarding the nickel transaction, of which, as Mr. Humphrey characterized it, both Hanna and the Government should be justly proud. We believe you will find his statement interesting and informative.

Sincerely yours,

W. A. Marting, *President*
The Hanna Mining Company

August 24, 1962

Statement by George M. Humphrey Before Senate Armed Services Stockpiling Subcommittee

I appreciate the opportunity to make this statement to you today, setting forth the facts with respect to Hanna's connection with the sale of nickel to the Government.

I would like to begin my statement with a short summary of exactly where both the Government and Hanna stand today as a result of this transaction, and then I would like to go back to the beginning and explain in detail just how this result came about and my own connection with it.

The net result of all of the transactions between the United States Government and all of the Hanna companies relating to all of the nickel contracts can be summarized as follows:

When the contracts are all completed, the Government will have on hand an inventory of 94,700,000 pounds of nickel at a total cost to it of $67,200,000, which is a cost of 71¢ per pound, as compared with the current market price of about 75¢ per pound.

Included in this total cost are the amounts used to repay in full to the Government its advances of $25,600,000 for the construction cost of the smelter plant and for working capital, and $4,800,000 of interest at 5% on these advances. This total cost also reflects the cash bonus of $1,722,000 paid to the Government by Hanna when the operation of the nickel plant was taken over for its account as well as the profit of $4,200,000 realized in cash by the Government from the sale of 30,300,000 pounds of Hanna nickel to others.

In addition to the foregoing items reflected in the cost of nickel, the Government has also received income taxes paid to it by Hanna of $5,800,000, withholding taxes of $2,000,000 for its employees at the nickel operation, and approximately $7,000,000 for power from the Bonneville Dam.

As compared with this, Hanna has sold one-quarter of its best nickel ore reserves, has realized a total net profit of $7,535,000 from all sources for the seven years of operation. Hanna now owns and is operating the smelting plant, the cost of which has been repaid to the Government in full with interest and cash bonus.

The results of these transactions are further summarized in the following table:

SUMMARY OF FACTS RELATING TO HANNA NICKEL CONTRACTS

		Amount
Sales to Government to August 14, 1962		
Cash payments to Hanna		$72.6 Million
Credited against loans to Hanna		25.6
Total cost for 108.0 million pounds of nickel		$98.2 Million
Less following amounts received by Government:		
Sales to others of 30.3 million pounds at a profit of $4.2 Million	$34.5 Million	
Cash from Hanna—bonus payment for plant	1.7	
Interest on advances credited	4.8	41.0 Million
Price paid for present inventory of 77.7 million pounds of nickel		$57.2 Million
17 million pounds to be delivered before June 30, 1965		10.0 Million
Total price paid by Government for 94.7 million pounds of nickel*		$67.2 Million
		Cost per Lb.—$.7102
Other amounts received by the Government		
Federal income and withholding taxes paid by Hanna		$ 7.8 Million
Sales to Hanna of power from Bonneville Dam		7.0 Million
		$14.8 Million
Net profit to Hanna from entire transaction		$ 7,535,000

*Sources: Report on Borrowing Authority dated December 31, 1961, submitted to the Congress by the General Services Administration pursuant to Section 304 (b) of the Defense Production Act as amended, and, Audit Report of Comptroller General of The United States dated April, 1961, covering Contracts DMP 49, 50, and 51.

Personal Participation Limited, Mistrusted Crash Program

I will now return to the history of the transaction and my connection with it.

My own personal participation in the nickel undertaking was very limited. The fact is that during the latter months of the Truman Administration, while the Hanna nickel contracts were being negotiated, I personally was engrossed in the negotiation and development of a very much larger project, embracing the building of a 360-mile railroad, opening of several iron mines, building of a shipping port, and construction of two good-sized towns, involving a total expenditure of something over $300,000,000 in Quebec and Labrador. Under these circumstances, I had very little time to spend personally on this nickel project of so much lesser importance, and the part I played was to advise from time to time with my associates who were conducting the negotiations. As a matter of fact, I was always doubtful about Hanna's undertaking the project in the way the Government proposed. The Labrador development, which was many times larger and more important to the national economy to supplement the dwindling iron ore supplies from the Mesabi Range, was straining the executive and technical capacity of our organization to the full, and I did not want that interfered with in any way. I also mistrusted the wisdom and practicability of the crash basis on which the Government felt it must go ahead with the nickel plant. And I am sure now that if we had proceeded on our own in an orderly, businesslike way without acceding to the Government's urging for a crash program, we would have been able to supply nickel in greater quantity at an even earlier time. The contracts were under negotiation by my

associates long before I had the slightest idea I might ever become an officer of the Government, and they were finally signed and delivered just before I took office.

When I was nominated as Secretary of the Treasury in January, 1953, I brought out, in my confirmation hearing in the Senate Finance Committee, the fact that these contracts had been negotiated and recently signed with representatives of the Truman Administration (see Print of Hearing before the Committee on Finance, United States Senate, Jan. 19, 1953, p. 22). As Secretary of the Treasury I had of course no occasion to take and did not take any action affecting them. As I told the Senate Committee (see Hearings p. 6) one of the first things I did when entering the Treasury was to issue a flat order that any questions of any kind that might thereafter arise affecting in any way any company with which I had been previously associated should go directly to an Under Secretary for attention, with full power to act without any reference of it to me. When I left the Treasury in July, 1957, I returned to the Hanna Company only as a director, without salary, and not as an operating officer of Hanna, and have had only general familiarity with the project since then until the hearings of your Committee prompted my recent, very careful review of the entire matter, on which I have just spent a good deal of time and effort.

This statement is based, therefore, upon my general familiarity with the origins and development of the nickel project and the careful review I have just made, and there are here today responsible officers of The Hanna Mining Company, who participated in the negotiations and directed the operations, to answer your detailed questions as to both.

For more than thirty years, the Hanna Company has spent an average of more than a million dollars a year in

geological and geophysical work, in drilling, and in research into metallurgy and into various methods of beneficiation, to find, seek out, acquire and develop metal mining projects anywhere in the western hemisphere and in a number of other, more distant places. Over the years there has been a high percentage of failures and losses, but there have been sufficient successes with profit enough to offset them so that, by and large, the Company has been repaid for its large expenditures, and grown and prospered.

Government Pressed Hanna To Open Nickel Deposit

In 1948, a mining prospect known as Nickel Mountain, near Riddle, Oregon, was brought to Hanna's attention. It was prospected and drilled, and enough ore proved to warrant a mining operation, but there was no known way of working out the metallurgy. Control of the property was acquired, and Hanna technicians went to work with their research. By the spring of 1952, Hanna's research and laboratory work indicated that a satisfactory process to make ferronickel out of this ore might be worked out, and Hanna was prepared to carry the project to the pilot plant stage of development.

The United States was then in a shooting war in Korea. The economy was controlled under wartime powers. Jet propulsion fighter planes were just coming into greater use and were of rapidly growing importance in the strategy of our defense effort. The construction of a great fleet of jet fighters would require substantially increased use of nickel, which was already in extremely short supply. There was then no nickel production within the borders of the United States. It all had to be imported. Small and large nickel

users were almost desperate in their search for nickel and were paying as much as $2.25 or more per pound in order to maintain their supply of this very essential element. The Government had been for some time pressing Hanna to open the only known domestic source of supply. For example, on February 3, 1951, then Senator Lyndon B. Johnson, Chairman of the Preparedness Subcommittee of the Committee on Armed Services wrote me as follows:

Dear Mr. Humphrey:

In its report on nickel, the Subcommittee recommended that the appropriate Government agencies, in cooperation with private industry, intensify efforts to develop American nickel ore deposits such as those in Douglas County, Oregon.

I note from recent press reports that your company has taken an option on nickel deposits near Riddle in Douglas County, Oregon.

I should greatly appreciate receiving from you a report on your program for the development of these deposits, including an estimate of the time which may be required for both the development of the mining processes and the treatment of the ores, an estimate of the amount of nickel recovery which you presently expect to be available, and what aid, if any, you may require from the Government.

Sincerely,

/s/ Lyndon B. Johnson
Lyndon B. Johnson
Chairman
Preparedness Subcommittee

As a matter of interest, I attach a series of statements on the subject of the urgency of the nickel shortage from reports

of various Congressional Committees from this time until the end of 1957. (See reports following this statement.)

Risks Not Justified For Commercial Development

The Government wanted crash action. But Hanna was being asked to enter a business that was entirely new and wholly untried, and Hanna was reluctant to go forward without pilot plant proof of the feasibility and economics of its process and a test of the marketability of its product in an orderly, businesslike way. This would have taken at least a year or more, but the greatest speed is often made by proven practical methods. The risks involved in a crash program were justified only for defense requirements, which might suddenly be changed. They were not justified for a commercial development. I was insistent with our own people that Hanna should not take the risks involved in an unbusinesslike crash program and in the immediate expenditure for the development of a mine and the construction of a plant under those circumstances. Through negotiations to overcome this situation, a plan was proposed which was finally accepted by both parties:

Hanna agreed to immediately invest, in addition to all past expenditures for acquisition, drilling, research and proving of the mining property and its process, up to $3,800,000 of Hanna's own money to open, equip and develop its own mine with no Government assistance of any kind. Hanna then agreed to meet the Government's request and make a plain, straight, firm sale under a long-term contract to the Government of the entire production of nickel ore from its own mine for a period of nine years estimated at

about 4,000,000 tons of ore at an agreed fixed price of $6 per ton subject to adjustment for nickel content and escalation.

The Government agreed to advance to a corporation formed for the purpose by Hanna but wholly financed by the Government sufficient funds (approximately twenty-two million dollars) to immediately build a full-scale commercial plant of Hanna's design, but with no profit to Hanna, and thus gain time, which the Government desired. If the process turned out not to be feasible, Hanna could convey the plant to the Government in satisfaction of the advances. And in consideration of turning over all its research and technical knowledge to the Government without any payment to Hanna, Hanna had the right at any time to acquire full title to the plant by paying off all unpaid Government advances, plus a bonus of 7½% of the original cost. Hanna agreed to not only design and construct, but also to operate the plant to produce ferronickel for sale to the Government at cost, with no profit to Hanna from its operation until the plant had produced the full tonnage of nickel then desired by the Government and contracted for at cost. Hanna received a flat fee of $100,000 a year toward the expense of providing the salaries and costs of its organization.

Both parties realized that the plant had no value except to operate on ore from this particular mine.

The Results — For the Government

Now, how did this work out, for the Government and for Hanna? The Government acted here in three capacities —first, as banker, advancing the funds to build the smelting plant and the working capital to run it; second, as customer,

purchasing the ore from the mine to run the plant to make nickel for the stockpile through operation of the plant at cost; and third, as the agency responsible for national defense, to broaden the mobilization base by creating the one and only source of domestic capacity to produce a material in critically short supply.

First, as banker, the Government advanced approximately $22,300,000 to build the smelter and $3,300,000 for working capital and has been repaid the whole amount, plus 5% interest.

Nickel Cost Government Less Than Present Market Price

Second, as customer, the Government has now bought 108 million pounds of nickel, has 17 million more due under contract at less than market, and has sold 30 million pounds at a profit of $4,153,000 during the period of acute shortage. When deliveries are completed, the Government will have acquired an inventory of 95 million pounds of nickel for the stockpile at a cost per pound of about 71¢. This cost per pound reflects the Government's total outlay, reduced by the $4,153,000 of profit which the Government got for the 30 million pounds it sold and by the $1,700,000 of bonus that Hanna paid it on transfer of the smelter, and also by the $4,799,000 of interest already paid to the Government on its loans. For purposes of comparison, the market price of ferronickel has ranged recently from 77¢ to 75¢ per pound.

Third, toward its objective of broadening our mobilization base, the Government has by this transaction stimulated the creation of the only United States facility for the production of nickel, with a capacity of 20-22 million

pounds per year. The Government's total net outlay to accomplish this is the acquisition of the 95 million pound inventory at a cost per pound less than the present market price, with every cent of additional Government expenditure fully repaid with interest. There was an obvious strategic advantage in creating the capacity in the United States; but the economic advantages were also very important. The Government's alternatives were limited to Cuba and Canada. Any Cuban capacity would now be lost to us. If a contract of the same dimensions had been made with a Canadian company, more than $100 million would have been spent outside instead of inside the United States for the purchase of nickel, with an adverse effect of that amount on our balance of payments, and the loss of millions in taxes, payrolls, and other benefits to our own economy. Those familiar with the nickel expansion program, I am sure, will agree that, of all the transactions the Government made for this purpose, the Hanna contracts involved the most efficient use of the least Government money, either per pound of nickel bought or per pound of capacity created, and it is surely one of the comparatively few cases where every cent of its expenditure has already been fully repaid to the Government with interest.

The Results — For Hanna

The result from Hanna's standpoint is this: In addition to all of its previous exploration expense, Hanna has invested $3.6 million of its own money in its own mine, and during the period to April 1, 1961, it has produced and sold to the Government 4.4 million tons of its best ore. It also designed and built the smelter, perfected the process, and operated the smelter at cost. During this period, it made a net profit on the operation of its own

mine of $7,535,000 over a period of seven years, after paying Federal taxes of $5,820,000 to the Government.

In addition, Hanna has taken over for its account operation of the smelter, having repaid the Government loans and having made the additional payment of $1,722,000 of bonus in cash on the basis provided for in the original contract.

Now, what of the future for Hanna? Hanna has now mined and sold about one-fourth of its best ore. The balance remains. It owns the mine and the plant. Through Hanna's own successful efforts, plus the loan from the Government, which has been fully repaid with interest, Hanna has introduced ferronickel, a product previously new to the American steel industry, for which Hanna is proceeding to try to develop a broadened market. If its efforts continue successful, a new commercial operation has been created that gives employment, pays taxes, supplies a needed material, and continues as the only source of nickel production within the borders of the United States.

Government Should Never Speculate In Commodities

Now, what is the real value of the Government's nickel stockpile? That is wholly dependent upon what the Government itself does from now on. The original purpose was to cover a deficiency in the supply of nickel required to meet the Government's essential requirements for war and for defense.

If the Government now changes its mind and wishes to dispose of its stockpile, it can sell it on the market, disturb normal nickel prices, operations and employment, and cause great losses, both to the Government itself and to

the entire nickel industry. That is one reason why in a strong, free-market economy, the Government should never speculate in commodities.

If, however, this stockpile or any part of it is to be resold in spite of the possible consequences involved, some plan should be worked out for long-range, orderly, careful distribution when market demands are strong and commercial requirements are high, in ways and under circumstances that will least affect normal market operations. That is the only way in which the Government's own values in the stockpile can be protected and preserved.

In recent weeks, one foreign nickel producer has already cut the price of refined nickel two cents per pound. The market is sensitive, and the Government's own action will affect the degree of pressure placed upon it.

But that is only part of the story. Beginning during a shooting war the Congress and three successive Administrations have approved and carried on this strategic stockpile program. The Truman Administration started it and contracted for the greater part of the total now in stockpile. The Eisenhower Administration carried it on with vigor and belief in its desirability, and the Kennedy Administration has continued to increase it right up to this day. Whether it was really wise to start it or not is no longer debatable. We have it on hand, paid for during the past decade.

Those commodities now in stock which will not deteriorate, which must be imported and are not available in this country when required and which in the event of world disturbance are essential to our economic life or safety, should be kept intact. They are assets we should hold on to for Government use when needed. They were bought to protect our national safety. They may well be required

again for that same purpose, and they should not be frittered away now, either to help the current budget or possibly disturb sensitive commodity markets. They should remain tightly held as a matter of permanent policy, subject only to considered Congressional control in the event any of them become clearly useless for Government use or national protection as time goes on if obsolescence should develop.

Conspicuously Successful Case; Both Parties Should Be Proud

In conclusion, this entire arrangement with Hanna was carried forward, not under the provisions of the Strategic Materials Stockpile Act, but under the terms of the Defense Production Act of 1950 which authorized the President to make commitments to purchase metals, minerals or other raw materials, and had as one of its purposes, as stated in its declaration of policy "the expansion of productive facilities . . . " Thus, through the Government's proper participation, as clearly designed and provided for by the Defense Production Act, and through Hanna's successful efforts, the Government is now protected not only with a stockpile of essential material for future use in any emergency, but a new industry has been created which may be successfully carried forward commercially and help to provide employment, taxes, and additional protection for the Government's possible future critical requirements in case of another emergency.

This is a conspicuously successful case, in which the objectives of the Congress have been fully realized, of which both Hanna and the Government should be justly proud.

FOURTH REPORT OF THE PREPAREDNESS SUBCOMMITTEE OF THE SENATE COMMITTEE ON ARMED SERVICES

January 8, 1951

"The current shortage has resulted from the collision of a rapidly increasing civilian and military demand for nickel with the relatively fixed supply produced by Inco. The foreseeable shortage, however, is even more serious. Nickel has important alloying qualities which are indispensable in steel making and the production of certain types of aircraft engines. The large increases in the production of these industries, which have now become basic to our survival as a free nation, depend substantially on a similar increase in nickel production." (page 1).

"It is reported that the M. A. Hanna Co. is engaged in a metallurgical study of certain ores in Douglas County, Oreg. According to a report by the Geological Survey, published in 1942, these deposits contain some 6,600,000 tons of ore, most of which have a nickel content of 1 percent or more. The report concluded as follows:

> The deposit can be mined by power shovels at low cost, but a new method of treating silicate ores or a great increase in the price of nickel would be required to make mining of the deposit profitable.

"In the present emergency, this deposit should not be overlooked and, accordingly, the subcommittee recommends that the Bureau of Mines and other interested agencies expedite efforts to develop this source." (page 14).

FOURTH ANNUAL REPORT OF THE ACTIVITIES OF THE JOINT COMMITTEE ON DEFENSE PRODUCTION

January 5, 1955

"At the suggestion of Arthur S. Flemming, Director of ODM, the committee held an executive hearing on March 8, 1954, to review the nickel situation and discuss its effect on our national defense and to the domestic economy as a

whole. The committee also invited Charles S. Thomas, Assistant Secretary of Defense for Supply and Logistics, to present the latest military requirements; Edmund F. Mansure, Administrator GSA, to report on the actions being taken under the nickel resources expansion program to speed up new development and production; and Sinclair Weeks, Secretary of Commerce, to discuss the impact which the stockpile acquisitions is having on the civilian economy.

"While most of the information and data discussed at this meeting is 'classified for security reasons', it was made crystal clear by each of the responsible officials that the most serious problem facing this Nation today in its preparedness program, is to develop new nickel deposits and at the same time substantially increase the production capacity at existing sources.

"Your committee strongly urged each agency to make a further effort to explore every potential source and technical process to overcome this critical bottleneck. In view of the essential use of this metal in the production of certain top priority items, it was further agreed that costs should be considered secondary to our Government's security until such time as the projected needs for both the military and civilian economy were more definitely in sight." (page 15).

FIFTH ANNUAL REPORT OF THE ACTIVITIES OF THE JOINT COMMITTEE ON DEFENSE PRODUCTION

January 25, 1956

"In view of the supply-demand imbalance that is currently forecast for months to come, and the strategic need for meeting stockpile objectives, your committee continues to urge that ODM and other Government agencies exert every effort to expedite the Nicaro expansion, increase the productive capacity of all other sources of supply available to the United States, and to make acquisitions of nickel at an aggressive rate for delivery to the stockpile until our defense position with respect to nickel is substantially improved." (page 38).

SIXTH ANNUAL REPORT OF THE ACTIVITIES OF THE JOINT COMMITTEE ON DEFENSE PRODUCTION

January 22, 1957

"In view of the critical shortage of nickel which currently exists, and the anticipated shortage which is forecast for many months ahead, your committee urges that the responsible Government agencies make a determined effort to increase the nickel supply as has been recommended by your committee repeatedly." (page 37).

SEVENTH ANNUAL REPORT OF THE ACTIVITIES OF THE JOINT COMMITTEE ON DEFENSE PRODUCTION

January 16, 1958

"With respect to supply, use, and distribution of nickel, the Department of Commerce made the findings which follow:

> "1. The supply of primary nickel available to the United States will not meet the Nation's full requirements for several years. Expansion of the free-world supply now underway or definitely planned, may not meet fully the needs of the United States by 1960-65, when such expansions are due to materialize. If additional projects for expansion of the total supply now under discussion with the General Services Administration with respect to governmental assistance are actually undertaken in the near future, it appears that the supply that would be available at the end of 5 or 6 years will be adequate for our needs at that time." (page 14).

Reduction of nickel and iron is accomplished by the Ugine Process, which consists of adding a reducing agent containing metallic silicon to an oxide ore in the presence of molten, ferrous metals and using vigorous mixing action for good contact of reductant and ore. In Hanna's smelter, crushed 48% ferrosilicon is used as the reductant, the ferrosilicon being produced in a separate electric furnace in the smelter. After the vigorous mixing cycle, the ferronickel is allowed to settle to the bottom of the ladle, after which the slag is skimmed off and granulated with high pressure water jets.

Refining

As the reducing reactions continue, ferronickel accumulates in the ladle. At regular intervals, a portion of this product is removed, or "thieved," and transported to one of two identical small electric steel furnaces. Here the impurities, predominantly phosphorous, are removed by suitable refining slags, after which the ferronickel is cast into pigs weighing approximately 28 pounds.

Samples from each cast are taken for complete chemical analysis and an accurate record of all casts is available for consumers. The ferronickel pigs are packaged on 4,000 pound pallets, with the exact weight and analysis stamped on each pallet. It has proven to be a very desirable product for the major stainless steel manufacturers of the United States.

RIDDLE NICKEL DEPOSIT

By

W. A. Foster*

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RIDDLE NICKEL DEPOSIT

The Riddle nickel deposit is located in southwestern Douglas County in Oregon, four miles west of the town of Riddle, which is inland from the Pacific coast approximately fifty miles and north of the California border about seventy miles. The deposit was discovered in 1864. Since then much prospecting and preliminary development work has been done on the property, but no ore was shipped for other than metallurgical tests until Hanna Coal & Ore Corporation started mining operations in 1954.

The ore mineral is largely garnierite. It occurs as a lateritic concentration in an intricate meshwork of iron- and nickel-stained chalcedony boxwork in sheared and weathered peridotite. In its fresh state the peridotite contains about .2% nickel. The major axis of the ore body strikes northeast and exploration so far has shown it to be roughly 6000 feet long and 3000 feet wide. The concentration ranges in thickness from a few feet to a maximum of 250 feet. It consists of three general layers; a top, brick-red soil layer, an intermediate thick, yellow, limonitic layer with some quartz-garnierite boxwork, and a root layer composed of quartz-garnierite boxwork in nearly fresh bedrock that is a transition between weathered material and fresh peridotite.

The favorable condition of shearing and fracturing of nickel Mountain peridotite made possible the formation of the quartz boxwork and garnierite. The nickel is believed to have been derived from olivine in the peridotite by decomposition during lateritic weathering which probably took place in late Tertiary time prior to uplift and canyon cutting. The Nickel Mountain deposit is an erosional remnant that escaped destruction, and under present climatic conditions, the original laterite has been altered resulting in quartz boxwork and nickel-rich garnierite.

Exploration of the deposit is being accomplished by churn drilling and trenching. A few test shafts were put down for the purposes of studying the ore in place, determining volume and moisture factors, and gathering bulk

samples for pilot plant and smelter tests. In churn drilling, 6-inch casing is driven down every two or three feet behind the drill bit and bottomed at each 5-foot interval. All the sludge for each cased 5-foot interval is dumped through a splitter and one-eighth is saved and analyzed. Churn drill holes are stopped after going through the ore zone and penetrating fresh peridotite in which the nickel content is less than .5%.

For estimative purposes we have used conservative factors as follows:

Cubic feet per short ton in place - 17

Moisture - 21%

Grade - 1.5% Ni.

Mining of the ore is done by open pit methods, utilizing 2-1/2-cubic-yard diesel shovels and 22-ton diesel trucks. The mining plan being developed at the property consists of a series of level benches, with a twenty-foot maximum height and a fifty-foot minimum width. Each bench is intersected at several points by access roads, for moving the ore from the benches to the crushing and screening plant. The mining operation can be divided into three phases, (1) mining and hauling, (2) crushing and screening, and (3) shipping.

The ore is dug from the face of a twenty-foot bench by a 2-1/2-yard-shovel and loaded into 22-ton trucks. The ore is hauled from the benches to a stockpile area in front of the screening plant. The truck loads average about 17 tons and using one shovel it is possible to handle 2500 tons per shift. Because of the fractured state of the ore in place, practically no blasting is necessary.

In the second phase of the operation the ore is screened and crushed and deposited by conveyor belt into a conical shaped surge pile of 25,000-ton capacity to await shipment. The ore is pushed by bulldozer into a hopper which feeds a 54-inch wobbler feeder. This feeder consists of thirteen rotating

eliptical manganese bars spaced at 5 inches. Over the length of the feeder, the minus 5-inch portion of the ore passes between the wobblers and into a bin from which it is fed by a 42-inch apron feeder onto the 30-inch belt going to the surge pile. The plus 5-inch portion of the ore is carried over the length of the wobbler feeder by its rotating action, and passes down a chute into a 30 x 42 jaw crusher set at 5 inches. The crusher product can either be placed on top of the wobbler undersize on the 30-inch belt to the surge pile, or on the 24-inch conveyor belt going to the reject pile. The decision to waste or save the crusher product is made by the engineering staff. The ore on the belt from the plant to the surge pile is sampled at regular intervals as a part of the grade control procedure.

Transporting the ore from the surge pile on the mountain to the smelter stockpile at the foot of the mountain is accomplished by means of a continuous aerial tramway. In a concrete tunnel under the surge pile, the ore is fed by an apron feeder onto a 30-inch conveyor belt which deposits the crushed material in a 100-ton bin where it is stored before being loaded in the tram cars. The ore is weighed and sampled on the 30-inch belt between the surge pile and the storage bin. A 42-inch apron feeder, electrically controlled, places a measured quantity of ore from the bin, into the loader, the door of which is tripped by the moving cars. Once in the car, the ore travels a distance of 8,306 feet, and drops 2,000 feet in elevation before being deposited at the smelter stockpile. The 50-cubic-foot capacity cars each carry approximately 2-1/2 tons of ore down the mountain at a speed of 500 feet per minute. The cars, spaced 260 feet apart by a two-inch connecting cable, travel loaded on 2-inch track cables and return inverted and empty on 1-1/2-inch track cables. The tramway is held to constant speed by two 300-horsepower induction generators, which when the tram cars are fully loaded, generate 500 horsepower in the form of 375 Kilowatts of electricity being returned to the power source. Two 30-horsepower electric motors are utilized in the starting of the tramway to overcome inertia and friction in the

system when the cars are empty. Hydraulically controlled brake bands acting on the drive wheel, effectively bring the tramway to a stop when loaded or empty.

A major problem in the operation of the mine is controlling the grade of ore going to the smelter at 1.5% nickel on the daily basis. Since the formation shows no continuity the exploration drill holes can be used only for depth, rather than the sample values being projected horizontally. Daily grade control is presently being attempted by horizontal bank sampling of shovel cuts, visual classification of the banks, limiting the width of the shovel cuts to ten feet. Using these methods it is necessary to have many cuts available for mining because of the length of time necessary to dry, prepare, and analyze the bank samples. A large number of digging faces are necessary also because of the wide variation in nickel grade over the property. Several areas must be available to make up an average daily shipment.

Since mining operations were started, a little over a million tons of ore has been delivered to the smelter.

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THE NICKEL MOUNTAIN PROJECT*

Introduction

A very important event in Oregon mining history occurred on January 16, 1953, in Washington, D.C., when the Defense Materials Procurement Agency signed contracts with the Hanna Coal and Ore Corporation and the Hanna Smelting Company, both subsidiaries of the M. A. Hanna Company, Cleveland, Ohio, for the production of nickel from the Nickel Mountain deposit near the town of Riddle, Douglas County, Oregon. In addition, signing of the contracts marked the opening of an important chapter in the domestic mining industry since no nickel has ever been produced in this country on a commercial scale from ore mined in continental United States (a total of a few hundred tons is recorded as a by-product in smelting copper ores). We have always depended on Canada for our nickel. Start of nickel production at Riddle will make the United States partly independent of outside sources of this very strategic metal.

Because of the importance of the Nickel Mountain project, it seems desirable to assemble background descriptive material as a record.

Geography

Nickel Mountain is about 5 miles northwest of Riddle, an incorporated town in Douglas County, as shown on the accompanying index map. Elevation of the summit of the mountain is 3533 feet. The nickel deposit, occupying much of the upper part of the mountain, may best be reached from the Hanna plant site which is about 3½ miles west of Riddle. The Hanna Company has constructed a new road more than 2 miles long extending from the plant to the deposit at the summit. Because of the hazard of meeting heavy trucks on this road, permission to drive over it must be obtained at the Hanna Company office, at present in Riddle. A gatekeeper is stationed at the entrance to the new road and a pass is required to enter.

Riddle, at an elevation of about 700 feet, is on the Southern Pacific Railroad about 220 miles south of Portland and 25 miles south of Roseburg. It is about 4 miles west of US 99, the main north-south highway in western Oregon which bypassed Riddle when it was built. Population in 1940 was reported to be 214. In 1950 it was 634, the increase caused by the lumbering boom. The main support of the population in recent years has been from a plywood mill and several sawmills together with accompanying logging. A small amount of income is received from farming. Population has increased further since the start of the nickel project but no exact record is available.

History

The town of Riddle, erroneously called Riddles, was named after William H. Riddle who, with his family, was the first settler in that part of Cow Creek valley.

In April 1851, the William H. Riddle family (including the son George who later became Judge of Douglas County) left their farm near Springfield, Illinois, and joined a party of pioneers headed for Oregon. The Riddle's outfit consisted of three wagons, each drawn by three yoke of oxen, one large carriage or "omnibus" for the family (the omnibus was abandoned at the Platte River), and about 40 head of cattle, cows, and heifers. They came into Oregon by the southern route, arriving, after 5 months of arduous travel, at what is now known as Canyonville. Here they met the first settler

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*By Department staff.

they had seen in Oregon, namely Joseph Knott, who had located the first donation land claim in the Cow Creek valley. Joseph Knott showed Riddle the Cow Creek valley, and Riddle, impressed by the beauty of the valley and the splendid range for cattle, selected a site near what is now the town of Riddle. Here he immediately cut and laid the first four logs of his cabin, this being sufficient in those days to hold a land claim.

Early in the spring of 1852, other settlers began to arrive in Cow Creek valley. One of these was John Smith, from South Bend, Indiana, who located a donation land claim embracing the present site of the town of Riddle. After establishing the claim, Smith returned to his home in Indiana, but sent his daughter and son-in-law, J.Q.C. Vandenbosch, out to take over the claim. The Vandenbosch family thereby were the first owners of the townsite of Riddle, and their name appears on all abstracts of title to Riddle town property. In 1866, Vandenbosch sold his claim to Abner and J. B. Riddle.

In 1882, the Oregon and California railroad (later the Southern Pacific railroad) began extending its line south from Roseburg and soon reached Cow Creek. Abner and J. B. Riddle donated land for a town site, and a depot was located on it. The little town which sprang up was named Riddle, sometimes called Riddleburg, and for 8 months it was the southern operating terminus of the railroad. Stages left from this point for Redding, California. A. G. Walling, in his "History of Southern Oregon," published in 1884, reports that during the time that Riddle was the railroad terminus, "the place was 'lively' in the broadest significance of the term, and its like the peaceful citizens of Cow Creek valley hope never to witness again." With the extension of the railroad, and the departure of "the horde which infested the terminus," Riddle became a subdued but thriving village and shipping point for a small but prosperous community. There were two hotels, a store, a warehouse, a saw mill, and a school house. Placer mines were being extensively worked and "a nickel mine was being worked with good results on a neighboring mountain called 'Old Piney.'"

The deposit of nickel was first discovered by sheepherders in 1865 and was thought to be tin. In the excavations the prospectors found green ore which they supposed was copper. Samples of the rock were sent to Mr. William Q. Brown, a mining expert, who was then mining on Althouse Creek in Josephine County. An analysis showed the ore to be not copper or tin, but nickel, and the sample contained 6 percent nickel.

According to a newspaper clipping dated January 17, 1908, Mr. Brown and associates purchased the property in 1882 and ran open cuts, tunnels, and shafts. More than 3,000 tons of the ore was piled on the dumps, showing an average of 5 percent nickel, the value of which at that time was about $150,000 (the price of nickel varied from 40 to 60 cents per pound). The mine was then placed on the market for sale at prices ranging from $400,000 to $1,000,000 but no purchasers were secured. In 1891, Mr. Brown and J. B. Riddle sold 200 acres of the property to the International Nickel Mining Company, of Chicago. The Company expended over $100,000 in surface improvements, including a hotel, houses for workmen, a large Corliss engine and boilers, and a saw mill. A complete smelting plant of 150 tons capacity was purchased but was never erected. The newspaper stated that the stockholders got into litigation, and the machinery for the smelting plant was still stored on the railroad at Riddle. Mr. Winslow of Chicago had become owner, and Mr. W. Q. Brown still held some of the original property. Both properties were idle in 1908, and the International Nickel Company had 60 acres in prunes, then a thriving industry in the Cow Creek valley.

Sometime during the latter part of the last century the Adams family of Oakland, California, acquired ownership in the nickel area, and early in the present century Edson F. Adams emerged as the owner of the land containing the deposit.

In the late 1930's and early 1940's at least two important groups examined the deposit. A few churn drill holes were put down, mainly on the lower deposit. It seems likely that some metallurgical testing work was done on the nickel ore at this time but the investigations were conducted quietly and no publicity was given to the field work or results obtained.

In 1941 Freeport Sulphur Company negotiated a lease with Mr. Adams and in 1942 carried on extensive exploration work. Besides geological studies, some 50-odd diamond drill holes were put down with the principal attention given to the upper deposit, which contains much the greater amount of nickel. Metallurgical testing work was done along with the drilling.

In 1943 Freeport relinquished the lease, mainly because of the seeming difficulties of economic treatment of the ore. (The market price of nickel was then 35 cents per pound.) Moreover the company had acquired the Nicaro nickel property in Cuba and put it in production under a government contract so that interest in the Oregon deposit waned. The area containing the deposit, as well as some adjoining land which had been acquired by Freeport, was turned back to Mr. Adams.

After World War II, the M. A. Hanna Company of Cleveland, Ohio, became interested in the Nickel Mountain property. Negotiations were carried on, first with Mr. Adams and then, after his death in 1947, with his estate and a deal was finally transacted. Geological work and extensive metallurgical testing were begun. This was supplemented by churn drilling, shaft sinking for testing purposes, and bulldozing deep trenches during the succeeding three years. The culmination of all the exploratory work was the signing of the government contract early in 1953.

Geology

1. General geology and geologic setting

Nickel Mountain is in the northwest part of the Siskiyou Mountains a few miles east of their juncture with the Tertiary rocks of the Coast Range. Approximately 30 miles to the northeast the Tertiary volcanics of the Cascade Range overlap the continuation of the rocks that are found in the vicinity of the nickel deposit at Nickel Mountain.

The summit of Nickel Mountain and the host rock of the nickel deposit is peridotite, an ultrabasic rock consisting chiefly of olivine and enstatite. All the peridotite is serpentinized to some extent - fresh specimens being rare. A band of serpentine several hundred feet wide divides the peridotite into two parts. Serpentine is an altered ultrabasic rock and in this area it may mark a zone of intense shearing and considerable movement within the main peridotite body. Feldspathic and quartzose dikes of small areal extent occur in the serpentine and metavolcanic rocks. The ultrabasic rocks are probably late Jurassic or early Cretaceous in age and are intrusive into metavolcanic and metasedimentary rocks of late Jurassic age. The metavolcanic rocks are greenish colored and were originally lavas or pyroclastic igneous rocks. They have undergone varying degrees of change and some may even be classified as schists or phyllites. The metasedimentary rocks are graywackes and shales with minor chert and conglomerate and belong to the Jurassic Dothan formation.

Sedimentary rocks belonging to the late Jurassic Knoxville formation, early Cretaceous formations, and the mid-Eocene Umpqua formation occupy a minor structural basin developed in the old terrain of the Klamath Mountains after the mountain-making period which followed or accompanied the intrusion of the ultrabasic rocks. The Knoxville and early Cretaceous formations are well indurated grayish-colored rocks. Graywacke type sandstones predominate in both but conglomerates composed almost entirely of chert pebbles from $\frac{1}{2}$ inch to 2 inches in diameter mark the Knoxville formation while shales are characteristic of the early Cretaceous formations. The jointing in the Knoxville formation is more pronounced than in the early Cretaceous rocks. It is most noticeable in the chert conglomerates where the fracture planes through the pebbles form smooth surfaces. The Umpqua sediments are lighter in color than the Mesozoic sediments. A yellowish sandstone is the most common material of this formation but a pebble to boulder conglomerate is found near the base and dark-colored, thin-bedded shales are found in the valley floor. The conglomerate is composed largely of pebbles derived from the metavolcanics and metasediments of the ancient Klamath Mountains. Chert pebbles are not as prominent as in the Knoxville conglomerate and the jointing is so poorly developed that the rock generally breaks around the pebbles rather than through them as in the Knoxville conglomerate. Fossils, the basis on which the age of these formations has been determined, are fairly common in the Umpqua and early Cretaceous formations, less common in the Knoxville formation and very rare in the Dothan formation.

The Dothan and metavolcanic formations generally have high dips to the southeast with a strike to the northeast. The peridotite and serpentine form a discontinuous band which can be traced for nearly 35 miles from Cow Creek near the mouth of Salt Creek northeastward to Little River near Peel. The Knoxville and younger formations have attitudes which suggest a basin in the Riddle area. All contacts of the serpentine and peridotite with the other rocks are faults, consequently when the younger formations are found lying next to the ultrabasics the otherwise low attitudes found near the middle of the basin are distorted and frequently quite steep. The contact between the Dothan formation and the volcanics appears to be gradational although in many places serpentine occurs between the two, indicating a fault. Differences in attitudes between the Knoxville, early Cretaceous, and Umpqua formations mark unconformities. The unconformity between the Knoxville and early Cretaceous formations is more pronounced than the one between the Cretaceous and the Eocene formations, while the unconformity between the Knoxville and older formations indicates that the most severe orogenic disturbances took place at that time.

2. Geology of the deposit

The nickel mineralization is confined to the area of the peridotite. The serpentine band separating the peridotite is barren.

The ore mineral is a nickel-bearing hydrosilicate. The name garnierite is generally applied to this light to dark green mineraloid but as pointed out by Pecora (Pecora, Hobbs, and Murata, 1949)* garnierite is not a single mineral but a mixture of at least two and possibly three hydrosilicates.

The source of the nickel was the olivine and enstatite, the main minerals of peridotite. Both olivine and enstatite are compatible to having nickel concealed in their structures. An analysis of olivine from Nickel Mountain showed 0.26 percent NiO while an analysis of bronzite (the alteration mineral of enstatite) showed 0.05 percent NiO (Pecora and Hobbs, 1942). According to Rankama and Sahama (1949), during weathering ultrabasic rocks are converted into magnesite by the carbon dioxide-bearing weathering solutions; the magnesite goes into solution as magnesium bicarbonate in the uppermost weathering zone, and only silica, hydrosilicates of nickel and magnesium, and iron oxide remain as a residue. Also, according to Rankama and Sahama, "Contrary to Fe^{2+} and Mn^{2+}, Ni^{2+} is very stable in aqueous solutions and is accordingly able to migrate for considerable distances under proper circumstances."

The deposit can be divided into three zones that conform well with this data. The upper zone is a brick-red soil layer from 0 to 10 feet thick that was formed under lateritic conditions. In this zone silica nodules are common but the boxwork structure of the underlying zone is lacking. Small round pellets of red iron oxide and the brick-red soil are characteristic. The green nickel-bearing silicate is not found and the mineral which contains the nickel is not known. Pecora and Hobbs (1942) give a nickel content for this zone from 0.61 percent to 1.10 percent on four composite samples. The second or medial zone is characterized by a preponderance of silica in the form of a limonite-stained boxwork. Garnierite also stains the boxwork, imparting to it a pleasing mint-green color. Boulders of peridotite which contain garnierite veinlets are common in this zone. The lower zone is referred to as the root zone by Pecora and Hobbs. Here garnierite veinlets are found filling fractures within the peridotite. The limonite-stained silica boxwork is missing, indicating that the waters depositing the nickel were relatively lower in silica and iron than those which formed the medial or boxwork zone. Undoubtedly the garnierite of this lowest zone is confined to the more permeable shear zones within the peridotite. Shearing has fractured the peridotite and localized the nickel-bearing solutions to definite zones to impart a rootlike shape. The depth to which this zone extends is not known but distances of over a hundred feet may exist. All three zones will grade into one another and the depth to which economic mineralization will extend will also probably be gradational as well as variable.

The age of the mineralization is directly related to the period of laterization. It is thought that this is Tertiary, probably early Tertiary, but until the topographic development

*Bibliography at end of this report.

of southwestern Oregon has been more accurately dated a more precise dating is not readily assignable. Probably the mineralization of the medial and lowest zones owes a great deal of its enrichment to leaching of the lateritic horizon. This suggests that mineralization in these zones has been continuous since laterization and may possibly extend to the present.

Government-Hanna contract

According to the contract between the Defense Minerals Procurement Agency and the Hanna Nickel Smelting Company and Hanna Coal and Ore Corporation, the Hanna Nickel Smelting Company will produce from 95 million to 125 million pounds of nickel in ferronickel to contain at least 25 percent nickel and not more than 75 percent iron. The government will pay not more than 79.39 cents a pound for the first 5 million pounds and 60.5 cents a pound thereafter. DMPA agrees to advance 24.8 million dollars for construction of smelting facilities and all but 2.4 million dollars will be spent on construction of the smelter. The loan will be written off under a mortgage for 24.8 million dollars recorded in Douglas County on June 25, 1953. The mortgage calls for liquidation by June 30, 1962.

The Hanna Coal and Ore Corporation contracts to develop the mine on Nickel Mountain at its own expense to cost approximately 4.3 million dollars. It is provided that ore from the deposit will be sold to the government at $6 a ton. In turn the government will sell the ore to the Hanna Nickel Smelting Company at the same price.

Plans have been made for transportation of the ore from the mine down the mountain to the smelting plant, a distance of about 1½ miles, by means of an aerial wire rope tramway. It is reported that the smelter will have four primary furnaces, one refining furnace, and two auxiliary furnaces. The company has obtained the rights to use the process of Societe D'Electro-Chimi, D'Electro Metallurgie et des Acieries Electrique D'Ungine. This process has been used successfully in treating New Caledonia ores having characteristics similar to the nickel silicate ore on Nickel Mountain.

At the time the DMPA announced the contract between the government and the company, it was stated that the ore to be treated would have an average grade of 1.5 percent nickel and that the ore would be mined by surface methods, put through a primary crusher and then conveyed to the smelter. A contract for construction of facilities was let to the Bechtel Corporation and construction has been underway since early in the spring. At the plant site furnace construction is well underway as well as numerous buildings. A railroad spur has been run from the Southern Pacific main line to the plant site, a distance of about 2½ miles. A pipe line and other water supply facilities have been installed. Sources of water will be Cow Creek and Rail Creek. Foundations for the tramway have been poured and the new first-class road from the plant to the mine has been completed. Timber is being logged off the ore body, some stripping has been done, and an office building erected at the mine. It is reported in the Mining World that production of ferronickel from one furnace will be started before September 30 of next year and that the remaining three furnaces will be installed by the end of 1954. The General Manager at Riddle is Earl S. Mollard and E. Emmons Coleman is Plant Manager. Mr. D. N. Vedensky, metallurgist, is Director of Hanna's Research and Development department.

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RIDDLE NICKEL WILL HAVE LONG LIFE

Under a Roseburg October 18 dateline the Oregon Journal published facts about the Hanna nickel project quoting Mr. Earl S. Mollard, General Manager of the project. Mr. Mollard stated that about 400 employees would be needed when the plant gets into production in the summer of 1954. It is expected that nearly all employees will be hired in the State. There will be five electric furnaces, four for the production of ferronickel and one for ferro-silicon. About 65,000 kilowatts of power will be required. The ore from the open pit mine will probably yield about 25 pounds of nickel to the ton of ore. The plan is to mine about 1800 tons of ore per day. The plant is expected to run three shifts a day for seven days a week, and ore reserves are sufficient for 30 to 40 years of operation at the capacity now planned, assuming that the operation is economic after the government contract is completed.

Mr. Mollard stated that the furnaces would not be able to refine anything but nickel. Some other elements in the ore would go to the slag pile and tests are being made to determine uses for the slag.

****

PHIL BROGAN NOW ASSOCIATE EDITOR

Phil Brogan, who has been on the Bend Bulletin staff for 30 years since graduating from the University of Oregon, has been named associate editor of the Bulletin, by Robert W. Chandler, the new owner. Brogan has been the geologists' spokesman in Oregon for many years, and a great many people look forward to his weekly article on Oregon geology in the Oregonian. He is chairman of the Oregon Geographic Board, member of the Legislative Interim Committee on Historical Institutions, member of the Geological Society of the Oregon Country and the Bend Geological Society.

****

MINING CLAIMS ABANDONED

The Bureau of Land Management, under William C. Guernsey, Regional Administrator, is trying cooperation with mining claimants in a new approach to administering the mining laws. The BLM sent letters to about 400 persons holding 890 mining claims on O & C land. These letters reminded the claimants that they had not filed the required notice that assessment work on the mining claims had been performed during the 1952-1953 assessment year. Replies have been received by BLM that 126 mining claims have been abandoned. Mr. Guernsey stated that he felt encouraged by the cooperation of mining claimants, and he urged those who have received a letter concerning lack of assessment work and have not replied to do so at once so that the status of the claim may be cleared.

Holders of mining claims on O & C lands must file an affidavit of proof of labor showing that annual assessment work has been done. This proof must be filed in the United States land office as well as the office of the county recorder of the county in which the claim is located.

****

OIL AND GAS CONSERVATION LAW HEARING HELD

On September 15, 1953, the Governing Board of the State Department of Geology and Mineral Industries, which administers the new oil and gas conservation law (Chapter 667, Oregon Laws 1953), held a public hearing in the auditorium of the State Office Building in Portland. The Board had previously compiled rules and regulations as required by the law and presented these rules for approval at the hearing. Minor changes were suggested by representatives of the industry and these have been taken under consideration by the Board. The final draft of rules and regulations is now being prepared.

****

NEW CHROME CONCENTRATOR

The Thompson Milling and Manufacturing Company owned by L. H. Thompson and Lawrence Wilson of Ashland, Oregon, has constructed a concentrating mill on the south bank of Bear Creek near the end of Oak Street in Ashland for the purpose of concentrating chromite ore. It was put into operation October 6, 1953. The mill, powered by Buda Diesel engine, includes a 12-inch jaw crusher, a 32 x 48 Denver ball mill, and a Deister table. The owners plan to enlarge the mill by addition of another ball mill and two tables. Most of the ore is from deposits on the Klamath River in California under lease to Thompson and Wilson. Ore is also being shipped from three properties near Red Mountain which is nearly 30 miles southwest of Ashland on the Mt. Ashland road. One deposit on patented ground in sec. 32, T. 40 S., R. 1 W., has been leased from Larry Basey. Another in sec. 3, T. 41 S., R. 1 W., near Red Mountain Creek has been leased, and the third property is a claim adjacent to Basey's claim located by L. H. Thompson.

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C.C.D.
BUSINESS DEVELOPMENT CORPORATION
ROSEBURG, OREGON

PROPOSAL

ALTERNATIVE USE STUDY
NICKEL MOUNTAIN SMELTER FACILITY

PB - 153
MAY, 1987

HATCH ASSOCIATES CONSULTANTS, INC. CONSULTING ENGINEERS

HATCH ASSOCIATES

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1.0 - INTRODUCTION

The mine and smelter at Nickel Mountain, four miles west of Riddle, Oregon, that is owned by M.A. Hanna of Cleveland, Ohio has been permanently closed. The C.C.D. Business Development Corporation has requested a formal proposal for an "Alternative Use Study". The objective of this study will be to identify ways by which the assets of the smelter plant can be used to create jobs thereby maximizing the value of the facility both to the community and to the M.A. Hanna Company.

On May 11, 1987 Richard W. Wilson, President, Hatch Associates Consultants, Inc., Walter D. Atchison, a consultant and formerly Sales Manager for M.A. Hanna accompanied H.D. Wedge of the M.A. Hanna Company on a tour of the smelter plant. Mr. Wedge said that layout drawings, together with specifications for major equipment, are available and he provided assurance that the study team will receive full cooperation from the M.A. Hanna Company.

The smelter plant was shut down in an orderly fashion. The plant is clean but the electrical equipment is not being rotated nor is there any ongoing maintenance program in place. Apparently the owner is in the process of disposing of the physical assets to used equipment dealers and salvage companies.

On May 12th we met with representatives of C.C.D. Business Development Corporation, a representative of the Albany Research Center of the Bureau of Mines and other interested parties. During this meeting various concepts for utilizing the smelter facilities were discussed. The proposed ferrochromium smelter plant that is in the planning stage at Coos Bay Port was also discussed. In one of the newspaper articles describing the Coos Bay project, it was stated that chromite ore from the Klammath Mountains in southern Oregon and northern California would be smelted to produce ferrochromium. The second concept that was discussed was one proposed by W.D. Smiley, Consulting Scientist, who suggests that chromite which can be mined on the shelf off-shore terraces in the vicinity of Coos Bay could be smelted in the Nickel Mountain smelter.

It was proposed that the initial study be restricted to identifying various alternative uses for the plant. The most likely concept that results from this study would then become the subject of a full scale feasibility study. At the stage when a feasibility study is initiated, it is important to have the proposed investor also involved.

It was agreed that the Alternative Use Study would have a budget not to exceed $50,000. Assuming that detailed information on the plant facilities is readily available and we are given authority to proceed by June 1, 1987, the final report should be completed by August 7, 1987.

2.0 - OBJECTIVE

The objective of this study is to identify the use or variety of uses for the physical assets that are in place at the smelter plant located at Nickel Mountain, four miles west of Riddle, Oregon. The assets associated with this facility ranges all the way from the availability of heavy industrial labor to state-of-the-art roasting, smelting and melting equipment and includes the availability of low cost power, modern pollution control equipment and transportation facilities. It is intended that priority concepts identified during this study will be those that use the entire plant whereas some only take advantage of small sections of the plant.

It must be emphasized that an alternative use study should not be confused with a comprehensive feasibility study. An alternative use study such as this must concentrate on identifying all of the manufacturing processes that can conceivably be carried on in the subject plant. This study will address only the key feasibility elements.

The final report for this project will prioritize the various concepts for alternative uses developed by the study team. It will describe the various feasibility elements that must be explored and expanded in a comprehensive feasibility study.

3.0 - SCOPE OF WORK

The initial task will be to catalog all of the assets and characteristics of the plant and of the region. The schematic flow diagram for the smelter plant shown in Figure 1 identifies much of the major equipment that will be evaluated. The specifications of all major equipment will be collected and the space and structural limitations of buildings will be shown. Information relative to the existing utility contracts, labor availability and transportation facilities will be reviewed.

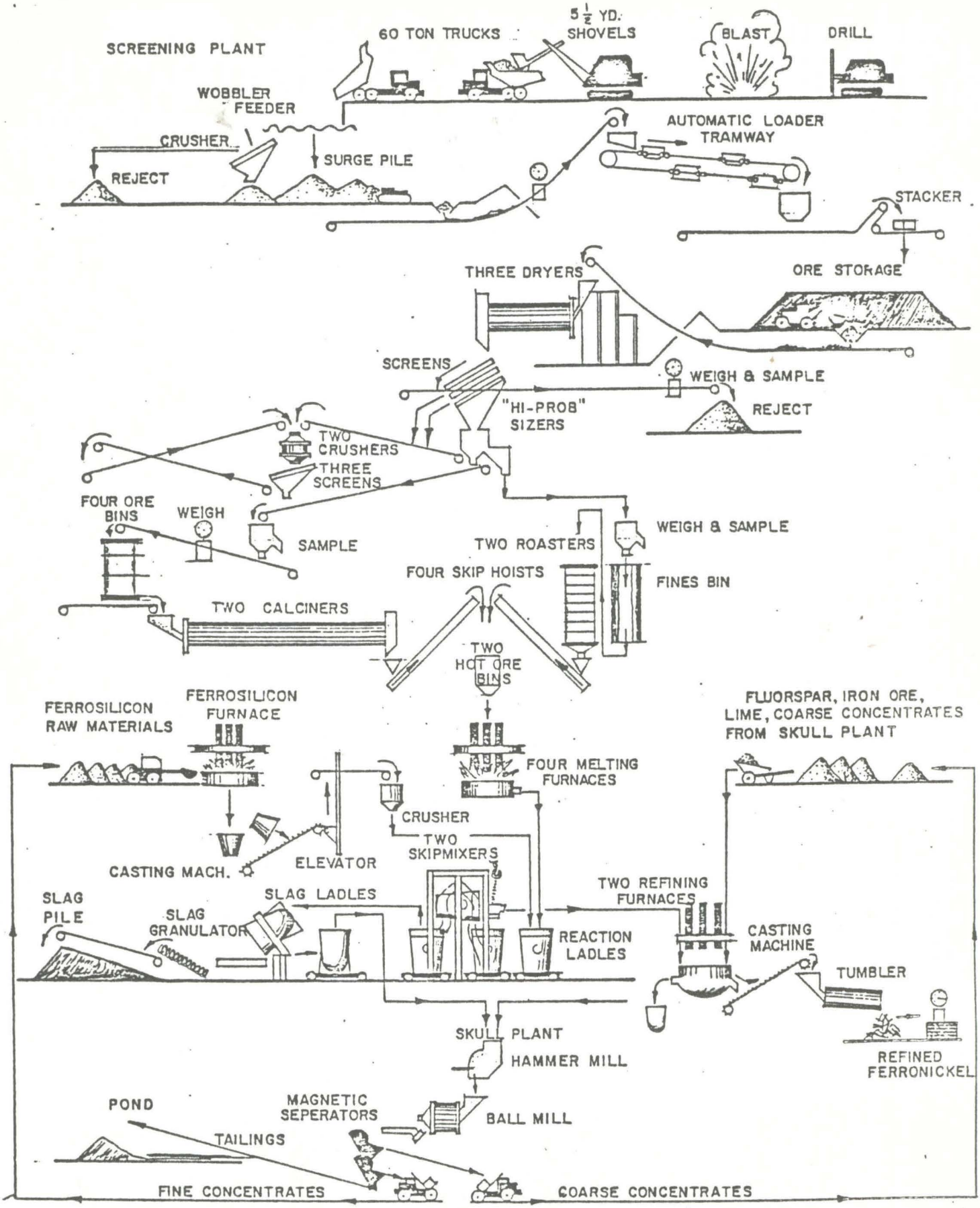
The study team will take advantage of the Hatch Associates' in-house information relative to a variety of processes that can be considered as alternative use plans. The concepts reviewed in this proposal are intended to be examples of those that will be explored.

3.1 - Ferrochrome From Black Sands

Dr. W.D. Smiley, Consulting Scientist, submitted a letter proposal to the C.C.D. Business Development Corporation on May 8, 1987. In this proposal Dr. Smiley states that there are black sands that are rich in chromite and ilminite occurring in on shore terraces, and on the shelf off shore terraces in the Coos Bay region to Cape Blanco area of southwest Oregon. He further states that these sands can be concentrated to produce a chromite suitable for smelting.

The market for ferrochromium remains depressed and is dominated by imports. There are, however, certain considerations that may make a project such as this worthy of consideration. During 1986 there was a total of 348,000 tons of ferrochromium imported which included 214,000 tons from South Africa. Our country is obviously dependent upon imports for this strategic material.

The most serious problem that we see in considering ferrochrome from black sands as a high priority alternative use for the subject smelter is that the feasibility of obtaining chromite from black sands has not been established. It may be more difficult to prove the economic feasibility



FLOW DIAGRAM

THE HANNA MINING COMPANY

HANNA NICKEL SMELTING COMPANY

FIGURE 1

of using the black sands as a source of chrome units than it will be to find an alternative use for the smelter.

3.2 - Sherwood Project (Coos Bay Port)

The newspaper in article in Coos Bay World dated April 11, 1987 describes the construction of a $24 million low carbon ferrochromium smelter plant that is in the planning stage for Coos Bay Port. It appears from the article that the site at Coos Bay was selected because the port facilities are important to the economic success of the project. It may be, however, that certain facilities currently in place at the Nickel Mountain smelter may be used in conjunction with this plant.

3.3 - Production of Stainless Steel Slabs

In mid-1982, Hatch Associates conducted a study to determine the feasibility of producing high carbon ferrochromium from chromite concentrates that originated from a North American ore source. It was determined that the subject chromite concentrates could be used to produce ferrochromium by any of the established smelting processes and that the product would be acceptable to domestic consumers. Unfortunately it was found that the concentrates could not be economically converted to ferrochromium because of the low prices that prevailed and still prevail in this depressed market.

An alternative scheme for developing domestic chromite deposits into a viable source of chromium units might be to build a plant that would convert the chrome units into stainless steel slabs or billets. An integrated plant such as this, constructed in an area where there are both raw materials and electrical energy, would have a cost advantage over competitive producers.

The flow sheet shown in Figure 2 illustrates the concept of converting low grade chromite concentrates into continuously cast slabs. This particular flow sheet was developed to illustrate the production of 400 series stainless slabs that do not contain nickel. Naturally, the

CONCEPTUAL FLOWSHEET FOR MANUFACTURE OF STAINLESS STEEL FROM LOW GRADE CHROMITE CONCENTRATES

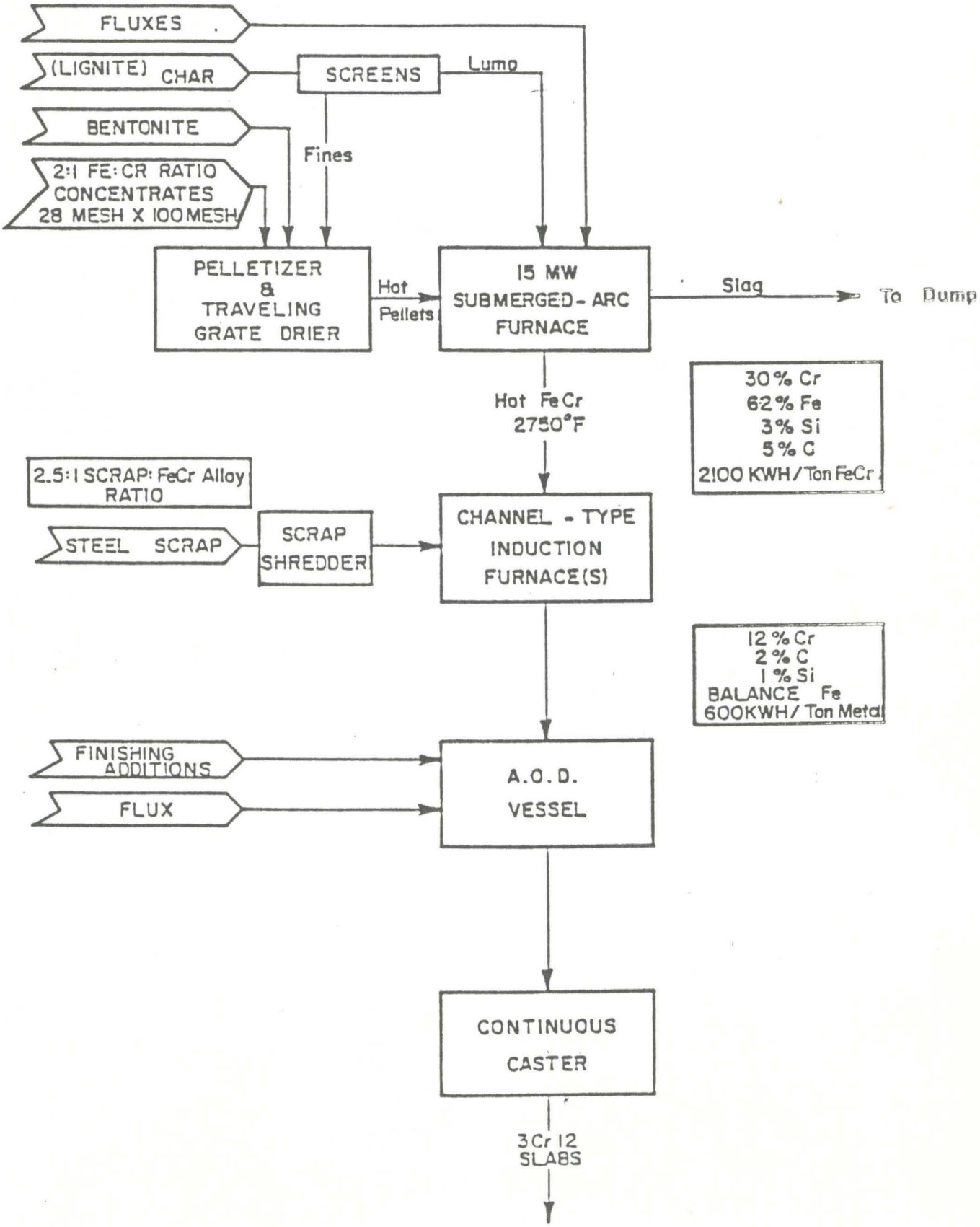


FIGURE 2

process could also be used to produce 300 series stainless containing both nickel and chromium. It should be noted on this flow sheet that a pelletizer and a dryer is required to prepare the pellets for feed to a submerged arc furnace. These major pieces of equipment are all in place in the Nickel Mountain smelter. The channel type induction furnace shown on the figure could also be replaced by the two arc furnaces installed in the smelter. Major equipment required that is not currently in place in the smelter would be the AOD vessel and the continuous caster.

We readily admit that this alternative use concept is a "long shot" because of the depressed condition of the specialty steel industry in the United States. It is, however, worthy of investigation because it has many advantages to the region in that natural resources and energy would not be shipped out in the form of raw materials but rather they would be shipped as semi-finished products; many more local jobs would be created.

3.4 - Specialty Alloys For Remelt

The two refining arc furnaces that have the capability of pouring molten metal directly into casting machines that feed their pig cast product into a tumbler, could be used for the production of a variety of specialty alloys. The raw material for this series of products would be scrap generated by the aircraft companies and other manufacturing firms located along the west coast. The product would be sold to induction melters located along the west coast.

We would not consider this to be a high priority alternative use because it would only utilize a very small part of the plant. It could, however, be used in conjunction with the slab casting process described in Section 3.3.

3.5 - Metals from Fly Ash

The Electric Power Research Institute (EPRI) has sponsored a program to evaluate the recovery of metals from fly ash. Based upon studies to date, the Direct Acid Leach Process appears to be the preferred route.

EPRI is looking for support on a $600,000 mini plant to pilot their process which has only been examined on a laboratory scale. The process flow sheet is shown in Figure 3.

The quantity of coal consumed by the power companies in the general region of southwest Oregon is shown in the following table:

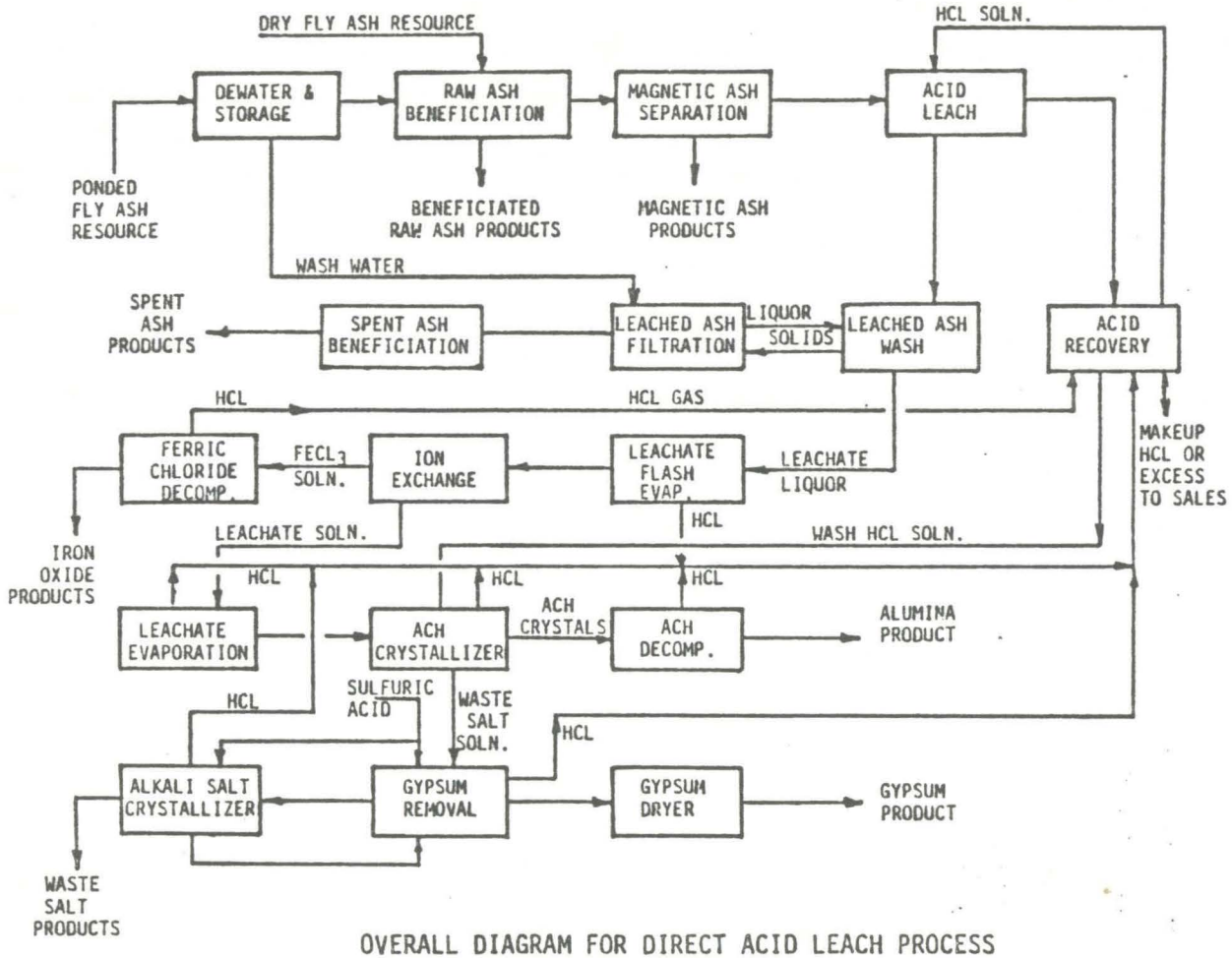
COMPANY	LOCATION OF OPERATIONS	COAL CONSUMPTION (NTPA)
Pacific Power & Light	Oregon	18.2×10^6
Southern California Edison	Nevada	3.9×10^6
Portland General Electric	Oregon	1.1×10^6
Idaho Power	Idaho	1.4×10^6
Sierra Pacific Power	Nevada	0.3×10^6
TOTAL COAL CONSUMPTION		25.4×10^6

We assume that there is 10% ash in the coal. The total fly ash produced by these five power companies each year totals more than 2.5 million tons.

3.6 - Hazardous Waste Destruction

Soils containing extremely low levels, expressed in parts per million (ppm) of polychlorinated biphenyls (pcb), and/or even lower parts per billion (ppb) levels of dioxins or furans are deemed to be hazardous and become subject to environmental restrictions. These hazardous contaminants may enter the soil as a result of leaching chemical disposal dumps.

Emerging technologies are being developed to collect the hazardous components using heat, distilling them from the soil. While the economics may be more favorable for a mobile processing concept, the use of a fixed facility may be feasible if there are sufficient hazardous waste sites in the area.



OVERALL DIAGRAM FOR DIRECT ACID LEACH PROCESS

FIGURE 3

This alternative process would utilize some of the roasting and calcining equipment in the smelter plant.

3.7 - Recycling of Electric Arc Furnace Dust

The steel industry generates large quantities of dust that is collected in filters. The dust quantity represents several percent of the steel produced. Since the dust consists mainly of metal oxides, it will be preferable to recycle the dust in the steel process but unfortunately today's processes do not generally allow an economic recycling. Much of the dust is therefore dumped or stockpiled, frequently causing environmental problems when heavy metals leach into the ground water.

Hatch Associates Consultants, Inc. has been a consultant to SKF Engineering, a Swedish based company, for the past two years. This consulting has been in connection with the application of plasma technology to both chrome smelting and to recycling of electric arc furnace dust. SKF is presently operating a plasmadust plant which converts 70,000 tons of dust per year that is located in southern Sweden. This plant converts virtually all of the electric arc furnace dust generated in Europe.

The plasmadust plant located near Riddle, Oregon would receive EAF dust from steel plants located in Seattle, California and possibly as far away as Utah. The plasmadust process is very energy intensive and it may be that the low cost electrical energy in Oregon will offset the high cost of freight.

4.0 - PROFESSIONAL STAFF

Hatch Associates offers comprehensive engineering services to the process industry, including all phases of steel and non-ferrous operations from ore processing to finished products. The company is particularly well known for its ability to work with client's top management in the planning and execution of projects involving the scale up of process technology, implementation of innovations and following through engineering, construction and start-up. Since its formation in 1955, the firm has grown to a staff of over 450, including approximately 200 engineers.

The process group is responsible for feasibility studies, new process development, pilot plant investigations, process design, environmental control projects and start-up of major industrial facilities. The group consists of over 50 chemical, environmental, metallurgical and mining engineers with many years of research, development and plant operations experience. Most of the personnel in this group have advanced degrees.

This alternative use study will require concentrated effort of a few dedicated professionals who will have the support of a variety of specialists from the Hatch organization on an as-required basis. Richard W. Wilson, President, will be Principal in Charge of the project. Paul O'Shaughnessy, Supervising Process Engineer, will be Project Manager and will be assisted by Walter Atchison and Tom Kaveney. Resumes of these key members of the project team together with resumes of various other staff members who are expected to participate in the study, are included in Appendix A.

We have contacted Dr. W.D. Smiley, Consulting Scientist, who is retired in Salinas, California. Dr. Smiley has some experience with the black sands along the coast of Oregon and he has indicated that he will be available for consultation on this project.

5.0 - PROJECT BUDGET

The scope of work may not be limited to the alternative use concepts listed in Section 3.0 of this proposal. The project team may also find that some of the concepts listed will be rejected. The project team will be in a better position to firm up the list of concepts after they have completed cataloging the facilities which is the initial phase of the project.

The not-to-exceed budget has been established at $50,000. We estimate that approximately $10,000 of the budget will be expenses, leaving $40,000 for professional fees. Based upon previous studies of this type, this equates to approximately 65 mandays of effort.

We estimate that the time required to complete the study together with the final report will be 10 weeks. It is possible that the project can be completed in less time but the wide range of concepts being considered requires a large amount of information to be gathered. In some cases the information is not readily available, thereby causing a delay.

The professional fees and terms of payment are provided on the schedule of rates included in Appendix B.

THE HANNA NICKEL OPERATION

THE HANNA MINING COMPANY

HANNA NICKEL SMELTING COMPANY

RIDDLE, OREGON

JUNE 1, 1970

P.S.M. Technologies Inc.

Head Office:
880 789 West Pender St.
Vancouver, B.C. V6C 1H2
Tel: (604) 669 3614

Subsidiary:
U.S. Chrome Inc.
U.S. Nickel Corp.

PRECIOUS
STRATEGIC
METALS

"PROJECT CHROMIUM SMELTER"

To Produce Low Carbon Ferro Chromium

The Company is pleased to announce that on April 11th, 1987, the corporate structure of SHERWOOD Pacific Limited was initiated. This company is formed to construct and operate a Chromium Smelter in Coos Bay, Oregon, to produce low carbon ferro chromium.

P.S.M. Technologies Inc. has a 31.5% interest in the project and has the exclusive right to supply all raw materials required.

The Board of SHERWOOD was elected as follows:

SIR MONTE FINNISTON
F.Eng. FRS Phd. Metallurgy
Retired, C.E.O. British Steel
Deputy Chairman Nuclear Research Centre,
Harwell U.K.
As Chairman of the Board

JOSEPH B. HOWE
BS Physics MS Physics
Group Vice-President Radio Corporation of America
Oversees two plants in New Jersey
As Director and Secretary

GEORGE E. KRUGER
BS Geology Dartmouth
MS Economic Geology U. of Minnesota
AMP Harvard Business School
20 years as Senior Vice-President of Chase Manhattan
Bank in charge of Mineral, Metal Development
Division of the Bank.
As Director.

WILLIAM G. WOOD
President of P.S.M. Technologies Inc. 30 years experience
in exploration and development of natural resources.
As Director.

PATRICK J. WOODING
BS E "Eng Lond", C.Eng Fifmech E,FIEE
Past Director of Engineering, Lectromelt, President of
Consarc and has been responsible for many of the
advanced melting projects in the United States and
overseas for the past 25 years.
As President and C.E.O.

The accumulated years of total experience of the Board of SHERWOOD with regard to their respective endeavours and expertise is 173 years.

Technical, financial and business administration are all well simulated and the Board of SHERWOOD is dedicated to one objective -- success!

Pacific Power and Light Company is funding the project in the amount of $2,000,000 (U.S.) in preferred equity. An incentive electrical supply agreement has also been negotiated subject to the approval of the Oregon Public Utility Commission. This agreement provides a price discount as well as funding for transmission, substation and other electrical facilities in the amount of approximately $4,000,000 (U.S.). This smelter will use 25/50 Megawatts of energy.

Oregon Governor Neil Goldschmidt, working in concert with the State Economic Development Department, under the direction of Chairman Roger Smith, will co-ordinate the state's major financial contribution to the project. Both Governor Goldschmidt and Chairman Smith have been extremely co-operative in bringing this new industry to Oregon.

The Oregon International Port of Coos Bay is also making a major financial contribution in the form of a fully-serviced site, including a deep-water dock on very attractive terms for the first six years. Much of the credit for this goes to Mr. Frank G. Martin Jr., the Port's General Manager, who has worked for months to bring the project to Coos Bay.

WOODING, a New Jersey corporation, headed by P. J. Wooding, an international leader in the metal melting industry, will license to SHERWOOD all patents, patent applications, and technology and will construct the smelter. The prototype primary melter was installed at full scale in one of Arbed's plants in Luxembourg and operated successfully for 18 months.

P.S.M. Technologies Inc. will provide $10,000,000 (U.S.) in equity and will have the exclusive right to supply raw material to the project. For this, it will receive a 31.5% interest directly in SHERWOOD. Initial raw material will come from Southern Oregon and Northern California properties, which P.S.M. Technologies Inc. owns or has under option from Del Norte Chromium and Asamera Metals (U.S.) Inc.

Thirty thousand tonnes of L.C.F.C. have been presold on a take or pay basis through two major metal companies for ten years. The smelter construction will be completed in August, 1988, and commissioned October, 1988. Total sales in the first full year of production will be $45,000,000 (U.S.) increasing to $60,000,000 (U.S.) in ten years with a gross profit of 35%.

Funding for this project will commence with a private placement. This financing will be announced as soon as the price has been agreed upon.

ON BEHALF OF THE BOARD

Wood.

WILLIAM G. WOOD, PRESIDENT

CCD BUSINESS DEVELOPMENT CORPORATION

JULY 30, 1987

MEETING

ALTERNATIVE USE STUDY-NICKEL MOUNTAIN SMELTER FACILITY

1.0 INTRODUCTION

2.0 ALTERNATIVE PROCESSES

3.0 RECOMMENDATIONS FOR FURTHER INVESTIGATION

LIST OF ALTERNATIVES

1) STAINLESS STEEL

2) ZINC RECOVERY FROM EAF STEELMAKING DUST ✓

3) METALS FROM FLY ASH ✓

4) SCRAP CATALYST PROCESSING ✓ (Horsehead →)

5) FERROSILICON

6) CENTRAL HAZARDOUS WASTE PROCESSING FACILITY

7) FERROCHROMIUM

8) NICKEL SLAG PRODUCTS ✓

STAINLESS STEEL

-- COMPETITIVE HOT METAL COSTS AT 50,000 TPA INGOTS.

-- PROCESS UTILIZES HANNA FACILITY AND ASSUMES ZERO COST FOR REJECT NICKEL ORE.

-- WEST COAST STAINLESS IMPORTS TOTAL APPROXIMATELY 50,000 TPA BUT THERE ARE MANY PRODUCT TYPES.

-- ONLY ONE EXISTING STAINLESS PRODUCER ON WEST COAST-JORGENSEN IN SEATTLE.

- STAINLESS POWDER MARKET IS 5,000 TPA AND COMPETITIVE.

ZINC RECOVERY FROM EAF STEELMAKING DUST

-- EAF DUST HAS BEEN RECLASSIFIED BY EPA AS HAZARDOUS AND LANDFILLING WILL BE BANNED AS OF 8/8/88.

-- SEVERAL PROCESSES HAVE BEEN DEVELOPED TO PROCESS DUST TO RECOVER THE VALUES (WHICH ARE THE HAZARDOUS COMPONENTS) AND DISCARD AN INERT PRODUCT.

-- DISCUSSIONS WITH NINE (9) STEEL PLANTS HIGHLIGHTED THEIR CONCERNS ABOUT THE EPA REGULATIONS AND THE HIGH COST OF DISPOSAL.

-- OF 500,000 TPA DUST GENERATED IN THE UNITED STATES, ONLY 35,000 TPA COMES FROM PLANTS FROM COLORADO WESTWARD.

-- HORSEHEAD RESOURCE DEVELOPMENT (HRD) IS THE ONLY FULLY COMMERCIAL OPERATOR RECOVERING ZINC FROM EAF DUST, HAS ONE OPERATING PLANT IN PENNSYLVANIA, ONE DUE TO START IN CHICAGO, AND IS LOOKING FOR OTHER SITES.

-- HRD MAY BE ABLE TO USE SOME EXISTING EQUIPMENT; EXPRESSED CONCERNS RELATIVE TO ASSUMING EXISTING ENVIRONMENTAL LIABILITY.

METALS FROM FLY ASH

-- EPRI HAS DEVELOPED A DIRECT ACID LEACH (DAL) PROCESS ON A BENCH SCALE TO RECOVER:

- ALUMINA
- IRON PRODUCTS
- GYPSUM
- ALKALI SALTS

AND THE RESIDUE HAS APPLICATIONS AS A FILLER IN PLASTICS.

-- FLORIDA PROGRESS CORP. DEVELOPED THEIR OWN DAL PROCESS ON A PILOT SCALE AND PATENTED SOME ASPECTS NOT COVERED BY EPRI.

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-- TOTAL AVAILABILITY IS 50,000 TPA MAX.

-- GULF CHEMICAL & METALLURGICAL AND CRI-MET ARE LOCATED ON THE GULF COAST AND HAVE COMBINED CAPACITY OF 70,000 TPA.

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-- CATALYST SCRAP GENERATION ON WEST COAST IS SMALL COMPARED WITH GULF COAST.

-- CHEVRON IS LANDFILLING Ni/W AND Ni/Sn SCRAP BECAUSE THERE IS NO ECONOMIC PROCESS AVAILABLE TO RECOVER THE METALS.

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-- THE HANNA FESI FURNACE IS SUITABLE FOR FESI50% PRODUCTION BUT MODIFICATIONS FOR FESI75% PRODUCTION MAY EXCLUDE THIS ALTERNATIVE PRODUCT.

-- UNITED STATES FESI FURNACE CAPACITY IS UNDERUTILIZED.

-- THE UNITED STATES IMPORTS 20% OF FESI50% REQUIREMENTS AND 70% OF FESI75% REQUIREMENTS, AND EXPORTS ARE SMALL.

-- HANNA'S PROJECTED PRODUCTION COSTS FOR FESI50% ARE GREATER THAN PREVAILING MARKET PRICES AND THERE IS LITTLE OPTIMISM FOR SIGNIFICANT UPWARD PRICE MOVEMENT BECAUSE OF WORLDWIDE OVERCAPACITY.

CENTRAL HAZARDOUS WASTE PROCESSING FACILITY

-- EPA HAS MADE DATA AVAILABLE ON 226 IDENTIFIED SITES IN OREGON.

-- THE LIST INCLUDES LANDFILLS AS WELL AS GENERATORS.

-- PLATING OPERATORS ARE NOW PROCESSING THEIR WASTES ON-SITE.

-- A CENTRALIZED INCINERATOR ~~WHICH~~ CAN ONLY PROCESS WASTES GENERATED IN OREGON AND ADJACENT STATES

-- A NEW PROCESS WOULD TAKE EXTENSIVE STUDY AND REVIEW TIME, PARTICULARLY FOR UNDEMONSTRATED TECHNOLOGIES.

PREVIOUSLY

FERROCHROMIUM

-- THE "WOODING" DEVELOPMENT REQUIRES A DEEP WATER PORT BECAUSE RAW MATERIALS MAY BE FROM OFF-SHORE AND MARKETS WILL BE WORLDWIDE.

-- OREGON BEACH SANDS COULD BE A SOURCE OF CHROMITE CONCENTRATES AND AN EXPLORATION PROGRAM IS BEING PLANNED BUT FINANCING HAS NOT BEEN SECURED.

-- THE "PROCESS" IDENTIFIED BY DR. SMILEY MAY BE BETTER LOCATED AT COOS BAY RATHER THAN RIDDLE.

NICKEL SLAG PRODUCTS

-- NICKEL SLAG IS CURRENTLY BEING USED AS AN ABRASIVE FOR SANDBLASTING AND AS THE BACKING GRANULES ON SHINGLES.

-- NICKEL SLAG HAS BEEN FOUND UNSATISFACTORY FOR HEAD LAP GRANULES ON SHINGLES; QUARRIED MATERIAL IS PREFERRED.

-- THERE IS A LIMITED MARKET FOR COLORED GRANULES IN THE NORTHWEST WITH COMPETITION IN CORONA (NEAR L.A.) AND RANCHO CORDOBA (SACRAMENTO).

-- UP TO 18 COLORS ARE CURRENTLY BEING MARKETED.

-- CAPITAL COST FOR COLORING PLANT COULD BE SEVERAL MILLION DOLLARS.

RECOMMENDATIONS FOR FURTHER INVESTIGATIONS

DEVELOPED PROCESS

-- HORSEHEAD RESOURCE DEVELOPMENT

PROCESSES NEEDING DEVELOPMENT

-- SCRAP CATALYST PROCESSING WITH CHEVRON.

-- METALS FROM FLY ASH WITH POZZOLANIC, EPRI AND FLORIDA PROGRESS.

-- NICKEL SLAG PRODUCTS (COLORED GRANULES) WITH GAF OR 3M.

	MAJOR FEED MATERIAL				SALEABLE PRODUCTS			
Process	Type	Quantity	Operating Costs ($/yr)	Capital Cost	Types	Revenues ($)	Demand Power (MW)	Employment (No.)
(1) DAL Leach	Fly Ash	540,000 TPA	11 Million	$162 Million	Magnetic Ash Alumina Gypsum Plastic Fillers	41 Million	6	200
(2) Elkem Dust	EAF Dust	30,000 TPA	3 Million	$ 2 Million	Zinc Lead	5 Million	4	40
(3) Horsehead Resource Development (N.J. Zinc)	EAF Dust	25,000 TPA	4 Million	$ 15 Million (Max.)	Zinc Concentrates Aggregate	5 Million	<1	25
(4) Stainless Slab	Reject Nickel Ore Domestic Chromite	520,000 TPA 45,000 TPA	40 Million	$ 5 Million	300 Series Stainless Ingot	50 Million	25	130
(5) Metal Recovery from Scrap Catalyst	Ni/W and Ni/Sn Catalyst	10,000 TPA	Not Known	Not Known	W and Sn Alloys with Ni Residue	2 Million	<1	20
(6) Slag Recovery Process	Nickel Slag	75,000 TPA	2 Million	$ 0.5 Million plus for coloring plant	Colored Granules	3 Million	<1	20

deC from study

BPA assignment of Power contract with Hanna Mr.

may consider the 7(b)3 charges to be "otherwise unrecoverable costs" under the terms of the power sales agreement. On this theory, they might assert that charges that would have been collected from Hanna if it were a customer can be collected as costs of termination. This position would have to be based on the contract rather than the statute since the charges are limited to "customers" under the statute.

At the meeting we simply asserted that 7(b)3 charges do not apply once Hanna ceases being a customer of BPA. The staff said they would informally respond to this position within a week. We can develop a more formal statement of position later if it appears the staff is going to be adamant in asserting that 7(b)3 charges can be imposed following termination. In the meantime it seems to make sense to work with them on an informal basis.

4. Transfer Charges Under the PP&L Agreement. We discussed the transfer charged of approximately $6,000 which BPA must pay to PP&L under its transfer agreement. Hanna bears the responsibility for these charges which continue until the time of termination. We do not see any way these charges can be avoided.

5. Other Indirect Costs. The staff did not know of any other indirect costs that can be imposed under the terms of the power sales agreement. However they said they would give the matter some additional thought and respond within the next week.

Assignment Issues.

We had an extensive discussion of the possibility of assigning the power sales agreement. The staff explained that BPA does not have a "formal" policy outlining the circumstances under which a power sales agreement can be assigned and in fact does not have any memos on this point. They did indicate that BPA is very interested in maintaining as much load as possible during the current surplus and therefore will be willing to read as much flexibility into the Regional Act and power sales agreements as possible. They specifically indicated that an assignment to a new location and to a related industry might be possible. They suggested Hanna compile a list of all products which were ever produced at Riddle even if production of one of those products was not the primary purpose of the facility. They concluded that Hanna ought to bring any possible assignment to BPA for further review.

A/S OLIVIN

A Success Story Which Illustrates How Demand can be Generated to Meet Supply

LEN, HAVE YOU SEEN THIS ARTICLE ? HOW DID THE OLIVINE SAMPLES YOU TOOK ON NICKEL MOUNTAIN TURN OUT ? Ken

Peridotite is made of ± 90% olivine. Any use for olivine in the US.

UMM

A/S Olivin is a Norwegian company which currently supplies almost half the world's 4½ million tonne per year demand for olivine sand. All this comes from a single deposit at Aaheim on the west coast of Norway. It was not always so. As recently as 1975 production was as little as 150 000 tonnes a year but research and clever marketing have opened up new uses for olivine and production has now reached 1.7 million tonnes a year. Its main use today is as a slag conditioner in iron and steel making.

Olivine is a magnesium silicate mineral made up of a solid solution of Fayallite ($FeO.SiO_2$) and Forsterite ($2MgO.SiO_2$). Chemically it assays 48 to 50% MgO, 41 to 43% SiO_2, and 6.1 to 6.6% FeO with minor quantities of chromite, alumina, nickel and manganese oxides. It is light green in colour, has a specific gravity of 3.25 and a hardness of 6.5 on Moh's scale. Olivine is a very common mineral being a component of many rocks, but it rarely occurs in exploitable deposits. There are several olivine deposits in the ultrabasic rocks of Norway but those at Aaheim are the largest and purest. Geologically the rock at Aaheim is a dunite. It consists of 90 to 95% olivine mineral with minor quantities of pyroxene, chlorite and other minerals. The deposits cover an area of 6½ km^2 and are surrounded by massive gneiss. The quality of the deposit is very consistent although there has been some serpentinisation of the olivine along the contact with the gneiss. Serpentine is a hydrated magnesium silicate formed by the action of steam on the olivine at the time of its emplacement. The water of crystallisation thus absorbed makes the serpentinised olivine unacceptable as a refractory. The gemstone peridot is a pure crystalline form of olivine.

An interesting fact from the geological point of view is that wherever the olivine outcrops the ground is covered with pine forest. Where there is no olivine, birch and other deciduous trees predominate. The conformation of the orebody can thus be clearly seen from the vegetation.

A/S Olivin, which is wholly owned by the Norwegian government, began operations in 1948 and slowly increased production to meet the demands of the traditional markets of blast cleaning and foundry sands. At the low production level of around 100 000 tonnes a year however operations were barely economic, and it was realized that a truly profitable operation could only be achieved by developing new uses in order that production could be increased and unit costs reduced. The lower costs would then hopefully further foment olivine use. The strategy has been highly successful, with production increasing more than tenfold in the ten years since 1975.

Uses

One of the traditional uses of olivine has been as foundry sand where its high melting point of 1760°C, good thermal conductivity, high heat capacity and low coefficient of expansion make it ideal as a casting medium. It has the additional advantage that there are no health hazards associated with its use as there are with silica sand, since the silica in olivine is chemically bonded to the magnesium. There is therefore no risk of workers developing silicosis.

Another traditional use is as a blast cleaning agent. Olivine sand has a hard angular grain of high density which acts as an excellent scourer. There are no health risks associated with its use since no free silica is released to the air.

The use which has accounted for the tremendous increase in production in recent years is as a slag conditioner in iron and steel making. The usual fluxing agents in steel making are dolomite or limestone, together with silica to lower the melting point. Since olivine contains both magnesia and silica the melting point of the charge is reduced and the viscosity of the slag lowered. This makes olivine an excellent substitute for dolomite when treating low silica ores. Olivine at 49% MgO also has a higher magnesia content than dolomite, so fewer tonnes are required and less slag is produced. The olivine is either mixed with the iron ore fines and fed to the sinter plant, mixed directly with the iron ore for the production of olivine pellets, or added to the blast furnace in lump form. In sinter plants the substitution of dolomite by olivine has been found to increase sintering capacity by 13 to 14%. This has been achieved through sintering temperatures about 100°C lower than before, a 20% reduction in coke consumption, and the production of a tougher sintered product, which has meant less recycle of fines. About one million tonnes a year of olivine are supplied for sinter feed with a further 250 000 tonnes a year for pellets and 250 000 tonnes a year of lump olivine for direct blast furnace feed.

Main photograph:-
The mobile crushing plant at the new pit with Lokomo double deck vibrating screen and G3210 gyratory crusher.

Bottom left:—
Inside the processing plant. Two of the four secondary crushers are shown, a Lokomo G3210 gyratory crusher and S21 cone crusher.

Top left:-
A/S Olivin processing plant and dock on the fjord.

Among the other uses to which olivine is being put is the manufacture of refractory bricks for ladles, torpedo tubes, and night storage heaters. The proximity of Aaheim to the North Sea oilfields and the high specific gravity of olivine has created a demand for it as ballast for oil platforms and for covering undersea pipelines.

Mining

Prior to 1970 production came from five or six different open pits. These were consolidated into a single operation and this pit is now being extended to avoid going into deeper and harder strata. A second open pit was recently started a few kilometres away.

Although olivine is a hard mineral it is quite a soft rock from the excavation point of view. Because the deposit is almost pure olivine, with little or no other minerals, there is no cementation between the individual crystals and the rock breaks easily along the grain boundaries. These characteristics make the rock resilient and elastic which causes problems when blasting. Much of the explosive shock is dissipated through the natural fractures and explosive consumption is therefore high.

Mining is on 15-m benches in the conventional manner. 102-mm holes 16-m long being drilled by hydraulic drills. Slurry gel type explosive is used with Nonel detonation and about 40 000 tonnes are produced with each blast. The explosive gel is prepared at a mixing station on the dockside and transported to the mine in tankers. Gel type explosive is used because of the fractures in the rock and the wet holes. It is extremely safe to use as it does not become an explosive until it has set. The blasted ore is loaded into trucks by two CAT 988 loaders and a Broyt 52 hydraulic excavator for transport to the primary crusher at the edge of the pit. The Broyt 52, which weighs 45 t and has a 4.8-m^3 bucket, is unusual in that it has no traction. It is fitted with two solid iron wheels and two rubber wheels and moves itself over short distances by leverage on the bucket boom.

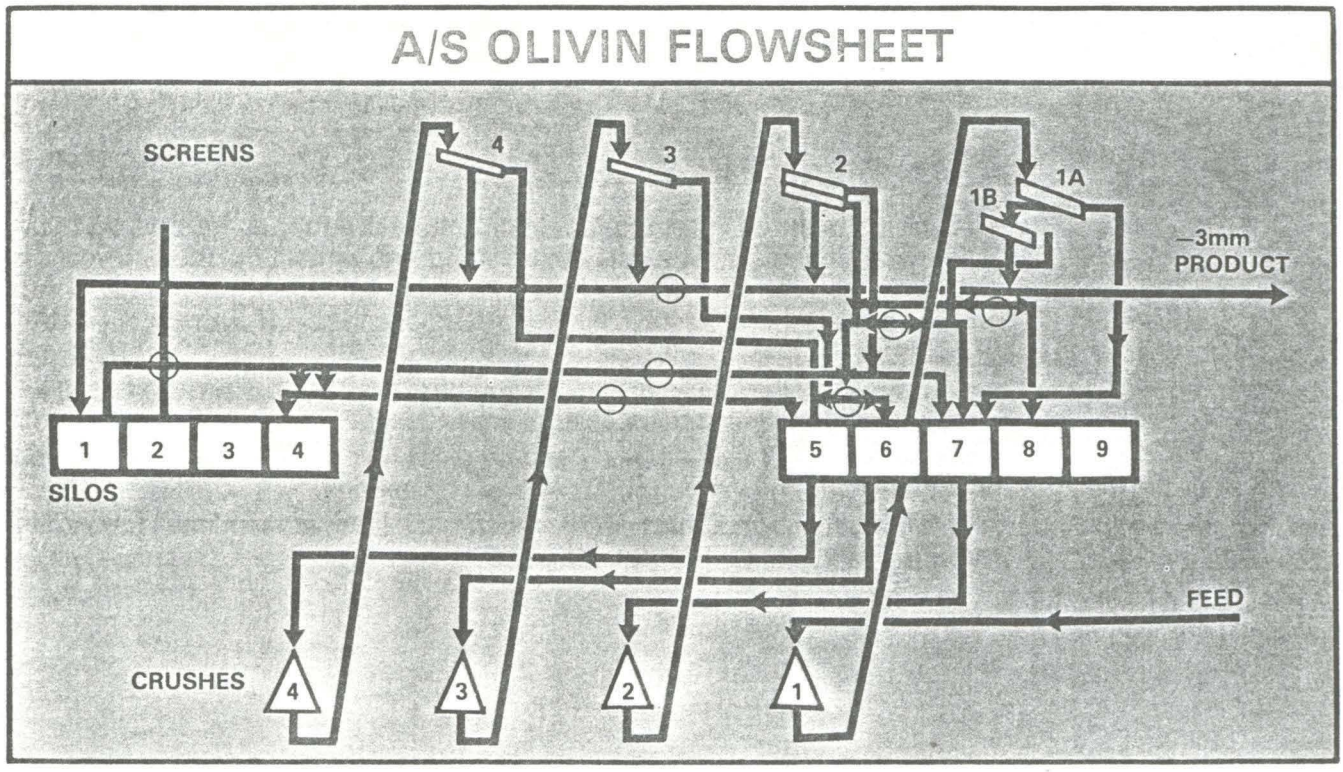
The primary crusher is a Lokomo MK120 jaw crusher which has 2½-m long jaws and is set at 300 mm. Crusher discharge goes to a conical covered stockpile and loading point. Primary crushed ore is transported to the treatment plant on the coast 7 km away by a fleet of Scania trucks with three axle trailers. The 34-t trailers are made of aluminium lined with rubber panels. The mine is currently in the process of replacing these 34-t trucks by 50-t versions.

Ripping proves an alternative to blasting

The soft nature of the rock, particularly close to the surface, led to discussion as to whether it would be feasible for excavation to be done by ripping instead of drilling and blasting. Trials at the new pit using a contracted D9L bulldozer with a single ripping tooth have been very successful, and the mine has placed an order for its own Komatsu 375 dozer. The shank of the single tooth is mounted on four hydraulic cylinders at the rear of the D9L. Ripping to a depth of about 600 mm is always done downslope. The technique is to start by tilting the dozer forward on its front axle with the tooth angled back in order to gain penetration. Once penetration has been achieved and the dozer is level, the hydraulic cylinders are actuated to force the tooth into the vertical position. The dozer makes several parallel rips and then uses its blade to push the material down the slope to the crusher. The method gives very good fragmentation, about half the production being reduced to the final size range. Olivin estimate that they will be able to remove the top 25 or 30 metres by this method. Below this the rock becomes harder and blasting will be necessary. One third of the 9000 tonne per day production is now coming from this new pit, the majority of it excavated by ripping.

Mobile Crushing Plant

The crushing plant at the new pit has been made as two mobile units so that it can be easily moved to a new site in the future. It consists of a feed hopper, grizzly, and Lokomo C125 jaw crusher as one unit, and a Lokomo double deck vibrating screen with G3210 gyratory crusher as the second unit. The jaw crusher is set at 120 mm and the G3210 gyratory at 20 mm. Gyratory discharge is recycled to the screen. Both the jaw crusher feeder and double deck screen are driven by hydraulic motors which give accurate speed control, and the gyratory crusher is mounted on rubber feet to isolate its motion from the frame.



A/S OLIVIN EQUIPMENT LIST

Crusher No.	1	Lokomo G4214	Set 50mm
"	2	" G3210	" 20mm
"	3	" S21	" 6mm
"	4	" S21	" 6mm
Screen No.	1a	Siebtechnik	Set 40mm
"	1b	" HF	" 3mm
"	2	"	"50/20/3mm
"	3	"	" 3mm
"	4	"	" 3mm
Silo No.	1	Size of Product	−3mm
"	2	" "	4-30mm
"	3	" "	Not in use
"	4	" "	+40mm
"	5	" "	3-40mm
"	6	" "	3-40mm
"	7	" "	+40mm
"	8	" "	10-40mm
"	9	" "	10-40mm

For transport the unit is raised on hydraulic jacks and a low-bed driven underneath. The steelwork and connecting conveyors for this installation were built locally by A/S Haahjem. This mobile crusher installation produces 150 t/hr of minus 4 mm product.

Processing

Since the mineral occurs in its almost pure state processing is largely a matter of producing the right size distributions. The main products are:

0 to 3 mm for sinter plant feed.
0 to 6 mm for sinter plant feed.
10 to 40 mm for blast furnace feed.
1 to 5 mm for refractory purposes.
3 to 7 mm for refractory purposes.
Foundry Sands — complete range in AFS grades 20 to 120.

Quality control is of paramount importance and begins with analysis of the samples from each blast hole. The most important parameter for a refractory mineral such as olivine is the "loss on ignition", or water content. This must be below 1%. Analysis for loss on ignition, chemical content, hardness and size distribution is carried out at regular stages from mining through to shipping.

The huge increase in production that has occurred over the past ten years has meant that the processing facilities have been in an almost continuous state of modification. A new plant with a capacity of 3 million tonnes a year has just come on stream but the old plant is being retained for the production of the more specialised products. The new plant has been designed for the maximum flexibility with four main crushing and screening circuits, reversible conveyors, and nine silos for final and intermediate products. Flexibility is extremely important to allow production of the different grades to be tailored to demand, and to accommodate special orders such as coarse ballast material for North Sea oil platforms.

Ore from the mine is dumped into a 1000-t feed hopper from where it is transported by belt to a Lokomo G4214 gyratory crusher set at 50 mm. All material passes through this crusher which operates in open circuit with two Siebtechnik screens. The upper screen removes the +40-mm material which goes to an intermediate silo while the −40-mm material passes to a Siebtechnik high frequency curved screen to remove −3-mm material. This forms one of the final products. The other three crushing circuits all work in closed circuit with screens and are used to produce the full range of products through a network of silos and conveyors. The crushers are a Lokomo G3210 gyratory and two Lokomo S21 cone crushers. The latter have a diameter of 2.1m and can be fitted with different liners for either coarse or fine crushing, thus eliminating the need to have both a standard and short-head crusher. All the screens are provided by Siebtechnik.

The following design features deserve a mention. The main vibrating feeders under the hopper can be quickly isolated by a hydraulically operated gate for maintenance purposes. The feed conveyor in the underground tunnel section is supported from the roof instead of the floor so that spillage can be easily cleaned up. Both the gyratory crushers are small enough to be mounted on rubber feet but the S21 cone crushers are solidly fixed. In order to save space and obtain a good distribution of the −40 mm material over the curved high frequency screen, a short conveyor of the same width as the screen has been installed beneath the primary 40-mm screen so that the entire feed stream travels the full length of the HF screen.

The fine size fractions to be used for foundry sand, blast cleaning and casting, are crushed, dried, screened on Mogensen sizers and a series of Rotex screens, and air cleaned to reach AFS specifications. Because of the need to dry certain fractions all crushing is done dry which can cause considerable problems in achieving the desired throughput. This is particularly so in winter when it is frequently freezing at the mine site and just above zero at the plant on the coast.

The olivine rock is very hard and abrasive but is brittle and crushes easily. Hardness and resistance to attrition are important in many applications and to achieve attrition resistance final products are not usually made on the first pass. Stage crushing and screening ensure that when producing an intermediate product like −40 +10 mm it contains only the most resilient stone since the more fragile material will have been broken up on earlier passes.

Abrasion is a serious problem in the crusher plant as the rock breaks so easily that the manganese crusher liners do not become properly work hardened. A typical bowl and mantle set will last about 4500 hours. To counteract the abrasion rubber is used for all the coarse screen cloths and polyurethane for the rest.

Refractory Production

A/S Olivin makes refractory bricks in a highly mechanised operation. One robot automatically transports the bricks from the hydraulic press to waggons for firing, and a second robot is on order to increase production. A third robot is planned, for handling the burned bricks from the waggons to pallets.

Shipping

The plant is situated right next to the dock where ships up to 80 000 tonnes can be loaded. Most of the production is shipped in bulk but some of the dry products are shipped in bags.

Conclusion

The market orientation of A/S Olivin has been responsible for its success in exploiting their unique deposit. Supply is no problem as reserves are almost limitless; what makes the business is quality, consistency, delivery dates, and a continual effort to find and develop new uses for this rather special mineral. ■

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STAINLESS STEEL

-- COMPETITIVE HOT METAL COSTS AT 50,000 TPA INGOTS.

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-- WEST COAST STAINLESS IMPORTS TOTAL APPROXIMATELY 50,000 TPA BUT THERE ARE MANY PRODUCT TYPES.

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LIST OF ALTERNATIVES

1) STAINLESS STEEL

2) ZINC RECOVERY FROM EAF STEELMAKING DUST

3) METALS FROM FLY ASH

4) SCRAP CATALYST PROCESSING Handbook

5) FERROSILICON

6) CENTRAL HAZARDOUS WASTE PROCESSING FACILITY

7) FERROCHROMIUM

8) NICKEL SLAG PRODUCTS

CCD BUSINESS DEVELOPMENT CORPORATION

JULY 30, 1987

MEETING

ALTERNATIVE USE STUDY-NICKEL MOUNTAIN SMELTER FACILITY

1.0 INTRODUCTION

2.0 ALTERNATIVE PROCESSES

3.0 RECOMMENDATIONS FOR FURTHER INVESTIGATION

	MAJOR FEED MATERIAL				SALEABLE PRODUCTS			
Process	Type	Quantity	Operating Costs ($/yr)	Capital Cost	Types	Revenues ($)	Demand Power (MW)	Employment (No.)
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(2) Elkem Dust	EAF Dust	30,000 TPA	3 Million	$ 2 Million	Zinc Lead	5 Million	4	40
(3) Horsehead Resource Development (N.J. Zinc)	EAF Dust	25,000 TPA	4 Million	$ 15 Million (Max.)	Zinc Concentrates Aggregate	5 Million	<1	25
(4) Stainless Slab	Reject Nickel Ore Domestic Chromite	520,000 TPA 45,000 TPA	40 Million	$ 5 Million	300 Series Stainless Ingot	50 Million	25	130
(5) Metal Recovery from Scrap Catalyst	Ni/W and Ni/Sn Catalyst	10,000 TPA	Not Known	Not Known	W and Sn Alloys with Ni Residue	2 Million	<1	20
(6) Slag Recovery Process	Nickel Slag	75,000 TPA	2 Million	$ 0.5 Million plus for coloring plant	Colored Granules	3 Million	<1	20

DOUGLAS COUNTY
INDUSTRIAL DEVELOPMENT BOARD

744 S.E. Rose Street – Roseburg, Oregon 97470
Telephone (503) 672-6728

OREGON STABILIZATION & CONVERSION FUND
FEASIBILITY STUDY APPLICATION:
NICKEL MOUNTAIN SMELTER--ALTERNATIVE USE STUDY

II. Project Information

6. Describe the facility (including type of construction and construction sector, pertinent features, current value, building sq. ft., land area and ownership)

The mine and smelting facility are described in some detail in an attached brochure. Since the brochure was written, rapidly increasing supply and especially power costs in the face of declining selling prices of FeNi during 1981 and 1982 resulted in a 19-month closure of the facility in April 1982. Events preceding closure are described in a copy of Hanna's pre-filed testimony at the Bonneville Power Administration rate case hearing. Subsequently, relying on an amendment in the Northwest Regional Power Bill which provided that the Bill should not adversely affect industries using materials indigenous to the region, Hanna worked out the techniques necessary to operate on an "off peak" form of power which was sold to them at $0.007 per KWH. Off-peak operations reduced costs by more than 30% but sales prices by 1984 were 10% less than production costs.

In a further attempt to regain economic operations, a modification costing approximately $12 million was made. The modification provided for recovery of an ore concentrate by a process of wet screening and separating the high grade fine fractions of ore at approximately 100 mesh size. Only economic ore was processed, melted and reduced to FeNi while the lower grade size fractions were rejected from the process as soon after mining as possible.

After construction in 1985 the new facility was tested during the end of that year and during early 1986. Approximately 70,000 tons of ore concentrate was produced, dewatered, agglomerated and stock piled. Smelting tests during June through August 1986 indicated that many unestimated advantages would be realized but that costs could not be reduced to a level roughly half of 1980 levels. The tests to produce the concentrate revealed that the $3 million wet screening and classification system required additional equipment to increase its capacity by about 60% to the 650,000 to 675,000 tons per year of concentrate needed to supply the smelter on the 104 hour per week "off peak" operating basis.

After completion of testing in August 1986, an indefinite shutdown of facility was declared. This was converted to a permanent shutdown in January 6, 1987 and plans were made to dismantle and salvage the equipment. Estimates of salvage value range from $7 to $10 million.

The land area involved includes approximately 5,200 acres of which nearly 4,000 acres is owned by M.A. Hanna Co. The balance is mostly BLM land on which Oregon Nickel and Wright leases have unpatented mining claims. Hanna has surface rights to their land but, although unmineralized, Douglas County has mineral rights. Nearly 2000 acres of the Hanna land is probably tillable.

7. Describe the most recent activity employed at the facility.

The most recent activity at this facility was the production of low carbon ferronickel and testing of the new equipment.

8. Based on available information, describe the prospects for a re-start and/or conversion of the facility.

The prospects for restarting are very remote. The equipment will be dismantled and the land sold unless an economic alternative use can be found. Even then, the equipment would most likely be sold to prospective users since, as a result of a major policy change, mining and metals are outside Hanna's corporate objective for use of new funds.

9. Please attach the facility's past three years financial statements (if available).

Financial statements are not available, but it is public knowledge that losses from Nickel Mountain operations were as follows:

FYE Sept. 30	Pre-Tax Operating Loss (000)
1982	($8,101)
1983	($5,321)
1984	($4,435)
1985	($2,228)
1986	($9,866)

The 1986 jump in the loss was due to the combination of new facility costs and a precipitate decline in nickel prices. A table showing sales prices and a graph of nickel prices for 1986 are attached.

10. Describe the facility's existing or last markets and customers for its product(s). Describe these products.

See the next to last page of the enclosed Hanna brochure for a brief description of product and markets. It is to be emphasized that an evaluation of uses of the facility other than the production of nickel are the subject of the current grant application.

11. Identify the level of employment during the last twelve months, and over the past three years.

Employment history

1987 Jan.- April	4	employees
1986 Dec.	9	"
1985 Dec.	59	"
1984 Dec.	277	"
1981	550-600	"

12. Describe the potential product mix for the facility.

See enclosed proposal from Hatch Associates

13. Describe any impediments to successful operation of the facility.

The equipment design is early 1950 vintage. It has been well-maintained and modernized where possible but modern equipment is larger by a factor of 3 to 4 and takes advantage of economy of scale.

It is somewhat difficult to speculate about other impediments prior to selecting an alternate use. For many (but not all) possible uses, the site's relative isolation and distance from major markets could be a significant impediment.

14. Describe the elements and an estimate of the cost of the feasibility study. Include specific costs for such study components as market research, asset appraisal and production cost analysis.

The Alternative Use Study will be generally as delineated in the enclosed proposal from Hatch Associates.

Hatch has been asked to provide additional information regarding:

- Definition of end-product, and likely scenario of next steps following submission of a positive report.

- Rough outline and schedule of work, with proposed review-and-reconfirm points.

- Breakdown by study component of probable type and level of effort for the not-to-exceed-$50,000 total.

15. List all individuals and/or organizations you believe are qualified to perform the feasibility study.

We are informed by former Hanna personnel that this study is sufficiently technical in nature that very few firms are qualified to undertake it. Hatch Associates is perhaps the only firm among them (others would be Bechtel Corporation, Ralph M. Parsons, Davey-McKee) who could be described as "medium" sized and who would be, in all likelihood, interested in bidding on this comparatively small project.

Hatch, whose brochure is enclosed, is perhaps uniquely qualified to perform this "Phase I" study because a) they are experts in both the iron and steel and the non-ferrous metals industries, b) they have done similar studies, currently performing a study for the State of Pennsylvania to determine alternative uses for closed steel mills in and around Pittsburgh, c) they offer an excellent potential for bringing potential investor/operators to the table in the event one or more of the alternative uses appears profitable, and d) they are available to do the study immediately, a significant factor in view of Hanna's plan to sell off the facilities (see enclosed letter from CCD Business Development Corporation to Hanna dated June 1, 1987).

16. List those individuals and community organizations supporting this application and re-starting the facility. Attach any letters of support.

Re-establishing some form of meaningful manufacturing activity at the Nickel Mountain site has virtually universal support throughout south and central Douglas County. A news article is enclosed, describing the effect of the loss of local property taxes on the local community.

The loss of the Hanna payroll, and of the trade and service jobs that the Hanna payroll supported, are if anything more dramatic. Metals industry jobs are family wage jobs--historically slightly outstripping even lumber and wood products.

In response to testimony from the neighboring communities of Canyonville and Myrtle Creek, the Douglas County Economic Strategy Committee named the $50,000 Nickel Mountain Alternative Use Study a priority project even though the primary focus of their (draft) strategy is tourism.

17. Attach a commitment letter for the 25 percent matching funds source for the feasibility study.

The Douglas County Industrial Development Board were handed the Hatch proposal on May 22. The results of their discussion are summarized in CCD's letter to Hanna of June 1. As soon as Hatch has responded to the questions listed in item 14 above, the DCIDB will reconvene and formalize its commitment. This is expected in the next two weeks.

3/16/87
Hanna

Hanna - pedalle wear (w/ specs) (rather than cr alone)

EDD - track along + be informed

- Lynn Youngbar (EDD) has memos etc. (Lens contact)
- (Jim Haights contact also)

Wedge will write a memo

Deadlines for future action — 6 mo start + 2 yr completion

[overview memo to file
statement of possibilities
Hanna deadlines]

Richard Hahn
(216) 589-4040
100 Erieview Pl
Cl. Ohio 44114

Jim Haight - 208000 tons drilled - refractory grade 22% Cr_2O_3

- actually was pursuing a broader coalition

- Establish closer liaison with EDD

⊙ Hanna feasibility statement

☆ Plan

Need internal deadlines + strategic plan

① sales brochure - Hanna ①
② deadlines - Hanna
③ Tax break from county - state (or loophole)
④ specific leads - EDD ②

concurrently

Regional economic goal setting should include
⑤ blend coastal ore w/ others to give two payoffs

Hanna File

Len, Don, John B, Ralph Natzwiger 4/1

Must attempt to retain expertise
John Day Ore @ $100/ton to product is $65/to on open market. SD ore better for local refractory brick making

$ payoff is .76% × $1.50/lb → $22/ton for nickel payout

1 yr time frame min. w/ smelter to be scrapped last. (furnaces @ 6.3M inc $600K heel)

Wedge is doing feasibility study in which plant upgrade is a part + for which EDD $ could be available

"Woodring" – ferrochrome Coos Bay option (sort of pie in the sky)
or "Bill Wood" – interested in natural gas / virgin iron contab in April at Chicago – gas as reductant would take place of coal or ferrosilicon
volume est. not provided for ferrochrome options

(diff eyes + ears + can make contacts etc. for takeover individuals)

$Fe^+ + Ni^? + e^- \rightarrow FeNi$
$Fe^+ + Cr^+ + e^- \rightarrow FeCr$

[gas
coal
other]

Upgrade needed to be competitive in any scenario

Stainless Steel market presently depressed

Need feasibility study with a look at the market first and the technology second. through SRI, Bechtel or whatever for ferro-nickel.

generic + non site specific in nature

As part of regional economic dev strategy

STATE OF OREGON

INTEROFFICE MEMO

TO: John B., Jerry G., Ron G.

DATE: August 10, 1987

FROM: Don Hull

SUBJECT: Hanna smelter alternate use study

The attached information has some interesting insights regarding industrial minerals.

DAH:rm
attachment

STATE OF OREGON INTEROFFICE MEMO

TO: Don Hull

RECEIVED
AUG 07 198
DEPT. OF GEOLOG
MINERAL IND

DATE: August 3, 1987

FROM: Len Ramp

SUBJECT: Hanna Smelter Facility Study
Douglas County Industrial Development Board Meeting, 7-30-87, 3:00 p.m.

The Group, including two representatives of Hatch Associates (the Spokesman's name - Paul O'Shaughnessy), Peter Graff, Secretary of the Douglas County Industrial Development Board, three members of the board, Herb Wedge, Lynn Youngbar of EDD, a TV reporter with his camera and recorder and me.
The meeting went into "executive session" excluding the media so the TV cameraman folded his camera and left.
Paul O'Shaughnessy summarized the preliminary investigations they have done (see enclosed summary sheets) and handed out a few copies of the "background data" consisting of about 400 pages of everything from some of my inter office memos to you (that I sent copies of to Herb Wedge), newspaper clippings and numerous calculation sheets with hand written figures related to production costs and various other costs and values to products, as well as numerous telephone memorandum from various contacts in industry on numerous subjects related to processes of interest.
At the end of the presentation, Herb Wedge and I were asked to comment. Herb wanted time to digest the data. He was concerned that possibly some things were being overlooked. We agreed and a second meeting is to be held August 4th at 3 P.M. in Roseburg.
Following the meeting I inquired as to the status of the proposed Coos Bay Ferro-Chrome plant. Peter Graff indicated that it was shelved temporarily for lack of funding but that the latest information he had was that funding would soon be, or was now available; but didn't relate the source.
I also asked Lynn Youngbar about EDD funding for the Hanna feasibility study and she indicated that there was a good possibility that they would be funding 75 percent of the cost.
I'll attend the meeting August 4th and report to you on it.

Len

Len

LR:rep
Encl: Preliminary investigations of Hatch Associates

RECOMMENDATIONS FOR FURTHER INVESTIGATIONS

DEVELOPED PROCESS

-- HORSEHEAD RESOURCE DEVELOPMENT

PROCESSES NEEDING DEVELOPMENT

-- SCRAP CATALYST PROCESSING WITH CHEVRON.

-- METALS FROM FLY ASH WITH POZZOLANIC, EPRI AND FLORIDA PROGRESS.

-- NICKEL SLAG PRODUCTS (COLORED GRANULES) WITH GAF OR 3M.

NICKEL SLAG PRODUCTS

-- NICKEL SLAG IS CURRENTLY BEING USED AS AN ABRASIVE FOR SANDBLASTING AND AS THE BACKING GRANULES ON SHINGLES.

-- NICKEL SLAG HAS BEEN FOUND UNSATISFACTORY FOR HEAD LAP GRANULES ON SHINGLES; QUARRIED MATERIAL IS PREFERRED.

-- THERE IS A LIMITED MARKET FOR COLORED GRANULES IN THE NORTHWEST WITH COMPETITION IN CORONA (NEAR L.A.) AND RANCHO CORDOBA (SACRAMENTO).

-- UP TO 18 COLORS ARE CURRENTLY BEING MARKETED.

-- CAPITAL COST FOR COLORING PLANT COULD BE SEVERAL MILLION DOLLARS.

FERROCHROMIUM

-- THE "WOODING" DEVELOPMENT REQUIRES A DEEP WATER PORT BECAUSE RAW MATERIALS MAY BE FROM OFF-SHORE AND MARKETS WILL BE WORLDWIDE.

-- OREGON BEACH SANDS COULD BE A SOURCE OF CHROMITE CONCENTRATES AND AN EXPLORATION PROGRAM IS BEING PLANNED BUT FINANCING HAS NOT BEEN SECURED.

-- THE "PROCESS" IDENTIFIED BY DR. SMILEY MAY BE BETTER LOCATED AT COOS BAY RATHER THAN RIDDLE.

CENTRAL HAZARDOUS WASTE PROCESSING FACILITY

-- EPA HAS MADE DATA AVAILABLE ON 226 IDENTIFIED SITES IN OREGON.

-- THE LIST INCLUDES LANDFILLS AS WELL AS GENERATORS.

-- PLATING OPERATORS ARE NOW PROCESSING THEIR WASTES ON-SITE.

-- A CENTRALIZED INCINERATOR ~~[illegible]~~ CAN ONLY PROCESS WASTES GENERATED IN OREGON AND ADJACENT STATES

-- A NEW PROCESS WOULD TAKE EXTENSIVE STUDY AND REVIEW TIME, PARTICULARLY FOR UNDEMONSTRATED TECHNOLOGIES.

PREVIOUSLY

FERROSILICON

-- THE HANNA FESI FURNACE IS SUITABLE FOR FESI50% PRODUCTION BUT MODIFICATIONS FOR FESI75% PRODUCTION MAY EXCLUDE THIS ALTERNATIVE PRODUCT.

-- UNITED STATES FESI FURNACE CAPACITY IS UNDERUTILIZED.

-- THE UNITED STATES IMPORTS 20% OF FESI50% REQUIREMENTS AND 70% OF FESI75% REQUIREMENTS, AND EXPORTS ARE SMALL.

-- HANNA'S PROJECTED PRODUCTION COSTS FOR FESI50% ARE GREATER THAN PREVAILING MARKET PRICES AND THERE IS LITTLE OPTIMISM FOR SIGNIFICANT UPWARD PRICE MOVEMENT BECAUSE OF WORLDWIDE OVERCAPACITY.

SCRAP CATALYST PROCESSING

-- TOTAL AVAILABILITY IS 50,000 TPA MAX.

-- GULF CHEMICAL & METALLURGICAL AND CRI-MET ARE LOCATED ON THE GULF COAST AND HAVE COMBINED CAPACITY OF 70,000 TPA.

-- NI/CO RESIDUE FROM GULF COAST PLANTS IS SHIPPED TO EUROPE AS WELL AS CANADA, AUSTRALIA AND JAPAN.

-- CATALYST SCRAP GENERATION ON WEST COAST IS SMALL COMPARED WITH GULF COAST.

-- CHEVRON IS LANDFILLING Ni/W AND Ni/Sn SCRAP BECAUSE THERE IS NO ECONOMIC PROCESS AVAILABLE TO RECOVER THE METALS.

-- TRANSITION METALS TECHNOLOGY'S PROPOSAL SEEMS TO ASSUME A LARGER SCRAP CATALYST AVAILABILITY.

METALS FROM FLY ASH

-- EPRI HAS DEVELOPED A DIRECT ACID LEACH (DAL) PROCESS ON A BENCH SCALE TO RECOVER:

- ALUMINA
- IRON PRODUCTS
- GYPSUM
- ALKALI SALTS

AND THE RESIDUE HAS APPLICATIONS AS A FILLER IN PLASTICS.

-- FLORIDA PROGRESS CORP. DEVELOPED THEIR OWN DAL PROCESS ON A PILOT SCALE AND PATENTED SOME ASPECTS NOT COVERED BY EPRI.

-- POZZOLANIC NORTHWEST HANDLES 3 MILLION TPA FLY ASH FROM SOURCES IN WASHINGTON, OREGON, WYOMING, COLORADO, NEVADA AND ALASKA AND SELLS MATERIAL AS A CEMENT SUBSTITUTE WITH SHIPPING DISTANCES UP TO 1,500 MILES.

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8) NICKEL SLAG PRODUCTS

CCD BUSINESS DEVELOPMENT CORPORATION

JULY 30, 1987

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Oregonian 2/29/88

Buyer of Riddle nickel mine to tap it for construction stone

An Ohio-based company that recently purchased the former Hanna Nickel Smelting Co. mine and plant near Riddle has auctioned off its mining and rock-processing equipment, company officials said Monday.

The new owner, Universal Consolidated Cos. of Fremont, Ohio, does not plan to resume nickel mining at the site in Douglas County, about 15 miles south of Roseburg, said Bill Niggemyer, the company's president.

"It's not a terribly economic mine. It never was," Niggemyer said of the nickel-recovery operation conducted by Hanna off and on since 1954.

Niggemyer said his company's subsidiary, Nickel Mountain Resources Co., would operate the plant instead as a producer of construction stone and sandblasting abrasives, using materials left over from the nickel mining. Those two operations would employ up to 27 people, he said.

He also said the company wished to process ferrosilicon, another material available from the mining wastes, but that he had not been able to reach an agreement with the Bonneville Power Administration on necessary electricity costs.

The operation involving ferrosilicon, used in nickel refining, would employ "50 to 75" people, Niggemyer said.

Niggemyer said that although worldwide nickel prices have soared in recent days to $23,900 per metric ton, "nobody expects that to be the long-term case".

Ladd Sutton, Bonneville Power's district manager in Eugene, said Nickel Mountain Resources had sought continuation of a special 1.2-cent-per-kilowatt-hour electricity price that had been charged to Hanna. That rate had been written into the Northwest Power Act of 1980 for the former mine and smelter operator, Sutton said.

STATE OF OREGON

INTEROFFICE MEMO

TO: **LEN RAMP,** 312 S.E. "H" St.
P.O. Box 417
Grants Pass, OR 975226

DATE: **AUGUST 11, 1988**

FROM: **DON HULL**

SUBJECT: **HANNAH NICKEL SMELTER SLAG AT RIDDLE, OREGON**

I am attempting to locate analytical information on the chemistry of the slag piles at the Hannah nickel smelter near Riddle. Could you please send any file information that you may have directly to Barry Harrington, Division Manager, Cojon Corporation, 11917 N.E. 95th Street, Vancouver, WA 98685 (206-892-8988). Please treat his interest in this matter as confidential.

cc: Barry Harrington

hull1/ramp8-11
81188/ch

bcc: Ron Geitgey
Jerry Gray

81-125-1387

Riddle vows to survive mine's closure

By DANA TIMS
Correspondent, The Oregonian

RIDDLE — There is sadness, just as there is anytime an old friend dies, say longtime employees of the Hanna Nickel Smelting Co., which has closed permanently after 32 years of operation.

But old-timers and civic leaders alike are adamant in vowing that rather than curling up and dying with the nickel operation, the town of Riddle, about 15 miles south of Roseburg, will survive and prosper.

Officials of M.A. Hanna Co., the parent company, announced the closure without warning Wednesday. The move followed several temporary shutdowns in the last few years, the most recent of which had left the rugged, 4,000-acre site largely idle. The last refined liquid was poured Oct. 7.

During a closure in 1985, the company invested $13 million in the plant to modernize operations and lower costs. The revamping included introduction of an entirely new technology in nickel processing and installation of nearly three miles of special pipe running from the huge smelting operation to the mine site.

Workers and townspeople held out hope that a miracle would occur, that the mine would somehow remain open.

But nickel prices had plummeted — from a high of $3.40 per pound in 1980 to the current rate of $1.58 — largely due to the dumping of less expensive foreign nickel onto the fragile international market. The mine's fate was sealed.

Closure letters dated Jan. 7 were sent to the 270 workers who had survived earlier layoffs due to seniority. Of those receiving the letters, at least a dozen were just shy of the 30 years necessary to qualify for a company pension, union leaders said.

At its peak in 1980, the world's only integrated nickel mining and smelting operation employed nearly 650 people.

"We always felt it would reopen for good if the prices could have just stayed high enough for the company to make a profit," said Jack Garren, 58. "But the way things were going, we could see this happening. I wasn't surprised at all."

Garren, a lifelong Riddle resident, worked more than 23 years at the mine as a millwright.

"I know it's going to hurt a lot of people around here," said John Wagoner, who was a crane operator for 32 years. "I think the town itself will be fine, but things are just tough all over for the working man."

Some employees conceded that the company had done all it could to keep the operation afloat as long as possible. Bill Morris, a 30-year warehouseman, disagreed.

"A lot of us felt they brought in nothing but junk machinery when they changed their production process in 1985 just to get some use out of the stuff," Morris said. "But I'll tell you, the men busted their butts out there to make it work. We just had too much rotten luck."

John Davenport, president of United Steel Workers of America Local 5074, was philosophical.

"We all made some mistakes and things just didn't turn out liked we hoped they would," Davenport said. "We wished they would have held off awhile to see what happened to prices, but given the trends, no one can say the company didn't do everything in its power to remain operating."

A special contract with the Bonneville Power Administration in 1985, for example, required the company — the largest single consumer of power betwen Eugene and San Francisco — to operate at "off-peak hours" in exchange for low power rates.

"But prices just refused to cooperate," said Marvin Johnson, Hanna Nickel engineering manager. "I find it difficult to believe there is anyone in the world who can produce nickel for a profit as a main line of business."

He and others recall the early

See RIDDLE, Page B2

Historical dates of Riddle

Here is a time line of significant events regarding operation of Hanna Mining Company and Hanna Nickel Smelting Co.'s mine at Riddle. It was announced Wednesday that the nickel mine and smelter would close permanently, leaving about 270 people out of work.

1864 — First ore deposits are discovered on Nickel Mountain by settlers, who, due to unusual green tint of ore, believe they have found major copper deposits.

1881 — Discovery that ore contains nickel, not copper, triggers prospecting and preliminary development work on the mountain.

1920 — Efforts to mine ore for shipment to Eastern processing plants proves too costly and is abandoned after several years.

1952 — Smelting operation is built by the federal government for strategic stockpiling and for use in building Korean War-bound jet engines.

1954 — Hanna buys smelting operation for $53 million; first refined liquid is poured July 12. Ferronickel, a combination of iron and nickel, is the first to be produced in the nation from domestic ores.

1980 — Employment hits an all-time peak of nearly 650 workers.

1982 — The first long-term closure takes place, due to falling nickel prices. Operation remains closed from April 1982 through December 1983. Nearly 400 jobs are trimmed by the time the mine reopens 19 months later.

1985 — Second major shutdown in August occurs; 200 workers lose jobs. Company invests $13 million to revamp processing method.

1986 — Third closure, in August, idles the plant. The last metal is poured Oct. 7. Remaining nickel stockpiles are loaded and shipped in mid-December.

1987 — Hanna's parent company, M.A. Hanna Co. of Cleveland, announces permanent closure of the plant Jan. 7. Termination notices are sent to 270 employees.

The Oregonian

SOURCE: THE (PORTLAND) OREGONIAN

DATE: JANUARY 11, 1987

COMMODITY SECTION: FERROUS (MORE)

STATE ARTICLE CONCERNS: OREGON

Mine reclamation work lies ahead

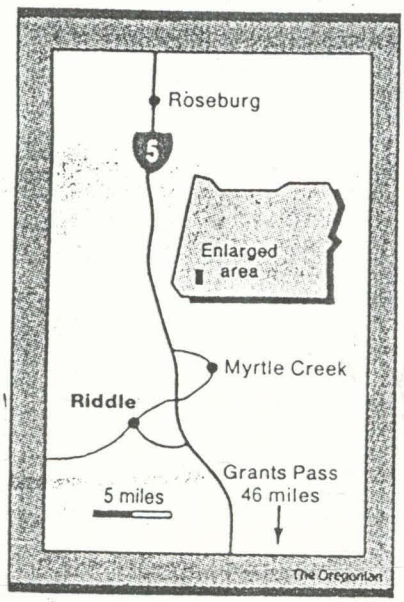
■RIDDLE, from Page B1.

1950s, when the U.S. government wanted so badly to stockpile nickel for use in building jet airplane engines for the Korean War that it built what was at that time the only nickel smelter in the world. After the war, the government sold the operation to Hanna for about $53 million. The first metal for entirely domestic purposes was poured July 12, 1954.

"It's tragic, certainly, but it's also the economic facts of life," said state Rep. Bill Markham, R-Riddle, who has a view of the scalped Nickel Mountain from the back of his house. "We are not going to dry up and die, but this obviously hurts anyone involved in the nickel business around here."

Markham said that several lumber mills, including the 650-employee Roseburg Lumber Company plant, already had absorbed many former Hanna workers.

"We've got at least 1,000 production jobs in the immediate Riddle vicinity alone," Markham said. "I'll bet that is a figure that would surprise many people."



Riddle Mayor Paul Parret also was optimistic.

"It won't really affect us in the long run because of the shutdowns and layoffs we have already experienced," he said. "The latest announcement will definitely hurt workers who are just short of their pensions, but I feel the community will get together and move forward. We'll come out of this just fine, but it may take awhile."

The job of reclaiming the 600-acre nickel mine still lies ahead. Yet because state reclamation laws weren't passed until 1972, Hanna is legally liable only for about 5 percent of the land, or some 34 acres.

"We don't know exactly what will be done up there," said Johnson, the company's engineering manager. "It's amazing what has already grown back without any help. But I'm sure something will be done."

Markham said the company would have to spend at least $75,000 on reclamation efforts.

"Those skinned-off areas will pretty well be put back in order," he said.

SOURCE: THE (PORTLAND) OREGONIAN

DATE: JANUARY 11, 1987

(END)

Ferronickel Production Reduced By 3 Firms; Strike Closes 4th

By TRICIA CRISAFULLI

NEW YORK—Three major ferronickel producers are operating at reduced levels and a fourth is shut by a strike, giving some indication that supplies will tighten.

Falconbridge Dominicana C. por A. in the Dominican Republic was closed by a strike April 1, while three other producers—Cerro Matoso SA in Colombia; SLN/Eramet in New Caledonia; and M.A. Hanna Co.'s Riddle, Ore., plant—are operating at reduced levels.

All of the production cutbacks come at a time when demand has been improving. The ferronickel market has continued to suffer from low prices, which are just a few cents per pound over nickel quotes on the London Metal Exchange.

Cerro Matoso, which has been beset by production problems for more than a year, is operating at about 88 percent of its rated capacity of 50 million pounds per year, according to company officials.

SLN/Eramet has reduced its planned production for the year by 7 percent to between 43,000 and 44,000 metric tons per year. SLN's planned production is believed to be well below its total capacity, but exact figures are not available, according to industry observers.

Hanna's Oregon ferronickel plant, which was supposed to be back on line in January, is still in the "start-up phase" and is not selling material. Because of current low ferronickel prices the company is building inventory, according to a company spokesman, but expects to be in full production at the end of the month.

Although Hanna has not been selling ferronickel at current prices, the company is "not out of the market," a spokesman said. "We are still quoting material. We just aren't willing to sell at these prices."

For the past few months ferronickel has been selling at the same pricing level as nickel briquettes, which are quoted by merchants in the U.S. at about $1.85 per pound. Normally, ferronickel carries a slight premium because of its iron content.

SOURCE: AMERICAN METAL MARKET

DATE: APRIL 11, 1986

COMMODITY SECTION: FERROUS

STATE ARTICLE CONCERNS: OREGON

4/8

Nickel mine squeezes each dime to stay in business

By JIM KADERA
of The Oregonian staff

RIDDLE — Technology, compromise and dedication are the keys in a long fight to keep the only nickel mine and smelter in the United States in business.

Hanna Nickel Smelting Co. is operating again in the hills four miles west of Riddle after a four-month shutdown to install $13 million in new equipment to improve efficiency and possibly restore profitability.

The reopening is a triumph, but does not assure long-term survival. Producing a small amount of the world nickel supply, Hanna is vulnerable to future curtailments or shutdowns if it cannot hold operating costs below prices.

"What is my biggest challenge? To return Hanna Nickel Smelting Co. to profitability," Joe Vaccari, plant manager, said in his office last week. "There is no deadline. We speak in terms of constant progress."

"I think it will work," said Charles McFarland, of Myrtle Creek, a furnace tapper helper who has worked at Hanna for about 10 years.

"Hanna has been good to my family. There isn't much else to do down here," added Donald Luft of Roseburg, a smelter controls operator and 12-year plant veteran.

Hanna and five wood products mills are the major employers in this part of Douglas County. All have suffered through market problems in the last five years, but the Hanna situation is one of a kind.

Discovered by settlers in 1864, the mineral deposits on Nickel Mountain initially were thought to contain copper. Not until 1881 did they realize it was nickel, iron and other minerals, but the first commercial mining waited until Hanna opened a smelter at the base of the mountain in 1954.

For years, the plant operated around the clock with about 600 employees to make ferronickel — half iron and half nickel — sold primarily to other companies that manufacture stainless steel.

However, problems developed. The deposits have less nickel than most of the nickel mines in the world. After the highest grade nickel was removed, it became increasingly difficult to make a profit. Each nickel market slump drove another nail in the coffin.

Hanna Mining Co., of Cleveland, owns the Riddle operations and closed the mine and smelter in April 1982 for 18 months. A reopening was ordered only after the company won concessions in electricity rates and reduced wage and benefits for employees who are members of the United Steelworkers of America union.

A provision of the 1980 Northwest Power Planning Act allowed the Bonneville Power Administration to give Hanna a special discounted power rate. Unlike the Northwest's aluminum smelters, Hanna utilizes minerals mined within the United States.

By limiting smelting to night and weekend hours when power demand is less, Hanna pays only 0.7 cents per kilowatt hour, compared with an industrial rate of 1.9 cents. That cut annual power costs from $9 million to about $3.5 million.

The annual labor costs were slashed from $18 million to less than $9 million by reducing the number of employees, trimming wages by $1.10 an hour, and cutting holidays and vacations.

Employment last week totaled 235 and will increase to about 250 later this month as new equipment is fine-tuned and full production resumes, Vacarri said.

New technology allows Hanna to begin smelting with ore that is more than 2 percent nickel, compared with less than 1 percent in the old "dry" system. A wet screening plant built last summer on the side of Nickel Mountain reduces the amount of impurities that must be eliminated in the smelter furnaces.

The aerial tram cars that carried dry ore have been idled in favor of a pipeline taking ore in a slurry down to the smelter.

The higher grade of ore fed to the plant will allow annual production of ferronickel "pigs" and small "nuggets" to increase to about 23.5 million pounds from the 1984 level of 17.6 million pounds, Vacarri said.

Smelter workers McFarland and Luft said they hoped the layoffs have ended. McFarland said he and his family lived off savings through part of the layoffs and he worked part of the time as a timber faller.

"My wife and I watched our money more closely," said Luft.

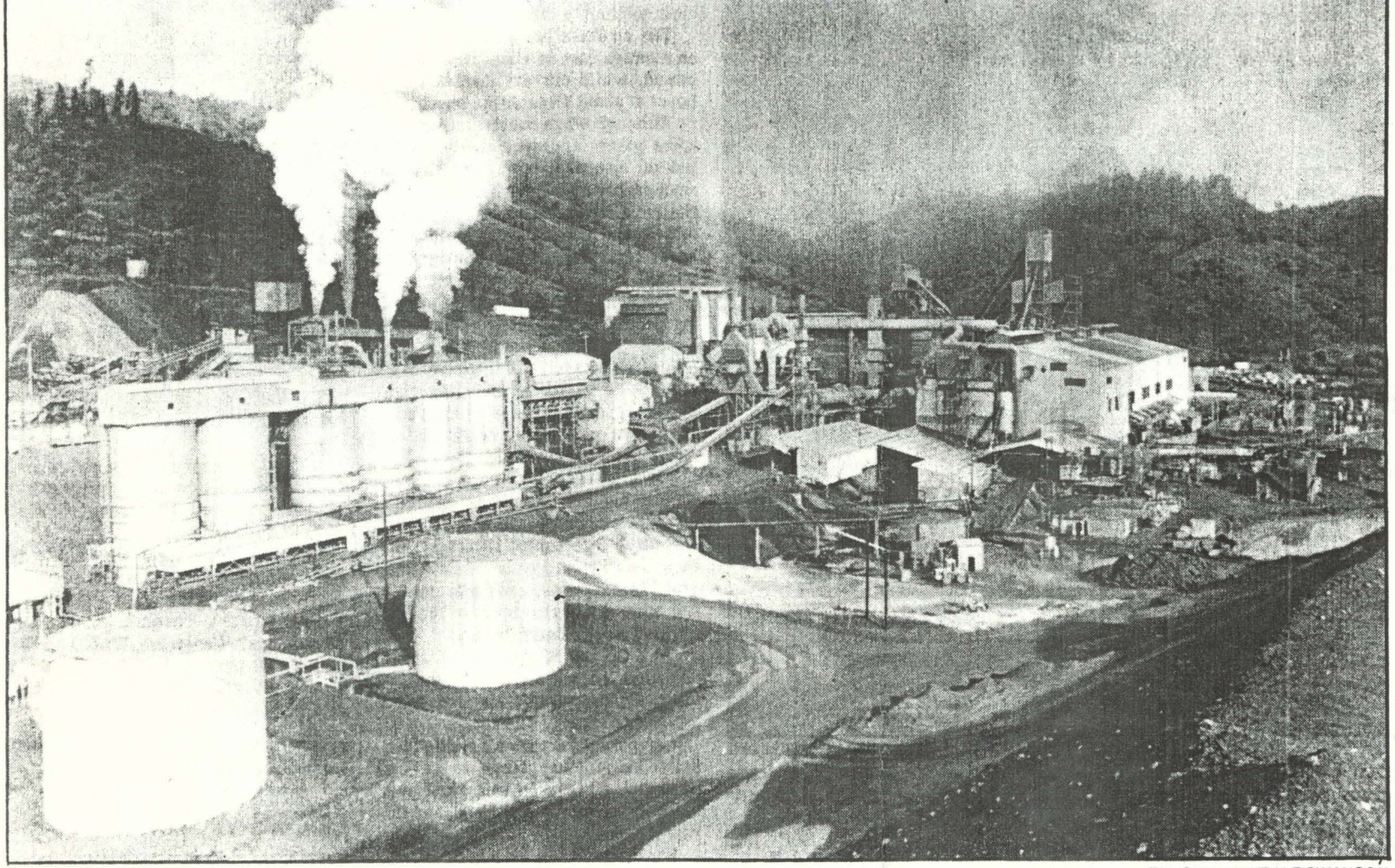
SOURCE: THE (PORTLAND) OREGONIAN

DATE: DECEMBER 9, 1985

COMMODITY SECTION: [redacted] FERROUS

STATE ARTICLE CONCERNS: OREGON

(MORE)



The Oregonian/DALE SWANSON

Steam rises from the Hanna nickel smelter west of Riddle. It has just reopened after a four-month shutdown for improvements.

"The concessions we made in our contract cost us about $6,000 a year. I've been working more overtime to make up for some of it," McFarland said.

The revised labor contract "put more burden on each employee to do more. We absorbed other people's jobs," McFarland said.

Employment declined also through automation. Two persons operate computers in the ore preparation room, compared with six workers in the past, he said.

Vacarri said the efficiency mode would suffer if there was excessive overtime when employees get 50 percent more pay per hour. "The management goal is to use the cheapest way to get the work done," the manager said.

Vacarri, who formerly worked in Hanna iron operations in northern Minnesota, said profit sharing instituted in 1983 allowed the employees to benefit from increased productivity. "I feel very good about it, but we are still subject to the sales price."

He pointed to a chart on his office wall. The price of nickel listed by a London exchange had dropped from $2.53 cents a pound in June to $1.81 on Dec. 3. The price includes 10 cents a pound for shipping that Hanna does not receive.

"It's a constant struggle for survival," Vacarri said. "You either fold up or you find another way to do it."

Business people in Riddle "feel a little better about the economy going smoother," Lorraine Gross said from her desk in the local branch of First Interstate Bank. "The forest industry also is doing better than some past Decembers. It all is uplifting the community," said Gross, who manages the branch.

"A lot of PMA is floating around. That's positive mental attitude," said Larry Linton, who recently opened a new hardware store. Linton and his wife Carol also have a grocery store that survived the recession.

"Anyone who can do business in Douglas County and survive is a wizard," he quipped.

(END)

SOURCE: THE (PORTLAND) OREGONIAN

DECEMBER 9, 1985

DATE

Another nickel operation closure frustrates area

he Oregon State Fair.

the mine and laid off 500 people.

Cutting both power and labor costs, the company rehired about 260 people when it resumed production in November 1983.

The Bonneville Power Administration agreed to give Hanna bargain electric rates if the company would run the smelters during off-peak periods at night and on weekends. The company estimated the savings at $5.5 million a year.

Cuts in the labor force, a wage rollback of $1.23 per hour and limited production brought the annual payroll down from $18 million before the 1982 shutdown to $6 million when the mine reopened.

After negotiating a new five-year labor contract and securing continued low electric rates, the company shut down the mine in June 1985 to install a new $13 million ore-screening process that was supposed to get a higher yield from the low-grade ore remaining on the mountain.

Operations resumed last October, but production has been spotty as the company worked to fine-tune the new ore-screening process.

"I know everybody thought this time we were going to go back for at least five years," said Page, who works on the refining furnace.

The one consolation was that the economic impact on southern Douglas County wouldn't be as bad as when the mine shut down four years ago, said Wally Farmer, senior vice president of the South Umpqua State Bank.

"Timber is in pretty good shape right now, so that should lessen the impact," said Farmer.

This time the four wood products mills in town are turning out lumber, plywood and laminated beams.

The last time, the mine shutdown hit when the region was reeling from a deep recession in the timber industry, the lifeblood of Oregon.

SOURCE: THE (PORTLAND) OREGONIAN

DATE: AUGUST 19, 1986

COMMODITY SECTION: FERROUS

STATE ARTICLE CONCERNS: OREGON

(MORE)

915

Many Hanna workers left the state to find work and some of those who remained had trouble finding jobs because companies were wary of hiring someone who would go back to Hanna as soon as the mine reopened.

"If I got a job now with a future and it was steady, I wouldn't go back," said Page. "It was a wonderful place to work when I first started. Now it's just up and down. By the looks of things it's not going to get any better."

There is lingering resentment in town over this latest shutdown. People grumble about decisions made by people from Hanna headquarters "back East."

Though there is talk in town that the mine could reopen after the first of the year, there also are indications Hanna may be de-emphasizing its nickel and silicon division, which reported a $2 million operating loss in the first six months of this year, compared with a $1 million profit for 1985.

With the appointment of former Rockwell International Corp. director Martin D. Walker as chief executive officer and chairman of M.A. Hanna, the company proclaimed it is embarking on a new phase of diversification.

"We are certainly not abandoning our traditional products and markets, but given the extraordinary difficulties facing the steel and energy industries, it is essential that we broaden our base of activity," outgoing chairman Robert F. Anderson said.

Larry Linton, who owns the local hardware store and the Riddle Grocery, remains optimistic.

"When they opened in 1951, they said it would only run for 20 years," he said of the mine. "If the price of nickel goes up, I'm sure it will be back open again and the frowns will turn to grins.

"People around here are pioneers," he added.

SOURCE: THE (PORTLAND) OREGONIAN

DATE: AUGUST 17, 1986

(END)

Nickel prices cause Hanna to shut down

M.A. Hanna Company has announced that Hanna Nickel Smelting Company in Riddle will be indefinitely shut down approximately Aug. 15, primarily due to slumping nickel sales prices.

Prices have dropped more than 20 percent since last summer when Hanna Nickel began construction of an innovative wet screening system that was hoped to make ferronickel produced at the nation's only integrated nickel mining and smelting operation competitive worldwide.

In July, nickel prices on the London Metal Exchange averaged only $1.77 per pound, with little hope for significant improvement in the near future.

"Although depressed nickel prices have indefinitely shut down Hanna Nickel, company management continues to evaluate results of the wet screening tests conducted over the past few months," General Manager Herbert D. Wedge said in a letter to employees.

"We expect our studies to be concluded this fall, at which time we hope to have better information for employees concerning the outlook for the operation," Wedge said.

"We are extremely disappointed that nickel market conditions have deteriorated to this point, particularly after the exceptional efforts displayed by employees as we have worked to implement the wet screening process over the past year," Wedge added.

The nickel mine and smelter, which opened in 1954, employed as many as 600 during peak operations in the 1970's. Because of declining nickel prices and high power costs, the mine and smleter were shut down for 18 months starting in May 1982, reopening after lower off-peak power rates were negotiated with the Bonneville Power Administration.

The operation was shut down again last June to install a new wet screening process for handling ore, which company officials hoped would lower costs and improve efficiency. According to company officials, the new process and other improvements represent an investment of about $13 million.

After a short start-up test period, both the mine and smelter were shut down two days before Christmas eve to correct problems with the new process.

Since early this year, maintenance personnel have worked to correct the problems and some mine workers were called back. The mine was shut down again three months ago and two of the four smelter furnaces were started up to produce nickel from the wet-screened ore.

The results were successful, but nickel prices have not hit the $1.90 to $2 a pound which company officials estimated would be necessary to operate at a profit.

The operation has employed about 180 to 190 and would employ 250 to 270 if operation can be resumed.

M.A. Hanna Company is an international natural resources concern engaged in five principal business areas: iron ore, oil and gas, nickel and silicon, coal, and management services.

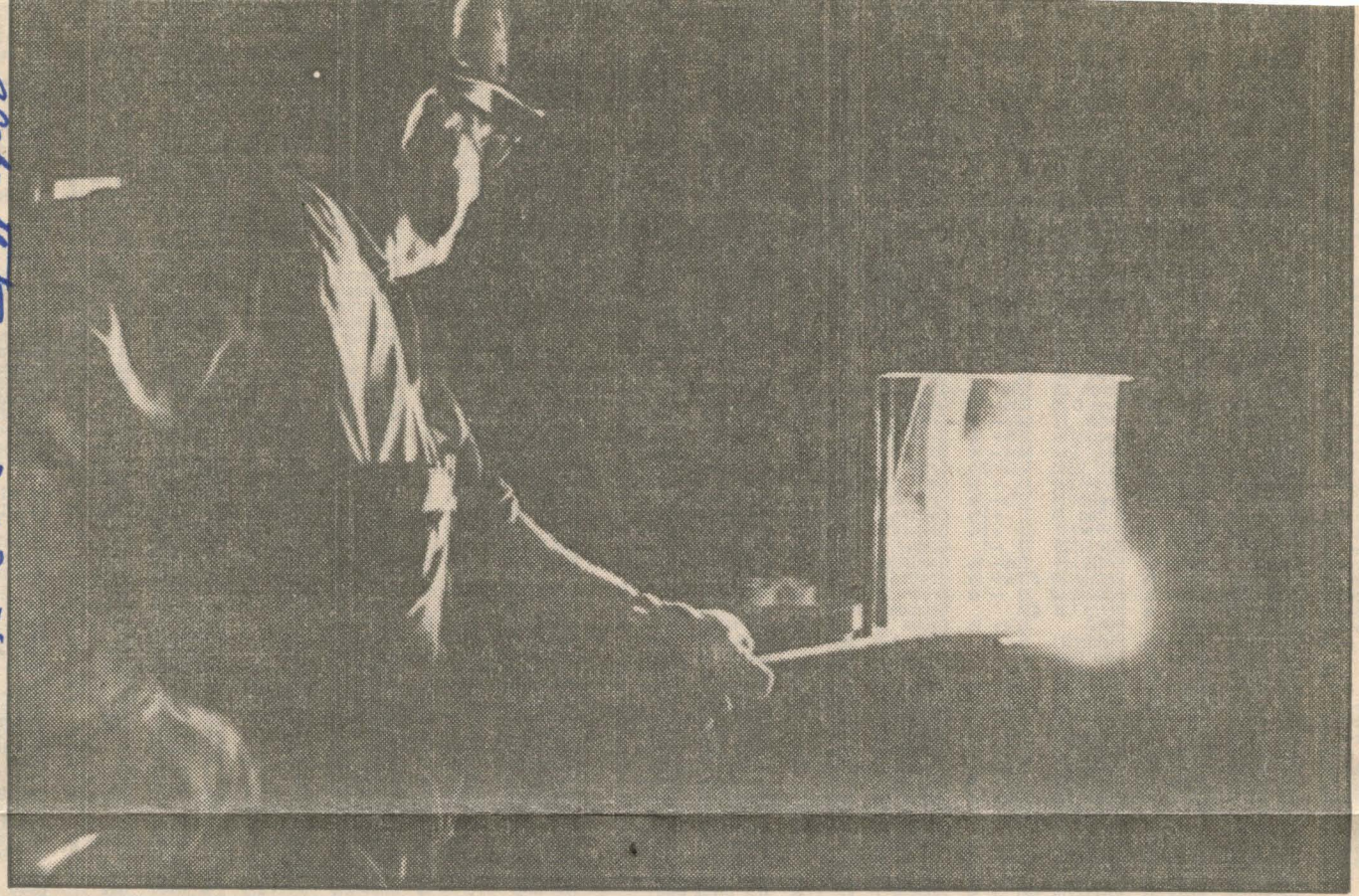
SOURCE: UMPQUA (OR.) FREE PRESS

DATE: AUGUST 14, 1986

COMMODITY SECTION: FERROUS

STATE ARTICLE CONCERNS: OREGON

Idaho Statesman F-2-3-86



The Associated Press

Mike Schauer samples 3,000-degree molten nickel with a ladle at Hanna Nickel.

Mine, smelter to close in Oregon

By JEFF BARNARD
The Associated Press

RIDDLE, Ore. — The sign on the road to Nickel Mountain has a line that reads, "Permission to pass revokable at any time."

That sign has taken on new meaning in this town of 1,115 people in southern Oregon.

For the third time in four years, M.A. Hanna Co. of Cleveland, Ohio, has announced it is shutting down the nation's only combined nickel mine and smelter.

"I don't know if I'll go back," said Hanna worker Gerald Page, sitting in the shade of his front lawn. "I've been out there 21 years. I'd like to get my 30 in, but it's tough six months at a time."

Hanna announced last week it was shutting down the Hanna Nickel Smelting Co. indefinitely because of falling nickel prices, putting about 180 people out of work.

Nickel is used as a hardening agent in steel production. The combination of increased competition from foreign suppliers and reduced steel production in the United States have combined to drop nickel prices from $2.52 a pound to $1.77 in the past year, said Hanna spokeswoman Mary Jackson.

The decision was frustrating for both the company and workers, since steps had been taken to make Nickel Mountain more efficient after the plant was first shutdown four years ago.

Falling prices were blamed in April 1982 when Hanna shut down the mine and laid off 500 people.

Cutting both power and labor costs, the company rehired about 260 people when it resumed production in November 1983.

After negotiating a new five-year labor contract and securing continued low electric rates, the company shut down the mine in June 1985 to install a new $13 million ore-screening process that was supposed to get a higher yield from the low-grade ore remaining on the mountain.

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Small Oregon Town Sees Nickel Mine Closed for Th

By Jeff Barnard
Associated Press Writer

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"Timber is in pretty good shape right now, so that should lessen the impact," said Farmer.

This time the four wood products mills in town are turning out lumber, plywood and laminated beams.

The last time, the mine shutdown hit when the region was reeling from a deep recession in the timber industry, the lifeblood of Oregon.

Many Hanna workers left the state to find work and some of those who remained had trouble finding jobs because companies were wary of hiring someone who would go back to Hanna as soon as the mine reopened.

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There is lingering resentment in town over this latest shutdown. People grumble about decisions made by people from Hanna headquarters "back East."

Though there is talk in town that the mine could reopen after the first of the year, there also are indications Hanna may be de-emphasizing its nickel and silicon division, which reported a $2 million operating loss in the first six months of this year, compared with a $1 million profit for 1985.

—Associated Press Laserphoto

Employees of Hanna Nickel Smelting, like Mike Schauer, above, may not come back to work after only nickel mine and smelter in U.S. closed for third time in 4 years.

s Nickel Mine Closed for Third Time in Four Years

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—Associated Press Laserphoto

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"People around here are pioneer he added. "They'll tough it out."

Smelters started at Hanna

Two smelting furnaces were started up at Hanna Nickel's mine and smelter in Riddle last weekend and about 30 smelter employees have been called back to work.

The smelters were shut down on Dec. 23, after problems developed during a test operation of a new "wet screening" process intended to move ore more efficiently from the nickel mine on top of Nickel Mountain to the smelter at the bottom of the mountain.

According to Mary Jackson, who handles Hanna's public relations out of the corporation's Cleveland headquarters, enough ore has been stockpiled to operate the two smelters for about three months.

The company shut down its mining operation at the end of May for a test to determine how ore from the wet screening process goes through the smelters, she said.

"Nothing's really changed," Jackson said in a telephone interview. "We want to test the ore from the wet screening process."

With the shut-down of the mine, Jackson said, about 30 mine workers have been laid off and the smelter start-up has not resulted in an increase in the employed work force at the Riddle operation.

Different workers were called back to replace those laid off because of the different skills required, she said.

The nickel operation in Riddle now employs a total of about 180, down from about 270 before the plant shut down one year ago this month to install a $13-million wet screening process.

"Wet screening" involves running the ore through a crusher, then mixes it with water into a slurry that flows down the mountain from the mine to the smelter, where the ore is dried before going into the furnaces.

Under the old process, the ore was moved in an aerial tramway from the mine to the smelter.

The new process and heavy capital investment were intended to make it possible to produce nickel at a profit with nickel prices just under $2 a pound, according to General Manager Herb Wedge.

However, after the new equipment was installed and started up last fall, problems developed, and both the mine and smelter were shut down on Dec. 23.

In addition to working to correct the problems with the wet screening process, after the shut-down maintenance crews installed a conveyor system to move ore to the ore crusher.

Jackson said that Hanna hopes to re-open the mine if the smelter test run goes well, but no date has been set.

Much depends on the price of nickel getting back up to about $2 a pound.

"Nickel prices haven't improved," Jackson said. Nickel closed recently at $1.83 on the London Metal Exchange, down from $2.54 a year ago when work began installing the wet screening process.

The smelter has four furnaces, only two of which are being used for the test period.

Hanna, which opened the Riddle mine and smelter in 1954, employed between 500 and 600 workers and office personnel in 1980, before nickel prices began to drop.

The Riddle operation is the only integrated nickel mine and smelter in the country.

SOURCE: UMPQUA (OR) FREE PRESS

DATE: JUNE 12, 1986

COMMODITY SECTION: FERROUS

STATE ARTICLE CONCERNS: OREGON

6/20

Albany, OR
Oregon Herald
(Cir. W. 864)

NOV 29 1978

Allen's P. C. B Est. 1888

Geologist reports on nickel

5018

PORTLAND (AP) — Nearly half of twenty-five deposits of nickel in Oregon are located partly or entirely in wilderness areas or areas under consideration for wilderness designation, a state geologist says.

Len Ramp of the Grants Pass field office of the Oregon Department of Geology and Mineral Industries said most of the deposits have been known of and prospected for years. But he foresees increased interest in the mineral.

The only producing nickel mine and smelter in the nation is at Riddle in Douglas County. Hanna Mining Co. produced nearly $50 million worth of nickel at the complex last year.

Nickel first was discovered in southwest Oregon in 1864, and except for the Riddle site all the deposits listed in Ramp's recently published report are in Josephine and Curry counties.

"I found only a few new ones," Ramp said, "but the most important part of the work was mapping the extent of known deposits and testing the ores at some sites."

Donald Hull, director of the geology department, said the timing of the report is important because of the pending land use planning decisions.

Hull said southern Oregon will have to diversify its economy because of the region's declining timber harvest.

"Mineral development is one of the available options," Hull said.

The report identifies the Illinois Valley between Cave Junction and the Oregon-California border and the Red Flats area southeast of Gold Beach as the main areas of future nickel production.

Hull said nickel exploration is at a peak in the ore belt extending from Grants Pass south to Del Norte County, Calif.

The report, financed in part by grants from the U.S. Bureau of Mines, does not estimated overall reserves of Oregon nickel or reserves of chromium and cobalt, which often are found in the same ore bodies as nickel.

Ontario, OR
Argus-Observer
(Cir. D. 6,528)

NOV 29 1978

Allen's P. C. B Est. 1888

Nickel ore valuable

GRANTS PASS, Ore. (UPI) — Two dozen unmined nickel deposits in Josephine and Curry counties may be Oregon's most valuable untapped commercial ore resource, a state geologist said.

The state's other nickel deposit, at Riddle in Douglas County, is being mined by Hanna Mining Co. and is the nation's only operating nickel mine.

Len Ramp, resident geologist at Grants Pass for the state Department of Geology and Mineral Industries, said in a report prepared for the department there are two main areas of potential nickel development — in the Illinois Valley between Cave Junction and the California border and at Red Flats southeast of Gold Beach.

Ramp said he found only a few previously unknown deposits "but the most important part of the work was mapping the extent of known deposits and testing the ores at some sites."

Broken Top geologic data may aid land-use planners

By PHIL F. BROGAN
of The Oregonian staff

Volcanoes of the Broken Top cluster in the high Central Cascades, immediately southeast of the Three Sisters in an area of spectacular scenery, glaciation and recurring volcanic activity over the ages, receive detailed geologic attention in a paper issued by the Oregon Department of Geology and Mineral Industries.

The paper, "Field Geology of S.W. Broken Top," touches on the violent volcanic activity in that part of the high Cascades west of Bend ranging from a few thousand years ago to millions of years. It was compiled by Edward M. Taylor, associate professor of geology at Oregon State University. The paper represents the author's research over a period of several years.

"The Broken Top area is currently the topic of continuing debate regarding future land use," state Geologist Donald A. Hull notes in a foreword. "Based on geologic factors, considerable interest has been shown in the potential geothermal energy resources adjacent to these volcanic centers."

Intelligent land use planning must be based upon sound geologic data, and Dr. Taylor's report will be of immediate value for both public decision-making and the scientific community."

Ash and cinders from eruptions of Rock Mesa at the southwest base of the South Sister fell over the entire Broken Top area 2,300 years ago. Crater Lake pumice spread over the region when giant Mazama blasted its top into the heavens.

Alpine glaciers and fiery lava had parts in shaping ancient Broken Top, named nearly a century ago by range riders trailing cattle to the Farewell Bend Ranch and other ranches on the Deschutes River.

It was glaciation, extensive in the fading Ice Age, not a terrific volcanic blast, that gave Broken Top its jagged summit. In the previous epoch, the Pliocene, massive faulting, intensive volcanic activity and glaciers slipping from peaks now buried, had roles in shaping the land. After the retreat of Pleistocene (Ice Age) glaciers, there was some intense volcanic activity in the Todd Lake area.

Shortly before the appearance of Mazama ash from Crater Lake about 6,000 years ago, lava erupted to form a small cone on the north side of 9,165-foot Bachelor Butte.

Late Ice Age glaciers covered all of the southwest Broken Top area except the summit of Tumalo Mountain.

Ice formed imposing cirque basins in various parts of the area. The best known is that on the north slope of Broken Top over which McArthur Rim, a conspicuous feature of the area, pushes its cliffs into the Cascade sky.

The Broken Top country has been a land of intense volcanic activity for millions of years. "There is abundant evidence that a great volume of volcanic material was delivered to the eastern slope of the central Cascades during an interval that began some 12 million years ago," Taylor writes. "Much of this was piled over the Deschutes formation along the Metolius River."

Volcanic activity continued into recent geologic time, Taylor says, adding that "future eruptions in this area are not unlikely."

Half of state's nickel in wilderness areas

PORTLAND (AP) — Nearly half of 25 deposits of nickel in Oregon are located partly or entirely in wilderness areas or areas under consideration for wilderness designation, a state geologist says.

Len Ramp, of the Grants Pass field office of the state Department of Geology and Mineral Industries, said most of the deposits have been known of and prospected for years. But he forsees increased interest in the mineral.

The only producing nickel mine and smelter in the nation is at Riddle in Douglas County. Hanna Mining Co. produced nearly $50 million worth of nickel at the complex last year.

Nickel was first discovered in Southwest Oregon in 1864 and except for the Riddle site all the deposits listed in Ramp's recently published report are in Josephine and Curry counties.

"I found only a few new ones," Ramp said, "but the most important part of the work was mapping the extent of known deposits and testing the ores at some sites."

Donald Hull, director of the geology department, said the timing of the report is important because of the pending land use planning decisions.

Hull said Southern Oregon will have to diversify its economy because of the region's declining timber harvest.

"Mineral development is one of the available options," Hull said.

The report identifies the Illinois Valley between Cave Junction and the Oregon-California border and the Red Flats area southeast of Gold Beach as the main areas of future nickel production.

Hull said nickel exploration is at a peak in the ore belt extending from Grants Pass south to Del Norte County, Calif.

The report, financed in part by grants from the U.S. Bureau of Mines, does not estimated overall reserves of Oregon nickel or reserves of chromium and cobalt, which are often found in the same ore bodies as nickel.

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State pinpoints nickel deposits; study quickens mining interest

By TOM BRENNAN
of The Oregonian staff

Twenty-five deposits of nickel, perhaps Oregon's most valuable commmercial ore resource, have been identified in a study recently published by the state Department of Geology and Mineral Industries.

Publication of the inventory is expected to quicken interest in mining and processing of the mineral, first found in Southwest Oregon in 1864.

The only producing nickel mine and smelter in the nation is at Riddle in Douglas County. Hanna Mining Co. produced nearly $50 million worth of nickel at the Nickel Mountain complex last year.

The report was prepared by Len Ramp, resident geologist at the Grants Pass field office of the department. The work was financed in part by grants of $35,652 from the U.S. Bureau of Mines.

Ramp said in a telephone interview Monday the nickel deposits (all but the Hanna deposit are in Curry and Jospephine counties) have in most cases been known of and prospected for years.

"I found only a few new ones," he said, "but the most important part of the work was mapping the extent of known deposits and testing the ores at some sites."

Ramp said the report does not estimate over-all reserves of Oregon nickel or companion reserves of chromium and cobalt, which are often found in the same ore bodies as nickel.

No total estimate was drawn because of the preliminary nature of much of the data and because the department shies away from such estimates, he said.

But any trained geologist could prepare such an estimate by calculating tonnage from the geological data cited by Ramp, according to several persons who already have read the report.

Ramp identified two main areas of future nickel production. One is in the Illinois Valley between Cave Junction and the Oregon-California border and the other is Red Flats area southeast of Gold Beach in Curry County. Northeastern Oregon deposits are not considered commercially important.

Donald Hull, director of the geology department, called the report timely bscause of land-use planning decisions pending in Southwest Oregon. Also, exploration for nickel "is at a peak" in the ore belt extending from Grants Pass south to Del Norte County, Calif., Hull said.

Nearly one-half of the 24 deposits are located partly or entirely in wilderness areas or areas under consideration for wilderness, according to Ramp.

Even where mining development is precluded, as in wilderness areas, it is important to know and consider all types of resources for good land-use planning, Hull pointed out. And several of the nickel sites are in areas involved in RARE II studies.

RARE II (Roadless Area Review and Evaluation) sites are being studied for designation as wilderness areas, with the issue to come before Congress in 1979.

Hull said Southern Oregon will have to diversify its economy in the future because of the region's declining timber harvest.

Ramp listed several factors that will govern the state's future mineral development: world supply and demand for nickel, chromium and cobalt; national policy on strategic mineral production; availability of satisfactory and inexpensive methods of reclamation; and progress in developing more efficient ways to refine low-grade ores such as found in Oregon.

Nickel prices are depressed the world over at $2 a pound now. But a doubling to $4 a pound by 1981, as seen by one geologist, could justify a major investment in Oregon-Northern California production.

Cobalt prices soared from $4-$5 a pound to a peak of $30 after the 1977 invasion of Zaire shut down one of the free world's most productive mines. The price has settled down to about $17 but supply uncertainties and high prices could help spur Oregon development projects.

A process developed at the Bureau of Mines research unit at Albany holds promise of greater yields and energy-efficiency than existing refining methods. The process will be further tested next year at a pilot smelter at Tucson, Ariz., rather than at Albany as earlier planned.

Richard Siemens., Albany project leader, said modifying the Tucson facility to handle the new eletrochemical process will be less costly than building a new plant at Albany.

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A Future Bonanza?

5018

A report from local geologist Len Ramp, of the state Department of Geology and Mineral Industries, says that nearly half of the 25 deposits of nickel in Oregon are located partly or entirely in wilderness areas or in areas under consideration for wilderness designation.

Ramp also notes in his report that the nation's only producing nickel mine and smelter is in Riddle, Ore., in Douglas County. Hanna Mining Co. produced nearly $50 million worth of nickel at the complex last year.

Nickel is a metal used in various alloys, and is of strategic importance both to the nation's defense and to its economy. Thus Ramp's report takes on a special significance, particularly since there is a continuing pressure on the Congress to lump yet more of Josephine and Curry Counties' land into the wilderness, locking away the mineral resources from future utilization.

Nickel can, of course, be gotten from other nations, and possibly still cheaper than mining the Southwestern Oregon deposits. But the day could come when the deposits in our own back yard could be of crucial importance to our continued prosperity. We would be wise to study very hard the damage we could do by locking up so much in our wildernesses that we hamper our future unjustly and prevent the orderly development of these resources.

H.L.E.

Allen's P. C. B. Est. 1888

New nickel deposits are inventoried

5018

The Oregon department of geology and mineral industries recently completed a statewide assessment of nickel deposits in Oregon in cooperation with the United States Bureau of Mines. Results of the study are summarized in Miscellaneous Paper 20, "Investigations of Nickel in Oregon". The 67-page report contains numerous figures and maps.

The report is designed to supply basic resource data to various groups, policy formulators, agencies, and land use planners needing information on the nickel potential of the state.

During the period 1966-77, the entire United States primary mine production of nickel was from the Hanna Mine near Riddle, Ore., in Douglas county.

The report describes 24 deposits, in addition to the Hanna mine. These deposits lie in the southwest corner of the state in Curry and Josephine counties. Future development of one or more of the nickel areas could make a major economic impact in this part of Oregon.

Two other main areas of future nickel production potential lie in Oregon. One is in the Illinois Valley, in which a centrally located plant could draw from the larger, better grade, and more accessible deposits in the Josephine peridotite sheet; the other is in the Red Flat area southeast of Gold Beach in Curry county.

Several factors will affect possible expansion of Oregon's nickel industry - future supply of and demand for nickel, chromium, and cobalt; national and local political policy regarding domestic production of these strategic minerals; the ability to develop energy efficient, inexpensive, and nonpolluting metallurgical processes; and the ability to develop satisfactory and inexpensive reclamation procedures for mined lands.

Miscellaneous Paper 20 is available from the offices of the State of Oregon Department of Geology and Mineral Industries in Portland, Grants Pass and Baker. The price is $5.00.

Nickel deposit value cited

GRANTS PASS (UPI) — Two dozen unmined nickel deposits in Josephine and Curry counties may be Oregon's most valuable untapped commercial ore resource, a state geologist said Monday.

Len Ramp, resident geologist at Grants Pass for the state Department of Geology and Mineral Industries, said in a report prepared for the department there are two main areas of potential nickel development — in the Illinois Valley between Cave Junction and the California border and at Red Flats southeast of Gold Beach.

Nickel deposits may be valuable untapped commercial resource

5018

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Ramp said he found only a few previously unknown deposits "but the most important part of the work was mapping the extent of known deposits and testing the ores at some sites."

His report does not estimate overall reserves of nickel or of chromium and cobalt, which are often found with nickel. Ramp said his data was too preliminary for such estimates.

Nearly half the deposits are in areas which are either wilderness or under study for possible wilderness designation, Ramp said.

He said Southern Oregon must diversify its economy because of a declining timber harvest.

Development of the minerals, he said, will be depend on world supply and demand, national policy on strategic minerals, and availability of efficient means of mining and processing, especially of lower grade ores.

Nickel prices are now considered depressed at $2 a pound but geologists say the price is expected to double by 1981 and that level could justify development of the Southwestern Oregon ore.

A process developed by the U.S. Bureau of Mines at Albany will be tested next year in a pilot smelter at Tucson, Ariz., and holds promise of greater yields and energy efficiency than current methods, the bureau said. The bureau helped finance Ramp's study with grants totaling $35,652.

Mineral in Wilderness Areas

PORTLAND, Ore. (AP) — Nealy half of twenty-five deposits of nickel in Oregon are located partly or entirely in wilderness areas or areas under consideration for wilderness designation, a state geologist says.

Len Ramp, of the Grants Pass field office of the state Department of Geology and Mineral Industries, said most of the deposits have been known of and prospected for years. But he foresees increased interest in the mineral.

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Donald Hull, director of the geology department, said the timing of the report is important because of the pending land use planning decisions.

Hull said Southern Oregon will have to diversify its economy because of the region's declining timber harvest.

"Mineral development is one of the available options," Hull said.

The report identifies the Illinois Valley between Cave Junction and the Oregon-California border and the Red Flats area southeast of Gold Beach as the main areas of future nickel production.

Hull said nickel exploration is at a peak in the ore belt extending from Grants Pass south to Del Norte County, Calif.

Nickel May Be Best Resource

5018

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Unmined nickel valuable

5013

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Value of ore noted

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24 in southwest Oregon

Nickel sites inventoried here

Potential commercial nickel deposits at 24 sites in southwest Oregon have been inventoried by the Oregon Department of Geology and Mineral Industries in cooperation with the U.S. Bureau of Mines.

The result of the project is summarized in a new 60-page publication just released by the ODGMI titled "Investigations of Nickel in Oregon" (Miscellaneous Page 20).

The report is available to the public at ODGMI offices in Portland, Baker and Grants Pass for a cost of $5. The Grants Pass office is located at 521 N.E. E St.

From 1966 to 1977 the only source of primary commercial nickel ore in the U.S. was the Hanna Mine near Riddle in Douglas County.

The 13,000-plus tons of nickel produced annually at Hanna in recent years represents 4 to 8 percent of total U.S. consumption of the metal. Imports and secondary production along with other minerals make up the remainder.

More than 62 percent of current annual U.S. nickel consumption is provided by imports from Canada, the world's largest producer of nickel.

But state and federal geologists indicate that there are more than 20 additional sites with a potential capacity to produce commercial quantities of nickel in Oregon, all of them located in Josephine and Curry counties.

"Future development of one or more of the nickel areas could make a major economic impact in this part of Oregon," said ODGMI spokesman Len Ramp in Grants Pass.

Ramp said development of nickel resources in the Illinois River Valley by means of a centrally located production plant "could draw from the larger, better grade, and more accessible deposits in the Josephine peridotite sheet."

Ramp added that "several factors will affect possible expansion of Oregon's nickel industry — future supply of and demand for nickel, chromium, and cobalt; national and local political policy regarding domestic production of those strategic minerals; the ability to develop energy-efficient, inexpensive and nonpolluting metallurgical processes; and the abliity to develop satisfactory and inexpensive reclamation procedures for mined lands."

Miscellaneous Paper 20 contains numerous figures and detailed maps, and summaries of nickel potential on each of the identified sites in southwest Oregon.

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5018

Most State Nickel Near Wilderness

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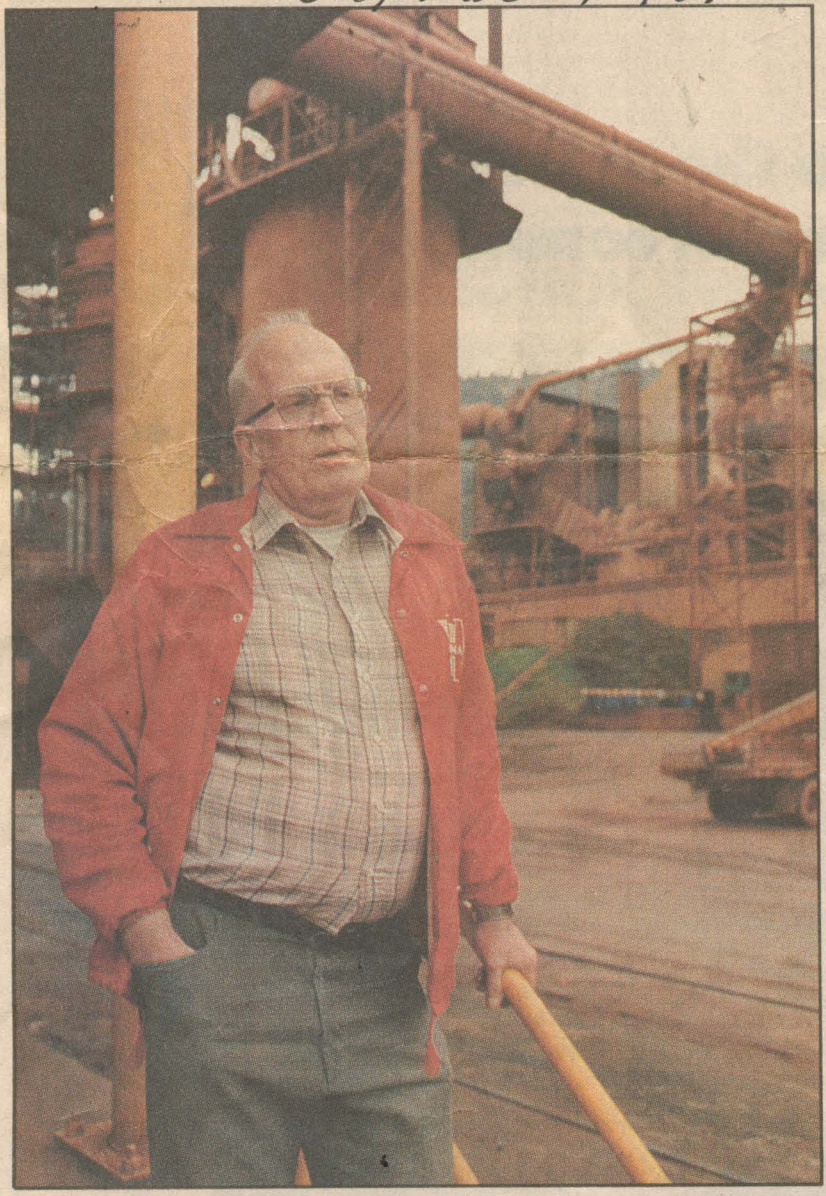
Oregonian 1/11/87



PEGGY SHEKELL

Marvin Johnson, engineering manager for the Hanna Nickel Smelting Co., discusses the closure of the mining operation in Riddle.

Riddle vows to survive mine's closure

By DANA TIMS
Correspondent, The Oregonian

RIDDLE — There is sadness, just as there is anytime an old friend dies, say longtime employees of the Hanna Nickel Smelting Co., which has closed permanently after 32 years of operation.

But old-timers and civic leaders alike are adamant in vowing that rather than curling up and dying with the nickel operation, the town of Riddle, about 15 miles south of Roseburg, will survive and prosper.

Officials of M.A. Hanna Co., the parent company, announced the closure without warning Wednesday. The move followed several temporary shutdowns in the last few years, the most recent of which had left the rugged, 4,000-acre site largely idle. The last refined liquid was poured Oct. 7.

During a closure in 1985, the company invested $13 million in the plant to modernize operations and lower costs. The revamping included introduction of an entirely new technology in nickel processing and installation of nearly three miles of special pipe running from the huge smelting operation to the mine site.

Workers and townspeople held out hope that a miracle would occur, that the mine would somehow remain open.

But nickel prices had plummeted — from a high of $3.40 per pound in 1980 to the current rate of $1.58 — largely due to the dumping of less expensive foreign nickel onto the fragile international market. The mine's fate was sealed.

Closure letters dated Jan. 7 were sent to the 270 workers who had survived earlier layoffs due to seniority. Of those receiving the letters, at least a dozen were just shy of the 30 years necessary to qualify for a company pension, union leaders said.

At its peak in 1980, the world's only integrated nickel mining and smelting operation employed nearly 650 people.

"We always felt it would reopen for good if the prices could have just stayed high enough for the company to make a profit," said Jack Garren, 58. "But the way things were going, we could see this happening. I wasn't surprised at all."

Garren, a lifelong Riddle resident, worked more than 23 years at the mine as a millwright.

"I know it's going to hurt a lot of people around here," said John Wagoner, who was a crane operator for 32 years. "I think the town itself will be fine, but things are just tough all over for the working man."

Some employees conceded that the company had done all it could to keep the operation afloat as long as possible. Bill Morris, a 30-year warehouseman, disagreed.

"A lot of us felt they brought in nothing but junk machinery when they changed their production process in 1985 just to get some use out of the stuff," Morris said. "But I'll tell you, the men busted their butts out there to make it work. We just had too much rotten luck."

John Davenport, president of United Steel Workers of American Local 5074, was philosophical.

"We all made some mistakes and things just didn't turn out liked we hoped they would," Davenport said. "We wished they would have held off awhile to see what happened to prices, but given the trends, no one can say the company didn't do everything in its power to remain operating."

A special contract with the Bonneville Power Administration in 1985, for example, required the company — the largest single consumer of power betwen Eugene and San Francisco — to operate at "off-peak hours" in exchange for low power rates.

"But prices just refused to cooperate," said Marvin Johnson, Hanna Nickel engineering manager. "I find it difficult to believe there is anyone in the world who can produce nickel for a profit as a main line of business."

He and others recall the early

See RIDDLE, Page B2

Historical dates of Riddle

Here is a time line of significant events regarding operation of Hanna Mining Company and Hanna Nickel Smelting Co.'s mine at Riddle. It was announced Wednesday that the nickel mine and smelter would close permanently, leaving about 270 people out of work.

1864 — First ore deposits are discovered on Nickel Mountain by settlers, who, due to unusual green tint of ore, believe they have found major copper deposits.

1881 — Discovery that ore contains nickel, not copper, triggers prospecting and preliminary development work on the mountain.

1920 — Efforts to mine ore for shipment to Eastern processing plants proves too costly and is abandoned after several years.

1952 — Smelting operation is built by the federal government for strategic stockpiling and for use in building Korean War-bound jet engines.

1954 — Hanna buys smelting operation for $53 million; first refined liquid is poured July 12. Ferronickel, a combination of iron and nickel, is the first to be produced in the nation from domestic ores.

1980 — Employment hits an all-time peak of nearly 650 workers.

1982 — The first long-term closure takes place, due to falling nickel prices. Operation remains closed from April 1982 through December 1983. Nearly 400 jobs are trimmed by the time the mine reopens 19 months later.

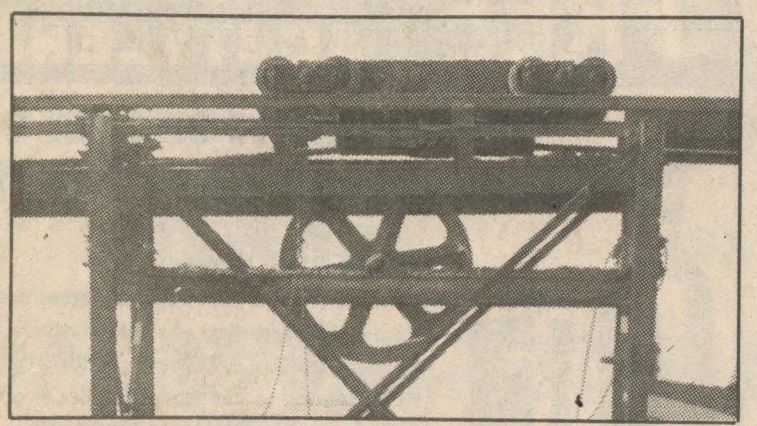
1985 — Second major shutdown in August occurs; 200 workers lose jobs. Company invests $13 million to revamp processing method.

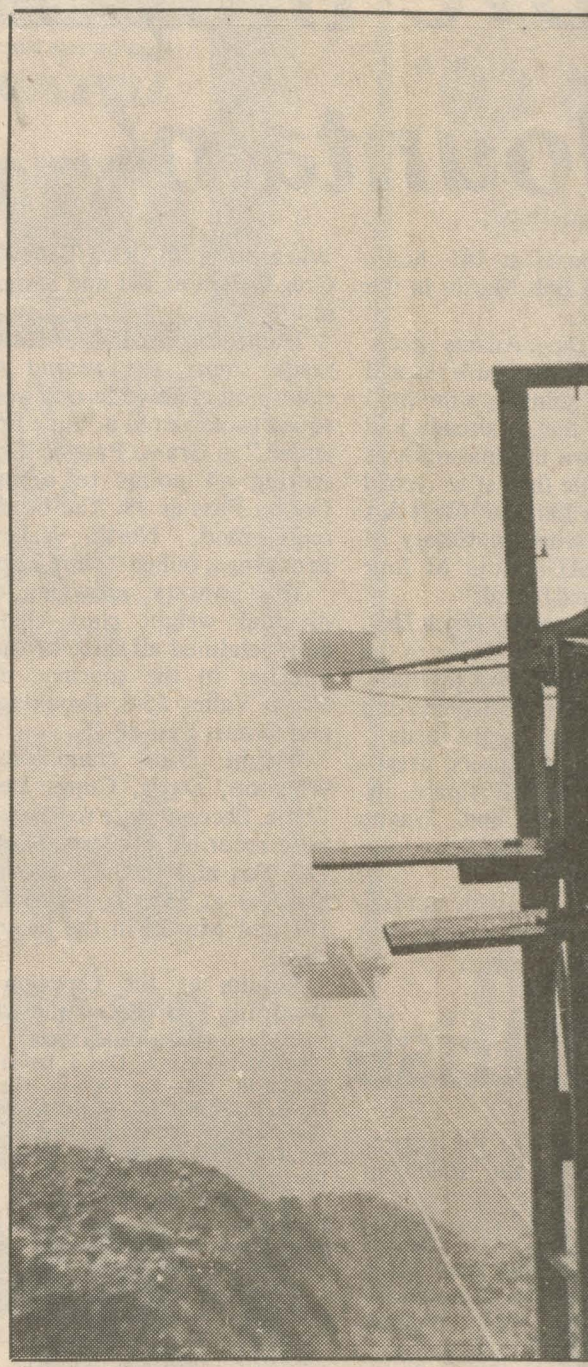
1986 — Third closure, in August, idles the plant. The last metal is poured Oct. 7. Remaining nickel stockpiles are loaded and shipped in mid-December.

1987 — Hanna's parent company, M.A. Hanna Co. of Cleveland, announces permanent closure of the plant Jan. 7. Termination notices are sent to 270 employees.

The Oregonian

Tram After Tram After Tram...





...that nickel-tainted ore just keeps flowing down Nickel Mountain—or so every current Hanna Nickel employee hopes. After the loud silence of idleness, endured for close to 20 months, the pleasant purr of tram car after tram car carrying ore from atop the mountain to the smelter below merely serves as soothing music to Hanna workers' ears.

And the music is virtually non-stop, with the mine running 24 hours a day, seven days a week, 19 of 21 possible shifts. Since the mine started back up in mid-January, more than 72,000 tons of waste material has already been however, and there are about 80 workers employed at the mine, bringing the total Hanna Nickel workforce to around 310.

If it's details about the mine operation that you seek, the man with the answers is mine supervisor John Murphy (at center right), who attended to lots of questions and microphones last Thursday when the company scheduled a "media tour" centered around the re-opening of the mine, which signalled a return to full production under the "off-peak power plan"

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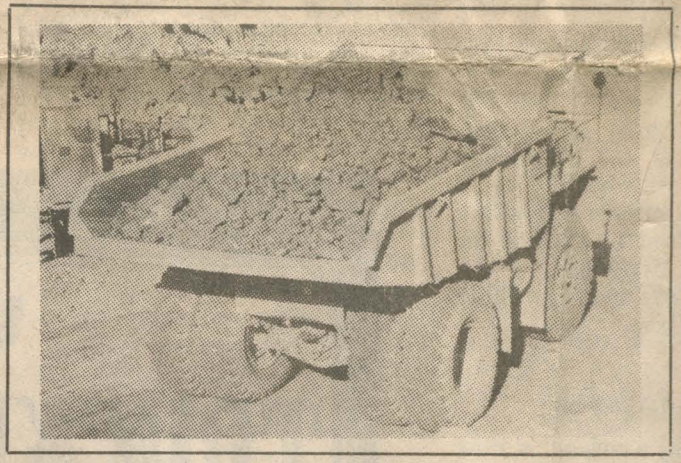
Nickel Mountain stands 3,500 feet above sea level, and many days stands above cloud cover as well, resulting in a surrealistic view of tram cars which seem to disappear into white nothingness (above right) but actually find their proper destination some four miles away at the plant smelter. The 63 tram cars each have a 50-to 52-cubic-yard capacity, or roughly two tons of material.

At present, one area of Nickel Mountain is currently being mined (below left) while another is being prepared for mining. It takes between 15 and 18 shovel loads—and only about eight or nine minutes of an experienced operator's time—to fill up one of the 100-ton capacity trucks. The shovel bucket itself can scrape up 4.6 cubic yards of rock material.

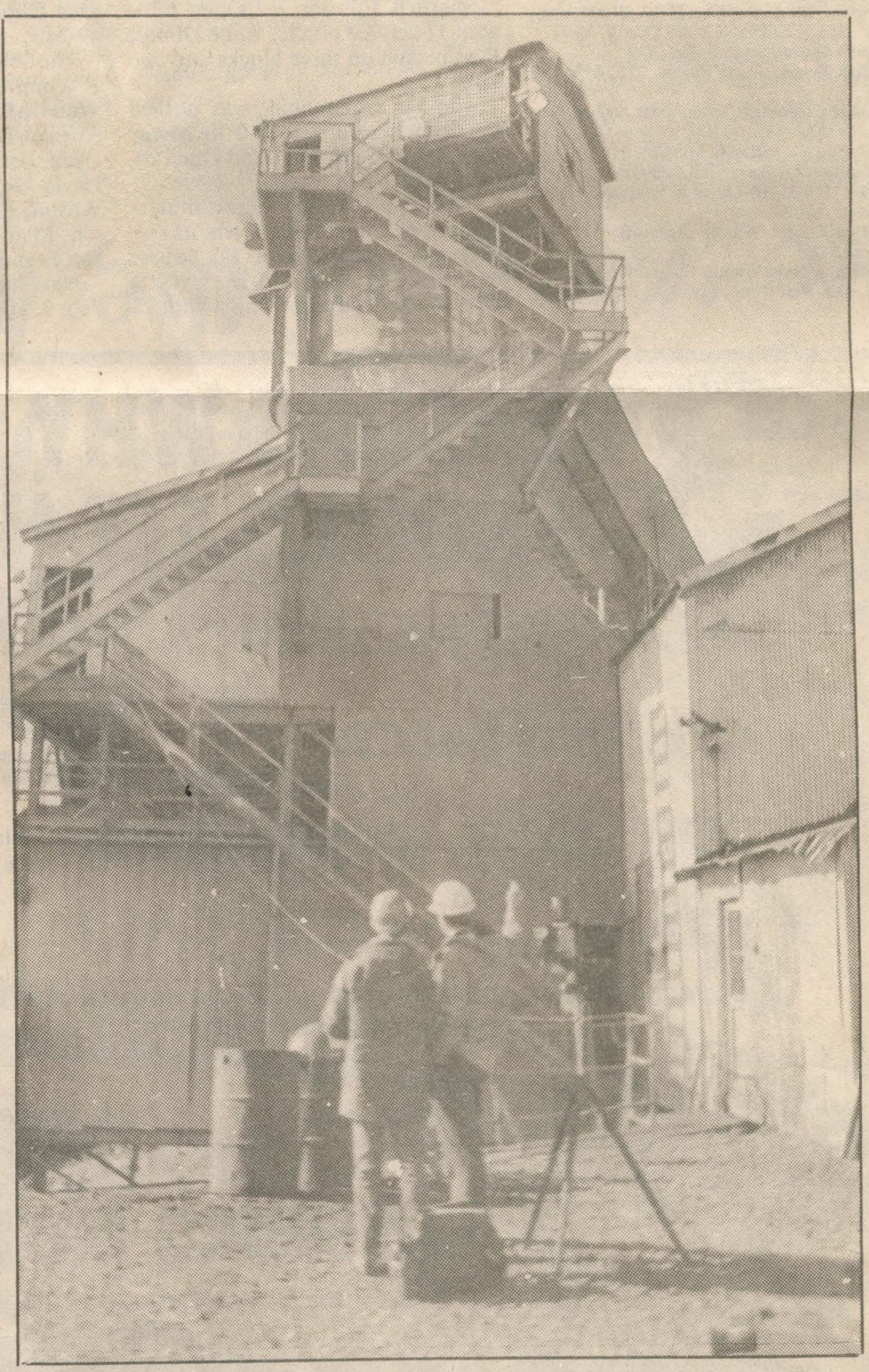
From the trucks, the rock material is taken to the tram loading facility (below left), where the yellow tram cars do the next leg of work. Human labor is still at the crux of it all, however, and there are about 80 workers employed at the mine, bringing the total Hanna Nickel workforce to around 310.

If it's details about the mine operation that you seek, the man with the answers is mine supervisor John Murphy (at center right), who attended to lots of questions and microphones last Thursday when the company scheduled a "media tour" centered around the re-opening of the mine, which signalled a return to full production under the "off-peak power plan"



initiated in conjunction with the Bonneville Power Administration.

The off-peak plan—utilizing the electricty-gulping smelter only during off-peak hours when rates are cheaper—has a 20-month life which could see Hanna continue operation through mid-1985. But Hanna executives have expressed the hope that further BPA negotiations, along with an improved international nickel market, could keep things going for much longer, tram after tram after tram...



VICTOR ATIYEH
GOVERNOR

Department of Geology and Mineral Industries

1129 S.E. SANTIAM ROAD, ALBANY, OREGON 97321 PHONE (503) 967-2039

June 12, 1981

Pat Beyer
Hanna Nickel Smelting Company
P. O. Box 85
Riddle, Oregon 97469

Dear Pat:

Thank you for your help with the nickel article. Here are a few copies for your use.

Thank you again.

Sincerely,

Jerry J. Gray

Jerry J. Gray
Economic Geologist

JJG/bjd

Enclosures

12/30/80

Mr. Gray:

As promised, I am enclosing a couple of copies of our most current brochure on the Riddle operation. Also, for your information and records, Herbert D. Wedge is now our general manager replacing Mr. Matson.

Pat Beyer
Sec. to Mr. Wedge

874-2211

WHAT STRATEGIC METAL DOES OREGON SUPPLY THE REST OF THE UNITED STATES?

NICKEL

BY JERRY J. GRAY

What strategic metal does Oregon Supply the rest of the United States?

Nickel! Oregon has the only producing nickel mine in the United States.

Of the U.S.'s demand for nickel, how much does Oregon supply?

Oregon's annual production of contain nickel in ferronickel (50% iron and 50% nickel) ranges from 14 to 16,000 tons which is 6 to 10 percent of U.S.'s demand for nickel. Scrap accounts for 20 to 30 percent and the rest is imported.

Why is nickel called a strategic metal?

Nickel is vital to the iron and steel industry. Without nickel, the sophisticated industrial complexes, including the aerospace industry, that provide our high standard of living would not be possible. Nickel's greatest value is in alloys with other elements, where it adds strength and corrosion resistance over a wide range of temperatures.

Where in Oregon is nickel ore being mined and smelted?

The ore body being mined lies on top of Nickel Mountain. The smelter is at the foot. Nickel Mountain is located four miles west of the town of Riddle in southwestern Douglas County.

Who is doing the mining and smelting?

The Hanna Mining Company and Hanna Nickel Smelting Company began production of ferronickel (a combination of iron and nickel), the first to be produced in the United States from domestic ores, in July 1954. The companies have operated on an around-the-clock schedule since that time and provided steady, year-around work for approximately 600 employees.

In early 1953, two subsidiaries of M. A. Hanna Company signed a Federal

contract to build a nickel smelter and to develop the deposit of nickel ore at Nickel Mountain. The firm was to furnish, for the national stockpile, 95 to 125 million pounds of contained nickel in ferrnonickel at a price of 79.39¢/lb for the first 5 million pounds and 60.5¢/lb thereafter. In later years when the Federal Government sold the ferronickel from its stockpile, it realized over $2.00/lb.

What kind of ore deposit is at Nickel Mountain?

Nickel Mountain ore is a garnierite type which is classified into three groups: soil (bright red at surface grading into a yellow-brown color at depth), saprolite (weather peridotite, light to dark green) and box works (yellow-brown to bright green). Soil has 20 percent of the nickel resource, the saprolite 70 percent, and the box works 10 percent. Nickel Mountain appears to be a peridotite erosional remnant of an overthrust sheet. Fresh peridotite contains 0.2 percent nickel. Ore body was formed by the leaching and transportation downward of the nickel during the weathering of the peridotite. The deposit is made up of six major areas, covering approximately 600 acres. Average nickel grade in the crude ore presently under active development is approximately 1.0 percent.

How is the deposit mined?

The mining is by the multiple bench open pit method. The benches are at least 50' wide with 20' vertical faces. Up to 80 percent of the ore can be dug without blasting. When blasting is necessary, a hole is drilled and filled with an explosive and set off. Loading pit run ore is accomplished with diesel shovels. The ore is loaded into 60-ton diesel trucks and hauled to the screening plant. See flow diagram shown in Figure 1.

Can the ore be upgraded by flotation or other standard ore benefaction methods?

Because of the mineralogy of the ore, the only upgrading that can be done must be based on the physical characteristic of the ore such as soft or hard, fine or coarse and/or color.

How is the ore upgraded?

As the ore is being mined, large boulders, called pit rejects, are separated from the ore by the shovel operator and ultimately deposited on waste dumps. The boulders are mostly unweathered peridotite and contain low amounts of nickel in them. More upgrading takes place at the screening-crushing plant. The trucks dump the ore directly into the screening plant feed hopper. A separation is made according to the size of the material, with the smaller going directly to the tramway surge pile and the larger to the crusher. After crushing, the material is visually classified and directed to the tramway or the reject stockpile.

How does the ore get from the screening-crushing plant on top of Nickel Mountain to smelter at the foot of the Mountain?

An 8,300 foot aerial tramway with a 2,000 foot drop connects the screening-crushing plant with the smelter. At the tramway the ore is fed to the loading terminal where it is loaded automatically into 50-cubic foot tram cars. It is conveyed downhill to the smelter storage stockpile.

The tramway runs continuously, carrying ore in the upright tram cars and returning the empty cars in an inverted position. The ore is discharged on to the stockpile by inverting the cars at the lower end of the tramway. A speed of 600 feet per minute is maintained by the braking action of the two 300-horsepower generators driven by the weight of the loaded tram cars. The braking action of the generators produces approximately 500 horsepower, which is used in the generating of electricity for the operation of the mine facilities.

How is the nickel gotten from the ore?

Ore from the stockpile is processed at the smelter to produce ferronickel, containing approximately 50 percent nickel. Steps in the process include reclaiming ore, drying, fines screening, rejection of lean rock by screening, crushing, sampling, calcining, melting, reducing to ferronickel, refining, casting, and skull metallics recovery. These steps are shown in the pictorial flow diagram , Figure 1. The highlight system with its 4th of July pyrotechnics, Figure 2 and 3, is the melting and reducting of the ore and refining of the nickel. The ore is fed into the melting furnaces by gravity and further heated to a temperature of approximately 3000 degrees Fahrenheit where it melts. This molten ore is then poured from the melting furnaces into ladles where the nickel extraction occurs.

Reduction of nickel and iron is accomplished by the Ugine Process, which consists of adding a reducing agent containing metallic silicon to an oxide ore in the presence of molten ferrous metals and using vigorous mixing action for good contact of reductant and ore. In Hanna's smelter, crushed ferrosilicon containing 48 percent silicon is used to extract the nickel. The ferrosilicon used is produced in a separate electric furnace in the smelter. During a mixing cycle, nickel and iron are extracted from the molten material through a chemical reaction between the nickel ore and the ferrosilicon. The ferronickel is allowed to settle to the bottom of the ladle. The slag is poured off and granulated with high pressure water jets.

What is done with the slag?

After the slag is granulated, it is transported by water to a large green slag pile. A small portion of the slag is sent to another company that screens the slag into different sizes, bags it, and ships it to California and elsewhere

for use in sandblasting. The slag also is used for fill and sanding of highways.

How long will this operation last?

As quoted in the reclamation plan on file with the Department, mining will be going on until at least the year 2003. Other deposits, somewhat lower in grade, are known in Curry and Josephine Counties which might provide a source of ore after Nickel Mountain has been mined out.

What effect has the Riddle operation had on the local economy?

Employment in Douglas County is mainly timber dependent, which means employment can have seasonal highs and lows and can have periodic wild swings up and down caused by the national demand for wood products. Because of the year round employment of 600 plus, the Riddle operation tends to provide a steady base level for the local economy.

The following table summarizes the Riddle operation's annual performance:

TABLE 1:

PRODUCTION--Ferronickel	42,250,415 Lbs.
Nickel Contained	21,787,960 Lbs.
ORE MINED	3,822,587 Tons
PAYROLL	$16,000,000
ELECTRICAL POWER AND FUELS	$ 9,000,000
ENVIRONMENTAL COST	$ 504,400
PROPERTY TAXES	$ 298,400
COUNTY ROYALTY FEES	$ 275,000

Figure 1. A Pictorial Flow Diagram for the Riddle Operation at Nickel Mountain (Courtesy - The Hanna Mining Company)

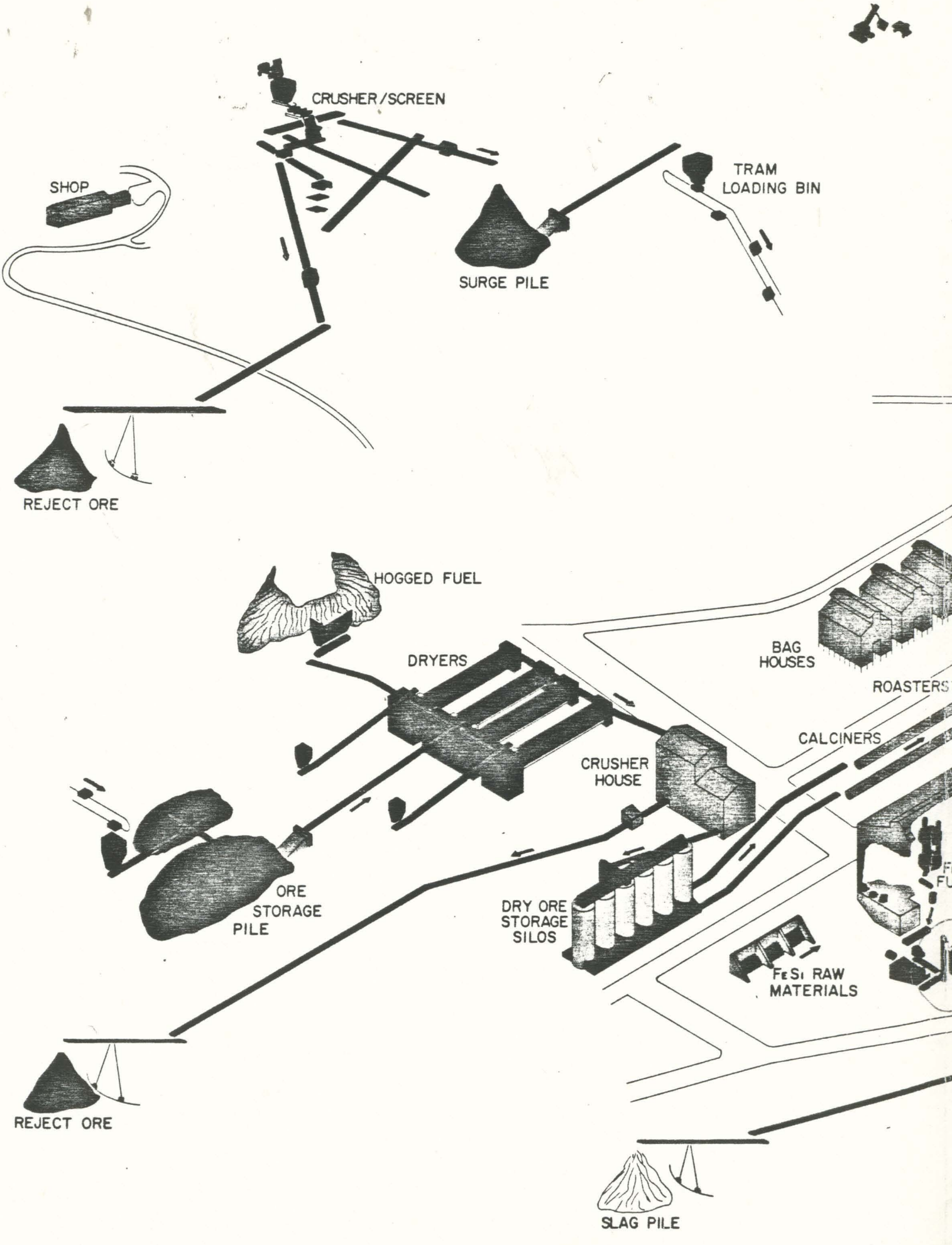
The mining ore is shown at the top center. The ore is moved to the top left for crushing/screening and start of the tram ride. The end of the tram ride is on bottom left. The ore moves to the right, through the smelter complex ending as ferronickel at the right and slag at bottom left center.

Figure 2. Pyrotechnics Show during Nickel Ore Smelting (Courtesy - The Hanna Mining Company)

The molten nickel ore and ferrosilicon are mixed by pouring from ladle to ladle.

Figure 3. Pyrotechnics Show During Nickel Metal Refining (Courtesy - The Hanna Mining Company)

The nickel refining is carried out while the ferronickel is molten.


CRUSHER/SCREEN
SHOP
TRAM
LOADING BIN
SURGE PILE
REJECT ORE
HOGGED FUEL
DRYERS
BAG
HOUSES
ROASTERS
CALCINERS
CRUSHER
HOUSE
ORE
STORAGE
PILE
DRY ORE
STORAGE
SILOS
FeSi RAW
MATERIALS
REJECT ORE
SLAG PILE

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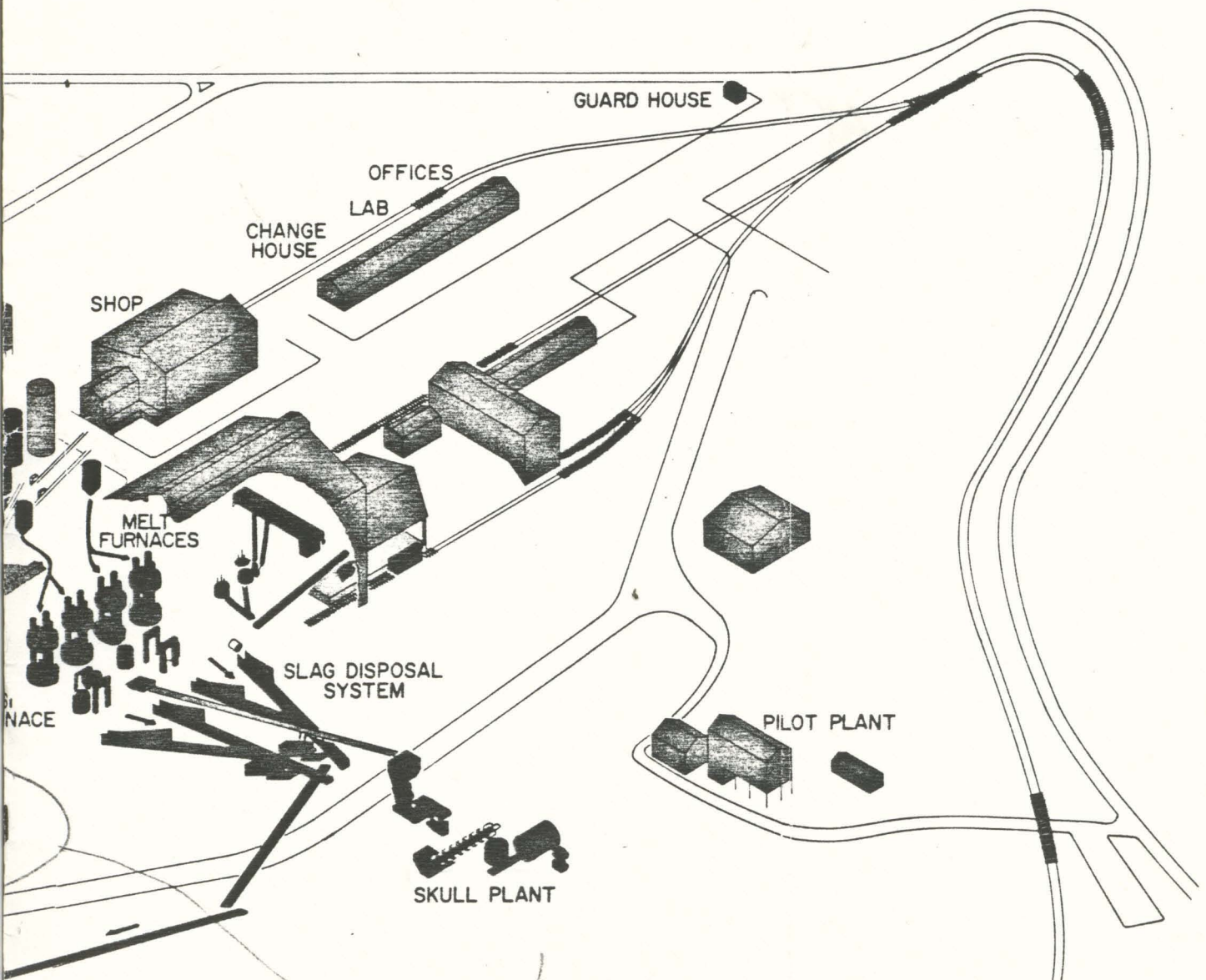

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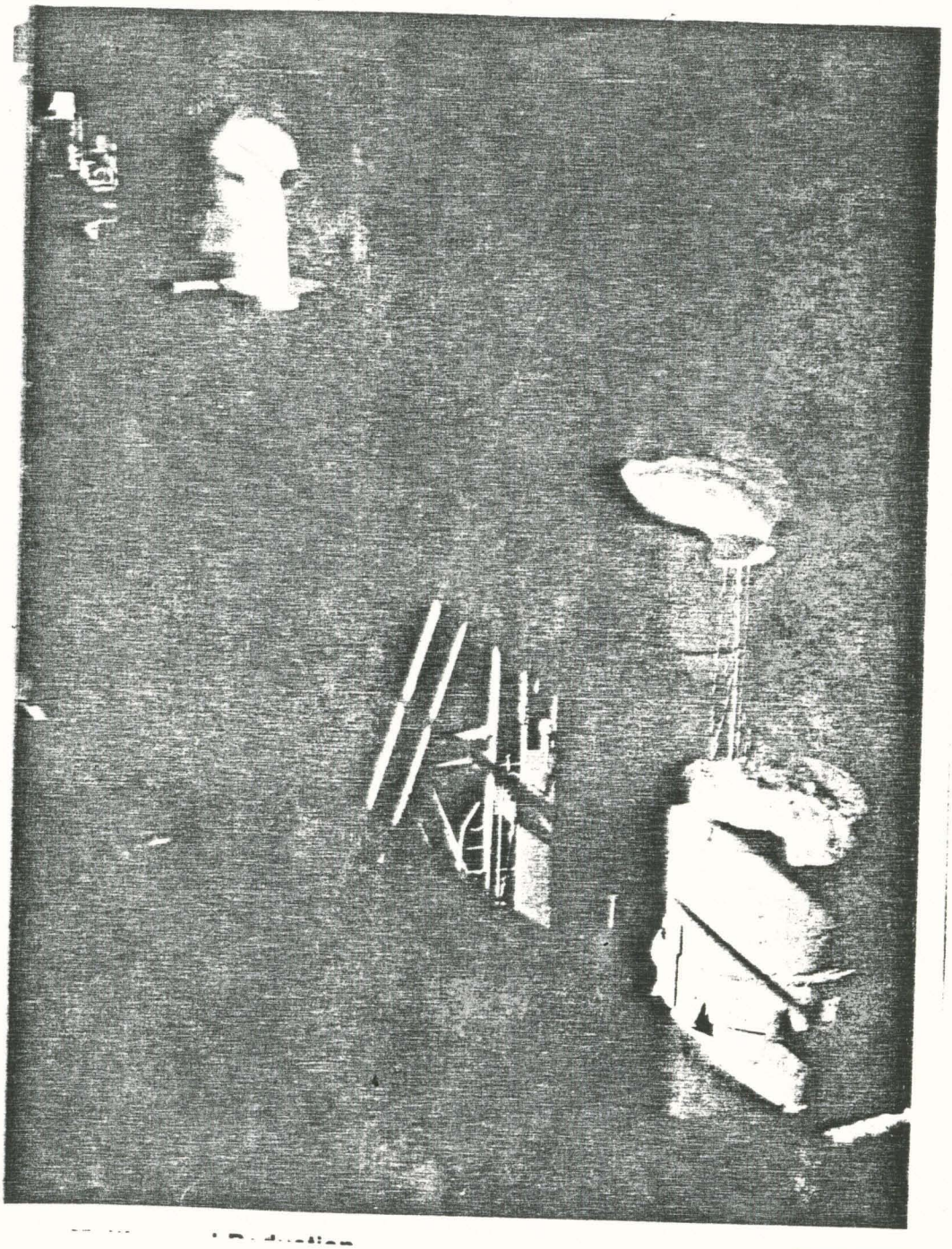

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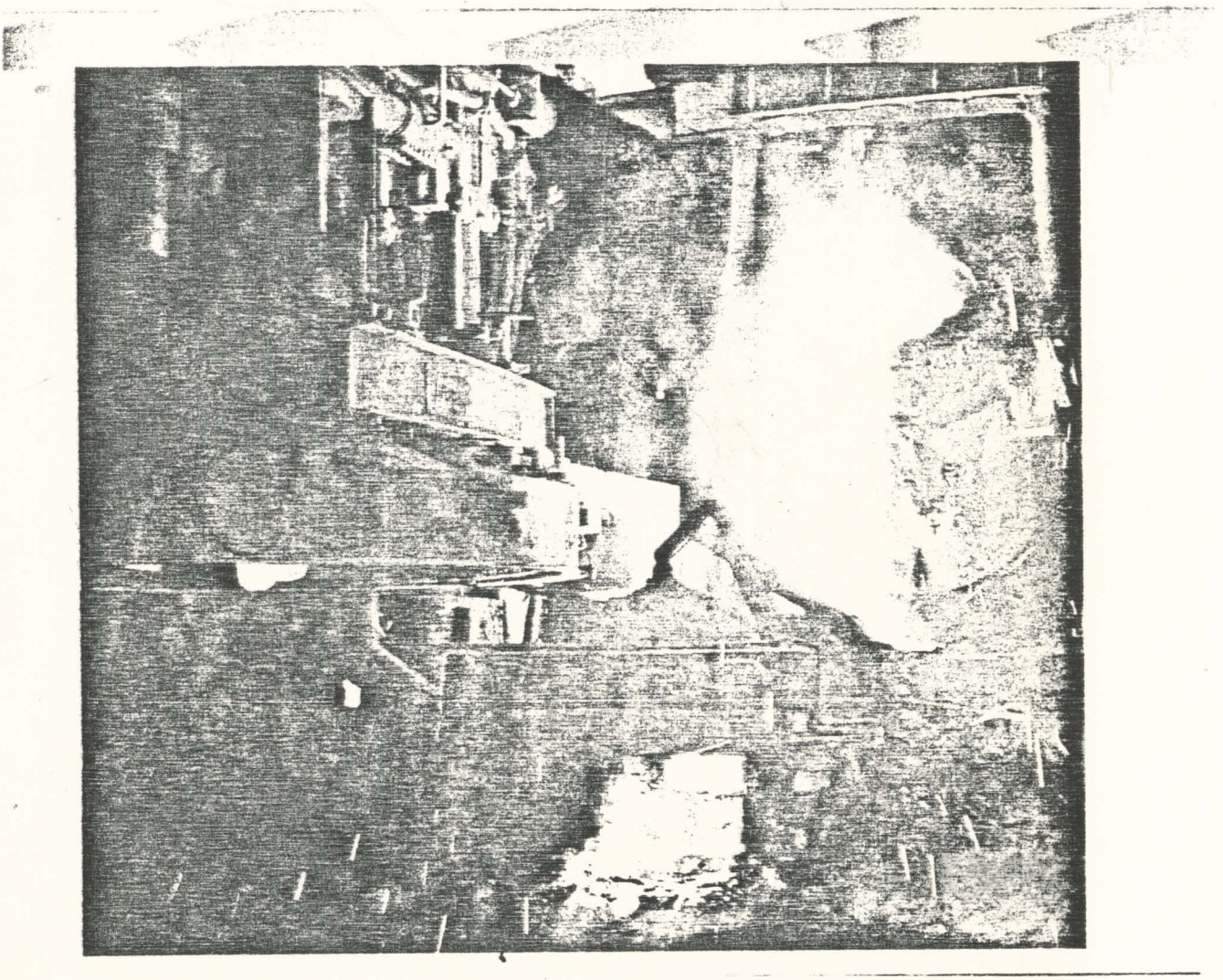

Figure 3. Pyrotechnics Show During Nickel Metal Refining
(Courtesy - The Hanna Mining Company)

The nickel refining is carried out while the ferronickel is molten.

Cal-Nickel project a threat to Smith

By DAVID JAMIESON
For The Mail Tribune

CRESCENT CITY — If while walking on a dirt road miles from the nearest civilization you were to suddenly come upon a great chemical processing complex full in the heat of production, you would probably be struck speechless.

As accustomed as we are to piecemeal evidence of logging, mining and road-building in isolated areas, the straight combination of industry and a back-county setting seems odd, like mixing oil and water.

Yet if a California mining corporation proposal for claims in northern California's Del Norte County come to pass, just such a mix could be created. That possibility has raised profound environmental concerns, and it has sorely tested the cooperative capabilities of local, state and federal agencies to deal with those concerns.

The Califonia Nickel Corp. — Cal-Nickel — is midway through a two-year, $3 million feasibility study of its holdings on Gasquet Mountain about 20 miles northeast of Crescent City. At the heart of the study is a plan to strip mine nickel and cobalt ore from the 3,500-acre claim and extract the metals by means of a $200 million ore processing plant to be constructed on the site.

The initial findings of a comprehensive study confirm what generally was suspected: the existence of about 50 million tons of low-grade nickel laterite ore, enough for Cal-Nickel to project the annual extraction of $150 million worth of nickel and cobalt over a 30-year period.

On that basis, Cal-Nickel has contracted for further environmental, engineering, economic and chemical processing studies, due out in a final report sometime this summer.

The proposal is unprecedented in Oregon and Califonia. It has set the wheels of government spinning.

Because the claims are in the Six Rivers National Forest, the U.S. Forest Service invoked the 1872 Mining Law, which was and is a blank check for miners to exploit mineral resources as best they can. The state of California was just as quick to claim the protection of the Smith River as its primary ground for involvement, pushing Del Norte County as lead agency.

About 10 percent of the Cal-Nickel claim overlaps a RARE II area — the North Fork of the Smith — that has been designated for "further study." The project lies wholly within the drainage of the Smith River, the only California river classified a state "Wild and Scenic River."

Much of the initial confusion has been ironed out. Del Norte County has been designated lead agency and will apply an agreed-upon combination of local, state and federal standards to the project. All the agencies will take an active role in monitoring development. The Forest Service has taken the attitude that the 1872 Mining Law has precedence over RARE II considerations.

Still very much in doubt, however, is the application of the Wild and Scenic Rivers designation.

Two years ago the California Department of Fish and Game was commissioned to come up with a classification and management use plan for the Smith. The project has advanced

or tailings since all agents are re-used by reduction of gas and recycling of all leach and solvent extraction re-agents."

The relatively low concentration of the metals — perhaps 20 pounds of nickel, two pounds of cobalt and 40 pounds of chromium per ton of ore — necessitates the location of an on-site processing plant.

It also necessitates strip mining the ore. Because Cal-Nickel's deposits have been found to average 15 to 25 feet in depth over the entire 3500 acre claim — with some pockets to 90 feet — the environmental impact could be considerable.

That impact could be heightened by the nature of the Gasquet Mountain site.

The soil is both highly erodible and permeable and it is drenched with an annual rainfall of about 100 inches. While much of the deposit is located on the relatively flat bench surrounding Gasquet Mountain, the deposit boundary, in some cases, extends to the edges of slopes that drop steeply into Hardscrabble Creek and the Smith's North Fork.

That could be Cal-Nickel's biggest problem. The state Regional Water Quality Board is obligated to enforce a "zero turbidity over background count" for the Smith, a river of remarkable clarity. Cal-Nickel officials are well aware of the problem and have commissioned specific plans to deal with it.

Revegetation is another problem Cal-Nickel is expected to address in its study report.

Unlike surrounding areas, Gasquet Mountain is sparse of plant growth and animal life. Trees 40 years old are less than 30 feet tall and eight inches through the base. Largely responsible for that are the laterite soils present and the heavy rainfall. Over the years, much of the common earth has been lost through leaching, leaving soil low in plant nutrients and high in plant-toxic, oxidized minerals such as nickel, cobalt, iron and magnesium.

Ironically, one of the re-agents used in the industrial extraction process could play a part in revegetation of the mined areas, according to the initial Dames and Moore report.

Ammonia, which is an ingredient of some commercial fertilizers, will be present in the tailings, the solids remaining after the nickel and cobalt have been extracted. As they note, "It could be an advantage if it remains as fertilizer . . . a disadvantage if it leaches out and becomes a contaminant."

The removal of those minerals and the fortification of the soil may well result in more abundant plant growth. On the other hand, it could upset the delicate ecological balance that has been achieved over decades of weathering.

The California Department of Fish and Game has pointed out a cut-over area quite close to the Cal-Nickel claim that has resisted eight separate Forest Service efforts to revegetate it. And at, according to Fish and Game, on "presumably better soil on the edge of the laterite."

Cal-Nickel also can expect to do considerable road improvement. The existing network, established over the years by scattered mining activity, is largely unmaintained and nearly impassable in the rainy season. A good

further environmental, engineering, economic and chemical processing studies, due out in a final report sometime this summer.

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Still very much in doubt, however, is the application of the Wild and Scenic Rivers designation.

Two years ago the California Department of Fish and Game was commissioned to come up with a classification and management use plan for the Smith. The project has advanced erratically over that period, accumulating information but arousing local ire because of its general lack of organization and direction.

The study has undergone a change in leadership and is moving from the classification stage to the development of a management plan.

Cal-Nickel officials are aware of a general Department of Fish and Game opposition to their project, but they, as yet, have no guidelines to follow in drawing up their plans.

Some of the restrictions Cal-Nickel faces are quite clear, though, especially those involving the use of surface water. The Wild and Scenic Rivers Act prohibits diversion of any water from the Smith or its tributaries for anything other than domestic use.

Like any chemical processing plant, the Cal-Nickel plant would require water, plenty of it.

Harris Lowenhaupt, vice president of the company and chief chemist for the project, estimates the plant would require 2.9 million gallons of water daily at a rate of 270 feet per minute. While declining to quote an actual percentage, Lowenhaupt says "virtually all" the water could be recycled and re-used, the major loss coming from evaporation in cooling towers.

But if the nearby waters of Hardscrabble Creek and the Smith's North Fork are forbidden to use, where to get it? The answer, according to Lowenhaupt, lies in on-site wells.

"Hydrologists from Dames and Moore (the environmental consultants retained by Cal-Nickel to compile environmental information) have done exploratory work on the mountain and their findings indicate that there is sufficient water available for the project at a depth of 500 feet," Lowenhaupt says.

State law prohibits discharge of any waste into the Smith, a fact which unsettles those associated with the project less than one would think. A quote from a recent U.S. Bureau of Mines paper on the advancements in nickel extraction technology gives reasons:

"(The process) does not affect air quality or create polluting discharges of waste water and eight inches through the base. Largely responsible for that are the laterite soils present and the heavy rainfall. Over the years, much of the common earth has been lost through leaching, leaving soil low in plant nutrients and high in plant-toxic, oxidized minerals such as nickel, cobalt, iron and magnesium.

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Cal-Nickel also can expect to do considerable road improvement. The existing network, established over the years by scattered mining activity, is largely unmaintained and nearly impassable in the rainy season. A good portion of Cal-Nickel's exploratory effort has gone into rocking, grading and waterbarring the roads, improvements that will have to be expanded to accommodate the heavy equipment and traffic necessary to build and operate the plant.

There are other restrictions as well. The plant must meet California standards of air quality. Scenic considerations would be handled through Regional Water Quality Board action. The initial Dames and Moore report states that the plant itself would not be visible from Gasquet or Highway 199.

Gasquet Mountain is only part of an enormous laterite deposit called the Josephine Belt. It extends from southern Oregon down to Mendocino County in California. According to Grants Pass geologist Lloyd Frizzell, a local geologist and currently under contract to Cal-Nickel, the entire deposit covers a total of between 20,000 and 30,000 acres. It is the only one of its kind in North America, he says.

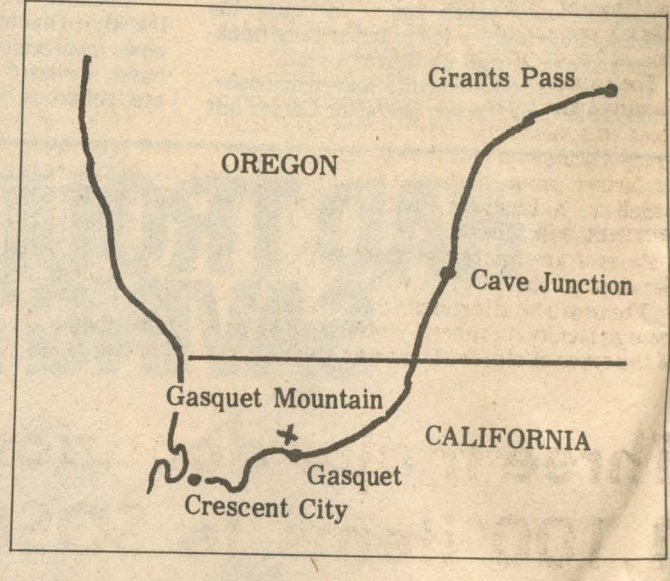
The laterite has largely gone untapped because richer deposits exist elsewhere in the world, because of the comparatively low market price of nickel and cobalt, and because of the difficulty in extracting the metals. The only plant on the deposit, operated by the Hannah Mining Co., in Riddle, was built during World War II and it relies heavily upon cheap electricity from the Columbia River system. Even with that, when the price of metal drops, the plant is forced into shutdowns and layoffs.

Recent developments in the extraction process and a general market trend of elevated prices for raw materials are two reasons for the latest interest.

Cal-Nickel, actually a wholly-owned subsidiary of a Vancouver, B.C.-based company called Ni-Cal Developments LTd., owns rights to two other substantial claims in Del Norte County. The company has voiced plans to proceed in a similar manner once the Gasquet Mountain operation begins.

Inter-American Nickel, the Oregon subsidiary of Ni-Cal, controls claims on Eight-Dollar Mountain and other portions of southern Oregon west of Highway 199.

Photos by Steve Yarbrough



Cal-Nickel Corp. is half way through $3 million feasibility study at Gasquet Mountain in northwestern California (top). If sample nickel laterite ore excavation proves potential, and other environmental considerations can be met, the company expects it could extract $130 million of nickel and cobalt during a 30-year period. Map indicates location of exploration site north of Gasquet.

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COMMODITIES

Canada Nickel Producers to Cut Output Sharply In Response to Last Year's Price Decline of 68%

By Neil Behrmann
Special to The Wall Street Journal

LONDON — The nickel market has turned to gloom from boom, in one of the most rapid turnarounds ever in the metals markets.

As a result, both **Inco** Ltd. and another leading Canadian producer, **Falconbridge** Ltd., announced that they intend to slash production this year by around 16,000 metric tons, or 6% of total output. Canada is the world's leading producer of nickel.

World nickel prices slumped 68% during the past year, following a surge in Soviet exports and cutbacks in consumer orders. The "price decline has been spectacular," said David Phillips, chief executive officer of Inco.

At $2.75 a pound, current nickel quotes compare with a peak of $10.84 a pound in April 1988. Prices have fallen by 35% since the middle of last month alone, dealers say.

Nickel prices collapsed because an acute shortage in the market was transformed into a surplus, says Jim Lennon, a metals analyst at Shearson Lehman Hutton Ltd. in London.

A boom in the stainless steel industry, which accounts for 60% of nickel demand, came to an end, he says. Meanwhile, the Soviet Union raised exports to around 80,000 metric tons last year from 60,000 metric tons in 1988.

Soviet exports account for only about 12% of world supplies, but it is "the swing factor" in the market, says Angus MacMillan head of research at Billiton-Enthoven Metals Ltd. in London.

He estimates that the Soviets sold as much as 85,000 metric tons last year and "assumes that these levels will more or less be maintained in 1990."

Moreover, Cuba, which traditionally sells a large proportion of its nickel output to East Europe, also exported about 14,000 tons of the metal to the West last year, up from 12,000 tons in 1988, Mr. Lennon of Shearson says. Cuba is planning to double production to 100,000 tons by the mid-1990s, he says.

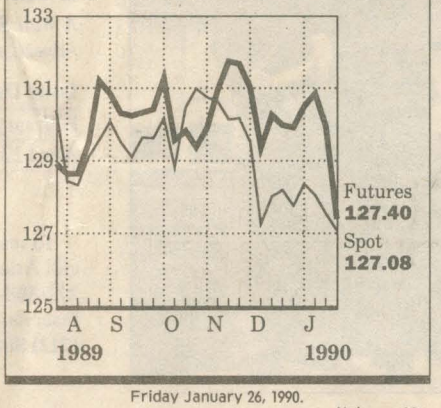
"Both the Soviet Union and Cuba need the money and they had to increase the volume of exports to offset the declining price," Mr. Lennon says.

The steep fall in nickel prices is the inevitable result of an unusual boom in 1987 and 1988, dealers say.

After averaging between $1.80 and $2.25 a pound from 1982 to 1987, prices surged after strikes and other supply disruptions in such producing nations as the Dominican Republic, Brazil, Indonesia and Australia. The turnaround caught stainless steel producers and other consumers in the Far East, Europe and the U.S. by surprise, and dealers say there was such a shortage that buyers were forced to bid up prices to exceptional levels.

Dow Jones Commodity Indexes

(Weekly averages)



Friday January 26, 1990.

	Close		Net Chg.	Yr. Ago
Dow Jones Futures	127.40	+	.13	141.78
Dow Jones Spot	127.08	+	.03	140.07
Reuter United Kingdom	1785.0	–	3.3	1963.1
C R B Futures*	231.37	–	.06	241.27

*Division of Knight-Ridder.

Yet as 1989 got under way, the shortage of nickel came to an end, dealers say. Despite the numerous production disruptions in 1988, output managed to rise in that and the following year. Meanwhile, high prices encouraged merchants to recover more nickel from scrap metal.

Demand has also begun to sag. Following extraordinary growth in stainless steel production in the past two years, output may be "significantly lower" this year, says Mr. MacMillan of Billiton-Enthoven. There will be lower orders for stainless steel from the automobile, house building and capital goods industries, he says.

In addition to buying cheap nickel from scrap merchants, stainless steel manufacturers and other users are depleting nickel stocks that they had built up in the past two years.

Industry is thus buying less metal from the mines, Mr. MacMillan says. As a result, supplies from Western and Communist bloc producers will exceed world consumption of 605,000 metric tons by 80,000 metric tons, estimates Mr. Lennon of Shearson.

In the next few months, however, there could be "a good price rally," says Edwin Arnold, metals analyst at Merrill Lynch Pierce Fenner & Smith in London.

Low nickel prices will "choke off the supplies of extra scrap," he predicts, and prices should stabilize, provided that stainless steel production isn't too depressed.

Looking forward to other commodity markets this week:

RESULTS OF PETROGRAPHIC STUDY OF DIAMOND DRILL CORE SAMPLES FROM NICKEL MOUNTAIN, RIDDLE, OREGON

D.D. #1 80-90

Color - limonite brown
Texture - brecciated, veined
Odor - earthy (strong)
Minerals:

(1) Limonitic clay, possibly nontronite, a hydrated silicate of ferrous iron	90% plus or minu
(2) Augite and enstatite)	
(3) Tremolite, probably formed by the hydrothermal alteration of the above augite) ----	8% plus or minu
(4) Chromite	2% plus or minu

D.D. #1 120-125

Color - variable
Texture - brecciated, veined
Odor - earthy
Minerals:

(1) Quartz, aggregate, latest mineral (unfractured)	45% plus or minu
(2) Actinolite (hydrothermal)	1% plus or minu
(3) Antigorite and chrysotile (hydrothermal)	25% plus or minu
(4) Limonitic clay, possibly nontronite	29% plus or minu

D.D. #1 220-223½

Color - brown with green streaks
Texture - brecciated, veined
Odor - earthy
Minerals:

(1) Limonitic clay, possibly nontronite	60% plus or minu
(2) Antigorite (hydrothermal)	30% plus or minu
(3) Quartz, aggregate, latest mineral	10% plus or minu

D.D. #1 314-318

Color - dark green
Texture - massive but slightly veined
Odor - slightly earthy
Minerals:

(1) Antigorite (hydrothermal)	70% plus or minu
(2) Olivine, altered, in part to antigorite and secondary magnetite	30% plus or minu
(3) Carbonate coating	1% minus

Remarks - Rock, originally a peridotite, is largely antigorite and secondary magnetite (with some relict olivine) produced by hydrothermal alteration.

D.D. #1 372.5-376.5

Color - variable green
Texture - massive but veined
Odor - somewhat earthy
Minerals:

(1) Olivine (with included magnetite)	80-90%
(2) Antigorite	5-10%
(3) Nickeliferous serpentine	5%

Remarks: Nickeliferous serpentine appears to be latest mineral.

D.D. #1 399-405

Color - dark green
Texture - massive but slightly veined
Odor - slightly earthy
Minerals:

(1) Olivine, in part altered to antigorite	80% plus or mi
(2) Enstatite and intergrowth of a } ———	20% plus or mi
(3) Clino pyroxene [augite (?)] }	
(4) Carbonate	1% minus

D.D. #1 405-415

Color - green
Texture - massive but veined
Odor - slightly earthy
Minerals:

(1) Olivine	60% plus or mi
(2) Enstatite	5% plus or mi
(3) Antigorite, part chrysotile, and included magnetite grains (hydrothermal)	35% plus or mi

REMARKS:

Very little nickeliferous material was identified. Nickeliferous serpentine is present in one sample. The original material, peridotite, has been partly altered to serpentine, possibly by hydrothermal solutions as indicated by so-called hydrothermal minerals, i.e. the tremolite-actinolite and the antigorite. The antigorite is associated with the fractures in the rock and if it was hydrothermal solutions that caused serpentinization, they would naturally have altered most markedly the areas surrounding the cracks and fissures. Quartz was the latest mineral formed and may very well have been deposited by circulating ground water.

The presence of nickeliferous serpentine, however, shows that some nickel-bearing minerals were probably formed by hydrothermal solutions.

TO FREEPORT SULFUR COMPANY

Spectro-chemical Analysis of Drill Cores

Sample No.	% Nickel	% Cobalt	% Chromium	% Aluminum
80-90	1.20)	0.005)	0.74)	0.20)
	1.05)	0.004)	0.64)	0.25)
120-125	0.35)	0.003)	0.11)	0.066)
	0.36)	0.005)	0.09)	0.070)
220-223½	0.29)	0.003)	0.15)	0.038)
	0.30)	0.004)	0.22)	0.030)
314-318	0.13)	0.005)	0.28)	0.029)
	0.15)	0.004)	0.31)	0.038)
372-376½	0.18)	0.004)	0.28)	0.092)
	0.21)	0.004)	0.26)	0.100)
399-405	0.21)	0.005)	0.34)	0.50)
	0.24)	0.005)	0.36)	0.48)
405-415	0.16)	0.003)	0.33)	0.49)
	0.17)	0.004)	0.25)	0.46)

Lab. No.	Description	Assays	
	Rough and Ready Creek	Ni	Cr_2O_3
P-8805	Hole 1 0' - 1'	1.06	3.29
P-8806	" 1' - 2'	1.18	2.59
P-8807	" 2' - 3'	1.18	2.20
P-8808	" 3' - 4'	1.29	2.62
P-8809	Hole 2 0' - 1'	0.92	3.56
P-8810	" 1' - 2'	1.20	2.94
P-8811	" 2' - 3'	0.96	1.71
P-8812	" 3' - 4'	0.61	1.27
P-8813	" 4' - 5'	0.52	0.84
P-8814	Hole 4 0' - 1'	0.95	2.64
P-8815	" 1' - 2'	1.07	2.58
P-8816	" 2' - 3'6"	1.11	2.35
P-8817	Chetco Trail - Baldface Trail Junction Shovel pit depth 1'	0.59	2.68
P-8818	" " " 1' - 2'	0.47	1.84
P-8819	" " " 2' - 3'	0.44	1.53
P-8820	" " " 3' - 4'	0.40	1.51
P-8821	Mud Springs Trail 1' - 2'	0.31	2.50
P-8822	" " " 2' - 2'6"	0.40	2.33
P-8827-B	Alberg Mine Flat 0' - 1'	0.68	3.14
P-8828	" " " 1' - 2'	0.74	3.22

MEMO OF FIELD TRIP TO SOUTHERN OREGON JUNE 21 TO JULY 2 INCLUSIVE, 1949

To: F. W. Libbey

A total of six localities were visited by the writer, who was accompanied by Mr. Lorne Turville, during the recent inspection of Josephine County nickeliferous laterite areas. None of the spots inspected proved to be very promising, in fact, almost without exception the areas were found to contain a great preponderance of both surface and subsurface boulders which made sampling at depth extremely difficult. Samples were taken at the following places:

(1) Section 14, T. 40 S., R. 9 W. This is located at the lower end of the Mud Springs Trail at a point 200 feet more or less south of Rough and Ready Creek. The hole was drilled in transported material.

(2) NE¼ Section 5, T. 40 S., R. 9 W. A hole was drilled beside the trail leading to the Alberg cabin. The area surrounding the hole is a rather extensive flat, but unfortunately the amount of soil that has been developed is small.

(3) Section 9, T. 40 S., R. 9 W. A small flat lying on top of a ridge was drilled at several places where characteristic laterite soil was noted.

(4) SW¼ Section 17, T. 40 S., R. 9 W. The flat at this place was nearly completely paved with surface boulders and no samples were taken.

(5) NW¼ Section 19, T. 40 S., R. 9 W. This area was similar to that in Section 17, no samples being taken.

(6) The flats on the west side of Josephine Creek due west of Woodcock Mountain were examined but found to contain no suitable lateritic material. The area is characterized by numerous boulders with very little soil in evidence.

In addition to the above areas the following samples were taken on the Cook Trail which follows along the divide which forms the Josephine-Curry County boundary immediately north of the Wimer Road: At the Bald Face Creek junction a series of samples was taken some of which apparently contain manganese; a second series of samples was taken from a shallow hole drilled along the narrow gauge road about .4 of a mile north of the Cedar Springs junction.

Four properties were sampled for possible cobalt-nickel mineralization: the upper tunnel of the Cowboy Mine, Mr. C. W. Martin's tunnel on Sams Creek; an outcrop on Upper Evans Creek in section 25, T. 34 S., R. 3 W.; and the tunnel being driven in the hornblendite mass not far from the Gold Ray Dam.

Two days were spent assisting Wolfe in moving his office across the street, and about four hours were spent in a futile search for the property on Josephine Creek which Niel Allen requested an inspection of.

Numerous rock specimens for the student rock collection were brought back to the Portland office from Grants Pass where Wolfe had collected them.

Ralph S. Mason

Lab. No.	Description	Assays Ni	Cr_2O_3
	Woodcock Mountain		
P-6529	Redbird No. 2, Hole 1 0" - 1'	1.45	0.94
P-6530	" " ", Loc cut channel 2' - 3'	1.38	0.94
P-6531	" " ", Hole No. 2 0'6" - 1'6"	1.03	2.65
P-6532	" " ", " " " 1'6" - 2'6"	1.38	2.26
P-6533	" " ", " " " 2'6" - 3'6"	1.24	1.85
P-6534	Grab of inclined shaft dump	0.40	0.34
P-6535	" " top of inclined shaft	1.33	0.94
P-6536	" " unweathered peridotite top of mountain	0.23	0.40
P-6537	Claim No. 4 Loc cut 2½" - 4'0" laterite	0.67	1.50
P-6538	Grab of soil at top of mtn. 6" below surface	0.88	2.12
	Nickel Mountain		
P-6539	Laterite from big cut 2'3" - 4'0"	0.53	1.60
P-6540	" " " " 4'0" - 6'0"	0.66	1.41
P-6541	" " " " 6'0" - 8'0"	0.65	1.11
P-6542	" " " " 8'0" - 9'0"	0.67	0.89
P-6543	Surface of saddle "potential ore" zone	0.60	1.48
P-6544	Top of ridge Hole No. 1 6" - 1'0"	1.72	1.26
P-6545	" " " " " " 1'0" - 2'0"	2.37	0.93
P-6546	" " " " " " 2'0" - 3'0"	2.30	1.06
P-6547	" " " " " " 3'0" - 4'0"	1.65	0.77
P-6548	" " " " " " 4'0" - 5'0"	1.97	0.74

Lab. No.	Description	Assays	
	Nickel Mountain (Cont.)	Ni	Cr_2O_3
P-6549	Top of ridge Hole No. 1 5'0" - 6'0"	2.01	0.77
P-6550	" " " " " " 6'0" - 7'0"	1.85	0.87
P-6551	" " " " " " 7'0" - 8'0"	1.79	0.84

June 7, 1948

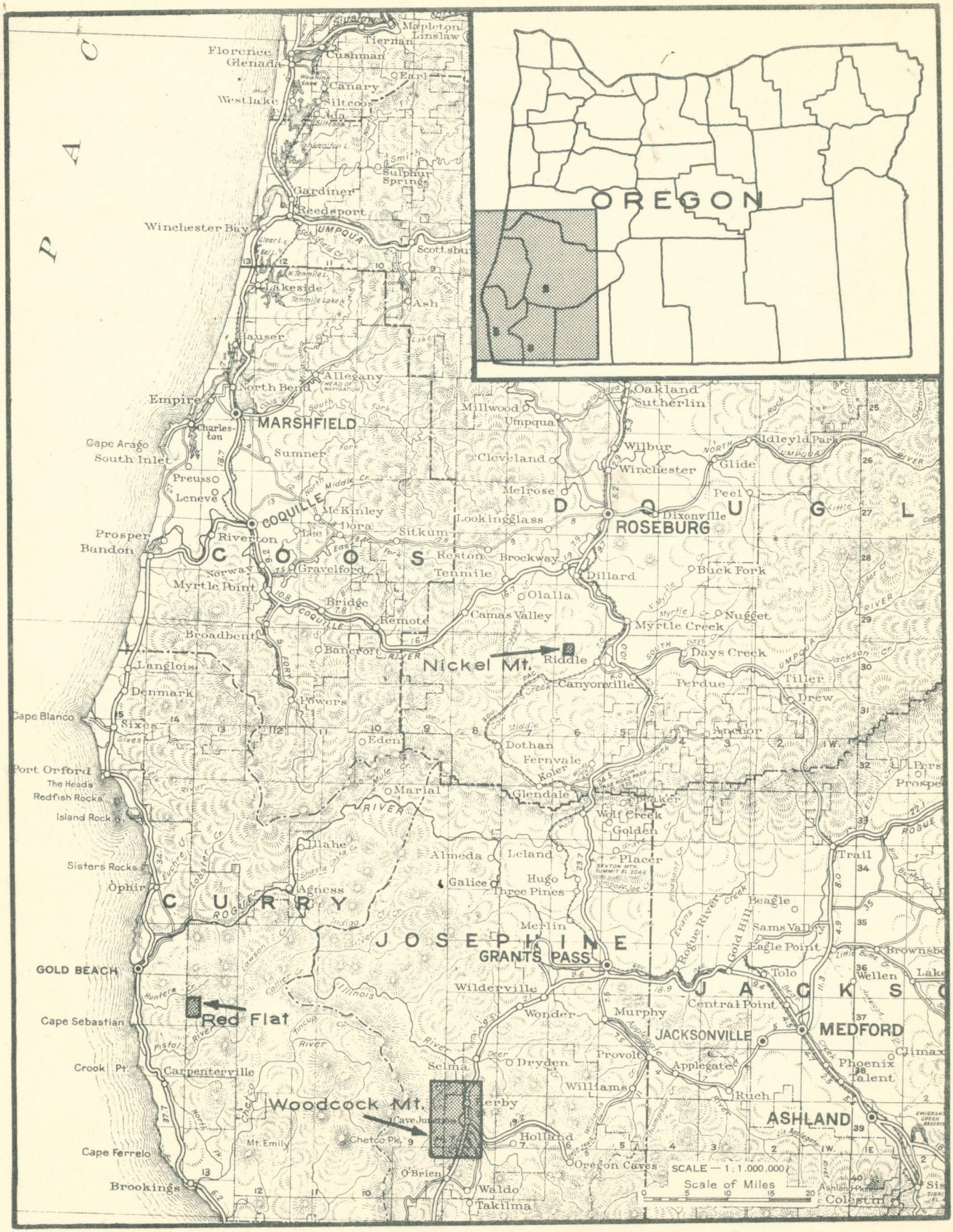
Nickel Occurrence near Azalea

To: F. W. Libbey

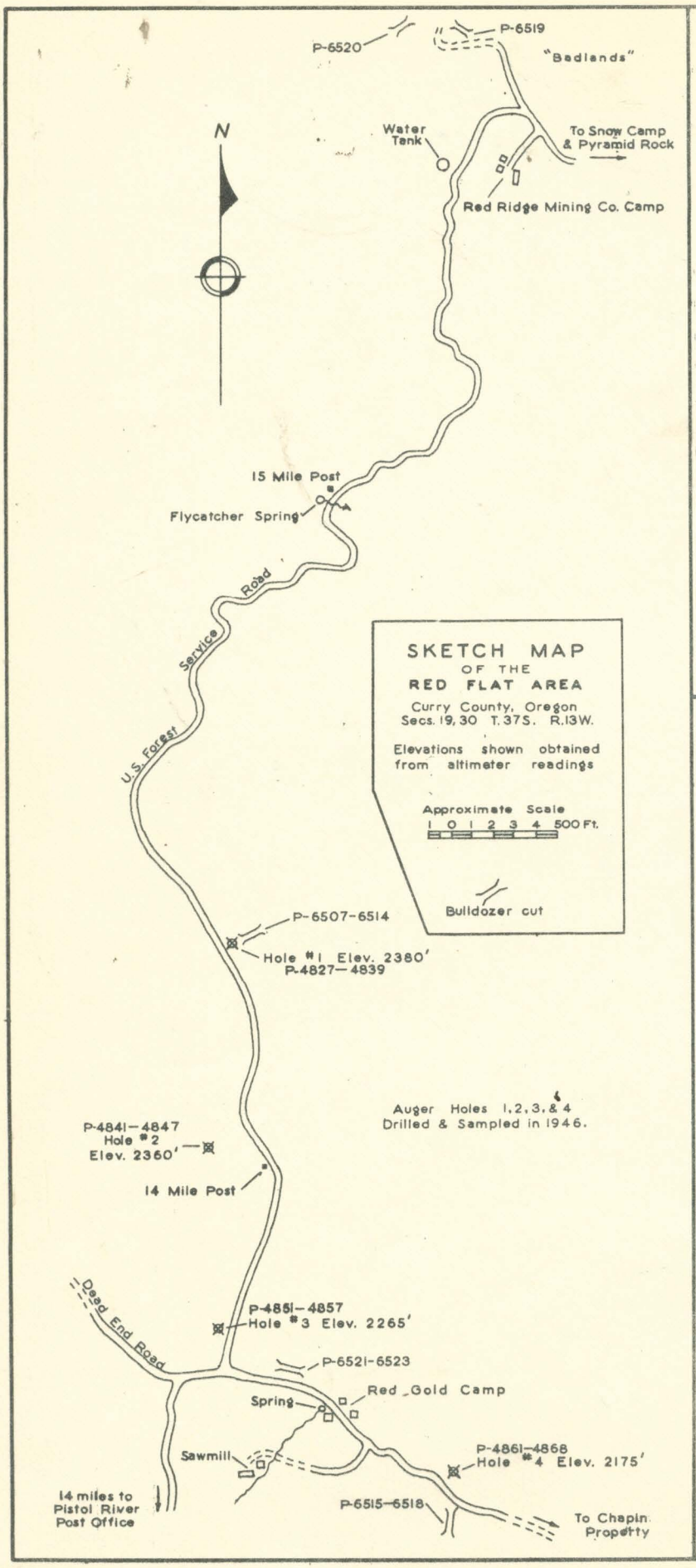
From. R.S.M.

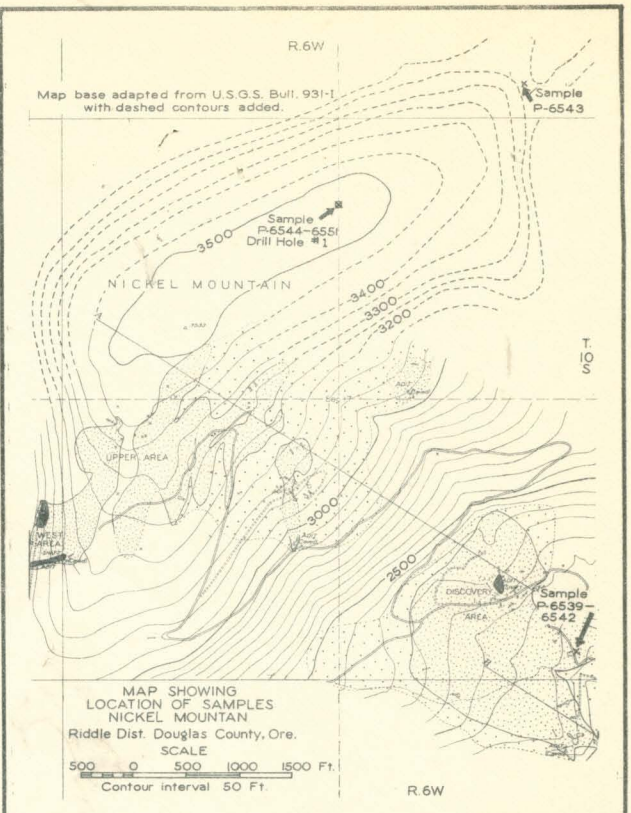
Frank Kolkow reported (June 7, 1948) that he visited a nickel deposit about twenty years ago in either the NE quarter of sec. 33 or the N.W. quarter of sec. 34, T 32 S., R. 4 W. The deposit is reached from Azalea by taking the road up Cow Creek to Starveout Creek, thence up Starveout to Fizzleout, up Fizzleout to Hogum Creek, inquiring at some of the houses along Hogum Creek how to get to the Jantzer (pronounced Yountzer) Mine. According to Kolkow the deposit has been opened up with a pit with perhaps a short adit in the face, the workings being visible from the Jantzer Mine. A trail leads up the northwest slope of Green Mountain from Jantzer Mine and the workings are said to be at an elevation of about 3,600 feet. Kolkow said that the ore was not garnierite but appeared to be more metallic, probably a nickel sulphide.

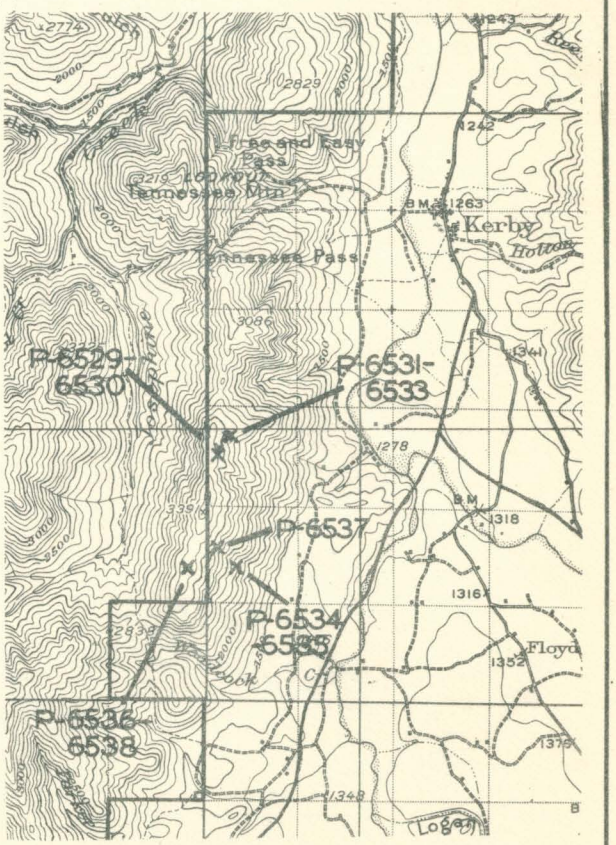
RSM:de



Index Map of Southwestern Oregon Showing
Location of Nickel-Bearing Laterite Areas







MAP SHOWING LOCATION OF SAMPLES
WOODCOCK MOUNTAIN
Josephine County, Oregon
Map base from U.S.G.S. Kerby Quad.
Scale
1 0 1 2 3 4 5 Miles.
Contour interval 100 Feet

D.I.B.

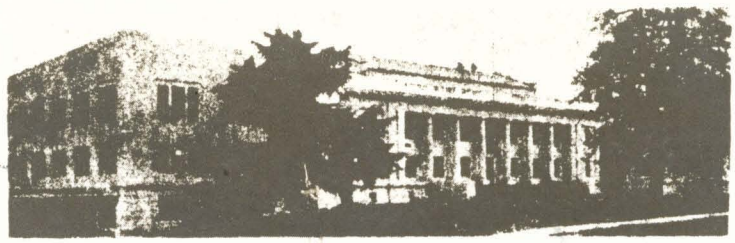
E. R. METZGER
COUNTY COMMISIONER

V. T. JACKSON
COUNTY JUDGE

RAY E. DOERNER
COUNTY COMMISIONER

CHARLES DOERNER
CLERK
LELAND W. SVARVERUD, JR.
ASSESSOR
BERT LAURANCE
TREASURER

AVERY W. THOMPSON
DISTRICT ATTORNEY
IRA C. BYRD
SHERIFF
FRED M. DARBY
SURVEYOR



DOUGLAS COUNTY
Roseburg, Oregon

June 18, 1964

Hanna Mining Company
1300 Leader Bldg.
Cleveland 14, Ohio

Attn: Legal Department

Gentlemen:

We are in receipt of a report on the geology of certain county-owned mineral rights by the Oregon Department of Geology and Mineral Industries. These mineral rights are currently under lease to Hanna by Douglas County as recorded in the Douglas County Deed records Volume 329 pages 422-429.

The Court has examined this report and finds that it verifies the fact that no ores or minerals exist having present economic value to mine or extraction or under the following described properties:

> $W\frac{1}{2}$ of the $SE\frac{1}{4}$ Section 18 and the $NE\frac{1}{4}$ of the $NE\frac{1}{4}$ of Section 19; and the $W\frac{1}{2}$ of the $NW\frac{1}{4}$ Section 20 and the $NW\frac{1}{4}$ of the $SW\frac{1}{4}$ of Section 20, all in Township 30 South, Range 6 West, Willamette Meridian.

In the interest of further clarification, these lands shall be included in the operation of the lease.

Very truly yours,

DOUGLAS COUNTY COURT

BY: V T Jackson
County Judge

BY: E R Metzger
County Commissioner

BY: Ray E Doerner
County Commissioner

cc: E.E. Coleman
Hollis M. Dole

RECEIVED
JUN 19 1964
STATE DEPT. OF GEOLOGY
& MINERAL INDS.

Yakobi Island 1.23% Ni | Inch 2 ... 4th Tl...

Aurora Nickel mine mirror Harbor Chichagof Id -

1 - 56 ft wide aver 3.42% Ni + 2.18% Cu

2 - 3.09% Ni + 0.61% Cu

3 - 2.41% Ni + 1.0% Cu

1st Mathe ch -

USGS Bull 692 p. 117 (Evidently p. 127 where indeposits described - no assay)

Ec Geol 1924 p. 375 - (19 Tons to Tacoma smelter 3.70% Ni + 1.7% Cu)
(Paul F Kerr Magmatic Sulphide ore from alaska)

Aurora ore zone 2½ mi long

(2) 1000 ft long + 140 ft wide 3.34% Ni + 1.4% Cu
1,400,000 tons of ore each 100 ft depth
50,000,000 tons for 1000 ft -

USGS Bull 947-C by Kennedy + Walton, Pecora
disseminated ore body should produce 13,500 tons ore
each 1-ft depth mixed waste with ore gets
0.2% Ni + 0.1% Cu - Bureau of Mines put down dd hole
- wrong direction

USGS Bull 931-F Reed + Dorr PP 105-138
936-I Pecora

(2)

Another dd hole hit ore at 20 ft & Bureau quit

Yakobi Id ni located in Bohemia Basin reported on by Prof Grider of Univ of Kansas samples assayed 0.98% Ni - 3.65% Ni & half as much Cu

Buddington
USGS Bull 773 page 98 assays 2.18% Ni 1.55% Cu, 2.45% Ni, 0.68% Cu, 1.72% Ni 0.87% Cu, 4% Ni + 0.82 Cu.

[very small out 773 not much devel. w]

1936
Dr. Hoegbom, Stockholm Sweden, Ch geol of Swedish gov Yakobi Id ni deposits next to Kirunawara iron mines of Sweden largest ore deposits in the world - 2 billion tons ore over 2% Ni above valley floor

773 - assays represent only picked samples ~~or from~~

USGS Bull 773

773 - Snipe Bay, Baranoff good assays but from spec -

P.8 - Prof F. Bastingxam Yakobi John C Reed, John Van N Dorr Pecora - Art Thane of Int. Nickel Co - Muir for Pres Roosevelt

773 admiralty Id Fair nickel assay from spec - sample

US GS Bull

692 (1917) USBM War Min Rep 333 (1944) [1]
Mirror Harbor, Chichagof Id, Alaska

773 (1923) RI 4168 litho (1948) Jan

931-F (1942) RI 4182 Yakobi Island Nidep
Sitka Mining Dist. Alaska
1948 Jan

936-I (1942)

947-C (1946) Alaska Dept. of Mines pamphlet No. 1 Strategic Min Occurrences in Interior Alaska May 1942

692 - deposits on W. coast Chichagof Id - Very small amount of devel work in 180-ft. shaft + 2-levels
no pertinent assays - no record of sampling

773 - ~~Chichagof~~ Chichagof Id ~~Bohemia Basin~~ ~~Yakobi Id~~. In 1921 SHP Vevelstad located 40 claims. Other locations by other groups made - statement of devel + assays given as furnished him by Mr. Vevelstad from a private report - Devel about same as mentioned in 692 - Assays + widths given are somewhat indefinite ~~[illegible]~~ and allow no picture of reserves - An average of 3.42% Ni + 1.58% Cu is given for upper level and on lower level "from 1.65 to 5.7% + 0.4 to 2.3% Cu widths are given as from 1.1 to 7.9 ft. "Narrower widths gave the higher assays"

773 (contin) Bohemia Basin on Yakobi
Little in way of development - Assays
from spec show 1.18% Ni & 1.98 Cu -

931-F Bohemia Basin on Yakobi Id.
8 - Ni-bearing ore bodies - Prob - 4 more
unprospected indicated by float & outcrops -
Devel mainly pits & tunnels -
Authors believe more sulphide
bearing ore bodies may be found
~~945 feet~~ Estimated tonnage and
grade - 61 samples 5,853,000 tons 0.36 Ni & 0.27% Cu

936-I West Coast Chichagof Id. 3 deposits
160 mi southwest of Juneau. 2 types of
deposits (1) disseminated sulphides and
(2) conc sulphides in pod-like masses
One of the conc sulph deposits is on
Fleming Id developed by 175 ft-shaft
(same as before) and ore shoot may contain
more than 10,000 tons have Ni & Cu content
of 2.00% ~~Ni~~ and 1.00% respectiv

A second outcrop of conc sulph 3000 ft. southeast of the 1st has had no sub surface devel. It is prob of lower grade

The dep of disseminated ore is 1000 ft southeast of the 2nd dep.

"It prob contains a few million tons of low-grade material with perhaps 0.2% of Ni and 0.1% of Cu.

Conc sulph dep good grade but small. Dissem deposits large but very low grade.

947-C Yakobi Bureau of Mines drilled & sampled in 1941 & 1942 USGS did magnetometer wk in 1943.

Authors make revised estimate of reserves 20,700,000 tons average about 0.33% Ni and 0.21% Cu

Chichagof Id - several concentrated sulph
deposits - known - largest on Fleming Id
contains prob. about 8000 l/ns of ore grade
of 1.57% Cu and 0.88% Cu - The other
deposits are all apparently small
The large disseminated deposit
prob contains several million tons
of material averaging 0.2% Ni and 0.1% Cu

Baranof Id deposit stated to contain only
a few tons of nickel-bearing rock.

Ex-factors - low grade of the large
deposits - on Yakobi Id & small tonnage
of heavy sulp bodies of Chichagof.
More ore could be developed on
Yakobi if further drilling is done
also on Chichagof -

P. 3

Aurora Nickel Mine Mirror Harbor, Churchill of Id. - no question quality of ore - quantity questionable. Correct to say that character of ore same as Sudbury ore.

"Ore zone" and ore reserves 2 diff things -

Cannot determine value of ore body by picked specimens -

P. 6 - Reference to statement on P. 6 that USGS Bull 947-C p. 45 - that side hill ore bodies all ~~are~~ ore body 1600 ft long and 1200 ft wide wrong - statement is that deposits are in an area about 1600 ft long and about 1200 ft wide - In bull no mention here make of grade as Vreeland infers on p. 6

Reference to single assay samples Buildings considered #3 sample average grade not verified - report

June 10, 1964

Douglas County Court
Court House
Roseburg, Oregon

Gentlemen:

I am in receipt of correspondence from Mr. E. E. Coleman, General Manager - Oregon, The Hanna Mining Company, Riddle, Oregon, in which he notes that Hanna leased land from Douglas County and that one of the provisions of the lease was that a determination be made as to whether or not any valuable mineral existed on these lands.

To this end Mr. J. T. Cumberlidge, geologist for Hanna Mining Company, prepared a map and a report of the geology and possible mineral potential of said land, a copy of which is attached. Also attached is a letter from our field geologist in charge of our Grants Pass office who accompanied Mr. Cumberlidge in the field in reviewing his work. You will note that it is his considered opinion that under present conditions there is nothing of economic interest in the area under consideration. I concur with our field geologist in this determination.

A copy of the lease form has been sent to me by Mr. Coleman and I would agree with the statement on the first page where it says that the leasing of this land would be in the public interest.

If this Department can be of any further assistance to you in this matter, please feel free to call upon us.

Sincerely yours,

Hollis M. Dole
State Geologist

HMD:jr
Encl.
cc E.E. Coleman
bc Len Ramp

Mr. Dole

The Hanna Mining Company

Riddle, Oregon

February 19, 1963

The Honorable Carl Back
House of Representatives
Oregon State Capitol Building
Salem, Oregon

Dear Mr. Back:

I would like to express my opposition to HB 1233 establishing a Department of Natural Resources. To me this bill, as written, would result in even higher governmental expenses than we are presently enduring, as well as providing a possible mammoth spoils system that could be exploited for maximum political influence by the party electing the Governor. This would not promote the best interests of the citizens of Oregon, regardless of what party might be in power.

Under the present law, the various departments, such as Agriculture, Forestry, Mineral Resources, etc., are administered by competent men, especially trained in their fields as provided by law. In most cases, they have held their positions for long periods of time and are thoroughly familiar with their departments and the problems involved therein.

HB 1233 would make all of these departments divisions of the Department of Natural Resources and the administrators of the various divisions would serve "at the pleasure of" the department head, who in turn would be appointed by and serve "at the pleasure of" the Governor. The bill states that director and division administrators must be "well qualified" but the qualifications are not spelled out. A very loose interpretation of qualifications could be made.

In the final analysis, all of these men would be, in essence, appointed by and could be removed by the Governor, at his pleasure.

RECEIVED
FEB 25 1963
STATE DEPT. OF GEOLOGY
& MINERAL INDS.

This places entirely too much power in the hands of one man. Oregon is essentially a natural resource state and these resources should continue to be administered by capable, well trained men, not subject to appointment or removal "at the pleasure of" any one man.

Very truly yours,

E. E. Coleman

E. E. Coleman
General Manager-Oregon

EEC/il

bcc: Ivan Congleton - Salem
James B. Corlett - Portland
Hollis M. Dole - Portland

Al Flegel - Salem
W. O. Kelsay - Salem
Sidney Leiken - Salem

Letters were mailed to:

Sen. John D. Hare
Sen. John J. Inskeep
Sen. Arthur P. Ireland
Sen. Don S. Willner
Sen. Alice Corbett
Rep. Carl Back
Rep. Kessler R. Cannon
Rep. Gerald W. Detering
Rep. Wm. H. Holmstrom
Rep. Ross Morgan
Rep. Robert F. Smith

December 20, 1962

Mr. Emmons E. Coleman, General Manager - Oregon
The Hanna Mining Company
P.O. Box 85
Riddle, Oregon

Dear Emmons:

I have just received from the Tax Commission a copy of a memorandum prepared by one of their staff attorneys in regard to taxation of severed mineral interests. This also contains suggestions on how the problem might be solved by the State of Oregon.

Although I do not have extra copies of this, I am sure that you can obtain the same by writing to the State Tax Commission, 412 State Office Building, Salem, Oregon (attention: Donald H. Burnett).

It would appear to me that this would have more than ordinary interest to your company.

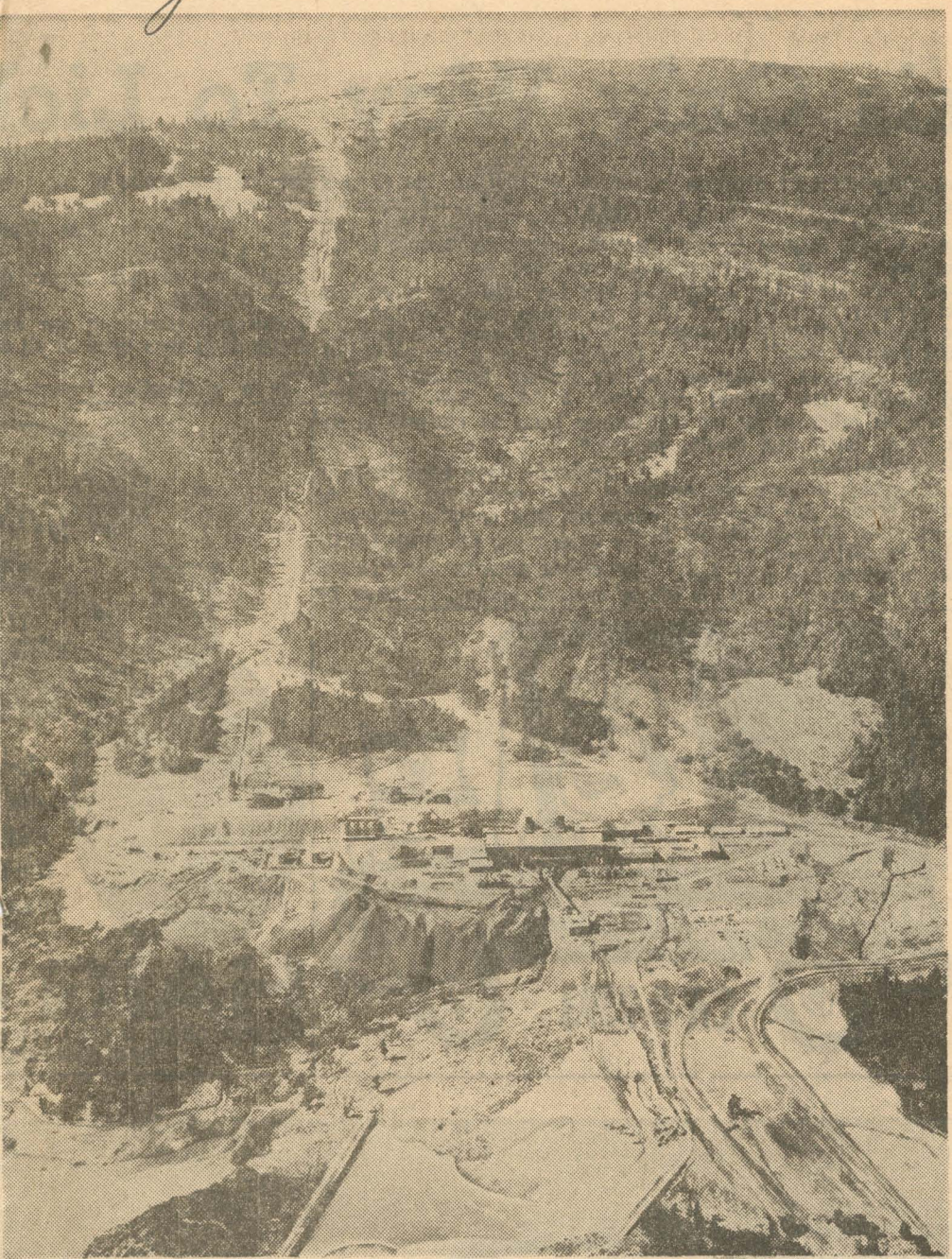
Best wishes for the Christmas season.

Sincerely yours,

Hollis M. Dole
Director

HMD:jr

Oregonian 4-26-61



HIGH GRADE ferronickel for production of stainless and other alloy steels comes from this Hanna Mining Co. mine at the top of Nickel Mountain near Riddle, in Douglas County. Nickel plant is in foreground and aerial tramway can be seen connecting two locations. Hanna has completed acquisition of site.

Hanna Adds New Line

Mine Company Reveals Plans

The Hanna Mining Co. has entered a new field, the commercial production of marketing of nickel, W. A. Marting, president, announced Tuesday. The company has completed acquisition of the smelter that processes ore from the nation's only large nickel deposit and has begun marketing high grade ferronickel for use in the production of stainless and other alloy steels.

Through a subsidiary, the Hanna Nickel Smelting Co., Hanna Mining has operated the plant at Riddle, in Douglas County, since it was opened in 1955. To date it has produced more than 100 million pounds of nickel, all of which has been for the account of the government to help build the defense materials inventory of the strategic material.

Marting said Tuesday the company's experience has shown that it can produce nickel of dependable high quality at a competitive price. He said the company has sales agreements with major alloy steel producers in the country.

Canadian Link Included

Hanna Mining for many years has been a supplier of raw material to the steel industry. It is among the largest independent producers of iron ore, with holdings in Minnesota, Michigan and Missouri and has a substantial interest in Iron Ore Co. of Canada, which can produce more than 12 million tons of ore annually from the Quebec-Labrador fields.

The firm also has interests in ore vessels in the Great Lakes trade, in the St. Lawrence Seaway and on saltwater.

The company will distribute the nickel to steel companies and foundries across the country from warehouse stocks in Chicago, Detroit, Pittsburgh and Riddle.

Total employment at the plant and mine in Riddle is 450. Crude ore, containing about 1.5 per cent nickel comes from a deposit held for many years by Hanna Mining. It is moved to the plant over a 1.5 mile aerial tramway.

ANALYSES OF WOODCOCK MOUNTAIN NICKEL-BEARING LATERITE SAMPLES

Thickness of sample (feet)	Percent Ni	Percent Cr_2O_3
(Hole 1)		
0 - 1	1.02	2.23
1 - 2	1.18	2.51
2 - 3	1.39	2.27
3 - 4	1.04	2.64
4 - 5	0.57	1.93
	1.04*	2.32*
(Hole 2)		
0 - 1	0.85	2.80
1 - 2	0.91	2.79
2 - 3	1.08	2.79
3 - 4	1.02	2.08
4 - 5	0.88	1.90
5 - 5'8"	0.88	1.65
	0.94*	2.33*
(Hole 3)		
0 - 1	0.82	2.18
1 - 2	0.80	1.99
2 - 3	1.08	2.54
3 - 4	0.79	1.62
4 - 5	0.65	1.11
5 - 6	0.72	1.04
6 - 6'3"	0.59	1.10
	0.78*	1.65*
(Hole 4)		
0 - 1	0.92	3.47
1 - 2	1.53	3.74
2 - 3	1.63	3.80
3 - 4	1.40	3.32
4 - 5	1.58	4.39
5 - 6	(sample lost)	
	1.41*	3.74*
(Hole 5)		
0 - 1	0.93	3.61
1 - 2	0.99	3.27
2 - 3	0.95	2.60
3 - 4	0.93	2.52
4 - 5	1.21	2.37
5 - 6	1.40	2.14
6 - 7	0.78	0.94
7 - 8	0.68	1.28
8 - 9	0.71	0.75
9 - 10	0.71	1.08
10 - 11	0.64	0.65
11 - 12	0.91	2.94
	0.90*	2.01*
(Hole 6)		
0 - 1	0.75	2.94
1 - 2	0.98	2.89
2 - 3	0.83	1.42
3 - 4	0.95	2.41
4 - 5	1.05	2.09
	0.91*	2.35*
(Hole 7)		
0 - 1	0.97	4.60
1 - 2	1.15	3.99
2 - 3	1.12	3.96
3 - 4	0.99	3.73
4 - 5	1.21	4.85
5 - 6	1.13	3.44
6 - 7	1.40	4.13
7 - 8'2"	1.66	4.30
	1.20*	4.12*

Thickness of sample (feet)	Percent Ni	Percent Cr_2O_3
(Hole 8)		
0 - 1	1.10	4.28
1 - 2	1.40	5.30
2 - 3	1.68	6.37
3 - 4	1.25	5.51
4 - 5	1.96	4.56
5 - 6	2.02	4.70
6 - 7	1.85	4.07
7 - 8	1.80	2.96
8 - 9	1.51	2.78
9 - 10	1.79	3.50
10 - 11	1.14	3.02
11 - 12	1.50	2.52
12 - 13	1.33	2.26
13 - 14	1.26	2.26
14 - 15'2"	1.02	1.69
	1.51*	3.72*
(Hole 9)		
0 - 1	0.58	1.87
1 - 2	0.62	1.08
2 - 3	0.67	0.86
3 - 4	0.64	0.62
4 - 5	0.65	0.85
	0.63*	1.06*
(Hole 10)		
0 - 1	0.85	2.62
1 - 2	0.82	3.22
2 - 3	0.93	1.81
3 - 4	0.84	1.59
4 - 5	0.88	1.27
5 - 6	0.69	1.33
6 - 7	0.61	1.15
7 - 8	0.90	1.08
8 - 9	0.80	1.02
9 - 10	0.71	1.01
	0.81*	1.61*
(Hole 11)		
0 - 1	0.46	1.56
1 - 2	0.59	1.84
2 - 3	0.57	2.03
3 - 4	0.61	1.91
4 - 5	0.75	1.89
5 - 6	0.73	1.33
6 - 7	0.60	0.82
7 - 8	0.61	0.73
8 - 9	0.67	0.68
9 - 10	0.52	0.58
10 - 10'6"	0.42	0.60
	0.59*	1.27*

*Arithmetical average.

Thickness of sample (feet)	Percent Ni	Percent Cr_2O_3
(Hole 12)		
0 - 1	0.29	1.76
1 - 2	0.31	1.89
2 - 3	0.36	2.00
3 - 4	0.47	2.14
4 - 5	0.50	2.06
5 - 6	0.35	2.12
6 - 7	0.38	1.79
7 - 8	0.43	2.04
8 - 9	0.47	1.94
9 - 10	0.59	1.84
10 - 11	0.80	2.19
11 - 12	0.95	1.66
12 - 13	0.99	1.72
13 - 14	1.00	1.59
14 - 15	0.88	1.46
15 - 16	0.79	0.98
	0.54*	1.82*
(Hole 13)		
0 - 1	0.74	2.40
1 - 2	0.92	2.56
2 - 3	1.17	2.78
3 - 4	1.30	2.66
4 - 5	1.36	1.55
5 - 6	1.41	0.88
6 - 7	1.15	0.88
7 - 8	0.98	0.57
8 - 8'6"	1.03	0.71
	1.12*	1.67*
(Hole 14)		
0 - 1	0.77	2.26
1 - 2	0.76	2.29
2 - 3	0.72	1.75
	0.75*	2.10*
(Hole 15)		
1 - 2	1.47	1.02
2 - 3	1.45	1.26
3 - 3'6"	1.32	0.86
	1.41*	1.05*
(Hole 16)		
0 - 1	0.66	2.68
1 - 2	0.75	2.86
2 - 3	0.92	2.99
3 - 4	1.14	3.26
4 - 5	1.12	3.23
5 - 6	1.07	2.92
6 - 7	0.97	2.56
7 - 8	1.18	2.45
8 - 9	1.097	2.08
9 - 10	1.207	1.82
10 - 11	1.36	1.26
11 - 12	1.49	1.90
12 - 13	1.63	1.93
13 - 14	1.43	1.17
14 - 15	1.43	1.10
15 - 15'6"	1.23	0.99
	1.16*	2.20*

ANALYSES of WOODCOCK MOUNTAIN Ni & Cr LATERITE SAMPLES

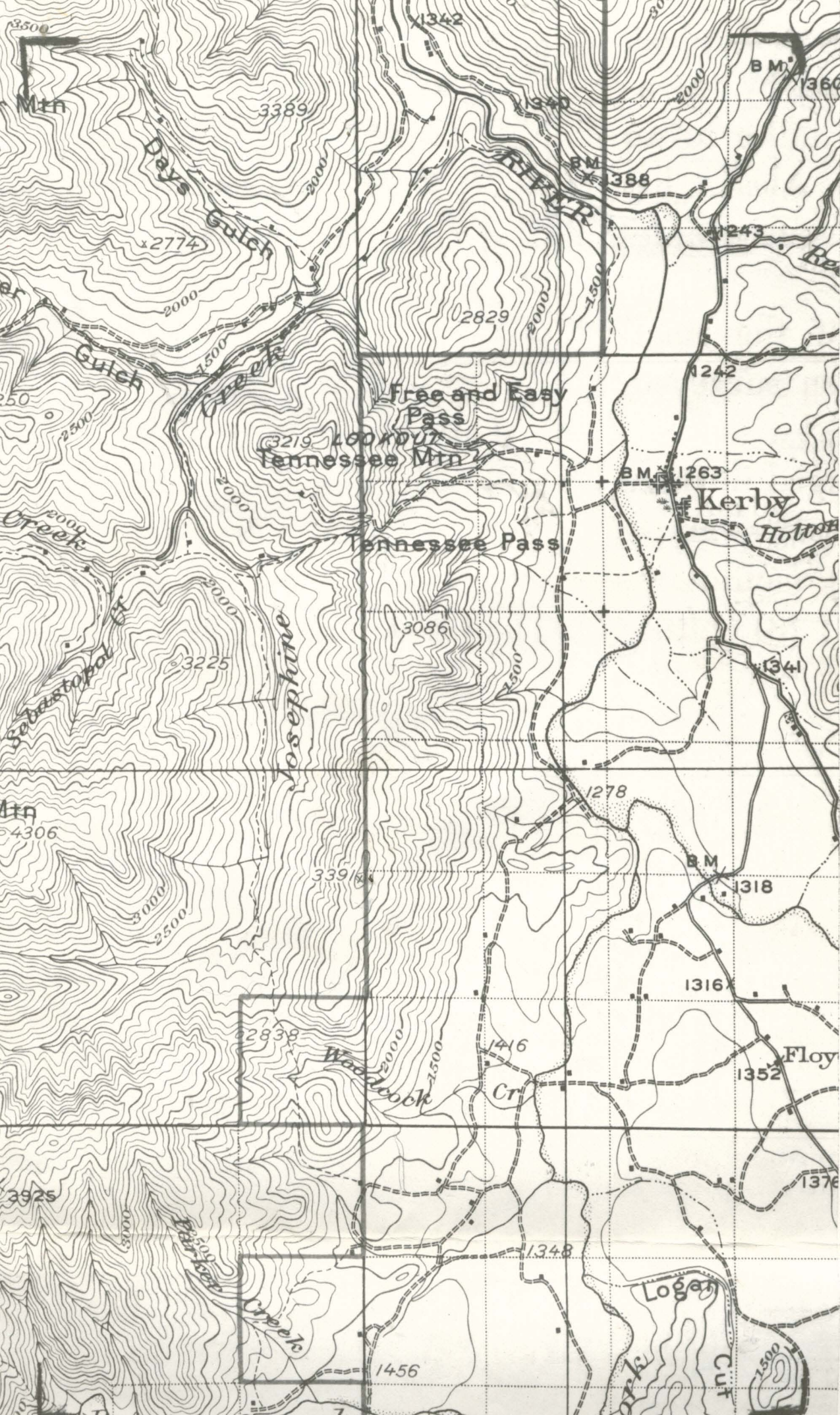
Date Sampled	Dept. LAB. No.	Auger Hole No.	Thickness of Sample (feet)	% Ni	% Cr_2O_3	Remarks
7/9/48	P-7425	1	0-1	1.02	2.23	
	P-7426		1-2	1.18	2.51	
	P-7427		2-3	1.39	2.27	
	P-7428		3-4	1.04	2.64	
	P-7429		4-5	0.57	1.93	
				1.04	2.32	Arithmetical average
7/9/48	P-7430	2	0-1	0.85	2.80	
	P-7431		1-2	0.91	2.79	
	P-7432		2-3	1.08	2.79	
	P-7433		3-4	1.02	2.08	
	P-7434		4-5	0.88	1.90	
	P-7435		5-5'8"	0.88	1.65	
				0.94	2.33	Arithmetical average
7/10/48	P-7436	3	0-1	0.82	2.18	
	P-7437		1-2	0.80	1.99	
	P-7438		2-3	1.08	2.54	
	P-7439		3-4	0.79	1.62	
	P-7440		4-5	0.65	1.11	
	P-7441		5-6	0.72	1.04	
	P-7442		6'-6'3"	0.59	1.10	
7/10/48		4		0.78	1.65	Arithmetical Average
7/10/48	P-7443	4	0-1	0.92	3.47	
	P-7444		1-2	1.53	3.74	Sample Bottle broken #20
	P-7445		2-3	1.63	3.80	
	P-7446		3-4	1.40	3.32	Sample Bottle broken #22
	P-7447		4-5	1.58	4.39	
	P-7448		5-6	—	—	Sample Bottle broken #24
				1.41	3.74	Arithmetical Average (5 samp
7/11/48	P-7449	5	0-1	0.93	3.61	
	P-7450		1-2	0.99	3.27	
	P-7451		2-3	0.95	2.60	
	P-7452		3-4	0.93	2.52	
	P-7453		4-5	1.21	2.37	
	P-7454		5-6	1.40	2.14	
	P-7455		6-7	0.78	0.94	
	P-7456		7-8	0.68	1.28	
	P-7457		8-9	0.71	0.75	

7/11/48	P-7458	5	9-10	0.71	1.08	
	P-7459		10-11	0.64	0.65	
	P-7460		11-12	0.91	2.94	
				0.90	2.01	Arithmetical Average
7/11/48	P-7461	6	0-1	0.75	2.94	
	P-7462		1-2	0.98	2.89	
	P-7463		2-3	0.83	1.42	
	P-7464		3-4	0.95	2.41	
	P-7465		4-5	1.05	2.09	
				0.91	2.35	Arithmetical Average
7/12/48	P-7466	7	0-1	0.97	4.60	
	P-7467		1-2	1.15	3.99	
	P-7468		2-3	1.12	3.96	
	P-7469		3-4	0.99	3.73	
	P-7470		4-5	1.21	4.85	
	P-7471		5-6	1.13	3.44	
	P-7472		6-7	1.40	4.13	
2nd column	P-7473		7-8'2"	1.66	4.30	
				1.20	4.12	Arithmetical Average
7/13/48	P-7474	8	0-1	1.10	4.28	
	P-7475		1-2	1.40	5.30	
	P-7476		2-3	1.68	6.37 X	
	P-7477		3-4	1.25	5.51	
	P-7478		4-5	1.96	4.56	
	P-7479		5-6	2.02	4.70	
	P-7480		6-7	1.85	4.07	
	P-7481		7-8	1.80	2.96	
	P-7482		8-9	1.51	2.78	
7/13/48	P-7483	8	9-10	1.79	3.50	
	P-7484		10-11	1.14	3.02	
	P-7485		11-12	1.50	2.52	
	P-7486		12-13	1.33	2.26	
	P-7487		13-14	1.26	2.26	
	P-7488		14-15'2"	1.02	1.69	
				1.51	3.72	Arithmetical Average
7/13/48	P-7489	9	0-1	0.58	1.87	
	P-7490		1-2	0.62	1.08	
	P-7491		2-3	0.67	0.86	
	P-7492		3-4	0.64	0.62	X
	P-7493		4-5	0.65	0.85	
				0.63	1.06	Arithmetical Average

				Ni	Cr_2O_3	
7/13/48	P-7494	10	0-1	0.85	2.62	
	P-7495		1-2	0.82	3.22	
	P-7496		2-3	0.93	1.81	
	P-7497		3-4	~~0.88~~ 0.84	1.59	
	P-7498		4-5	0.88	1.27	
	P-7499		5-6	0.69	1.33	
	P-7500		6-7	0.61	1.15	
	P-7501		7-8	0.90	1.08	
	P-7502		8-9	0.80	1.02	
	P-7503		9-10	0.71	1.01	
				0.81	1.61	Arithmetical Average
7/15/48	P-7504	11	0-1	0.46	1.56	
	P-7505		1-2	0.59	1.84	
	P-7506		2-3	0.57	2.03	
	P-7507		3-4	0.61	1.91	
	P-7508		4-5	0.75	1.89	
	P-7509		5-6	0.73	1.33	
	P-7510		6-7	0.60	0.82	
	P-7511		7-8	0.61	0.73	
	P-7512		8-9	0.67	0.68	
	P-7513		9-10	0.52	0.58	X
Col. 3 ?	P-7514		10-10'6"	0.42	0.60	
				0.59	1.27	Arithmetical Average
7/15/48	P-7515	12	0-1	0.29	1.76	X
	P-7516		1-2	0.31	1.89	
	P-7517		2-3	0.36	2.00	
	P-7518		3-4	0.47	2.14	
	P-7519		4-5	0.50	2.06	
	P-7520		5-6	0.35	2.12	
	P-7521		6-7	0.38	1.79	
	P-7522		7-8	0.43	2.04	
	P-7523		8-9	0.47	1.94	
	P-7524		9-10	0.59	1.84	
	P-7525		10-11	0.80	2.19	
	P-7526		11-12	0.95	1.66	
	P-7527		12-13	0.99	1.72	
	P-7528		13-14	1.00	1.59	
	P-7529		14-15	0.88	1.46	
	P-7530		15-16	0.79	0.98	
				0.69	1.82	Arithmetical Average

54

				Ni	Cr_2O_3	
7/15/48	P- 7531	13	0-1	0.74	2.40	
	P- 7532		1-2	0.92	2.56	
	P- 7533		2-3	1.17	2.78	
	P- 7534		3-4	1.30	2.66	
	P- 7535		4-5	1.36	1.55	
	P- 7536		5-6	1.41	0.88	
	P- 7537		6-7	1.15	0.88	
	P- 7538		7-8	0.98	0.57	
	P- 7539		8-8'6"	1.03	0.71	
				1.17	1.67	Arithmetical Average
7/15/48	P- 7540	14	0-1	0.77	2.26	
	7541		1-2	0.76	2.29	
	7542		2-3	0.72	1.75	
				0.75	2.10	Arithmetical Average
7/16/48	P- 7543	15	1-2	1.47	1.02	
	P- 7544		2-3	1.45	1.26	
	P- 7545		3-3'6"	1.32	0.86	
				1.41	1.05	Arithmetical Average
7/16/48	P- 7546	16	0-1	0.66	2.68	
	P- 7547		1-2	0.75	2.86	
	P- 7548		2-3	0.92	2.99	
	P- 7549		3-4	1.14	3.26	
	P- 7550		4-5	1.12	3.23	
	P- 7551		5-6	1.07	2.92	
	P- 7552		6-7	0.97	2.56	
	P- 7553		7-8	1.18	2.45	
	P- 7554		8-9	1.097	2.08	
	P- 7555		9-10	1.207	1.82	
	P- 7556		10-11	1.36	1.26	
	P- 7557		11-12	1.49	1.90	
	P- 7558		12-13	1.63	1.93	
	P- 7559		13-14	1.43	1.17	
	P- 7560		14-15	1.43	1.10	
	P- 7561		15-15'6"	1.23	0.99	
				1.16	2.20	Arithmetical Average



Mtn
3389
Days Gulch
2774
Gulch
Creek
2829
RIVER
1342
1340
BM
1388
1243
1242
Free and Easy Pass
3219
LOOKOUT
Tennessee Mtn
BM
1263
Kerby
Holton
Tennessee Pass
Creek
Sebastopol Cr
3225
Josephine
3086
1341
1278
Mtn
4306
3391
BM
1318
1316
2838
Woodcock
Cr
1416
Floy
1352
3925
Parker
Creek
1348
Logan
1456
Cut

BENCH MARKS NEAR CAVE JUNCTION

C 57 (O.S.H.D.) -- About 1.9 miles north along the Redwood Highway from Kerby, Josephine County, at the northwest corner of the highway bridge over Reeves Creek, in the concrete wing wall. An Oregon State Highway Department standard disk, stamped "C 57 1930." (377.013 meters or 1,236.917 feet.)

1263 (U.S.G.S.) -- At Kerby, Josephine County, on the west side of the Redwood Highway, 1 foot from the southeast corner of the Taff store building. A United States Geological Survey standard cap, stamped "1263 2 1915" and set in the footing of the foundation. (384.925 meters or 1,262.875 feet.)

E 57 (O.S.H.D.) -- About 0.4 mile south along the Redwood Highway from Kerby, Josephine County, at the northwest corner of the highway bridge over Holton Creek, in the concrete wing wall. An Oregon State Highway Department standard disk, stamped "E 57 1930." (385.878 meters or 1,266.001 feet.)

H 57 (O.S.H.D.) -- About 4.4 miles south along the Redwood Highway from Kerby, Josephine County, on a concrete highway culvert, in the south end of the east head wall. An Oregon State Highway Department standard disk, stamped "H 57 1930." (398.993 meters or 1,309.030 feet.)

J 57 (O.S.H.D.) -- About 5.6 miles south along the Redwood Highway from Kerby, Josephine County, on the highway bridge over the West Fork Illinois River, in the top of the northwest pier. An Oregon State Highway Department standard disk, stamped "J 57 1930." (402.690 meters or 1,321.159 feet.)

L. 57 (O.S.H.D.) -- About 7.8 miles south along the Redwood Highway from Kerby, Josephine County, at the northwest corner of the highway bridge over Rough and Ready Creek, in the top of the concrete wing wall. An Oregon State Highway Department standard disk, stamped "L 57 1930." (422.716 meters or 1,386.861 feet.)

M 57 (O.S.H.D.) -- About 9.5 miles south along the Redwood Highway from Kerby, Josephine County, about 0.4 mile north of the post office at O'Brien, on the concrete highway culvert over O'Brien Creek, in the top of the south end of the east head wall. An Oregon State Highway Department standard disk, stamped "M 57 1930." (429.316 meters or 1,408.514 feet.)

HOLE	% Ni	% Cr2O3	Depth	Why Abandoned
1	1.04	2.32	5 '	Hit rock
2	0.94	2.33	5' 8"	" "
3	0.78	1.65	6' 3"	" "
4	1.41	3.74	6'	" "
5	0.90	2.01	6'	" "
6	0.91	2.35	5'	" "
7	1.20	4.12	8' 2"	" "
8	1.51	3.72	15' 2"	" "
9	0.63	1.06	5'	" "
10	0.81	1.61		" "
11	0.59	1.27	10' 6"	" "
12	0.60	1.82	16'	" "
13	1.12	1.67	8' 6"	" "
14	0.75	2.10	3'	" "
15	1.41	1.05	3' 6"	" "
16	1.16	2.20	15' 6"	" "

17 —

WOODCOCK H1

1 2 3
43,560
15 DEPTH

217800
43560 | 38,435 TONS/ACRE/15 THICK

2
5 17 | 653,400 CU/FT/ACRE
51
143
136
74
68
60
51
90
85

4 2 1
38,435
25 ACRES

192175
76870

960,875 TONS IN AREA
50% DILUTION FOR ROCKS

480,437 TONS LATERITE SANS ROCKS 25 ACRES 15' THICK

~~38,435~~
960,875
76870

2 | 1,037,745

518,872 TONS 1% H1

AVERAGE ANALYSES

	HOLE	% Ni	% Cr2O3	Depth	Why Abandoned	
5.20	1	1.04	2.32	5'	Hit rock	5
5.32	2	0.94	2.33	5' 8"	" "	5.66
4.87	3	0.78	1.65	6' 3"	" "	6.25
8.46	4	1.41	3.74	6'	" "	6
5.40	5	0.90	2.01	6'	" "	6
4.55	6	0.91	2.35	5'	" "	5
9.81	7	1.20	4.12	8' 2"	" "	8.16
22.84	8	1.51	3.72	15' 2"	" "	15.16
3.15	9	0.63	1.06	5'	" "	
8.10	10	0.81	1.61	10	" "	
6.43	11	0.59	1.27	10' 6"	" "	10.5
9.60	12	0.60	1.82	16'	" "	
9.52	13	1.12	1.67	8' 6"	" "	8.5
2.25	14	0.75	2.10	3'	" "	
4.93	15	1.41	1.05	3' 6"	" "	3.5
17.98	16	1.16	2.20	15' 6"	" "	15.5

128.41

.993 % Ni W1 Ar Am Hole

129.25) 128.410
116325
120850
116325
45250

STATE DEPARTMENT OF GEOLOGY & MINERAL INDUSTRIES
Head Office: 702 Woodlark Bldg., Portland 5, Oregon

Field Offices:
2033 First Street, Baker, Oregon
714 East "H" Street, Grants Pass, Oregon

WELL LOG
Date _____ 19____ Number _____

Recorded by MASON Source _____

County DOUGLAS Area _____

Quadrangle RIDDLE ____ ¼ ____ ¼ sec. ____ T ____ N/S., R ____ E/W.

HOLE NO 1
(Drilling Company and Address)

Method of Drilling HAND AUGER 3"ØZ" Date 8-20 19 47

NICKEL MTN - FLAT 1000' E HOLE 47 250' N OF CU
(Property Owner and Address) AT END OF ROAD

Land surface, datum _____ ft. above / below ELEV 3525

Material	Thickness (feet)	Depth (feet)	Remarks
RED BROWN SOIL	6"	6"-1'	ROCK FRAGMENTS
" " "	1'	1'-2'	" "
GARNIERITE CHIPS YELLOW-BROWN	1'	2'-3'	" "
MORE GARNIERITE BOXWORK QTZ.	1'	3'-4'	" "
SERPENTINE - PERIDOTITE YELLOW-BROWN - FINE QTZ CHIPS	1'	4'-5'	" "
SERP - PERID QTZ. LIMONITE - BOXWORK	1'	5'-6'	" "
LITTLE CHANGE	1'	6'-7'	" "
YELLOW LIMONITE BOXWORK QTZ - OLIVINE	1'	7'-8'	" "
HOLE BOTTOMED AT 8'			

NL 24-D

NL-28

STATE DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

702 WOODLARK BUILDING
PORTLAND 5, OREGON

June 3, 1949

mple submitted by R. S. Mason

mple received on May 23, 1949

alysis requested Silica, Iron, Magnesia

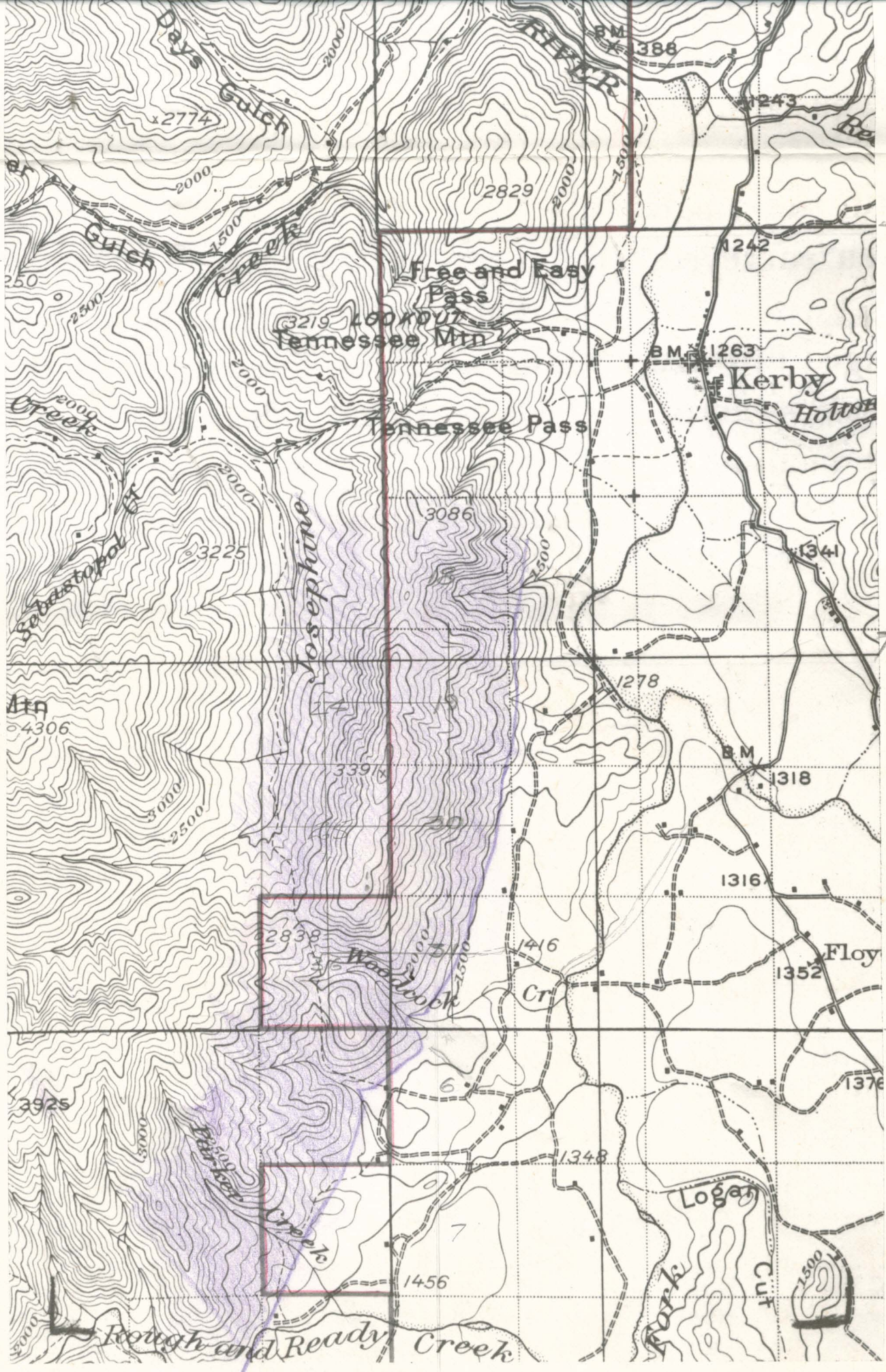
Analysis by:

L. L. Hoagland
Assayer

ab. No.	Sample Marked	Results of Analysis		Remarks
P-8586	Composite P-7494 - 7503 Hole #10 0 - 10 feet	Silica (SiO_2)	32.5 %	- - - - - - - - - - - - -
		Iron (Fe)	19.46%	
		Magnesia (MgO)	14.66%	
		Calcium (CaO)	1.13%	
* * *	* * * * *	* * * * * * * * * * * * *		* * * * * * * * * * * * * *

WOODCOCK #1

The Department did not participate in the taking of this sample and assumes responsibility only for the analytical results.


Days Gulch
Creek
Gulch
Creek
Creek
Sebastopol Ct
Josephine
Mtn
4306
3925
Free and Easy Pass
Tennessee Mtn
Tennessee Pass
Kerby
Holton
Floy
Logan
Woodbock
Cr
Fairbanks Creek
Rough and Ready Creek
Fork
Cut
BM 1263
BM 1318
BM 1388
1242
1243
1341
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1316
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1456
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2838
2829
3086
3225
3219
2774
T39S
R9W
R8W

MONTANA NATIONAL FINANCE INC.
PHONE: (406) 586-1372 FAX (406) 586-9776

DATE: 2-09-89

TO: Alan Young

COMPANY: Sunshine Mines

FROM: Thomas H. Langel

SUBJECT: Alan,

E:

Brian Marler
USA Investment & Mortgage Co.
1005 Durston
Bozeman, MT
59715

309 W. Mendenhall
Bozeman, MT
59715

Please reveiw the following information. Give me a call with any questions that you may have. I am sure that we can quickly answer them all now.

RIDDLE, OREGON
NICKEL MINE & SMELTER

Opportunity & Overview

Several large mineral facilities closed in the last few years during a low price cycle. Many of these properties have been purchased by entrepreneurial groups and put back into operation, taking advantage of current positive price cycles. Several have been spectacularly successful. Those that have, purchased hundreds of millions of dollars of infrastructure at pennies on the dollar and the market price of their product soared. This list includes the White Pine Copper Mine in Michigan, the Anaconda Mine in Butte, Montana, and the Anaconda Moly Mine in Tonapah, Nevada. The Hanna Nickel Mine & Smelter in Riddle, Oregon, falls into this same category.

The Hanna Nickel Mine and Smelter presents a tremendous opportunity. The plant and facility can be acquired at 5% of replacement cost. A worldwide nickel shortage has tripled nickel prices since the plant was closed down. Strong nickel prices are projected to continue for at least the next two years. The plant can be put back into operation within 150 days to quickly take advantage of the price window. The plant and infrastructure could not be replaced for $300 million and can be acquired for under $10 million.

With an investment of $4 million, the property can be started on a Phase 1 basis and could well return over $30 million of net profit in the next year.

FEB 9 '89 16:00 406 586 1372 PAGE.002

SUMMARY OF ESTIMATES FOR NICKEL MINE

At current prices of more than $7.00 per pound, a dramatic economic opportunity seems to exist for venturers to reactivate the Riddle smelter. USA Investments has indications that customers are willing to option the production in exchange for assured availability. In order to utilize the current economic environment, the least time consuming renovation of remaining Riddle equipment would enable production from the ore stockpiled adjacent to the smelter during its 30 years of production. A modification of the kilns to permit drying as well as calcination would eliminate the immediate need to set up the dryers. The reject stockpiles would not upgrade appreciably anyway. If modest venture capital was available to organize an exploitation team, engineer the modifications and prearrange procurement; the production might commence as early as two months after satisfactory financing. The foregoing describes Phase 1 of a four phase program each of which stand alone. Market conditions would dictate whether the venturers would wish to proceed to the succeeding phase.

Over five million tons of ore have been stockpiled at the smelter site over the years of operation. This ore has a grade of .85% nickel, which, after process loss, would yield 14 pounds of nickel per ton. Approximately 2,400 tons per day could be smelted, yielding over one million pounds of nickel per month.

The smelter facility was closed in 1986 and partially salvaged. Because of this, certain reacquisitions of equipment and reconstruction is necessary, as outlined hereafter.

Description	Capital (million$)	Cum. Capital (million$)	Monthly Production Pounds Ni.	Product Cost per Pound	Startup Period
Phase 1 Modify rotary kiln with lifters & reline 2 furnaces & stock skulls	1.82	1.82	425,000	$4.09	2 mo.
Phase 2 Modify other kiln reline other 2 furnaces and stock skulls	1.56	3.38	850,000	$4.00	1 mo.

FEB 9 '89 16:01 406 586 1372 PAGE.003

OPERATING COST ESTIMATE

Cost estimate for two (2) furnaces using stockpile to produce 6,000,000 pounds of Nickel per year (1984 cost basis).

	$1,000/yr
FeSi 3208 x $\frac{6}{17.6}$	1,094
Reclaim 414,000 tons x $1.5/ton	621
Calcining (9710 + 3833) .5	6,772
Smelting (14,465 - 3208 FeSi - 4418 Power) .5	3,420
Power $\frac{4418}{2}$ x $\frac{27}{7}$ = (27 mills)	8,520
Skulls	300
Refining 1526 x $\frac{6}{17.6}$	520
Product Handling 233 x $\frac{6}{17.6}$	80
O & A Supply	988
Taxes	750
TOTAL	$23,065

Without skull plant @ 425,000 lb/ni/yr:

Phase 1 $\frac{20,856 \text{ cost}}{5,100 \text{ lbs/ni/yr}}$ = $4.09 lb/ni cost

Phase 2 850,000 lb/ni/yr = $4.00 lb/ni cost
(cost spread a little better)

With skull plant:

Phase 3 $\frac{20,856}{6,000}$ = 3.40/lb. Ni. @ 20 Mill Power

Phase 4 $\frac{40,047 \text{ cost}}{18,850 \text{ lbs/ni/yr}}$ = $2.22 lb/ni cost

$\frac{23,065}{6,000}$ 3.84/lb. Ni. @ 27 Mill Power

Each Mill increases cost per pound of nickel by $0.05
There are two years remaining on a seven (7) Mill Power contract operating 13 hours per day - off peak.

Phase3 Reactivate skull plant	0.06	3.98	1,000,000	$3.40	2 mo.
Phase 4 Contract Mining, replace mine screens and set up used dryers (see main data pkg)	2.73	6.71	1,500,000	$2.22	4 mo.

HDW 2-7-89

STARTUP CAPITAL PAYBACK AND NET PROFIT PER MONTH AFTER PAYBACK

Phase 1

425,000 lb.Ni x $2.80(profit)/lb = $1.19 million/month

1.82 (capital investment) = 1.53 mo. to recover capital then
1.23 (profit) Profits = $1.19 million/month

Phase 2

425,000 lb. Ni added x $2.90 (profit)/lb. = $1.23 million/month

1.56 (cap.inv.) = 1.26 months to recover capital then
1.23 (profit) Profits = 850,000 Ni x $2.90 profit = $2.46 million/month

Phase 3

150,000 lb. Ni added x $3.50/lb = $0.525 million/month

0.600 (cap.inv.) = 1.14 months to recover capital then
0.525 (profit) Profits = 1,000,000 Ni x $3.50 profit = $3.5 million/month

Phase 4

500,000 lb. Ni added x $4.63/lb = $2.34 million/month

2.73(cap.inv.) = 1.17 months to recover capital then
2.34 (profit) Profits = 1,500,000 Ni x $4.68 profit =
$7.00 million/month

HDW 2-5-89

Costs for lease or acquisition assumptions of the property and kilns remain open but refurbishing costs can be economically evaluated as follows:

Universal Equipment owns the smelter and all infrastructure except the rotary kilns. Vancouver Energy purchased the kilns last summer. It is believed that Universal will accept a lease purchase offer that would require $500,000 to $1,000,000 front payment - monthly payments of $250,000 per month for 12 months and a purchase option price of $4-$6,000,000. All lease payments would be credited to the purchase price.

The rotary kilns can be purchased for $1-$2,000,000 on a lease basis with $250,000 to $500,000 up front - monthly lease payments and a buy-out at the end of a year.

Funds per month for capital based on nickel sales at $7.00 and an allowance of $0.10 for freight and commissions, a minimum of one month operation at reduced production would be required for crew training assuming 25% of experienced employees from the area can be rehired.

PROCESS & REBUILD DESCRIPTION

Phase 1

This phase consists of starting one rotary kiln and two smelting furnaces and acquiring and reactivating all other components in order to cast ferronickel ingots ready for market.

A 988 front-end loader and truck will be acquired to move ore from the stockpile to a feedbin in front of the rotary kiln. The feedbin must be constructed. The feedbin will feed the ore onto existing conveyer belts that feed the rotary kiln. The rotary kiln must be activated to combine the function of a dryer and a calciner. This is done by adding lifters in the first 100 feet of the 250 foot kiln. The lifters cause the ore to have better exposure to the hot air stream to remove the natural moisture then the other 150 feet of the kiln calcines the ore to remove the chemically bound moisture. The kiln must be relined with refractory. From the calciner, the ore is hoisted to holding bins at the top of the smelter and from there, feed almost continuously into the electric ore smelting furnaces. the furnace shells are 22 feet in diameter and constructed from 1.5 steel plate panels. Some of the panels must be replaced and the four shells must be relined with refractory (brick).

Once the ore is melted in the four furnaces, it is poured into large 18 by 10 foot reaction ladles. These ladles must be acquired along with several smaller slag ladles. These ladles ride on ladle cars and these cars must be fabricated. Ferro-silicon, which is produced in a fifth furnace, is added to the molten nickel ore in the reaction ladles and the molten ore is poured from one ladle to another to cause the reduction of the nickel leaving the slag on top. The slag is poured off into slag ladles and then poured into a granulator and sent to the slag pile by conveyer belt. The nickel is sent to two refining furnaces and then poured into molds and formed as ingots to be shipped to market.

Phase 2

Phase 2 parallels Phase 1 in process and requires installing lifters & relining in the second kiln and repairing the other two furnace shells and relining the furnaces.

Phase 3

This Phase requires reconstruction of the skull plant. This facility was salvaged and must be rebuilt. It is used to extract the nickel from the "skulls" that are formed in the various reaction, slag, and refining ladles, as nickel rich material cools and adheres to the surface of the ladles. This material is chipped out and processed at the skull plant which consists of a hammermill, a ball mill, magnetic separator, a screen and conveyers.

Phase 4

Phase 4 puts the mine back into operation and replaces the ore drying circuit along with crushing and screening. The benefit is creating a 1.3% nickel feed grade to the smelter instead of .85% from the reject ore stockpile.

The raw ore grade at the mine starts at an average of .85% to material containing the lower grade. Strip ratio would average 0.5 to 1.0 and then 10% of the ore mined is rejected in the pit. A set of wobbler bars set at 5.5" to 3.5" spacing rejects another 20% of the lower grade ore at the mine. The wobbler bars, a jaw crusher and reject conveying system needs to be reinstalled.

A contract miner would be brought in for the mining operations. The tram is still intact down the mountain but would have to be purchased at around $300,000. At the tram bottom, ore stockpile conveying equipment and pan feeders would have to be reinstalled to connect the tram with the dryers.

The ore is very wet with 18% to 24% moisture content. It has to be dried to 6% in order to screen it and crush to upgrade further. The dryers are 10 foot by 100 foot rotary kilns, fired by gas or hog fuel. Three dryers need to be reinstalled. Also, the screen and crusher need to be reinstalled. From this point on, the process circuit is intact from Phase 1 & 2.

RESTART CAPITAL COSTS

	ITEM	MATERIAL & LABOR	MANPOWER men/shift		COMPLETION TIME (wks)
1.	Ore feed to calciner				
	frontend loader 988	100,000			
	70 - ton truck	30,000			
	Hopper feeder	60,000	2	1	2
2.	Rotary Kiln (2)				
	Install lifters and reline				
	Lifters	50,000	8	1	2
	Lining	140,000	12	2	2
	Electric Controls	26,400			
3.	Smelter feed cars	10,000			
4.	Smelter furnaces				
	Repair and reline				
	install starter electrodes	45,000	3	1	2
	Repair furnace shell & pour lips	260,000	16	3	2
	Refractory lining	416,000	12	3	2
	Catwalks & hoods	70,000	8	1	2
	Deskuller (2)	60,000			
	Electrode cables	268,000	8	1	2
5.	Ladles				
	Slag pots (6) used	120,000			
	Ladles (20) used	550,000			
	Ladle refractory	used kilnbrick	contract		
6.	Slag cars (2)	60,000			
	Reaction Ladle cars	90,000			
7.	Water-cooled mandrills	72,000			
8.	Slag conveyer	100,000			
	Skull truck	30,000			
	Skull Plant	600,000			

Total for 1 kiln and 2 furnaces = $1.82 million Phase 1

Total for 2 kiln and 4 furnaces = $3.38 million Phase 2

Skull plant equipment = $600,000 Phase 3

Mine & dryer circuit(main rpt) = $2.73 million Phase 4

TO: BRIAN MARLER

FROM: H.D. WEDGE

SUBJECT: ESTIMATE OF PRODUCTION FROM REJECT ORE USING KILNS MODIFIED WITH LIFTERS
ONE KILN AND TWO FURNACES - PHASE ONE
DOUBLE FOR PHASE TWO

Traditional kiln feed was 60 tons per hour of 5/16" ore @ 7% moisture and 10% LOI to produce a product at 2% LOI

60 tons x .07 H_2O = 4.2 tons H_2O eliminated
Energy equivalent 4.2 x 200 = 840
60 tons x .08 LOI =4.8 tons LOI eliminated
Energy equivalent 4.8 x 1000 = 4800 + 840 = 5640

Reject kiln feed scalped to 1" and feed directly to a kiln modified with lifters in the first 100' of the 250' long 9" diameter kiln.

Reject .8 x 4 = 3.2
.2 x 12 = 2.4

5.6% average moisture

60 tons x .056 H_2O = 3.4 tons H_2O eliminated
Energy equivalent 3.4 x 200 = 680
60 tons x .08 = 4.8 tons LOI
Energy equivalent 4.8 x 1000 = 4800 + 680 = 5480
$\frac{5640}{5480}$ x 60 tons = 61.8 tons kiln capacity for undryed reject

However, the two furnaces carrying a 46 kwh load @ 800 kwh/ton requires 58 tons of molten ore/hour. 58 tons/.92 = 63 tons needed to calcine.

Assume 300 ton rooster surge filled during 4 hours/day furnace delay.

4 x 61.8 tons = 247/24 = 10.3 tons available to supplement deficiency in kiln rate of 1.2 tons/hour.

REJECT PROGRAM

Reject @ 0.85% NI FED DIRECTLY TO KILN
@ .08 LOI = 0.924% Ni in M.O. - .2 in slag nets
0.724% Ni/ton of M.O. produced.

$$\frac{58 \text{ tons}}{\text{hour}} \text{ M.O. x .85} \frac{}{} \text{ time x } \frac{24 \text{ hours}}{\text{day}} \text{ x } \frac{350 \text{ days}}{\text{year}}$$

$$\frac{414120 \text{ tons}}{\text{year}} \text{ M.O. x } \frac{14.48 \text{ lbs. Ni}}{\text{ton M.O.}} = 5{,}996{,}458$$

Say 6 million lbs./year without mine screening tram or drying cost.

STAFFING

WAGE

Smelter Crew 17 per shift x 4 shifts	136
Yard Crew	4
Millwright	10
Electricians	6
Brick layers	2
Mechanics	2
Fabrication	1
Shift Bosses	4

*Wage rate $20/hr. including taxes & benefits

TOTAL COST PER MONTH: $792,000

SALARY		**YEARLY**
General Manager	1	65,000
Lab Technician	1	40,000
Safety	1	40,000
Personnel	1	40,000
Clerical & Administrative	3	75,000
Maintenance Foreman	1	40,000
Engineer	1	45,000
Marketing	1	45,000
Purchasing & Warehouse	1	35,000

TOTAL COST PER MONTH: $35,417

TOTAL MONTHLY STAFF & LABOR: $827,417

INTEROFFICE MEMORANDUM

DATE: December 27, 1988

TO: Robert H. Peterson

FROM: Allan R. Young ARY

RE: Oregon Nickel Property Douglas County

I spoke with Mr. Tom Langel on 12/20/88 regarding his option on a previously producing nickel mine in the Cabinet Mountains near Riddle, Oregon. This is the property which was operated by Hanna since the late 1940's and was the only significant nickel producer in the U.S. A processing plant and smelter exists at the site but would require some $8 million of rehabilitation work before start-up. Permits are still apparently valid.

I asked Mr. Langel to send a data package on this property to which he has not as yet responded. When the mine shut down in 1986, it was my understanding that it was considered "mined out," although at today's nickel prices Mr. Langel states that it has several years of reserves remaining. His estimate of cash flow is based on Hanna's operating costs prior to shutdown. It is quite probable, however, that the stripping ratio for a reactivated pit would be much higher since, during the final year of operation, waste mining was undoubtedly minimized.

Apparently the option which Mr. Langel has on this property has an extremely "short fuse." He reportedly must come up with the $7 million option in the next few weeks and suggests a $500,000 refundable payment now followed by a 10-day "due diligence."

If we had someone in the organization with intimate knowledge of this property, it may be worth pursuing. After all, nickel is now selling at almost three times what it was when the mine shut down. However, it would not be prudent for Sunshine, or any other company for that matter, to put down $7 million under the above time constraints. The apparent lack of any organized data package further supports this caution. Indeed, it is quite likely that, given Mr. Langel's handling of this matter to date, the property may again become available directly from the owners in the next month or two. In the meantime, it may be advisable for Sunshine to give some thought to whether we want to enter into the nickel business.

My recommendation is that we inform Mr. Langel that we are presently not interested in his proposal. Please advise.

ARY:rs

STATE DEPARTMENT OF GEOLOGY & MINERAL INDUSTRIES

Nickel Mountain
Project

Hole No. 1 Location Riddle Quadrangle Flat 1000' E. hole 47 250' N. of cut at end of road.

north ½ of sec. 17 T. 30S R. 6W County Douglas

Coord. N. E.

Elev. collar 3525

Depth to top of bed 2' ?

Elev. of top of bed

Thickness of bed

Elev. bottom bed

Depth of hole 8' - 0"

Elev. water table

Bottomed in Limonite Box Work

****

Drill used 2"-3" hand auger

Number men 3

Engr. in charge Libbey

Mtrl. classfd. by Dole

Sampler Mason

Date hole began 8-20-47

Date hole finished 8-20-47

Shifts actually drilled ½

From	To	Thickness of sample	Sample No.	Description
6"	1' - 0"		P6544	Red Brown Soil Rock Fragments
1' - 0"	2' - 0"		P6545	Red Brown Soil Rock Fragments
2' - 0"	3' - 0"		P6546	Garnierite Chips, Yellow-Brown Rock Fragments
3' - 0"	4' - 0"		P6547	More Garnierite, Box Work. Qtz Rock Fragments
4' - 0"	5' - 0"		P6548	Serpentine - Peridotite, Yellow-Brown - Fine Qtz Chips
5' - 0"	6' - 0"		P6549	Serp. - Perid. - Qtz Limonite-Box Work, Rock Fragments
6' - 0"	7' - 0"		P6550	Little Change Rock Fragments
7' - 0"	8' - 0"		P6551	Yellow Limonite Box Work Qtz - Olivine, Rock Fragments

Remarks Hole abandoned when hard rock encountered.

WL-24b

Hole No. 1

STATE DEPARTMENT OF GEOLOGY & MINERAL INDUSTRIES

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north ½ of sec. 17 T. 30S R. 6W County Douglas

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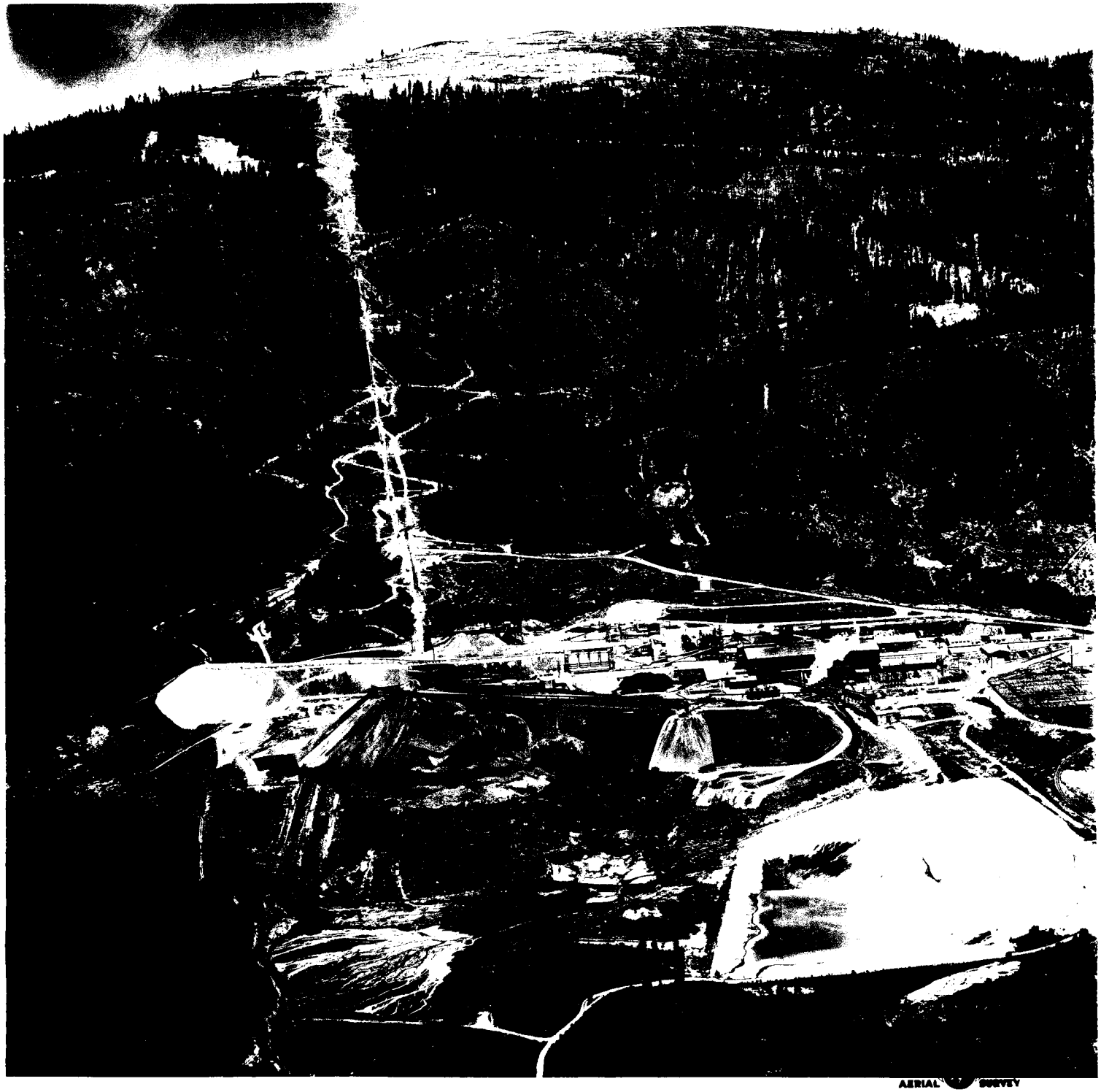
Remarks Hole abandoned when hard rock encountered.


AERIAL SURVEY

RIDDLE NICKEL DEPOSIT

By

W. A. Foster*

This paper is to be presented at the Northwest Regional Conference of the American Institute of Mining, Metallurgical and Petroleum Engineers, Portland, Oregon, April 11-13, 1957.
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* Geologist, Hanna Coal & Ore Corporation,
Riddle, Oregon

RIDDLE NICKEL DEPOSIT

The Riddle nickel deposit is located in southwestern Douglas County in Oregon, four miles west of the town of Riddle, which is inland from the Pacific coast approximately fifty miles and north of the California border about seventy miles. The deposit was discovered in 1864. Since then much prospecting and preliminary development work has been done on the property, but no ore was shipped for other than metallurgical tests until Hanna Coal & Ore Corporation started mining operations in 1954.

The ore mineral is largely garnierite. It occurs as a lateritic concentration in an intricate meshwork of iron- and nickel-stained chalcedony boxwork in sheared and weathered peridotite. In its fresh state the peridotite contains about .2% nickel. The major axis of the ore body strikes northeast and exploration so far has shown it to be roughly 6000 feet long and 3000 feet wide. The concentration ranges in thickness from a few feet to a maximum of 250 feet. It consists of three general layers; a top, brick-red soil layer, an intermediate thick, yellow, limonitic layer with some quartz-garnierite boxwork, and a root layer composed of quartz-garnierite boxwork in nearly fresh bedrock that is a transition between weathered material and fresh peridotite.

The favorable condition of shearing and fracturing of nickel Mountain peridotite made possible the formation of the quartz boxwork and garnierite. The nickel is believed to have been derived from olivine in the peridotite by decomposition during lateritic weathering which probably took place in late Tertiary time prior to uplift and canyon cutting. The Nickel Mountain deposit is an erosional remnant that escaped destruction, and under present climatic conditions, the original laterite has been altered resulting in quartz boxwork and nickel-rich garnierite.

Exploration of the deposit is being accomplished by churn drilling and trenching. A few test shafts were put down for the purposes of studying the ore in place, determining volume and moisture factors, and gathering bulk

samples for pilot plant and smelter tests. In churn drilling, 6-inch casing is driven down every two or three feet behind the drill bit and bottomed at each 5-foot interval. All the sludge for each cased 5-foot interval is dumped through a splitter and one-eighth is saved and analyzed. Churn drill holes are stopped after going through the ore zone and penetrating fresh peridotite in which the nickel content is less than .5%.

For estimative purposes we have used conservative factors as follows:

Cubic feet per short ton in place - 17

Moisture - 21%

Grade - 1.5% Ni.

Mining of the ore is done by open pit methods, utilizing 2-1/2-cubic-yard diesel shovels and 22-ton diesel trucks. The mining plan being developed at the property consists of a series of level benches, with a twenty-foot maximum height and a fifty-foot minimum width. Each bench is intersected at several points by access roads, for moving the ore from the benches to the crushing and screening plant. The mining operation can be divided into three phases, (1) mining and hauling, (2) crushing and screening, and (3) shipping.

The ore is dug from the face of a twenty-foot bench by a 2-1/2-yard-shovel and loaded into 22-ton trucks. The ore is hauled from the benches to a stockpile area in front of the screening plant. The truck loads average about 17 tons and using one shovel it is possible to handle 2500 tons per shift. Because of the fractured state of the ore in place, practically no blasting is necessary.

In the second phase of the operation the ore is screened and crushed and deposited by conveyor belt into a conical shaped surge pile of 25,000-ton capacity to await shipment. The ore is pushed by bulldozer into a hopper which feeds a 54-inch wobbler feeder. This feeder consists of thirteen rotating

eliptical manganese bars spaced at 5 inches. Over the length of the feeder, the minus 5-inch portion of the ore passes between the wobblers and into a bin from which it is fed by a 42-inch apron feeder onto the 30-inch belt going to the surge pile. The plus 5-inch portion of the ore is carried over the length of the wobbler feeder by its rotating action, and passes down a chute into a 30 x 42 jaw crusher set at 5 inches. The crusher product can either be placed on top of the wobbler undersize on the 30-inch belt to the surge pile, or on the 24-inch conveyor belt going to the reject pile. The decision to waste or save the crusher product is made by the engineering staff. The ore on the belt from the plant to the surge pile is sampled at regular intervals as a part of the grade control procedure.

Transporting the ore from the surge pile on the mountain to the smelter stockpile at the foot of the mountain is accomplished by means of a continuous aerial tramway. In a concrete tunnel under the surge pile, the ore is fed by an apron feeder onto a 30-inch conveyor belt which deposits the crushed material in a 100-ton bin where it is stored before being loaded in the tram cars. The ore is weighed and sampled on the 30-inch belt between the surge pile and the storage bin. A 42-inch apron feeder, electrically controlled, places a measured quantity of ore from the bin, into the loader, the door of which is tripped by the moving cars. Once in the car, the ore travels a distance of 8,306 feet, and drops 2,000 feet in elevation before being deposited at the smelter stockpile. The 50-cubic-foot capacity cars each carry approximately 2-1/2 tons of ore down the mountain at a speed of 500 feet per minute. The cars, spaced 260 feet apart by a two-inch connecting cable, travel loaded on 2-inch track cables and return inverted and empty on 1-1/2-inch track cables. The tramway is held to constant speed by two 300-horsepower induction generators, which when the tram cars are fully loaded, generate 500 horsepower in the form of 375 Kilowatts of electricity being returned to the power source. Two 30-horsepower electric motors are utilized in the starting of the tramway to overcome inertia and friction in the

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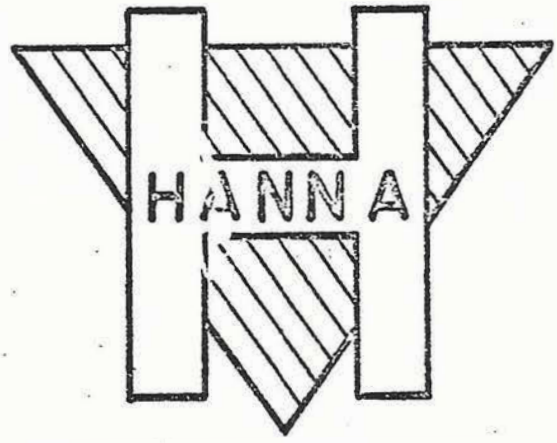
PAMPHLET FILE

THE HANNA NICKEL OPERATION



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THE HANNA MINING COMPANY

HANNA NICKEL SMELTING COMPANY

RIDDLE, OREGON

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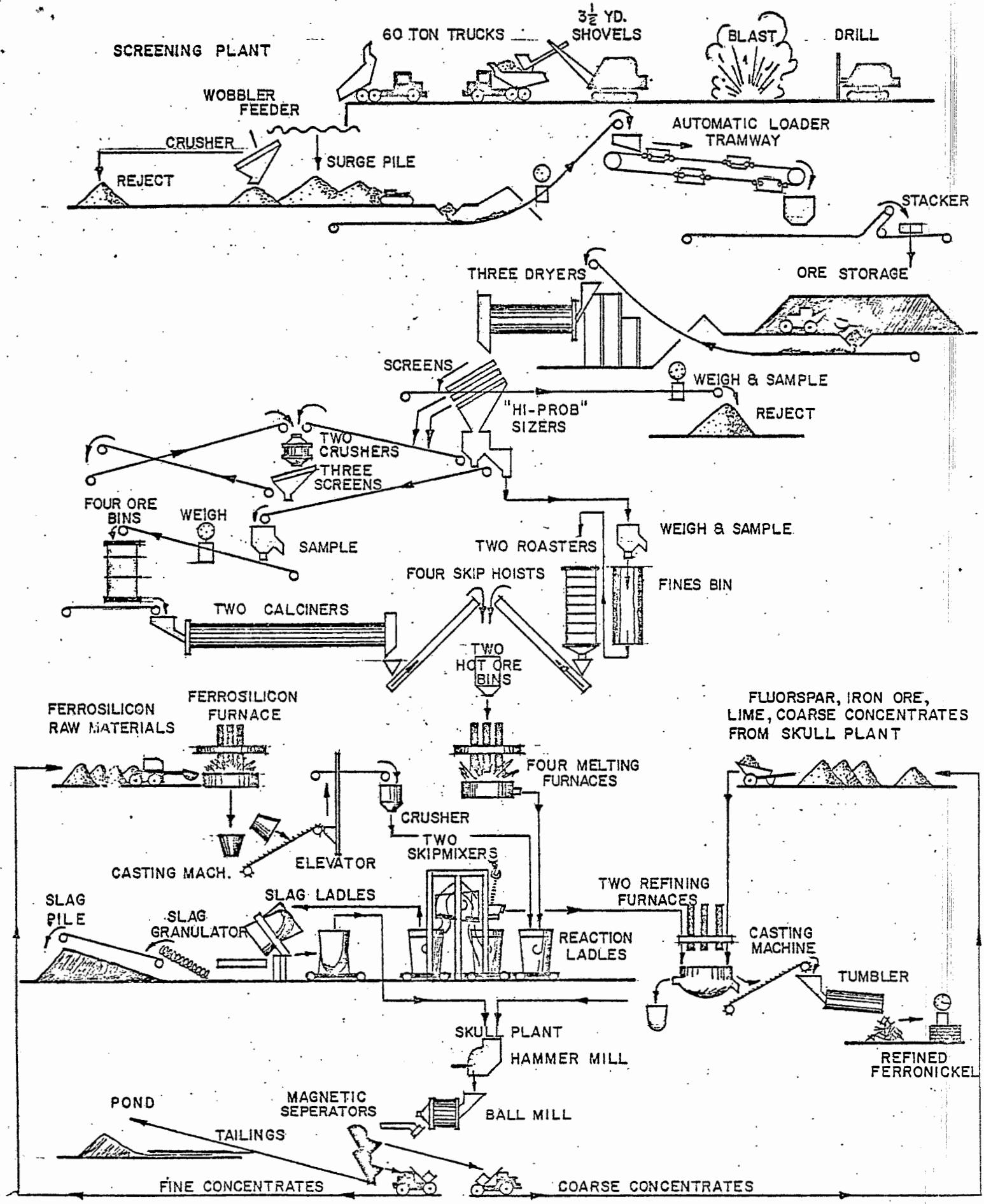


FLOW DIAGRAM

THE HANNA MINING COMPANY

HANNA NICKEL SMELTING COMPANY

THE HANNA NICKEL OPERATION

Nickel Mountain is located in southwestern Douglas County, Oregon, four miles west of the town of Riddle. The deposit was discovered in 1864 by local settlers, but it was not until 1881 that the ore was recognized to be nickel silicate rather than copper carbonate as originally assumed. Subsequent to 1881 much prospecting and preliminary development work was done, but no ore was processed for other than metallurgical tests until the present mining operation began.

The Hanna Mining Company and Hanna Nickel Smelting Company began production of ferronickel, the first to be produced in the United States from domestic ores, in July of 1954. The companies have operated on an around-the-clock schedule since that time and have provided steady, year around work for over 450 employees.

MINE

Geology

The deposit is approximately 3,000 by 6,000 feet, averaging 60 feet in depth. Mineralization occurs in a sheared and altered peridotite, and in many cases, consists of finely divided veinlets in a chalcedony boxwork. Several nickel minerals are found with garnierite, a complex magnesium silicate of nickel, being most easily recognized. Chromium, cobalt and aluminum occur in very minor amounts. Iron oxides, magnesia and silica make up the major constituents of the ore. Average nickel grade of the deposit is approximately 1.2%.

Grade Control

Nickel content of ore delivered to the smelter stockpile must be maintained as uniform as possible to produce optimum metallurgical results. This is somewhat difficult due to the wide, inconsistent variations in nickel content throughout the deposit. Twenty foot bench heights, narrow shovel cuts, bank samples, drill-hole samples, geologic interpretations and visual classification, combined with widely spaced daily cuts, make up the grade control pattern.

Development

Open cut mining methods are utilized. The topography is ideal for the development of level mining benches at twenty foot vertical intervals. This interval was chosen for grade control purposes. Benches are a minimum fifty foot width and extend to the limits of the deposit. Main haulage roads, sixty feet wide, traverse the area at a ten percent maximum grade and intersect the mining benches at intervals controlled by the maximum haul on level benches.

Mining and Hauling

Much of the ore can be dug without blasting. When this is necessary, however, a 6-1/2" down-hole drill is used. Ammonium nitrate - fuel oil is the blasting agent.

Loading is accomplished with 3-1/2 cubic yard diesel shovels. Large residual boulders, called pit reject, are separated from the ore by the shovel operator and ultimately deposited on waste dumps. The ore is loaded into 60-ton diesel trucks and hauled to the screening plant.

Screening and Crushing

The ore is deposited directly into the screening plant feed hopper. A separation is made on a wobbler feeder and scalping screens with the minus 5-1/2 inch product going directly to the tramway surge pile and the plus 5-1/2 inch to the crusher. Crushed material is visually classified and directed to the ore product or to the reject stockpile. After screening and crushing, the ore product is deposited in a 12,000 ton tramway surge pile.

Tramway

From the surge pile the ore is fed to the tramway loading terminal where it is loaded automatically into 50 cubic foot tram cars. It is conveyed downhill to the smelter storage stockpile at a maximum rate of 250 short tons per hour.

The tramway runs continuously carrying ore in the upright tram cars on the upper pair of suspended track cables and returning empty in an inverted position on the lower pair of track cables. Ore is loaded automatically and discharged by inverting the cars at the lower discharge terminal, where it is bedded in the smelter stockpile by an overhead belt conveyor and traveling wing tripper.

A speed of 500 feet per minute is maintained by two 300 horsepower induction generators driven by the loaded tram cars through a gripwheel and gear train in the loading terminal. The braking action of the generators produces approximately 500 horsepower which is used in the operation of the mine facilities.

The tramway is 8,300 feet long and drops a vertical distance of 2,000 feet in its length.

SMELTER

Ore from the stockpile is processed at the smelter to produce ferronickel containing approximately 50% Nickel. Steps in the process include reclaiming of ore, drying, fines screening, rejection of lean rock by screening, crushing, sampling, calcining, melting, reducing to ferronickel, refining, casting, and skull metallics recovery.

Ore Preparation

Ore is reclaimed from the stockpile by rubber-tired front end loaders and is conveyed to the dryers where the moisture content is lowered from an average of 21% to 3% - 5% in three concurrent fired rotary dryers. The dryers are heated by hogged fuel waste wood product from local sawmills. Natural gas auxiliary burners are installed for use in case sufficient hogged fuel is not available.

After drying, the ore is conveyed to the screening, crushing and sampling plant, where the coarse, low grade rock is rejected from the top deck of a double-deck screen. The ore remaining on the second deck of the screen, normally +5/16" - 3/4" is passed through cone crushers in closed circuits before it continues to storage. The -5/16" ore passes through Hi-Prob screens where fines are removed and sent to a storage bin. The coarse fraction from the screens is sent to separate storage bins. Both fine and coarse ore is sampled and weighed before going to storage.

From the storage bins the coarse ore (-5/16" +28 mesh) is fed to two natural gas fired rotary calciners, while the fines are fed to two natural gas fired multiple hearth roasters. To the feed of both calciners and roasters, sawdust is added as a pre-reductant to convert approximately three-quarters of the trivalent iron contained in the ore to the divalent state.

After calcining to approximately 1300 degrees Fahrenheit, the ore discharged from both the calciners and roasters is transported by automatic skips to hot ore bins above four electric melting furnaces in the smelter building. Skips, transfer chutes and bins are insulated to conserve the heat in the calcined ore.

Melting and Reduction

The ore is charged to the melting furnaces by gravity and heated to a temperature of 2900 to 3000 degrees Fahrenheit. Molten ore is poured from the melting furnaces into ladles for the reduction process.

Reduction of nickel and iron is accomplished by the Ugine Process, which consists of adding a reducing agent containing metallic silicon to an oxide ore in the presence of molten, ferrous metals and using vigorous mixing action for good contact of reductant and ore. In Hanna's smelter, crushed 48% ferrosilicon is used as the reductant, the ferrosilicon being produced in a separate electric furnace in the smelter. After the vigorous mixing cycle, the ferronickel is allowed to settle to the bottom of the ladle, after which the slag is skimmed off and granulated with high pressure water jets.

Refining

As the reducing reactions continue, ferronickel accumulates in the ladle. At regular intervals, a portion of this product is removed, or "thieved," and transported to one of two identical small electric steel furnaces. Here the impurities, predominantly phosphorous, are removed by suitable refining slags, after which the ferronickel is cast into pigs weighing approximately 28 pounds.

Samples from each cast are taken for complete chemical analysis and an accurate record of all casts is available for consumers. The ferronickel pigs are packaged on 4,000 pound pallets, with the exact weight and analysis stamped on each pallet. It has proven to be a very desirable product for the major stainless steel manufacturers of the United States.

APPENDIX 6

Previous Environmental Documents for the Former Glenbrook Nickel Smelter

Report of Confirmation Sampling

Prepared by August Mack Environmental Inc.

Prepared for Glenbrook Nickel Company

August 2000

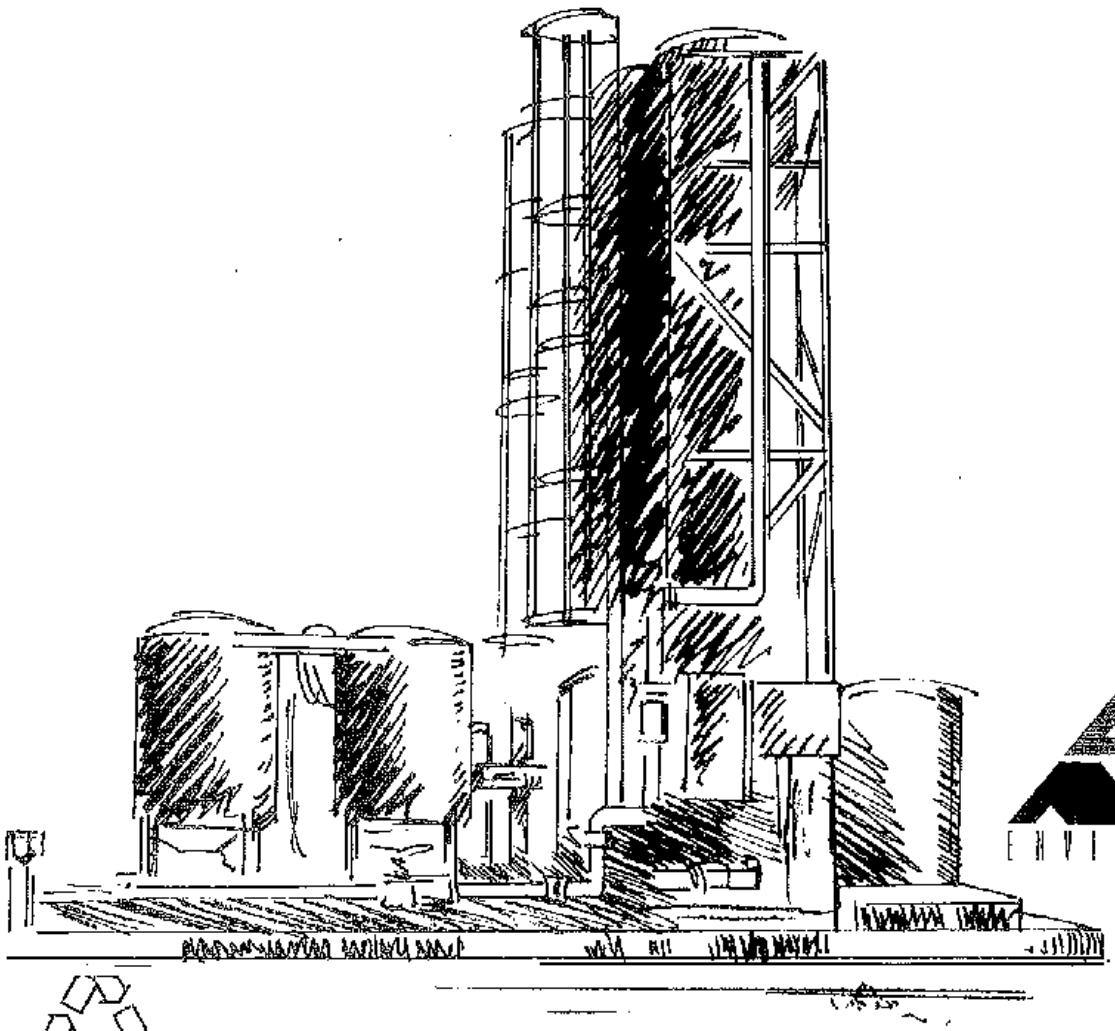
REPORT OF CONFIRMATION SAMPLING

RIDDLE AND COOS BAY FACILITIES
OREGON

Prepared for:

GLENBROOK NICKEL COMPANY
Riddle, Oregon

ATER WYNNE LLP
Portland, Oregon



AUGUST MACK ENVIRONMENTAL INC

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REPORT OF CONFIRMATION SAMPLING

RIDDLE AND COOS BAY FACILITIES OREGON

Prepared for:

GLENBROOK NICKEL COMPANY

Riddle, Oregon

ATER WYNNE LLP

Portland, Oregon

Prepared by:

August Mack Environmental, Inc.

Louisville, Kentucky

August 2000

Project JA003.35

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1.0 BACKGROUND AND OBJECTIVES

Glenbrook Nickel Company (Glenbrook) formerly operated a nickel mine and smelter in Riddle, Oregon. Associated with the smelter, Glenbrook also maintained port operations in Coos Bay, Oregon that included the off-loading, storage, and distribution of nickel ore (see Figures 1 and 2). Glenbrook has closed the Riddle and Coos Bay facilities and intends to divest these two properties. In association with that divestiture, Glenbrook's overall goals are to:

- Assure that the sites do not pose an unacceptable risk to human health and the environment.
- Limit potential long-term environmental liabilities associated with the sites.

To meet Glenbrook's goals, the following 10-step strategy was developed by personnel with August Mack, Glenbrook, and Ater Wynne, LLP (Glenbrook's outside legal counsel).

1. Identify areas of concern (AOCs)
2. Develop Confirmation Sampling Plan (CSP) to eliminate AOCs (as practicable) and collect preliminary data on groundwater and soil permeability conditions (as necessary).
3. Execute the CSP.
4. Incorporate results from the confirmation sampling into a comprehensive Sampling and Analysis Plan (SAP) to be submitted to the Oregon Department of Environmental Quality (DEQ).
5. Meet with the DEQ (at the time of SAP submittal) to request inclusion of the two sites under the DEQ Independent Clean-Up Pathway (ICP) program.
6. Execute the SAP.
7. Review analytical data. Execute additional field work (as necessary) to fill any data gaps identified. Prepare Report of Findings.

8. Prepare Remedial Action Plan (RAP), as necessary, to address AOCs requiring further action.

9. Execute RAP.

10. Submit RAP results to DEQ to obtain No Further Action letter.

The first step of the strategy was completed by August Mack in January 2000, with the identification of 22 AOCs at Riddle and 7 AOCs at Coos Bay.

The second step of the strategy was completed in March and April of 2000 with the submittal of August Mack's *Confirmation Sampling Plan* and subsequent *Confirming Scope of Services Letter* to Cominco.

This report includes the results of the completion of the third step, the implementation of the Confirmation Sampling Plan (item 3 above). Execute CSP

One additional area of concern was identified during our confirmation sampling activities at Riddle, bringing the total number of AOCs at the Riddle site to 23. Table 1 identifies the 23 AOCs at Riddle. Table 2 identifies the 7 AOCs at Coos Bay. The tables provide a description of each area and the potential concerns. Locations of the AOCs are shown in Figures 3 and 4.

2.0 SCOPE OF SAMPLING ACTIVITIES

The initial sampling activities were conducted at the AOCs at Coos Bay on April 25, 2000 and at Riddle on April 26-28, 2000. Additional sampling around the capacitor banks in the BPA Substation was conducted on June 6 and 7, 2000. A summary of the number of samples collected in each AOC and the laboratory analyses conducted is summarized in Tables 1 and 2. Further discussion of locations and analyses are in Section 3. Sampling and decontamination procedures used in the field were in general accordance with those described in August Mack's March 30, 2000 *Confirmatory Sampling Plan.* A description

of field procedures is in Appendix A. Boring logs for samples collected from depths greater than one foot are provided in Appendix B.

In addition to confirmation sampling, data on groundwater conditions and soil permeability were collected for use in DEQ's ICP site screening process. Information obtained for the preliminary groundwater evaluation included:

- Depth to the uppermost groundwater producing zone
- Impact to groundwater by potential past releases of chemical constituents (namely petroleum hydrocarbons)
- Presence of non-aqueous phase liquids (free product) on the water table

Information gathered for the soil permeability evaluation included:

- Grain Size
- Atterburg Limits
- Average Permeability

3.0 RESULTS

Results of the confirmation sampling, preliminary groundwater evaluation, and soil permeability evaluation are provided in the following subsections. Interpreted naturally occurring concentrations for metals shown in the results summary tables provided for each AOC were generated from the following resources:

- Dragun, J. and A. Chiasson. 1991. *Elements in North American Soils*. Hazardous Materials Control Resources Institute. Greenbelt, Maryland.
- Shacklette, H.T. and J.G. Boerngen. 1984. *Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States*. U.S. Geological Survey Prof. Paper 1270.

DEQ cleanup levels listed for constituents other than TPH and PCBs are those for industrial sites and were obtained from Appendix 1 of DEQ's *Environmental Cleanup Manual*. The TPH cleanup level shown is that for a Level 1 soil matrix cleanup, the most conservative TPH cleanup level listed by the DEQ for releases from petroleum underground storage tanks (USTs). These soil matrix levels are often used by DEQ as guidance for determining appropriate protective levels in soil for cleanups of petroleum releases from above ground storage tanks and other non-UST sources. The PCB cleanup standards are from the DEQ *Generic Remedies for Soil Contaminated with Polychlorinated Biphenyls* and the EPA "mega" rule (40 CFR 761.61). The DEQ generic remedy essentially applies a risk-based cleanup that allows the following protective levels to remain in the soils: 25 ppm (operating substation); 7.5 ppm (industrial sites); 1.2 ppm (residential). In addition to these DEQ cleanup levels, there is the possibility of using "risk-based" cleanups for the non-PCB constituents. The EPA "mega" rule essentially uses a 25 ppm cleanup standard for "low occupancy" areas (compares to DEQ "industrial" areas) and a 1.0 ppm standard for "high occupancy" areas (compares to DEQ "residential" areas).

3.1 Confirmation Sampling – Riddle Site

- *AOC-R-1 - Sand Blast Area:* Three soil samples were collected by shovel to a depth of approximately six inches. The samples were analyzed for total lead by EPA Method 6010.

AOC-R-1 – Sand Blast Area						*milligrams / kilogram*
Sample #	*Matrix*	*Depth*	*Constituent*	*Result*	*Interpreted Naturally Occurring Concentration*	*DEQ Cleanup Level*
HA-29	Soil	6 inches	Lead	6.27	0-30	2,000
HA-31	Soil	6 inches	Lead	0.866	0-30	2,000
HA-31	Soil	6 inches	Lead	0.865	0-30	2,000

- *AOC-R-2 - Lab Drain Line Discharge Point:* One grab sediment sample was collected from the drainage ditch at the discharge point. The sample was analyzed for volatile organic compounds (VOCs) by EPA Method 8260, Polynuclear Aromatic Hydrocarbons (PAHs) by EPA Method 8310, and seven

key metals (arsenic, cadmium, chromium, lead, manganese, mercury, nickel) by EPA Method 6000 series.

AOC-R-2 – Lab Drain Line Discharge Point						*milligrams / kilogram*
Sample #	*Matrix*	*Depth*	*Constituent*	*Result*	*Interpreted Naturally Occurring Concentration*	*DEQ Cleanup Level*
SG-1	Sediment	Surface	Arsenic	0.771	3.0-31	3.0
			Cadmium	ND	0-11	1,000
			Chromium	1270	3.0-2,000	1,500
			Lead	2.02	0-30	2,000
			Manganese	622	30-5,000	2.0E+5
			Mercury	6.62	0.01-0.7	600
			Nickel	8480	<5-70	40,000
			PAHs	ND	--	--
			VOCs	ND	--	--
ND = Not Detected -- = Not Applicable/None Established						

- *AOC-R-3 - Former Sand Blast Area:* Two soil samples were collected by shovel approximately six inches deep. The samples were analyzed for total lead by EPA Method 6010.

AOC-R-3 Former Sand Blast Area						*milligrams / kilogram*
Sample #	*Matrix*	*Depth*	*Constituent*	*Result*	*Interpreted Naturally Occurring Concentration*	*DEQ Cleanup Level*
HA-27	Soil	6 inches	Lead	52.9	0-30	2,000
HA-28	Soil	6 inches	Lead	61.6	0-30	2,000

- *AOC-R-4 - Sanitary Sand Filter Beds:* A total of two samples were collected; one by Geoprobe from each bed. The sample was collected at a depth of 11 feet in the east bed (GP-14) and 10 feet in the west bed (GP-15). The samples were analyzed for VOCs (Method 8260), PAHs by Method 8310, and the aforementioned seven key metals.

AOC-R-4 – Sanitary Sand Filter Beds						*milligrams / kilogram*
Sample #	*Matrix*	*Depth*	*Constituent*	*Result*	*Interpreted Naturally Occurring Concentration*	*DEQ Cleanup Level*
GP-14	Soil	11 feet	PAHs	ND	--	--
			VOCs	ND	--	--
			Arsenic	22.2	3.0-31	3.0
			Cadmium	ND	0-11	1,000
			Chromium	4.48	3.0-2,000	1,500
			Lead	18.2	0-30	2,000
			Manganese	295	30-5,000	2.0E+5

			Mercury	1.18	0.01-0.7	600
			Nickel	102	<5-70	40,000
GP-15	Soil	10 feet	PAHs	ND	--	--
			VOCs	ND	--	--
			Arsenic	19.5	3.0-31	3.0
			Cadmium	ND	0-11	1,000
			Chromium	213	3.0-2,000	1,500
			Lead	15.3	0-30	2,000
			Manganese	982	30-5,000	2.0E+5
			Mercury	0.921	0.01-0.7	600
			Nickel	220	<5-70	40,000
ND = Not Detected -- = Not Applicable/None Established						

- *AOC-R-5 - Granulation Ladle Tilt Station Hydraulic System:* One sample consisting primarily of ore and slag was collected by shovel under each hydraulic unit (total of four units) to a depth of approximately one foot. The samples were analyzed for PAHs by EPA Method 8310.

AOC-R-5 – Granulation Ladle Tilt Station Hydraulic System					*milligrams / kilogram*
Sample #	***Matrix***	***Depth***	***Constituent***	***Result***	***DEQ Cleanup Level***
HA-1	Ore/slag	1 foot	PAHs	ND	--
HA-2	Ore/slag	1 foot	PAHs	ND	--
HA-3	Ore/slag	1 foot	PAHs	ND	--
HA-4	Ore/slag	1 foot	Benzo(a)pyrene	**17.5**	**1.0**
			Benzo(b)fluoranthene	**1.05**	1.0
			Benzo(ghi)perylene	**10.1**	--
			Benzo(k)fluoranthene	**1.10**	**1.0**
ND = Not Detected -- = Not Applicable/None Established					

- *AOC-R-6 - Lube Oil Storage Area:* One surface soil sample was collected by shovel adjacent to the used-oil AST located on the east side of the Lube Oil Storage Area. The sample was analyzed for TPH by DEQ Method TPH-D, VOCs by EPA Method 8260, PAHs by Method 8310, Polychlorinated Biphenyls (PCBs) by Method 8082, and seven key metals.

AOC-R-6 – Lube Oil Storage Area						*milligrams / kilogram*
Sample #	***Matrix***	***Depth***	***Constituent***	***Result***	***DEQ Cleanup Level***	***Interpreted Naturally Occurring Con-centration***
HA-26	Soil	Surface	Anthracene	1.48	6.0E+5	--
			Chloroethane	0.083	--	--
			1,1,1-Trichloroethane	0.003	9,000	--
			Benzene	0.003	2.0	--
			Toluene	0.003	6,000	--
			1,1,2-Trichloroethane	0.018	8,000	--
			1,1,1,2-Tetrachloroethane	0.002	--	--

			1,1,2,2-Tetrachloroethane	0.007	--	
			TPH-Oil	7,300	100	100
			PCBs	ND	0.7	
			Arsenic	3.62	3.0	3.0-31
			Cadmium	0.164	1,000	0-11
			Chromium	544	1,500	3.0-2,000
			Lead	0.359	2,000	0-30
			Manganese	1,330	2.0E+5	30-5,000
			Mercury	6.84	600	0.01-0.7
			Nickel	10,100	40,000	<5-70

ND = Not Detected -- = Not Applicable/None Established

- *AOC-R-7 - Ferro Silicon Bag House:* Two grab samples of dust from the west side drainage channel and three grab samples of dust from around the baghouse area were collected. The samples were analyzed for total lead by EPA Method 6010.

AOC-R-7 – Ferro Silicon Bag House ***milligrams / kilogram***

Sample #	*Matrix*	*Depth*	*Constituent*	*Result*	*Interpreted Naturally Occurring Concentration*	*DEQ Cleanup Level*
HA-21	Dust	Surface	Lead	ND	0-30	2,000
HA-22	Dust	Surface	Lead	0.033	0-30	2,000
HA-23	Dust	Surface	Lead	0.443	0-30	2,000
HA-24	Dust	Surface	Lead	6.03	0-30	2,000
HA-25	Dust	Surface	Lead	0.748	0-30	2,000

ND = Not Detected

- *AOC-R-8 - Calciner Lube Oil Areas:* One soil sample was collected by shovel at the base of each pillar (total of four pillars). The samples were collected from a depth of one foot. The samples were analyzed for PAHs by EPA Method 8310.

AOC-R-8 – Calciner Lube Oil Areas ***milligrams / kilogram***

Sample #	*Matrix*	*Depth*	*Constituent*	*Result*	*DEQ Cleanup Level*
HA-32	Soil	1 foot	PAHs	ND	--
HA-33	Soil	1 foot	PAHs	ND	--
HA-34	Soil	1 foot	Acenaphthene	0.98	1.0E+5
			Acenaphthylene	2.06	--
			Anthracene	1.03	6.0E+5
			Benzo(a)anthracene	4.09	1.0
			Benzo(a)pyrene	3.12	1.0
			Benzo(b)fluoranthene	2.53	1.0
			Benzo(ghi)perylene	18.4	--
			Benzo(k)fluoranthene	1.98	1.0
			Chrysene	1.02	1.0
			Dibenz(ah)anthracene	6.45	1.0

			Fluoranthene	2.78	80,000
			Indeno(1,2,3-cd)pyrene	3.39	1.0
			Naphthalene	1.01	8,000
			Phenanthrene	1.48	--
			Pyrene	0.35	60,000
HA-35	Soil	1 foot	PAHs	ND	--
ND = Not Detected		-- = Not Applicable/None Established			

- *AOC-R-9 - #3 Dryer:* Three soil samples were collected from a depth of six inches by shovel at the potential lube oil release areas. The samples were analyzed for PAHs by EPA Method 8310.

AOC-R-9 - #3 Dryer					*milligrams / kilogram*
Sample #	*Matrix*	*Depth*	*Constituent*	*Result*	*DEQ Cleanup Level*
HA-36	Soil	6 inches	PAHs	ND	--
HA-37	Soil	6 inches	Acenaphthylene	1.70	--
			Anthracene	1.19	6.0E+5
HA-38	Soil	6 inches	PAHs	ND	--
ND = Not Detected		-- = Not Applicable/None Established			

- *AOC-R-10 - Diesel Fueling Station and Fuel Line Area:* Ten soil samples and one groundwater sample were collected by Geoprobe in the fueling station area and along the product distribution lines under the road and railroad tracks east of the fueling station (see Figure 5). The borings were extended to depths of ten feet. Samples were screened in the field with a photoionization detector (PID) at two-foot intervals. The sample from the interval in each boring with the highest PID reading was selected for laboratory analysis. The samples were analyzed for TPH by DEQ Method TPH-D and PAHs by EPA Method 8310.

  Five borings located south of the railroad tracks encountered significant product in the soil. Consequently, in an attempt to delineate the visual limits of the contamination, these five borings were abandoned and moved approximately 20 to 30 feet north of the original locations, near the center or opposite side of the road/tracks. A total of fifteen borings were advanced, but only ten were sampled (see Figure 5).

AOC-R-10 – Diesel Fueling Station and Fuel Line Area					*milligrams / kilogram*
Sample #	*Matrix*	*Depth*	*Constituent*	*Result*	*DEQ Cleanup Level*
GP-1	Soil	4 feet	Acenaphthylene	1.88	--
			Fluorene	1.19	80,000
			Naphthalene	4.76	8,000
			Phenanthrene	1.91	--
			TPH - Diesel	900	100

			Oil	180	100
GP-2	Soil	10 feet	PAHs	ND	--
			TPH	ND	100
GP-3	Soil	10 feet	PAHs	ND	--
			TPH	ND	100
GP-4	Soil	6 feet	PAHs	ND	--
			TPH	ND	100
GP-5	Soil	10 feet	Acenaphthene	1.01	1.0E+5
			Fluorene	1.05	80,000
			Naphthalene	2.96	8,000
			Phenanthrene	1.27	--
			TPH - Diesel	**1,100**	100
GP-6	Soil	8 feet	PAHs	ND	--
			TPH	ND	--
GP-7	Soil	2 feet	Acenaphthylene	1.55	--
			TPH - Diesel	**3,300**	100
			Oil	**520**	--
GP-8	Soil	10 feet	PAHs	ND	--
			TPH	ND	--
GP-9	Soil	6 feet	Acenaphthene	2.23	1.0E+5
			Acenaphthylene	1.39	--
			Anthracene	1.43	6.0E+5
			Fluoranthene	2.19	80,000
			Fluorene	1.43	80,000
			Naphthalene	1.02	8,000
			Phenanthrene	6.08	--
			Pyrene	0.52	60,000
			TPH - Diesel	**8,400**	100
GP-10	Soil	8 feet	Acenaphthylene	1.02	--
			Naphthalene	0.53	8,000
			TPH - Diesel	**190**	100
GP-11	Water	2.3 feet	Acenaphthene	0.019	2.0
			Anthracene	0.079	10
			Benzo(a)pyrene	**0.007**	1.0E-5
			Benzo(b)fluoranthene	**0.008**	1.0E-5
			Pyrene	0.022	1.0
			1,1,1,2-Tetrachloroethane	1.001	--
			Naphthalene	0.002	0.1

ND = Not Detected -- = Not Applicable/None Established

- *AOC-R-11 - AST Area:* Six test pits were excavated with a trackhoe within the AST secondary containment structure (see Figure 6). One soil sample was collected from each test pit for laboratory analysis. The samples were analyzed for PAHs by EPA Method 8310 and TPH by DEQ Method TPH-D.

AOC-R-11 – AST Area				*milligrams / kilogram*
Sample #	***Matrix***	***Depth***	***PAH***	***TPH***
TP-1	Soil	12 feet	ND	ND
TP-2	Soil	12 feet	ND	ND
TP-3	Soil	12 feet	ND	ND

detection limit 1.0 mg/kg

TP-4	Soil	12 feet	ND	ND
TP-5	Soil	12 feet	ND	ND
TP-6	Soil	12 feet	ND	ND
ND = Not Detected				

- *AOC-R-12 - Pilot Plant Fuel Oil AST:* Two soil samples were collected from inside the secondary containment structure. The samples were collected by shovel from a depth of approximately one foot. The samples were analyzed for PAHs by EPA Method 8310 and TPH by DEQ Method TPH-D.

AOC-R-12 – Pilot Plant Fuel Oil AST					*milligrams / kilogram*
Sample #	*Matrix*	*Depth*	*Constituent*	*Result*	*DEQ Cleanup Level*
HA-39	Soil	1 foot	PAH	ND	--
			TPH	ND	100
HA-40	Soil	1 foot	Benzo(a)pyrene	**6.65**	1.0
			Pyrene	5.04	60,000
			Oil	**8,400**	100
ND = Not Detected -- = Not Applicable/None Established					

- *AOC-R-13 - Vehicle Maintenance and Washdown Area:* Four soil samples were collected by Geoprobe from around the sump and drain area to the south of the washdown pad. The samples were screened in the field with a PID at two-foot intervals. The sample from the interval in each boring showing the highest PID reading was selected for laboratory analysis. The samples were analyzed for PAHs by EPA Method 8310, VOCs by EPA Method 8260, and the 7 aforementioned key metals.

AOC-R-13 – Vehicle Maintenance and Washdown Area						*milligrams / kilogram*
Sample #	*Media*	*Depth*	*Constituent*	*Result*	*Interpreted Naturally Occurring Concentration*	*DEQ Cleanup Level*
GP-16	Soil	4 feet	Arsenic	23.1	3.0-31	3.0
			Cadmium	ND	0-11	1,000
			Chromium	79.2	3.0-2,000	1,500
			Lead	18.8	0-30	2,000
			Manganese	858	30-5,000	2.0E+5
			Mercury	ND	0.01-0.7	600
			Nickel	1,190	<5-70	40,000
			PAH	ND	--	--
			VOC	ND	--	--
GP-17	Soil	4 feet	Arsenic	**240**	3.0-31	3.0
			Cadmium	ND	0-11	1,000
			Chromium	43.2	3.0-2,000	1,500
			Lead	13.6	0-30	2,000
			Manganese	857	30-5,000	2.0E+5
			Mercury	ND	0.01-0.7	600

			Nickel	98.2	<5-70	40,000
			PAH	ND	--	--
			VOC	ND	--	--
GP-18	Soil	6 feet	Arsenic	20.9	3.0-31	3.0
			Cadmium	ND	0-11	1,000
			Chromium	40.1	3.0-2,000	1,500
			Lead	14.1	0-30	2,000
			Manganese	216	30-5,000	2.0E+5
			Mercury	ND	0.01-0.7	600
			Nickel	98.4	<5-70	40,000
			PAH	ND	--	--
			VOC	ND	--	--
GP-19	Soil	4 feet	Arsenic	150	3.0-31	3.0
			Cadmium	ND	0-11	1,000
			Chromium	214	3.0-2,000	1,500
			Lead	0.196	0-30	2,000
			Manganese	476	30-5,000	2.0E+5
			Mercury	ND	0.01-0.7	600
			Nickel	1910	<5-70	40,000
			PAHs	ND	--	--
			VOCs	ND	--	--
ND = Not Detected		-- = Not Applicable/None Established				

- *AOC-R-14 - Generator Shed Behind Skull Plant:* One soil sample was collected by Geoprobe on the east side (stained area) of the shed. The boring was extended to a depth of six feet and samples were screened in the field with a PID at two-foot intervals. The sample with the highest PID reading was selected for laboratory analysis. The sample was analyzed for PAHs by EPA Method 8310 and TPH by DEQ Method TPH-D.

AOC-R-14 – Generator Shed Behind Skull Plant				***milligrams / kilogram***
Sample #	***Matrix***	***Depth***	***PAHs***	***TPH***
GP-13	Soil	6 feet	ND	ND
ND = Not Detected				

- *AOC-R-15 - USTs at Mine Site:* Four trackhoe test pits were excavated to determine if the USTs were present, and to collect soil samples. One soil sample was collected from each test pit for laboratory analysis. No tanks were found. The samples were analyzed for TPH (gasoline and diesel) by DEQ Methods TPH-G and TPH-D, BTEX by Method 8021B, PAHs by EPA Method 8310, and PCBs by Method 8082.

AOC-R-15 – USTs at Mine Site					***milligrams / kilogram***
Sample #	***Matrix***	***Depth***	***TPH***	***BTEX***	***PCBs***
TP-7	Soil	15 feet	ND	ND	ND
TP-8	Soil	15 feet	ND	ND	ND
TP-9	Soil	15 feet	ND	ND	ND
TP-10	Soil	15 feet	ND	ND	ND
ND = Not Detected		-- = Not Applicable/None Established			

PAH? lab reports not included in Appendix

- *AOC-R-16 – Near Creek Above Smelter Building:* One temporary groundwater monitoring well was installed. The sample was obtained through the Geoprobe rods using a vacuum pump and tygon tubing. The sample was filtered to reduce turbidity and analyzed for 7 key total and dissolved metals (arsenic, cadmium, chromium, lead, manganese, mercury, nickel). The well was removed after sampling.

AOC-R-16 – Near Creek Above Smelter Building						*milligrams / liter*
Sample #	***Matrix***	***Depth***	***Constituent***	***Total***	***Dissolved***	***USEPA Drinking Water Standard***
GP-21	Water	6 feet	Arsenic	1.5	ND	0.05
			Cadmium	ND	ND	0.005
			Chromium	4.63	ND	0.1
			Lead	0.156	ND	0.015
			Manganese	13.5	0.668	4.0*
			Mercury	ND	ND	0.002
			Nickel	80.7	0.291	0.1
ND = Not Detected * = DEQ Reference Concentration						

- *AOC-R-17 – Below Two Middle Ponds:* One temporary groundwater monitoring well was installed. The sample was obtained through the Geoprobe rods using a vacuum pump and tygon tubing. The sample was filtered to reduce turbidity and analyzed for 5 key total and dissolved metals (aluminum, chromium, manganese, nickel, and silver). The well was removed after sampling.

AOC-R-17 – Below Two Middle Ponds						*milligrams / liter*
Sample #	***Matrix***	***Depth***	***Constituent***	***Total***	***Dissolved***	***USEPA Drinking Water Standards***
GP-23	Water	3.0 feet	Aluminum	279	13.0	--
			Chromium	7.17	ND	0.1
			Manganese	10.9	0.111	4.0*
			Nickel	8.30	0.038	0.1
			Silver	0.061	ND	--
ND = Not Detected -- = Not Applicable/None Established * DEQ Reference Concentration						

- *AOC-R-18 – Below Lower Pond:* One temporary groundwater monitoring well was installed. The sample was obtained through the Geoprobe rods using a vacuum pump and tygon tubing. The sample was filtered to reduce turbidity and analyzed for 5 key total and dissolved metals (aluminum, chromium, manganese, nickel, and silver).

AOC-R-18 – Below Lower Pond						*milligrams / liter*
Sample #	***Matrix***	***Depth***	***Constituent***	***Total***	***Dissolved***	***USEPA Drinking Water Standard***
GP-22	Water	3.5 feet	Aluminum	273	0.137	--
			Chromium	9.56	ND	0.1
			Manganese	15.4	3.96	4.0*
			Nickel	2.32	0.010	0.1
			Silver	0.020	ND	--

ND: Not Detected -- = Not Applicable/None Established
* = DEQ Reference Concentration

- *AOC-R-19 – Below AST Area:* One temporary groundwater monitoring well was installed. The sample was obtained through the Geoprobe rods using a vacuum pump and tygon tubing. The sample was filtered to reduce turbidity and analyzed for PAH (Method 8310), TPH (DEQ Method TPH-D) and the aforementioned 7 key metals.

AOC-R-19 – Below AST Area						*milligrams / liter*
Sample #	***Matrix***	***Depth***	***Constituent***	***Total***	***Dissolved***	***USEPA Drinking Water Standard***
GP-12	Water	6 feet	Arsenic	0.388	ND	0.05
			Cadmium	ND	ND	0.005
			Chromium	7.00	ND	0.1
			Lead	0.075	ND	0.015
			Manganese	2.36	3.16	4.0*
			Mercury	ND	ND	0.002
			Nickel	0.279	0.033	0.1
			TPH	ND	ND	--
			PAH	ND	ND	--

ND = Not Detected -- = Not Applicable/None Established
* = DEQ Reference Concentration

- *AOC-R-20 – BPA Substation:* Twenty soil samples (designated by "HA" prefix in table below) were collected by shovel below the gravel base (approximately 1 to 2 feet) within the BPA substation (see Figure 7). Samples were collected adjacent to and below transformers and capacitors in the substation. The samples were analyzed for PCBs (EPA Method 8082), TPH (DEQ Method TPH-D), and 1,1,1-Trichloroethane (TCA) by EPA Method 8270. Six wipe samples (designated by "W" prefix in table below) were also collected from electrical equipment in the substation. Sample areas comprising 100 cm^2 were wiped with hexane-soaked gauze pads and analyzed for PCBs by EPA Method 8082. Forty additional soil samples (designated by "B" prefix in table below) were collected from twenty trackhoe test pits around the perimeter of the capacitor banks, in the northwest corner of the substation. Two samples were

collected from each test pit at depths of two and four feet, and analyzed for PCBs.

AOC-R-20 – BPA Substation					*milligrams / kilogram*
Sample #	*Matrix*	*Depth*	*PCB*	*TPH*	*TCA*
HA-1	Soil	2.0 feet	ND	ND	ND
HA-2	Soil	2.0 feet	ND	ND	ND
HA-3	Soil	2.0 feet	**3,900**	**13,000** *d*	ND
HA-4	Soil	2.0 feet	**277**	ND	ND
HA-5	Soil	2.0 feet	**357**	55 *d*	ND
HA-6	Soil	2.0 feet	**30**	ND	ND
HA-7	Soil	1.5 feet	ND	ND	ND
HA-8	Soil	1.5 feet	ND	**740** *o*	ND
HA-9	Soil	1.5 feet	ND	**4,500** *o*	0.0098
HA-10	Soil	1.5 feet	ND	**940** *d*	ND
HA-11	Soil	1.5 feet	ND	**390** *d*	ND
HA-12	Soil	1.0 foot	ND	ND	ND
HA-13	Soil	1.0 foot	ND	ND	ND
HA-14	Soil	1.0 foot	ND	ND	ND
HA-15	Soil	1.0 foot	ND	**200** *o*	ND
HA-16	Soil	1.0 foot	ND	ND	ND
HA-17	Soil	1.0 foot	ND	**16,000** *o*	ND
HA-18	Soil	1.0 foot	ND	**4,700** *o*	0.0087
HA-19	Soil	1.0 foot	ND	**840** *o*	ND
HA-20	Soil	1.0 foot	ND	**490** *o*	ND
W-1	Wipe	Surface	ND	NA	NA
W-2	Wipe	Surface	ND	NA	NA
W-3	Wipe	Surface	ND	NA	NA
W-4	Wipe	Surface	ND	NA	NA
B-1	Soil	2.0 feet	ND	NA	NA
B-1	Soil	4.0 feet	ND	NA	NA
B-2	Soil	2.0 feet	ND	NA	NA
B-2	Soil	4.0 feet	ND	NA	NA
B-3	Soil	2.0 feet	ND	NA	NA
B-3	Soil	4.0 feet	ND	NA	NA
B-4	Soil	2.0 feet	ND	NA	NA
B-4	Soil	4.0 feet	ND	NA	NA
B-5	Soil	2.0 feet	ND	NA	NA
B-5	Soil	4.0 feet	ND	NA	NA
B-6	Soil	2.0 feet	ND	NA	NA
B-6	Soil	4.0 feet	ND	NA	NA
B-7	Soil	2.0 feet	ND	NA	NA
B-7	Soil	4.0 feet	ND	NA	NA
B-8	Soil	2.0 feet	ND	NA	NA
B-8	Soil	4.0 feet	ND	NA	NA
B-9	Soil	2.0 feet	ND	NA	NA
B-9	Soil	4.0 feet	ND	NA	NA
B-10	Soil	2.0 feet	ND	NA	NA
B-10	Soil	4.0 feet	ND	NA	NA
B-11	Soil	2.0 feet	ND	NA	NA
B-11	Soil	4.0 feet	ND	NA	NA

B-12	Soil	2.0 feet	ND	NA	NA
B-12	Soil	4.0 feet	ND	NA	NA
B-13	Soil	2.0 feet	ND	NA	NA
B-13	Soil	4.0 feet	ND	NA	NA
B-14	Soil	2.0 feet	ND	NA	NA
B-14	Soil	4.0 feet	ND	NA	NA
B-15	Soil	2.0 feet	ND	NA	NA
B-15	Soil	4.0 feet	ND	NA	NA
B-16	Soil	2.0 feet	ND	NA	NA
B-16	Soil	4.0 feet	ND	NA	NA
B-17	Soil	2.0 feet	ND	NA	NA
B-17	Soil	4.0 feet	ND	NA	NA
B-18	Soil	2.0 feet	ND	NA	NA
B-18	Soil	4.0 feet	ND	NA	NA
B-19	Soil	2.0 feet	ND	NA	NA
B-19	Soil	4.0 feet	ND	NA	NA
B-20	Soil	2.0 feet	ND	NA	NA
B-20	Soil	4.0 feet	ND	NA	NA
DEQ Cleanup Level (Soil)			7.5	100	6,000

d = Diesel *o* = Oil

- *AOC-R-21 – New Caledonia Ore Pile:* One groundwater sample was collected from a temporary groundwater monitoring well installed downgradient (south) of the New Caledonia Ore Pile. The sample was collected through the Geoprobe rods using a vacuum pump and tygon tubing. The sample was filtered and analyzed for total and dissolved metals (nickel, chromium, manganese, silver, aluminum and iron).

AOC-R-21 – Below New Caledonia Ore Pile — *milligrams / liter*

Sample #	*Matrix*	*Depth*	*Constituent*	*Total*	*Dissolved*	*USEPA Drinking Water Standard*
GP-20	Water	10 feet	Arsenic	0.342	ND	0.05
			Cadmium	ND	ND	0.005
			Chromium	2.05	ND	0.1
			Lead	0.237	ND	0.015
			Manganese	8.97	0.357	4.0*
			Mercury	ND	ND	0.002
			Nickel	15.2	0.065	0.1

ND = Not Detected * = DEQ Reference Concentration

- *AOC-R-22 – New Caledonia Ore Pile:* Three grab samples of ore were collected from the ore pile. The samples were analyzed for total nickel, chromium and manganese.

AOC-R-22 – New Caledonia Ore Pile — *milligrams / kilogram*

Sample #	*Matrix*	*Depth*	*Nickel*	*Chromium*	*Manganese*
HA-41	Ore	Surface	22,000	440	1,800
		PRG	41,000	450	32,000
		PRG (DES)	1600	210	1800

TABLES

Table 1
Areas of Concern – Riddle Site

Area	Description	Media Sampled	No. of Samples	Analyses
1. Sand Blast Area	Slag (Green Diamond granules) used for sand blast cleaning of equipment and parts. *Potential lead paint waste.*	Soil	3	Lead
2. Lab Drain Line Discharge Point	Discharge point of drain line from sinks and drains in the laboratory. *Potential discharge of lab chemicals down drain. Discharge is routed to surface ditch as part of NPDES middle pond system.*	Sediment	1	VOCs PAHs Metals
3. Former Sand Blast Area	Former area used for sand blasting (same as #2 above). *Potential lead paint waste.*	Soil	2	Lead
4. Sanitary Sand Filter Beds	Sand filter beds that received sanitary waste from the site's septic tanks. *Potential discharge of chemicals into sanitary system. Septic tank system receives water from sinks, showers and toilets, except from the lab.*	Soil	2	VOCs PAHs Metals
5. Granulation Ladle Tilt Station Hydraulic System	Hydraulic fluid used in the operation of the Granulation Ladle. *Soil staining beneath each of the four Granulation Tilt Ladle units.*	Soil	4	PAHs
6. Lube Oil Storage Shed	Drum storage of lube oils and greases in shed and one outside AST for used oil storage. *No signs of cracks in concrete floor of shed. Signs of spills and staining outside at used oil AST.*	Soil	1	TPH-D PCBs VOCs PAHs Metals
7. Ferro Silicon Bag House	Air emission control equipment. *Accumulation of dusts around the bag house.*	Dust/Soil	2	Lead
8. Calciner Lube Oil	Lube oils used in the operation of the calciners. *Signs of releases and staining at pillars supporting the calciners.*	Soil	1	PAHs
9. #3 Dryer	Lube oils used in the operation of the dryer. *Signs of releases and staining beneath the dryer.*	Soil	3	PAHs
10. Diesel Fueling Station and Line Area	Fueling station and product distribution lines under the roadway. *Signs of releases and staining at the fueling station, and potential releases along product distribution lines.*	Soil Groundwater	10 1	
11. AST Area	Diesel fuel and bunker-C ASTs. *Signs of releases within earthen secondary containment structure around tanks.*	Soil	6	TPH-D PAHs
12. Pilot Plant Fuel Oil Tank	Fuel oil AST. *Signs of releases and no concrete floor within secondary containment structure.*	Soil	2	TPH-D PAHs
13. Vehicle Maintenance and Washdown Area	Concrete pad, sump, and drains used for washing and maintenance of facility equipment. *Potential oils and cleaners entering sump and drains.*	Soil	2	PAHs VOCs Metals
14. Generator Shed	Small shed housing generators/motors behind skull plant. *Signs of releases and staining inside and outside of the shed.*	Soil	1	TPH-D PAHs
15. USTs at Mine Site	5,000 gallon gasoline and 10,000 gallon used oil USTs at mine site (top of mountain). *Potential releases from the USTs.*	Soil	4	TPH-G TPH-D BTEX PAHs PCBs
16. Near Creek above Smelter Building	Creek running down mountain. Evaluate groundwater for levels of total and dissolved metals.	Groundwater	1	Metals

Table 1 - Continued

Areas of Concern – Riddle Site

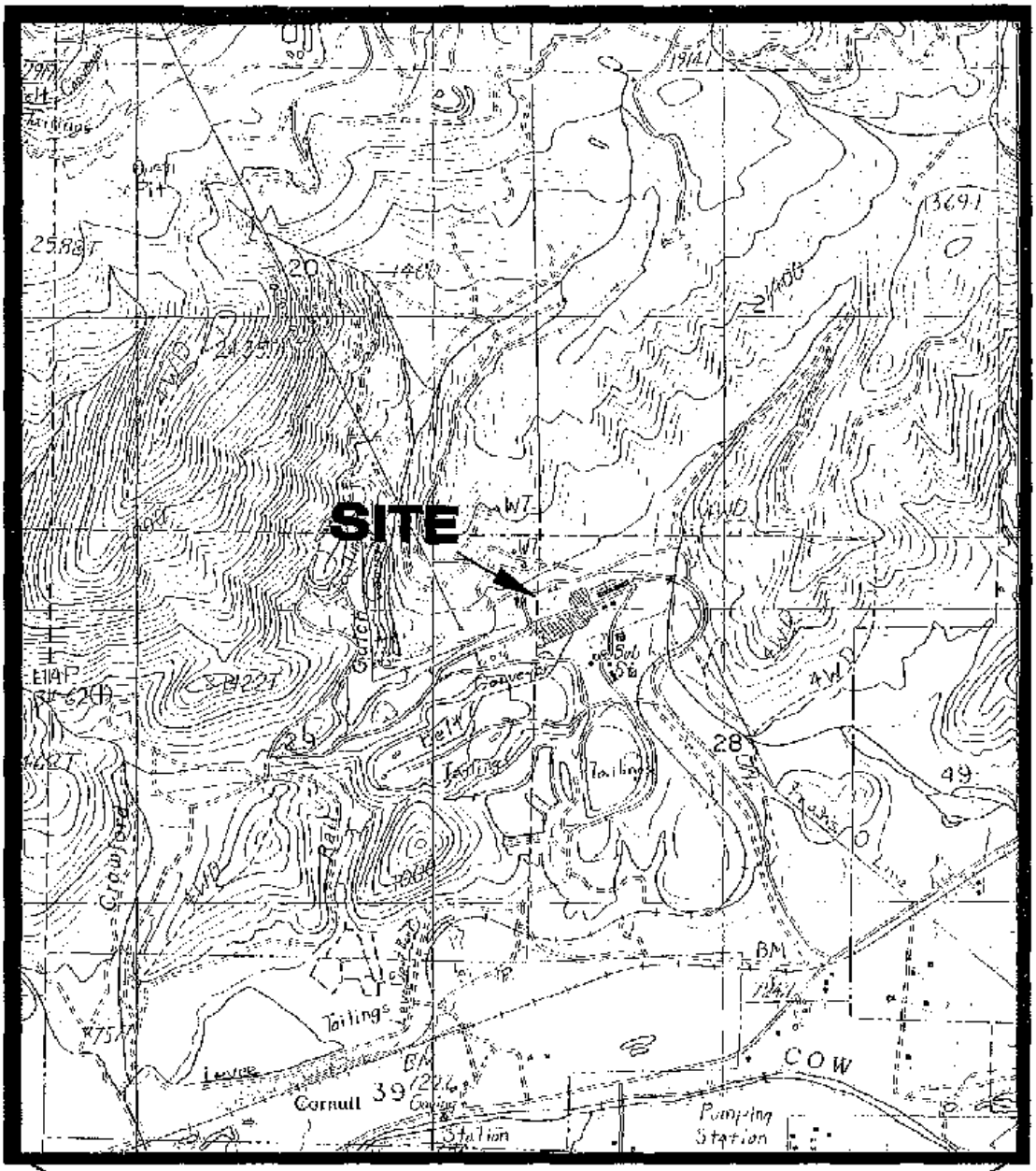
Area	Description	Media Sampled	No. of Samples	Analyses
17. Below Two Middle Ponds	Part of the NPDES Discharge system for the facility. Evaluate groundwater for levels of total and dissolved metals.	Groundwater	1	Metals
18. Below Lower Pond	Part of the NPDES Discharge System for the facility. Evaluate groundwater for levels of total and dissolved metals.	Groundwater	1	Metals
19. Below AST Area	Area downgradient from Diesel fuel and Bunker-C ASTs. Evaluate groundwater for impacts from the ASTs.	Groundwater	1	TPH-D PAHs Metals
20. BPA Substation	Bonneville Power Administration substation including transformers and capacitors. *Potential releases of PCBs from electrical equipment.*	Soil Equipment Wipe	60 6	PCBs TPH-D 1,1,1-TCA PCBs
21. Below New Caledonia Ore Pile	Area downgradient from New Caledonia Ore Pile. Evaluate groundwater for levels of total and dissolved metals.	Groundwater	1	Metals
22. New Caledonia Ore Pile	Stockpile of New Caledonia Ore northwest of smelter building. Evaluate ore for levels of total and dissolved metals.	Ore	3	Nickel Chromium Manganese
23. Shotting Water Tank	Location of former water storage tank, added as AOC. Not in original Confirmation Sampling Plan. *Potential impact by hydrocarbons observed during site sampling activities.*	Soil	1	TPH-D PAHs VOCs

Notes:

AST – Aboveground Storage Tank
UST – Underground Storage Tank
TPH-D – Total Petroleum Hydrocarbons – Diesel Fuel
TPH-G – Total Petroleum Hydrocarbons – Gasoline
PAH Polynuclear Aromatic Hydrocarbons
PCBs – Polychlorinated Biphenyls
BTEX – Benzene, Toluene, Ethylbenzene, Xylenes
VOCs – Volatile Organic Compounds

FIGURES

SOURCE: U.S. GEOLOGICAL SURVEY; 7.5 MINUTE SERIES (TOPOGRAPHIC)
NICKEL MOUNTAIN QUADRANGLE, OREGON; DATED 1986



GLENBROOK NICKEL - OREGON
DOUGLASS COUNTY, OREGON

AUGUST MACK ENVIRONMENTAL, INC.
2200 GREENE WAY
SUITE 100
LOUISVILLE, KENTUCKY
40220

SITE LOCATION MAP
RIDDLE

PROJECT NO: JA003.35
SCALE: -
FILENAME: JA003-1R
PLOT DATE: 6/00
FIGURE: 1

LEGEND FOR AREAS OF CONCERN

1 – SAND BLAST AREA
2 – LAB DRAIN LINE DISCHARGE
3 – FORMER SAND BLAST AREA
4 – SANITARY SAND FILTER BEDS
5 – GRANULATION LADLE TILT STATION HYDRAULIC SYSTEM
6 – LUBE OIL STORAGE SHED
7 – FERRO SILICON BAG HOUSE
8 – CALCINER LUBE OIL
9 – #3 DRYER
10 – DIESEL FUELING STATION AND LINE AREA
11 – AST AREA
12 – PILOT PLANT FUEL OIL TANK
13 – VEHICLE MAINTENANCE AND WASHDOWN AREA
14 – GENERATOR SHED
15 – USTs AT MINE SITE (OFF MAP)
16 – TEMPORARY GROUNDWATER WELL (NEAR CREEK)
17 – TEMPORARY GROUNDWATER WELL (OFF MAP AND BELOW MIDDLE PONDS)
18 – TEMPORARY GROUNDWATER WELL (OFF MAP AND BELOW LOWER POND)
19 – TEMPORARY GROUNDWATER WELL (BELOW ASTs)
20 – BPA SUBSTATION
21 – TEMPORARY GROUNDWATER WELL (ORE PILE)
22 – NEW CALEDONIA ORE PILE
23 – SHOTTING WATER TANK

DUST COLLECTORS
SHOP
OFFICE BUILDING
SMELTER BUILDING
BASIN
PARKING
PARKING
MATERIAL STORAGE

AUGUST MACK ENVIRONMENTAL, INC.
2200 GREENE WAY, SUITE 100
LOUISVILLE, KENTUCKY 40220

GLENBROOK NICKEL–OREGON
RIDDLE FACILITY

PROJECT No.:	FILENAME:	
JA036.15	JA036–2	
DRAWN BY: CCD	SCALE: 1=60	FIGURE: 2

SITE PLAN SHOWING ORIGINAL 23 AREAS OF CONCERN

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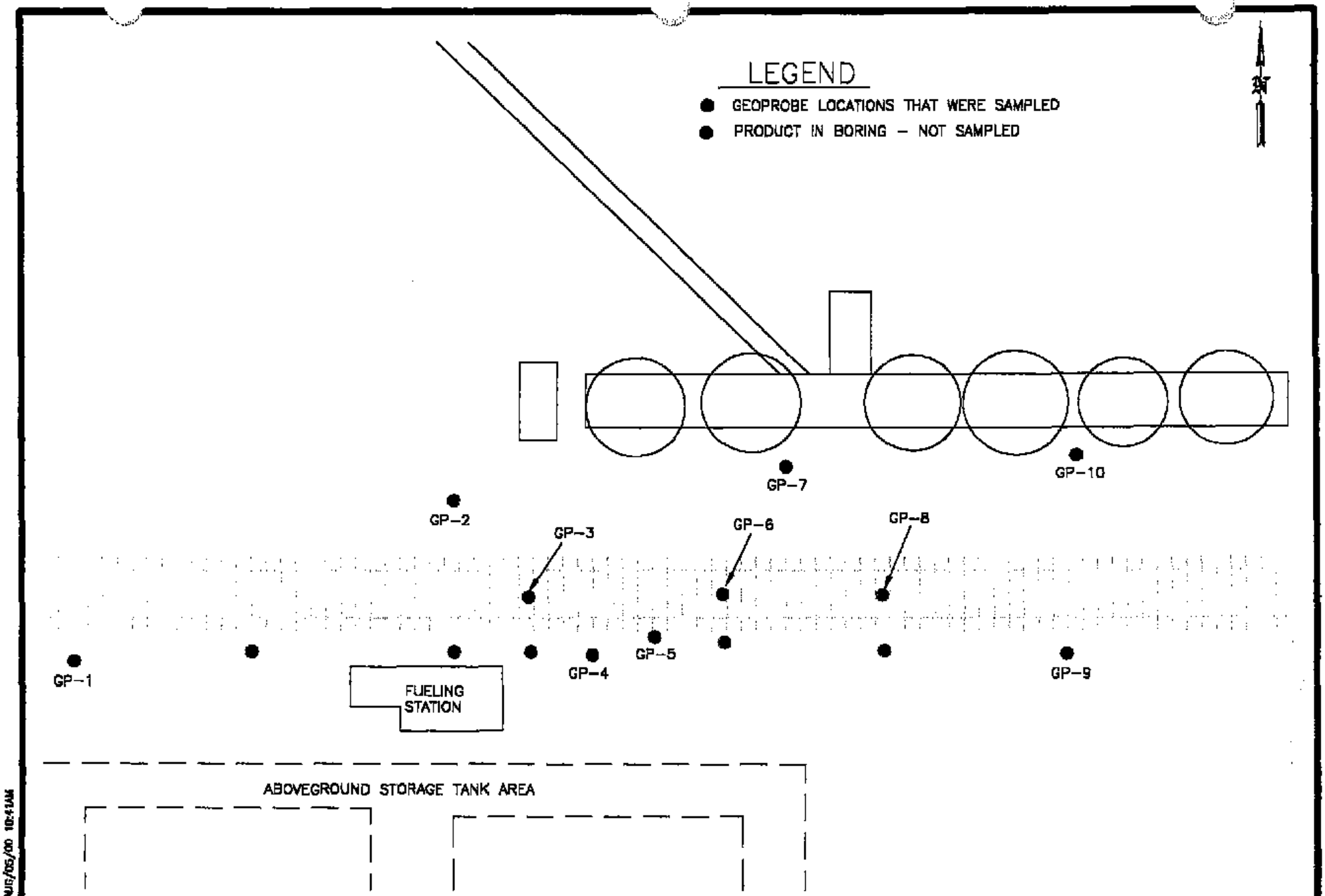

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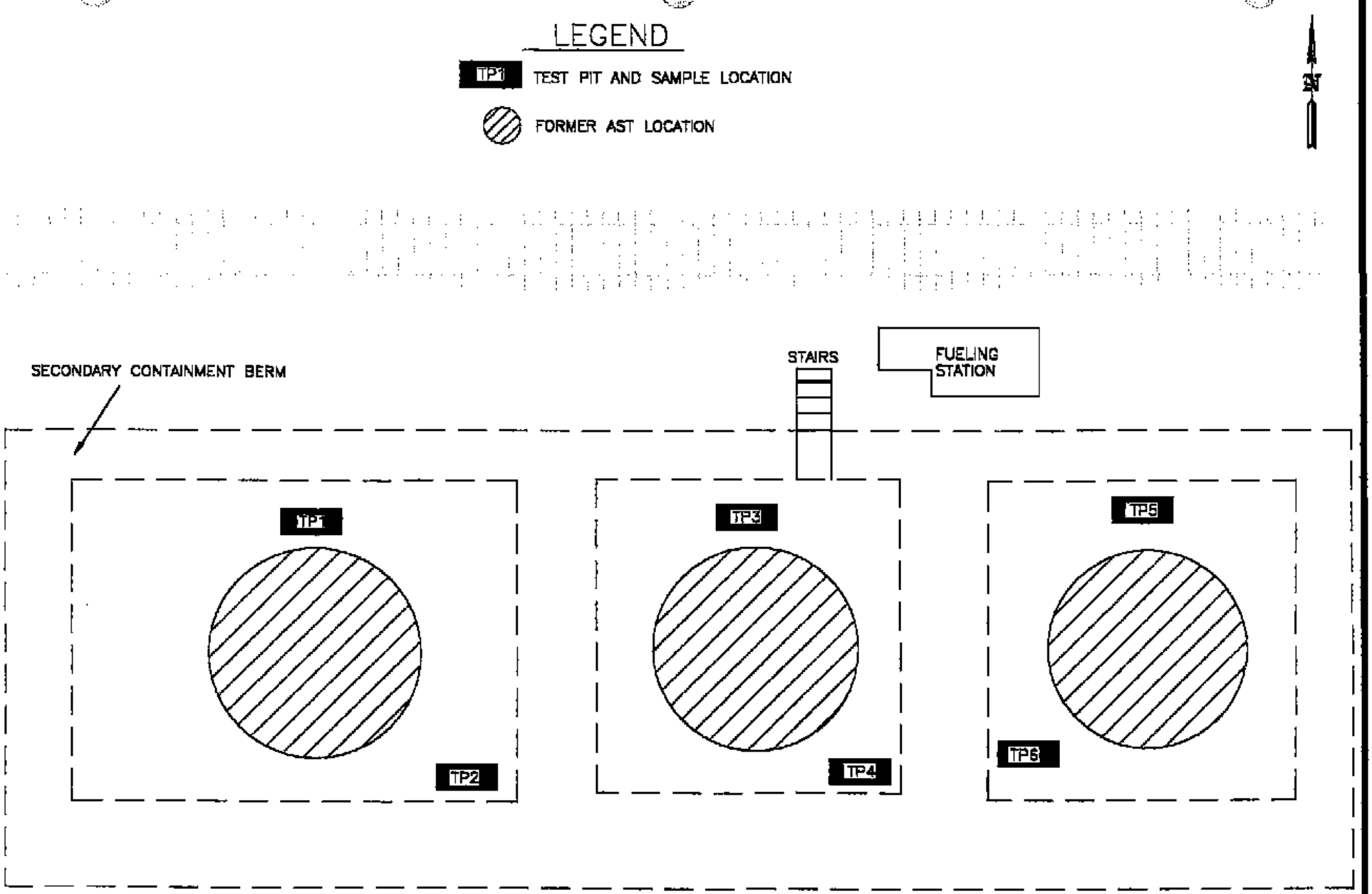

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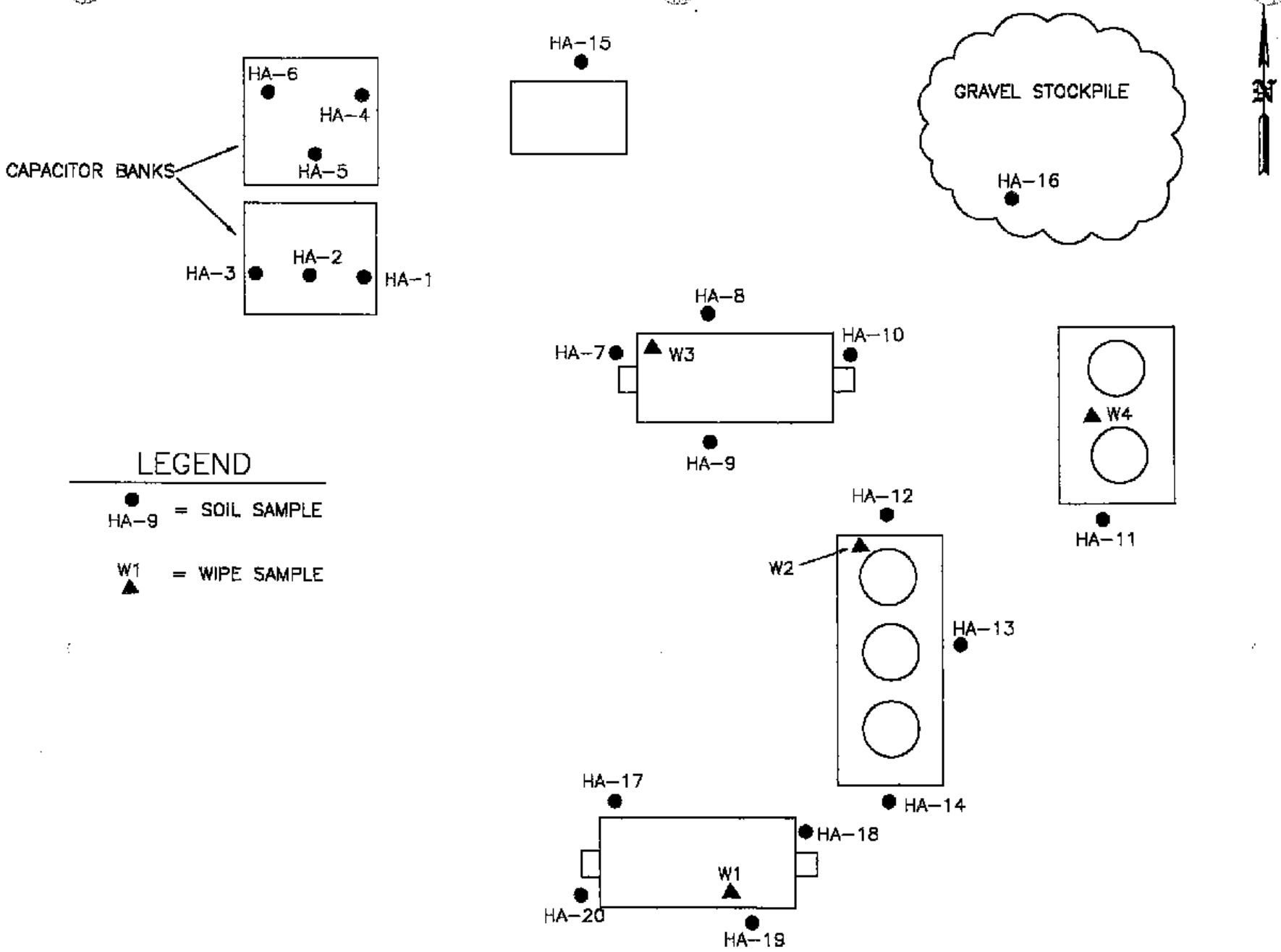
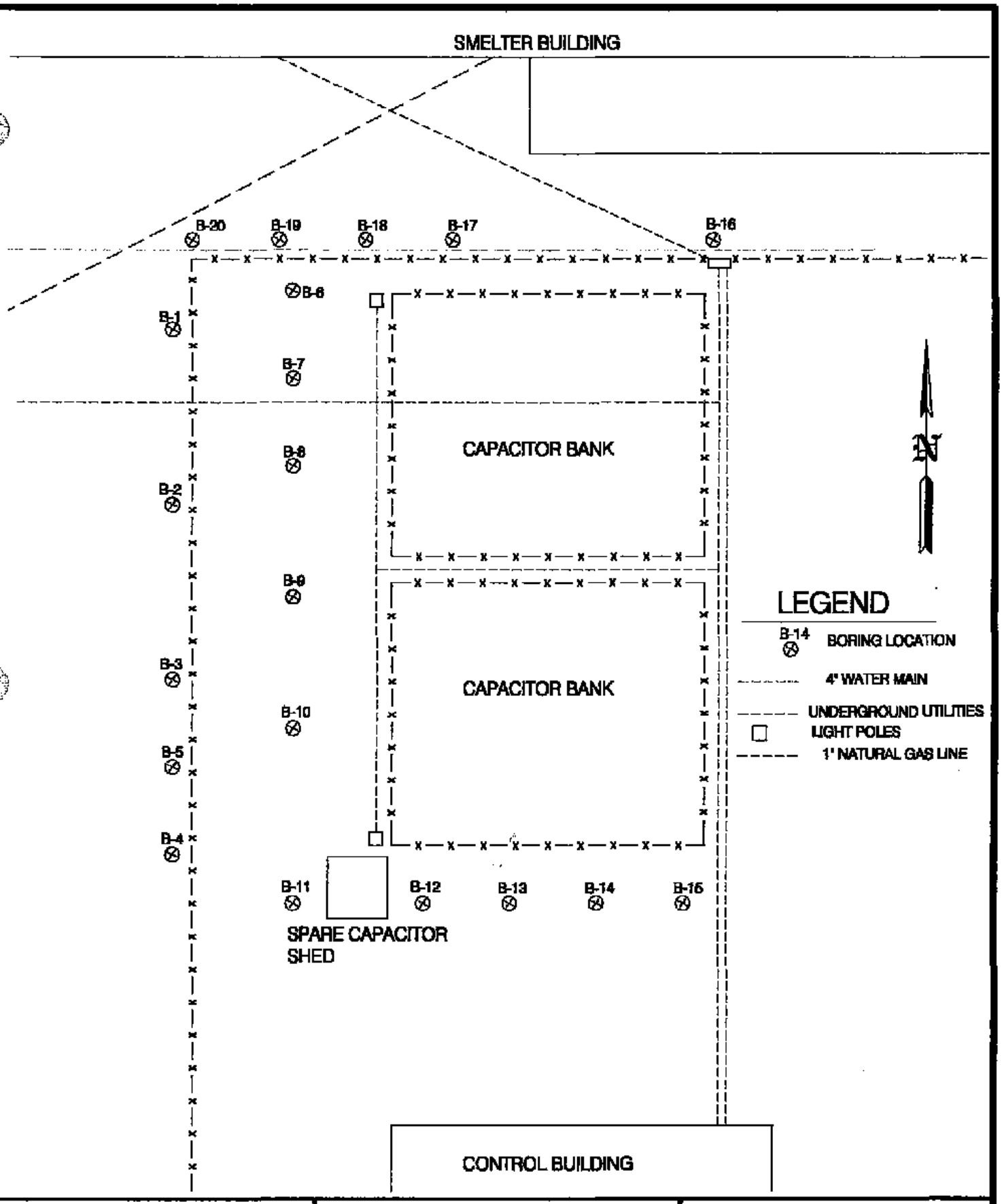
GLENBROOK NICKEL - OREGON RIDDLE FACILITY	AUGUST MACK ENVIRONMENTAL, INC. 2200 GREENE WAY, SUITE 100 LOUISVILLE, KENTUCKY 40220	FORMER ABOVEGROUND STORAGE TANK AREA	PROJECT No.: JA003.35	FILENAME: JA003-6	
			DRAWN BY: CCD	SCALE: -	FIGURE: 6



GLENBROOK NICKEL - OREGON RIDDLE FACILITY	AUGUST MACK ENVIRONMENTAL, INC. 2200 GREENE WAY, SUITE 100 LOUISVILLE, KENTUCKY 40220	BPA - SUBSTATION	PROJECT No.: JA003.35	FILENAME: JA003-7	
			DRAWN BY: CCD	SCALE: -	FIGURE: 7

PRINT DATE: AUG/09/00 10:47AM



GLENBROOK NICKEL - OREGON
RIDDLE FACILITY

AUGUST MACK ENVIRONMENTAL, INC.

2200 GREENE WAY
SUITE 100
LOUISVILLE, KENTUCKY
40220

BPA - CAPACITOR BANKS

PROJECT NO: JA003.35

SCALE: 1=15'

FILENAME: JA003-8

FIGURE: 8

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APPENDIX A

SAMPLING PROCEDURES

APPENDIX A

SAMPLING PROCEDURES

Samples of soil, sediment, groundwater, and nickel ore were collected from various areas of concern (AOCs) identified at Cominco's Riddle and Coos Bay, Oregon facilities. The purpose of the sampling activities was to identify which AOCs warranted further delineation or remediation, and which AOCs could be eliminated from further assessment. August Mack personnel used several sample collection methods; including shovels or hand augers for shallow soil samples, a *Geoprobe* drill rig to collect deeper soil and groundwater samples, and grab methods to collect surface samples. In some AOCs, test pits were excavated with a trackhoe and samples were collected from the trackhoe bucket. Sample locations were selected based on physical accessibility and spatial consistency.

Soil samples collected by the *Geoprobe* unit were field screened with a Photoionization Detector (PID) at two-foot intervals. The sample from the interval in each boring with the highest PID reading (or showing visual contamination) was selected for laboratory analysis. Consequently, the collected samples represent interpreted worst-case scenario conditions from a contamination standpoint. Soil samples collected with the trackhoe were selected from material near the center of the bucket that likely had not come into contact with the sides of the bucket. Groundwater samples collected by the *Geoprobe* were obtained through the *Geoprobe* rods using a vacuum pump and tygon tubing. The samples were filtered in the field to reduce turbidity.

Samples were collected in clean glass containers supplied by the laboratory. The containers were pre-labeled by August Mack field personnel. Disposable latex gloves were worn by August Mack personnel and were changed between uses at each sample location. Excess sample material was discarded at the sample location. Collected samples were immediately stored in an iced-cooler for transport to the laboratory. After the samples had all been collected, chain-of-custody documentation was completed and the cooler was sealed for transport to Umpqua Research Laboratory in Myrtle Creek, Oregon for analysis.

Samples were analyzed in the laboratory for a full suite of constituents including:

- Total and Dissolved Metals (USEPA Method 6010)
- Volatile Organic Compounds (USEPA Method 8260)
- Polynuclear Aromatic Hydrocarbons (USEPA Method 8310/8270)
- Total Petroleum Hydrocarbons (DEQ Methods TPH-G and TPH-D)
- Polychlorinated Biphenyls (USEPA Method 8082)

Decontamination procedures included washing sampling equipment with *Alconox* and rinsing with distilled water between each sample location. *Geoprobe* augers were steam-cleaned between each boring. Equipment used to collect samples for PCB analysis was decontaminated with hexane between each sample point.

For quality assurance/quality control (QA/QC) purposes, duplicate and trip blank samples were collected and analyzed by the laboratory. Umpqua Research Laboratory performed all preservation, handling, analysis, and QA/QC procedures in accordance with USEPA guidelines or equivalent methodology, where applicable.

APPENDIX B

BORING LOGS

SOIL TEST BORING FIELD REPORT

Boring No GP-1 A

Job No JA003 35 | Drilling Contractor Geotech | Page 1 of 1

Job Name Glenbrook Nickel | Inspector T.C. Tomes | Ground Surface Elev.

Date 4/26/00 (Riddle, OR) | Time - Rate (Cleaning, Etc.) Hrs. | Well Casing Elev.

Sampling					Time	Laboratory Sample	HNU Readings	Soil Classification
No.	Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"				
1	0-2.0				14:00			0-1.0 Light brown silty sandy CLAY with
								small gravels, dense
2	2.0-4.0				14:05			
								1.0-3.5 Blue light gray silty CLAY with
3	4.0-6.0							trace rock, dark brown oil pockets, lean,
								firm
4	6.0-8.0							
								3.5 Light brown and gray silty sandy CLAY
5	8.0-10.0							fat, trace small rocks, soft
					0			
								During pulling rods from 4-8.0' oil/water
								oozing from borehole
								Abandon hole due to raw oil
					5			
								Water/oil at 1.0'
								Boring terminated at 8.0'
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated: 8.0

Boring Refusal:

Water TOB Depth 1.0'

Water 24 Hr. Depth

Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud: W/Water. W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 8.0

Completion: Grout Backfill X Soil Backfill Well

AUGUST ASK

SOIL TEST BORING FIELD REPORT

AOC-R-10

Boring No. GP-1

Job No. JA003 35 | Drilling Contractor Geotech | Page 1 of 1

Job Name Glenbrook Nickel | Inspector T.C. Tomes | Ground Surface Elev.

Date 4/26/00 (Riddle, OR) | Time - Rate (Cleaning, Etc.) ____ Hrs | Well Casing Elev.

Sampling No.	Depth	"N" 1st 6"	2nd 6"	3rd 6"	Time	Laboratory Sample	HNU Readings	Soil Classification
1	0-2.0				2:20		2 ppm	0-2.0 Light brown and gray silty sandy CLAY with rock and gravel, dense
2	2.0-4.0				2:25	*	40 ppm	2.0-6.5 Orange light brown and gray, lean silty sandy CLAY, trace small rock, firm
3	4.0-6.0				2:30		7 ppm	
4	6.0-8.0				2:35		3 ppm	6.5-7.0 Light brown and gray silty clayey SAND, small gravels, loose
5	8.0-10.0						5 ppm	
					0			7.0-9.5 Red orange light brown and gray fat silty CLAY, trace small rocks moist, soft
								9.5-10.0 Blue light gray, fat silty CLAY, firm
					5			
								Boring dry TOB
								Boring terminated at 10.0'
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings ____ Disposition of Fluids ____

Boring Terminated: ____

Boring Refusal: ____

Water TOB Depth None

Water 24 Hr Depth ____

Water Losses ____

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud: W/Water: W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 10.0

Completion: Grout Backfill X Soil Backfill ____ Well ____

AUGUST ANDERSON

SOIL TEST BORING FIELD REPORT

AOC-R-10

Boring No. GP-2

Job No. JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T.C. Torres Ground Surface Elev.

Date 4/26/00 (Riddle, OR) Time - Rate (Cleaning, Etc.) Hrs. Well Casing Elev.

Sampling					Time	Laboratory Sample	HNU Readings	Soil Classification
No.	Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"				
1	0-2.0				14:50		2 ppm	0-0.6 Orange light brown silty CLAY
								firm (fill)
2	2.0-4.0				14:55		2 ppm	
								0.6-1.8 Orange light brown and gray lean
3	4.0-6.0				15:00		2 ppm	silty CLAY with trace small rocks, firm
4	6.0-8.0				15:05		2 ppm	1.8-7.5 Orange light brown and gray, fat
								silty CLAY with trace small rocks, firm
5	8.0-10.0				15:10	*	2 ppm	
					0			7.5-10.0 Orange light brown and gray
								lean, silty CLAY, dry, firm
								Boring terminated at 10.0'
					5			
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:

Boring Refusal:

Water TOB Depth None

Water 24 Hr Depth

Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud: W/Water: W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 10.0

Completion: Grout Backfill X Soil Backfill Well

AUGUST ACRE

SOIL TEST BORING FIELD REPORT

Boring No. GP-3

Job No. JA003.35 | Drilling Contractor Geolech | Page 1 of 1

Job Name Glenbrook Nickel | Inspector T.C. Tomes | Ground Surface Elev.

Date 4/26/00 (Riddle, OR) | Time - Rate (Cleaning, Etc.) Hrs. | Well Casing Elev.

Sampling					Time	Laboratory Sample	HNU Readings	Soil Classification
No.	Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"				
1	0-2.0				15:25		2 ppm	0-1.8 Light brown black and gray silty
								CLAY with gravel, dense, road bed
2	2.0-4.0				15:30		2 ppm	
								1.8-4.0 Orange light brown and gray
3	4.0-6.0				15:35		2 ppm	lean, silty CLAY, firm
4	6.0-8.0				15:40		2 ppm	4.0-10.0 Light brown and gray lean
								silty CLAY with trace shale fragments
5	8.0-10.0				15:45		4 ppm	and small rocks, firm
					0			Boring terminated at 10.0' Dry .
					5			
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:

Boring Refusal:

Water TOB Depth None

Water 24 Hr. Depth

Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud: W/Water: W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 10.0

Completion: Grout Backfill X Soil Backfill Well

AOC-R-10

SOIL TEST BORING FIELD REPORT

Boring No. GP-4

Job No. JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T.C. Tomes Ground Surface Elev.

Date 4/26/00 (Riddle, OR) Time - Rate (Cleaning, Etc.) Hrs. Well Casing Elev.

Sampling					Time	Laboratory Sample	HNU Readings	Soil Classification
No.	Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"				
1	0-2.0				15:55		1 ppm	0-1.0 Orange light brown and gray silty
								sandy CLAY with crushed stone, dense
2	2.0-4.0				16:00		1 ppm	
								1.0-3.0 Olive light gray lean silty CLAY
3	4.0-6.0				16:05		2 ppm	with shale fragments, dry, firm
4	6.0-8.0				16:10		1 ppm	3.0-10.0 Orange light brown and gray
								lean silty CLAY, firm, trace shale and
5	8.0-10.0				16:15		1 ppm	rock fragments
					0			
								Boring terminated at 10.0' Dry
					5			
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:

Boring Refusal:

Water TOB Depth None

Water 24 Hr Depth

Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud: W/Water: W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 10.0

Completion: Grout Backfill X Soil Backfill Well

AUGUST ACRE

SOIL TEST BORING FIELD REPORT

Boring No. AOC-R-10 GP-5

Job No. JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T.C. Tomes Ground Surface Elev.

Date 4/26/00 (Riddle, OR) Time - Rate (Cleaning, Etc.) Hrs. Well Casing Elev.

Sampling No.	Depth	"N" 1st 6"	2nd 6"	3rd 6"	Time	Laboratory Sample	HNU Readings	Soil Classification
1	0-2.0				16:20		11 ppm	0-0.5 Orange light brown silty CLAY
								with crushed stone, dense
2	2.0-4.0				16:25		90 ppm	
								0.5-4.0 Orange light brown and gray
3	4.0-6.0				16:30		70 ppm	lean silty CLAY, trace shale and rock
								fragments, firm
4	6.0-8.0				16:35		84 ppm	
								4.0 Olive gray light brown lean silty CLAY,
5	8.0-10.0				16:50		98 ppm	trace shale and small rock fragments, firm
					0			
								9.5-10.0 Light HC odor
								Boring dry
								Boring terminated at 10.0
					5			
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:

Boring Refusal:

Water TOB Depth None

Water 24 Hr. Depth

Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud: W/Water: W/Air	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 10.0

Completion: Grout Backfill X Soil Backfill Well

SOIL TEST BORING FIELD REPORT

Boring No. GP-6

Job No. JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T.C. Tomes Ground Surface Elev.

Date 4/26/00 (Riddle, OR) Time - Rate (Cleaning, Etc.) Hrs. Well Casing Elev.

Sampling					Time	Laboratory Sample	HNU Readings	Soil Classification
No.	Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"				
1	0-2.0				17:00		2 ppm	0-1.5 Light brown and gray silty CLAY
								with crushed stone, dense, road bed
2	2.0-4.0				17:05		2 ppm	between RR tracks
3	4.0-6.0				17:10		1 ppm	1.5-10.0 Orange light brown and gray lean
								silty CLAY, trace shale and rock fragments
4	6.0-8.0				17:15		2.5 ppm	firm, dry
5	8.0-10.0				17:20		2 ppm	Boring terminated at 10.0'

0

5

0

5

0

5

0

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:

Boring Refusal:

Water TOB Depth None

Water 24 Hr. Depth

Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud: W/Water: W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 10.0

Completion: Grout Backfill X Soil Backfill Well

AUGUST MACK

SOIL TEST BORING FIELD REPORT

AOC-R-10

Boring No. GP-7

Job No. JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T C. Tomes Ground Surface Elev.

Date 4/26/00 (Riddle, OR) Time - Rate (Cleaning, Etc.) Hrs. Well Casing Elev.

Sampling					Time	Laboratory Sample	HNU Readings	Soil Classification
No.	Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"				
1	0-2.0				17:25		18 ppm	0-1.2 Light brown and gray silty CLAY with crushed stone, dense road bed
2	2.0-4.0				17:30		0 ppm	1.2-2.7 Orange light brown and gray lean silty CLAY, trace shale and small rock fragments, firm
3	4.0-6.0				17:35		1 ppm	
4	6.0-8.0				17:40		0	2.7-4.2 Olive gray light brown lean silty CLAY with trace shale and rock fragments, firm
5	8.0-10.0				No Rec			4.2-8.0 Orange light brown and gray, fat silty CLAY, trace shale fragments
					0			Water in boring at 4.2
								No recovery 8.0-10.0 below water table
					5			pat clay
								Water at 1.5 TOB
					0			Boring terminated at 10.0'
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated: 10.0'

Boring Refusal:

Water TOB Depth 1.5'

Water 24 Hr. Depth

Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud: W/Water: W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 10.0

Completion: Grout Backfill X Soil Backfill Well

AUGUST MACK ENVIRONMENTAL, INC.

SOIL TEST BORING FIELD REPORT

AOC-R-10

Boring No GP-8

Job No. JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T.C. Tomes Ground Surface Elev.

Date 4/26/00 (Riddle, OR) Time - Rate (Cleaning, Etc.) Hrs. Well Casing Elev.

Sampling No.	Depth	"N" 1st 6"	2nd 6"	3rd 6"	Time	Laboratory Sample	HNU Readings	Soil Classification
1	0-2.0				18:10		0 ppm	0-0.8' Light brown silty CLAY with crushed stone, dense road bed between RR tracks
2	2.0-4.0				18:15		--	0.8-3.5 Orange light brown and gray lean silty CLAY, firm
3	4.0-6.0				18:20		--	
4	6.0-8.0				18:25		--	3.5-5.5 Orange light brown and gray fat, silty CLAY with trace shale and rock fragments, firm
5	8.0-10.0				18:30		--	
					0			5.5-10.0 Orange light brown and gray lean silty CLAY with trace shale and rock fragments, firm, dry
					5			Boring terminated at 10.0'
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:

Boring Refusal:

Water TOB Depth None

Water 24 Hr. Depth

Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud: W/Water: W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 10.0

Completion: Grout Backfill X Soil Backfill Well

AUGUST MINERALS

SOIL TEST BORING FIELD REPORT

AOC-R-10
Boring No GP-9

Job No. JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T.C. Tomes Ground Surface Elev

Date 4/26/00 (Riddle, OR) Time - Rate (Cleaning, Etc.) Hrs. Well Casing Elev.

Sampling					Time	Laboratory Sample	HNU Readings	Soil Classification
No.	Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"				
1	0-2.0				17:45		0 ppm	0-2.0 Orange light brown black and gray
								silty CLAY with crushed stone, dense
2	2.0-4.0				17:50		2.5 ppm	
								2.0-7.0 Olive gray light brown fat silty CLAY
3	4.0-6.0				17:55		80 ppm	with trace shale and rock fragments, firm
4	6.0-8.0				18:00		60 ppm	7.0-10.0 Orange light brown and gray fat
								silty CLAY , saturated with hydrocarbon
5	8.0-10.0				18:05		4 ppm	strong odor, moist
					0			
								Boring terminated at 10.0'
								Dry
					5			
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:
Boring Refusal:
Water TOB Depth None
Water 24 Hr Depth
Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud: W/Water: W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 10.0

Completion: Grout Backfill X Soil Backfill Well

AUGUST ACRE

SOIL TEST BORING FIELD REPORT

AOC-R-10
Boring No GP-10

Job No. JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T.C. Tomes Ground Surface Elev.

Date 4/26/00 (Riddle, OR) Time - Rate (Cleaning, Etc.) Hrs. Well Casing Elev.

Sampling No.	Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"	Time	Laboratory Sample	HNU Readings	Soil Classification
1	0-2.0				18:35		--	0-1.4 Light brown black and gray silty CLAY
								with crushed stone, dense
2	2.0-4.0				18:40		0 ppm	
								1.4-6.5 Orange light brown and gray lean
3	4.0-6.0				18:45		--	silty CLAY , trace shale and rock fragments,
								firm
4	6.0-8.0				18:50		25 ppm	
								6.5-8.0 Olive gray light brown, fat silty CLAY
5	8.0-10.0				18:55		12 ppm	with trace shale and rock fragments, firm
					0			
								8.0-10.0 Reddish dark brown and gray lean
								silty CLAY with trace shales and rock
								fragments, firm
					5			Boring terminated at 10.0
								Dry
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:
Boring Refusal.
Water TOB Depth Dry
Water 24 Hr. Depth
Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud, W/Water: W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 10.0

Completion: Grout Backfill X Soil Backfill Well

AOC-R-10

SOIL TEST BORING FIELD REPORT

Boring No. GP-11

Job No JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T.C. Tomes Ground Surface Elev.

Date 4/27/00 (Riddle, OR) Time - Rate (Cleaning, Etc.) Hrs. Well Casing Elev.

Sampling					Time	Laboratory Sample	HNU Readings	Soil Classification
No.	Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"				
						Water		Probe to 10.0'
								Obtain water samples
								Water at 2.3' TOB
								Boring terminated at 10.0
					0			
					5			
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:

Boring Refusal:

Water TOB Depth 2.3'

Water 24 Hr. Depth

Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud, W/Water W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 10.0

Completion: Grout Backfill X Soil Backfill Well

AUGUST ASK

SOIL TEST BORING FIELD REPORT

AOC-R-19
Boring No. GP-12

Job No. JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T.C. Tomes Ground Surface Elev.

Date 4/27/00 (Riddle, OR) Time - Rate (Cleaning, Etc.) Hrs. Well Casing Elev.

Sampling					Time	Laboratory Sample	HNU Readings	Soil Classification
No.	Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"				
						Water		Probe to 20.0'
								Pull rods back to 12.0'
								Water up to 6.0'
								Boring terminated at 20'
					0			
					5			
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:
Boring Refusal:
Water TOB Depth 6.0'
Water 24 Hr. Depth
Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill. W/Mud: W/Water: W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 20.0

Completion: Grout Backfill X Soil Backfill Well

AUGUST ASK

SOIL TEST BORING FIELD REPORT

AOC-R-14
Boring No. GP-13

Job No. JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T.C. Tomes Ground Surface Elev

Date 4/28/00 (Riddle, OR) Time - Rate (Cleaning, Etc.) Hrs. Well Casing Elev.

Sampling					Time	Laboratory Sample	HNU Readings	Soil Classification
No.	Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"				
1	0-2.0				9:35		4 ppm	0-0.2 Gray silty SAND, brown gravel
2	2.0-4.0				9:40		4 ppm	Gray silty SAND, silty CLAY, green gravel
3	4.0-6.0				9:45		9.5 ppm	2'-4'
								4-6' Brown fat CLAY
					0			
					5			
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:

Boring Refusal:

Water TOB Depth None

Water 24 Hr. Depth

Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud: W/Water: W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 6.0

Completion: Grout Backfill X Soil Backfill Well

AOC-R-4

SOIL TEST BORING FIELD REPORT

Boring No GP-14

Job No. JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T.C. Tomes Ground Surface Elev.

Date 4/28/00 (Riddle, OR) Time - Rate (Cleaning, Etc.) Hrs. Well Casing Elev.

Sampling					Time	Laboratory Sample	HNU Readings	Soil Classification
No.	Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"				
1	9.0-11.0				10:35	*		0-0.5 Thumb size pea gravel coarse
								0.5 Medium clean SAND, very dense
								9.0-10.0 Orange light brown and gray
								fat silty CLAY, soft
								10.0-12.0 Orange light brown lean silty
								CLAY, firm
					0			
								12.0-13.0' Orange light brown and gray
								fat clayey SILT, firm
					5			
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:

Boring Refusal:

Water TOB Depth None

Water 24 Hr. Depth

Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud: W/Water: W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 13.0

Completion. Grout Backfill X Soil Backfill Well

AUGUST ACRES

SOIL TEST BORING FIELD REPORT

Boring No AUG-R-4 GP-15

Job No. JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T C. Tomes Ground Surface Elev.

Date 4/28/00 (Riddle, OR) Time - Rate (Cleaning, Etc.) Hrs. Well Casing Elev.

Sampling					Time	Laboratory Sample	HNU Readings	Soil Classification
No.	Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"				
1	6.0-10.0				10:55	*		0-0.5 Large crushed stone
								0.5-8.0 Medium clean greenish loose
								SAND
								8.0 Orange light brown and gray fat silty
								CLAY, firm
								GP - 6.0' soft
					0			Sample 6.0-10.0'
								Boring terminated at 10'
					5			
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:

Boring Refusal:

Water TOB Depth None

Water 24 Hr. Depth

Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud: W/Water: W/Air.	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 10.0

Completion: Grout Backfill X Soil Backfill Well

SOIL TEST BORING FIELD REPORT

Boring No. AOC-R-13 GP-16

Job No. JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T.C. Tomes Ground Surface Elev.

Date 4/26/00 (Riddle, OR) Time - Rate (Cleaning, Etc.) Hrs Well Casing Elev.

Sampling No.	Depth	"N" 1st 6"	2nd 6"	3rd 6"	Time	Laboratory Sample	HNU Readings	Soil Classification
1	0-2.0				8:05		25 ppm	0-1.2 Dark red orange sandy silty CLAY
								with crushed stone, dense
2	2.0-4.0				8:10	*	12 ppm	
								1.2-10.0 Orange light brown and gray
3	4.0-6.0				8:15		8.5 ppm	lean silty CLAY, trace shale/rock
								fragments, firm
4	6.0-8.0				8:20		12 ppm	
								clays fat 4.0-10.0
5	8.0-10.0				8:25		13 ppm	
					0			Boring terminated at 10.0'
								Dry
					5			
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated: 10.0'

Boring Refusal:

Water TOB Depth None

Water 24 Hr. Depth

Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud. W/Water: W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 10.0

Completion: Grout Backfill X Soil Backfill Well

AUGUST MACK ENVIRONMENTAL, INC.

SOIL TEST BORING FIELD REPORT

Boring No. AOC-R-13 GP-17

Job No. JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T.C. Tomes Ground Surface Elev. ____

Date 4/28/00 (Riddle, OR) Time - Rate (Cleaning, Etc.) ____ Hrs. Well Casing Elev. ____

Sampling No.	Depth	"N" 1st 6"	2nd 6"	3rd 6"	Time	Laboratory Sample	HNU Readings	Soil Classification
1	0-2.0					No rec	--	0-0.2 Asphalt
2	2.0-4.0				8:30		14 ppm	0.2-2.0 Crushed stone
3	4.0-6.0				8:35		13 ppm	2.0-4.0 Olive gray light brown fat silty CLAY with trace shale/rock fragments,
4	6.0-8.0				8:40		13 ppm	firm
5	8.0-10.0				8:45		13 ppm	4.0-10.0 Orange light brown and gray lean silty CLAY, trace shale and rock fragments, firm
					0			
								Fat clays at 6.0'
								Boring terminated at 10.0
					5			Dry
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings ____ Disposition of Fluids ____

Boring Terminated: ____

Boring Refusal: ____

Water TOB Depth None

Water 24 Hr. Depth ____

Water Losses ____

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud W/Water W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 10.0

Completion: Grout Backfill X Soil Backfill ____ Well ____

AUGUST ACRE

SOIL TEST BORING FIELD REPORT

Boring No. AOC-R-13 GP-18

Job No. JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T.C. Tomes Ground Surface Elev.

Date 4/28/00 (Riddle, OR) Time - Rate (Cleaning, Etc.) Hrs. Well Casing Elev.

Sampling					Time	Laboratory Sample	HNU Readings	Soil Classification
No.	Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"				
1	0-2.0				8:40	No rec	11 ppm	0-0.2 Asphalt
2	2.0-4.0				8:45		13 ppm	0.2-1.0 Crushed stone
3	4.0-6.0				8:50		13.5 ppm	1.0-10.0 Orange light brown and gray fat silty CLAY, trace shale and rock
4	6.0-8.0				8:55		11 ppm	fragments, firm
5	8.0-10.0				9:00		13 ppm	Boring terminated at 10.0
					0			Dry
					5			
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:

Boring Refusal:

Water TOB Depth: None

Water 24 Hr. Depth

Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud; W/Water; W/Air.	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 10.0

Completion: Grout Backfill X Soil Backfill Well

AUGUST JACK

SOIL TEST BORING FIELD REPORT

AOC-R-13

Boring No. GP-19

Job No. JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T.C. Tomes Ground Surface Elev.

Date 4/28/00 (Riddle, OR) Time - Rate (Cleaning, Etc.) Hrs. Well Casing Elev.

Sampling					Time	Laboratory Sample	HNU Readings	Soil Classification
No.	Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"				
1	0-2.0				9:00	No rec	0 ppm	0-0.2 Asphalt
2	2.0-4.0				9:05	*	2 ppm	0.2-3.5 Crushed stone, dark red silty CLAY, dense
3	4.0-6.0				9:10		3 ppm	
								3.5-3.8 Light brown and gray medium
4	6.0-8.0				9:15		1 ppm	SAND sense, moist
5	8.0-10.0				9:20		1.5 ppm	3.8-10.0 Orange light brown and gray lean silty CLAY, trace shale and rock fragments, firm
					0			
								Fat clays at 6.0-10.0
								Boring terminated at 10.0
					5			Dry
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:

Boring Refusal:

Water TOB Depth None

Water 24 Hr. Depth

Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud: W/Water: W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 10.0

Completion: Grout Backfill X Soil Backfill Well

AUGUST JACK

SOIL TEST BORING FIELD REPORT

AOC-C-1
Boring No. GP-1

Job No JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T. C. Tomes Ground Surface Elev.

Date 4/25/00 (Coos Bay) Time - Rate (Cleaning, Etc.) Hrs. Well Casing Elev.

Sampling					Time	Laboratory Sample	HNU Readings	Soil Classification
No.	Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"				
1	0-2.0				11:55		3 ppm	0-0.4 Gravels/dark brown silty CLAY
2	2.0-4.0				12:00		6 ppm	0.4-1.0 Light brown fine lean SAND
3	4.0-6.0				12:05		13. 5 ppm	1.0-3.0 Red orange light brown and gray silty CLAY, fat, firm
4	6.0-8.0				No rec			3.0-4.0 Dark gray clayey lean silt wet
					0			4.0-8.0 Wood chips saturated wet no soil sample
					5			Water come up to 1.4' 12:15 Grab water samples using vacuum pump through geoprobe rods
					0			PAH 8310 Metals total Dissolved metals field filter in line 0.45 micron VOCs 8260
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:
Boring Refusal:
Water TOB Depth 1.4'
Water 24 Hr. Depth
Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud: W/Water: W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 8.0

Completion: Grout Backfill X Soil Backfill Well

SOIL TEST BORING FIELD REPORT

Boring No. GP-2

Job No. JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T.C. Tomes Ground Surface Elev.

Date 4/25/00 (Coos Bay) Time - Rate (Cleaning, Etc.) Hrs. Well Casing Elev.

Sampling					Time	Laboratory Sample	HNU Readings	Soil Classification
No.	Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"				
1	0-2.0				13:25	*	20 ppm	0-2.0 Orange light brown and gray sandy silty CLAY with gravel, fill, dense
2	2.0-4.0				13:30		18 ppm	2.0-3.8 Light bluish gray clayey fine sandy
3	4.0-6.0				13:35		19 ppm	SILT
4	6.0-8.0				13:40		18 ppm	3.8-4.5 Orange light brown and gray lean silty sandy CLAY, firm, saturated wet at 4.0
								4.5-6.5 Dark brown and black clayey silt lean soft
								6.5-8.0 Light brown wood chips
								Boring terminated at 8.0
								Water up to 1.9' 13:42

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:

Boring Refusal:

Water TOB Depth 1.9'

Water 24 Hr. Depth

Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud: W/Water: W/Air.	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 8.0

Completion: Grout Backfill X Soil Backfill Well

AUGUST JADE

SOIL TEST BORING FIELD REPORT

AOC-C-1
Boring No. GP-3

Job No. JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T.C. Tomes Ground Surface Elev.

Date 4/25/00 (Coos Bay) Time - Rate (Cleaning, Etc.) Hrs. Well Casing Elev.

Sampling					Time	Laboratory Sample	HNU Readings	Soil Classification
No	Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"				
1	0-2.0				12:40		0 ppm	0-0.9 Light orange brown and gray gravely
								silty CLAY, dense
2	2.0-4.0				12:45		6 ppm	
								0.9-1.0 Light brown clean SAND, wet
3	4.0-6.0				12:50		14 ppm	
								1.0-1.2 Light brown wood chips
4	6.0-8.0				12:55		7 ppm	
								1.2-3.8 Light greenish gray clayey SILT
								with fine sand lenses
					0			
								3.8 Light gray clayey silt with fine greenish
								sand lenses, very soft, saturated wet,
								rainbow speck sheen on water
					5			Water 15 1.8' TOB 13:10
								13:10 grab water samples through rods
								Duplicate VOCs
								VOCs 8260
					0			PAH 8270
								Total metals
								Dissolved metals field filtered
								11:00 Fake time on duplicate
					5			
								Soils metals
								As, Cd, Cr, Pb, Mn, Hg, Ni
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:

Boring Refusal:

Water TOB Depth 1.8'

Water 24 Hr. Depth

Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill. W/Mud: W/Water: W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 8.0

Completion: Grout Backfill X Soil Backfill Well

AUGUST

SOIL TEST BORING FIELD REPORT

Boring No. AUC-C-1 GP-4

Job No. JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T.C. Tomes Ground Surface Elev.

Date 4/25/00 (Coos Bay) Time - Rate (Cleaning, Etc.) Hrs. Well Casing Elev.

Sampling No.	Depth	"N" 1st 6"	2nd 6"	3rd 6"	Time	Laboratory Sample	HNU Readings	Soil Classification
1	0-2.0				13:45	*	65 ppm	0-0.7 Orange light brown sandy CLAY
								with gravels, dense
2	2.0-4.0				13:50		20 ppm	
								0.7-2.0 Gray light brown silty sand CLAY
3	4.0-6.0							lean, firm
4	6.0-8.0							2.0-3.6 Dark brown clayey SILT, lean, firm
								3.6-4.0 Dark brown and black wood chips,
					0			wet
								Boring terminated at 4.0'
								Water at 1.7' 13:50
					5			
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:

Boring Refusal.

Water TOB Depth 1.7'

Water 24 Hr. Depth

Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud: W/Water: W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	C TO 4.0

Completion: Grout Backfill X Soil Backfill Well

AUG-07

SOIL TEST BORING FIELD REPORT

Boring No. GP-5

Job No. JA003.35 | Drilling Contractor Geotech | Page 1 of 1

Job Name Glenbrook Nickel | Inspector T.C. Tomes | Ground Surface Elev.

Date 4/25/00 (Coos Bay) | Time - Rate (Cleaning, Etc) Hrs. | Well Casing Elev.

Sampling					Time	Laboratory Sample	HNU Readings	Soil Classification
No.	Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"				
1							Water	15:15 Water samples
								Ni, Cr, Mn, Fe
								Metals
								Total & Dissolved
								Field Filter Dissolved
								GP to 14.0
								Screen to 13
					0			Water at 6.5'
					5			
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:

Boring Refusal

Water TOB Depth 6.5'

Water 24 Hr. Depth

Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill. W/Mud: W/Water: W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 14.0

Completion. Grout Backfill X Soil Backfill Well

AUGUST ASK

SOIL TEST BORING FIELD REPORT

Boring No. AOC-C-6 GP-6

Job No. JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T.C. Tomes Ground Surface Elev.

Date 4/25/00 (Coos Bay) Time - Rate (Cleaning, Etc.) Hrs. Well Casing Elev.

Sampling					Time	Laboratory Sample	HNU Readings	Soil Classification
No.	Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"				
1							Water	15:45 Water sample
								Metals Ni, Cr, Mn, Fe
								Total & Dissolved
								Probe to 12'
								Water at 10.5 15:45
								5.8 16:10
					0			
					5			
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:

Boring Refusal:

Water TOB Depth 5.8'

Water 24 Hr. Depth

Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud: W/Water: W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 12.0

Completion Grout Backfill X Soil Backfill Well

AUGUST ASK

SOIL TEST BORING FIELD REPORT

AOC-C-5
Boring No. GP-7

Job No JA003.35 | Drilling Contractor Geotech | Page 1 of 1

Job Name Glenbrook Nickel | Inspector T.C. Tomes | Ground Surface Elev.

Date 4/25/00 (Coos Bay) | Time - Rate (Cleaning, Etc.) Hrs. | Well Casing Elev.

Sampling					Time	Laboratory Sample	HNU Readings	Soil Classification
No.	Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"				
1							Water	Probe to 12.0 BT
								Water up to 4.3'
								16:55 sample water
								5 metals Ni, Cr, Mn, Ag, Al
								Total/dissolved filtered in field
					0			
					5			
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:
Boring Refusal:
Water TOB Depth: 4.3'
Water 24 Hr. Depth
Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud: W/Water. W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 12.0

Completion: Grout Backfill X Soil Backfill Well

SOIL TEST BORING FIELD REPORT

Boring No. GP-8

Job No JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T.C. Tomes Ground Surface Elev

Date 4/25/00 (Coos Bay) Time - Rate (Cleaning, Etc.) Hrs. Well Casing Elev

Sampling					Time	Laboratory Sample	HNU Readings	Soil Classification
No.	Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"				
1							Water	Geoprobe to water at 3.9'
								17:30 sample water
								5 metals Ni, Cr, Mn, Ag, Al
								Very dense to 9.5'
								9.5-14.0 soft
					0			Pulled rods back to 10.0
								Artisan water flow/methane gas ?
								No reading HNU approx. 3 min.
								boring terminated at 14.0
					5			
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:

Boring Refusal

Water TOB Depth 3.9'

Water 24 Hr. Depth

Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud W/Water W/Air	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 14.0

Completion: Grout Backfill X Soil Backfill Well

AUGUST MACK ENVIRONMENTAL, INC.

SOIL TEST BORING FIELD REPORT

AOC-C-2
Boring No. GP-9

Job No. JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T.C. Tomes Ground Surface Elev.

Date 4/25/00 (Coos Bay) Time - Rate (Cleaning, Etc.) Hrs. Well Casing Elev.

Sampling					Time	Laboratory Sample	HNU Readings	Soil Classification
No.	Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"				
1							Water	GP to 12.0
								Water at 7.0 TOB
								18:05 sample water 7 metals
								total/dissolved
								pH, nitrate nitrogen
								Kjeldahl nitrogen
					0			
					5			
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:
Boring Refusal:
Water TOB Depth 7.0'
Water 24 Hr. Depth
Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill: W/Mud, W/Water: W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 12.0

Completion: Grout Backfill X Soil Backfill Well

AOC-C-2

SOIL TEST BORING FIELD REPORT

Boring No. GP-10

Job No. JA003.35 Drilling Contractor Geotech Page 1 of 1

Job Name Glenbrook Nickel Inspector T.C Tomes Ground Surface Elev.

Date 4/25/00 (Coos Bay) Time - Rate (Cleaning, Etc.) Hrs Well Casing Elev.

Sampling					Time	Laboratory Sample	HNU Readings	Soil Classification
No.	Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"				
1							Water	GP to 12'
								Water at 4.3'
								18:35 sample water
								7 metals total/dissolved
								Field Filtered
								nitrate nitrogen
								Kjeldahl nitrogen
					0			
								pH
								Light ammonia NH_3 odor on water
					5			
					0			
					5			
					0			
					5			
					0			

Disposition of Cuttings

Disposition of Fluids

Boring Terminated:

Boring Refusal:

Water TOB Depth 4.3'

Water 24 Hr. Depth

Water Losses

Method of Advancing Boring	Depth
Hollow Stem Auger	TO
Rotary Drill. W/Mud: W/Water: W/Air:	TO
Diamond Core (Size)	TO
Hand Auger	TO
Geoprobe	0 TO 12.0

Completion: Grout Backfill X Soil Backfill Well

APPENDIX C

LABORATORY REPORTS – CHEMICAL ANALYSES

UMPQUA Research Company
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Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
Source Name:
Sampled At:

Date Reported: 05/19/00
Date Collected: 04/28/00
Time Collected: 14:15-14:30
Sampled By: AME/TT/DK

COMINCO Ltd., Glenbrook Operation
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

GNC Riddle
JA003.35

Invoice#
2744

Total Lead

Matrix: Soil

URC Sample#	Units	URC Sample #: 200428-57 / Sample ID: HA-29 Results	URC Sample #: 200428-58 / Sample ID: HA-30 Results	URC Sample #: 200428-59 / Sample ID: HA-31 Results	Method	Date Analyzed	Analyst
Total Lead	mg/kg	6.27	0.866	0.865	EPA 6010	05/05/00	JMR

= Maximum Contaminant Level
= None Detected At Level Indicated

Approved By:

200428-57-59

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/30/00
Date Collected: 04/28/00
Time Collected: 3:30 PM
Sampled By: TCT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	SG-1
Riddle, OR 97469	Invoice# 2744

Metals #1 — Matrix: Soil

URC Sample #: 200428-72
Sample ID: SG-1

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
TOTAL METALS						
Arsenic	EPA 7060	0.771	mg/kg		05/10/00	JMR
Cadmium	EPA 6010	ND@0.01	mg/kg		05/03/00	JMR
Chromium	EPA 6010	1270	mg/kg		05/03/00	JMR
Lead	EPA 200.9	2.02	mg/kg		05/05/00	JMR
Manganese	EPA 200.9	622	mg/kg		05/03/00	JMR
Mercury	EPA 7470	6.62	mg/kg		05/19/00	JMR
Nickel	EPA 200.9	8480	mg/kg		05/03/00	JMR

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-72

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/28/00
Time Collected: 3:50 PM
Sampled By: TCT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	SG-1 Grab
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2745

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200428-72
Sample ID: SG-1

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-72pah

URC QUA Research Company
626 N.E. Division St. Myrtle Creek, OR 97457
Phone: (541) 863-5201 – Fax: (541) 863-6199

OREGON STATE CERTIFIED LAB #015

Date Received: 04/26/00

COMINCO Ltd., Glenbrook Operations
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

Date Reported: 05/31/00
Results in (ppb)
Method: EPA 8260B

Volatile Organic Compounds - GC/MS - 8260B

URC Sample #	200428-54	200428-72	200428-78	200428-86	200504-1
Sample ID	GP-19 2'-6'	SG-1 Grab	HA-26	PW-1	Shedding
Matrix	Soil	Soil	Soil	Water	Water tank
MONITORING COMPOUNDS					
Fluorobenzene	109.6%	99.6%	95.4%	116.9%	89.8%
2-Bromo-1-chloropropane	104.6%	109.8%	94.5%	114.3%	83.5%
Dichlorodifluoromethane	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0
Chloromethane	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0
Vinyl chloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromomethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chloroethane	ND@5.0	ND@5.0	82.9	ND@5.0	ND@5.0
Trichlorofluoromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Acetone	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0
1,1-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Methylene chloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Acrylonitrile	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
trans-1,2-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1-Dichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Methyl ethyl ketone	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0
cis-1,2-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
2,2-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chloroform	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromochloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,1-Trichloroethane	ND@1.0	ND@1.0	3.2	ND@1.0	ND@1.0
1,2-Dichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1-Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Carbon tetrachloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Benzene	ND@1.0	ND@1.0	2.8	ND@1.0	ND@1.0
Trichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Dibromomethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromodichloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
cis-1,3-Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Toluene	ND@1.0	ND@1.0	3.0	1.4	ND@1.0
Units:	ug/kg	ug/kg	ug/kg	ug/L	ug/L

ND = None Detected

626 N.E. Division St. Myrtle Creek, OR 97457
Phone: (541) 863-5201 - Fax: (541) 863-6199

Volatile Organic Compounds - GC/MS - 8260B

URC Sample #	200428-54	200428-72	200428-78	200428-86	200504-1
Sample ID	GP-19 2'-6'	SG-1 Grab	HA-26	PW-1	Shedding
Matrix	Soil	Soil	Soil	Water	Water tank
trans-1,3-Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,2-Trichloroethane	ND@1.0	ND@1.0	18.1	ND@1.0	ND@1.0
1,3-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Dibromochloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Tetrachloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dibromoethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,1,2-Tetrachloroethane	ND@1.0	ND@1.0	1.5	ND@1.0	ND@1.0
Ethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
m,p-Xylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Styrene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
o-Xylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromoform	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,2,2-Tetrachloroethane	ND@1.0	ND@1.0	7.1	ND@1.0	ND@1.0
1,2,3-Trichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
n-Propylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
2-Chlorotoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
4-Chlorotoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3,5-Trimethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
tert-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,4-Trimethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
sec-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,4-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
4-Isopropyltoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
n-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dibromo-3-chloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,4-Trichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Naphthalene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,3-Trichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Cyclohexanes & derivatives			>500		
Various Alkanes			>200		
Units:	ug/kg	ug/kg	ug/kg	ug/kg	ug/L
Analysis Date:	5/8/00	5/8/00	5/8/00	5/8/00	5/8/00
Analyst:	BKO	BKO	BKO	BKO	BKO

ND = None Detected

Approved By:

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015 PWS#: Source Name: Sampled At:	Date Reported: 05/19/00 Date Collected: 04/28/00 Time Collected: 14:10-14:20 Sampled By: TCT/DK
COMINCO Ltd., Glenbrook Operation P.O. Box 85 5093 Riddle By-pass Road Riddle, OR 97469	HA-28 Grab GNC Riddle JA003.35 Invoice# 2745
Total Lead	Matrix: Soil

		Analyte: Total Lead Code/Method: EPA 6010 Units: mg/kg
URC Sample#	Sample ID	Results
200428-79	HA-27	52.9
200428-80	HA-28	61.6
	Date Analyzed:	05/05/00
	Analyst:	JMR

MCL = Maximum Contaminant Level

Approved By:

200428-79-80

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #01
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 12:00 PM
Sampled By: TCT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-14 9'-11'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2743

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200428-49
Sample ID: GP-14

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-49pah

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/23/00
Date Collected: 04/28/00
Time Collected: 10:35 AM
Sampled By: AME/TT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	GP-14 9'-11'
Riddle, OR 97469	Invoice# 2743

Metals #1 — Matrix: Soil

URC Sample #: 200428-49
Sample ID: GP-14

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
TOTAL METALS						
Arsenic	EPA 7060	22.2	mg/kg		05/02/00	JMR
Cadmium	EPA 6010	ND@0.01	mg/kg		05/03/00	JMR
Chromium	EPA 6010	4.48	mg/kg		05/03/00	JMR
Lead	EPA 200.9	18.2	mg/kg		05/05/00	JMR
Manganese	EPA 200.9	295	mg/kg		05/03/00	JMR
Mercury	EPA 7470	1.18	mg/kg		05/12/00	JMR
Nickel	EPA 200.9	102	mg/kg		05/03/00	JMR

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-49m

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/23/00
Date Collected: 04/28/00
Time Collected: 10:55 AM
Sampled By: AME/TT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	GP-15 6'-10'
Riddle, OR 97469	Invoice# 2743

Metals #1 — Matrix: Soil

URC Sample #: 200428-50
Sample ID: GP-15

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
TOTAL METALS						
Arsenic	EPA 7060	19.5	mg/kg		05/02/00	JMR
Cadmium	EPA 6010	ND@0.01	mg/kg		05/03/00	JMR
Chromium	EPA 6010	213	mg/kg		05/03/00	JMR
Lead	EPA 200.9	15.3	mg/kg		05/05/00	JMR
Manganese	EPA 200.9	982	mg/kg		05/03/00	JMR
Mercury	EPA 7470	0.921	mg/kg		05/12/00	JMR
Nickel	EPA 200.9	220	mg/kg		05/03/00	JMR

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-50m

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 12:00 PM
Sampled By: TCT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-15 7'-10'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2743

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200428-50
Sample ID: GP-15

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Napthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-50pah

626 N.E. Division St. Myrtle Creek, OR 97457
Phone: (541) 863-5201 - Fax: (541) 863-6199

OREGON STATE CERTIFIED LAB #015

Date Received: 04 28 00

COMINCO Ltd., Glenbrook Operations
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

Date Reported: 05 31 00
Results in (ppb)
Method: EPA 8260B

Volatile Organic Compounds - GC/MS - 8260B

URC Sample #	200428-49	200428-50	200428-51	200428-52	200428-53
Sample ID	GP-14 9'-11'	GP-15 7'-10'	GP-16 0'-4'	GP-17 2'-6'	GP-18 4'-6'
Matrix	Soil	Soil	Soil	Soil	Soil
MONITORING COMPOUNDS					
Fluorobenzene	119.1%	117.9%	120.4%	118.4%	84.3%
2-Bromo-1-chloropropane	112.8%	115.4%	117.2%	119.2%	94.7%
Dichlorodifluoromethane	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0
Chloromethane	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0
Vinyl chloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromomethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chloroethane	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0
Trichlorofluoromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Acetone	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0
1,1-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Methylene chloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Acrylonitrile	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
trans-1,2-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1-Dichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Methyl ethyl ketone	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
cis-1,2-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
2,2-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chloroform	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromochloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,1-Trichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1-Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Carbon tetrachloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Benzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Trichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Dibromomethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromodichloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
cis-1,3-Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Toluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Units:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg

ND = None Detected

620 N.E. Division St. Myrtle Creek, OR 97457
Phone: (541) 863-5201 - Fax: (541) 863-6199

Volatile Organic Compounds - GC/MS - 8260B

URC Sample #	200428-49	200428-50	200428-51	200428-52	200428-53
Sample ID	GP-14 9'-11'	GP-15 7'-10'	GP-16 0'-4'	GP-17 2'-6'	GP-18 4'-6'
Matrix	Soil	Soil	Soil	Soil	Soil
trans-1,3-Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,2-Trichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Dibromochloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Tetrachloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dibromoethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,1,2-Tetrachloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Ethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
m,p-Xylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Styrene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
o-Xylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromoform	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,2,2-Tetrachloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,3-Trichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
n-Propylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
2-Chlorotoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
4-Chlorotoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3,5-Trimethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
tert-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,4-Trimethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
sec-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,4-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
4-Isopropyltoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
n-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dibromo-3-chloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,4-Trichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Naphthalene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,3-Trichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Units:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Analysis Date:	5/8/00	5/8/00	5/8/00	5/8/00	5/8/00
Analyst:	BKO	BKO	BKO	BKO	BKO

ND = None Detected

 Approved By:

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/26/00
Time Collected: 6:10 PM
Sampled By: D Katz

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-1 0'-1'
P.O. Box 85	GNC-AOC-R-5
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200427-47
Sample ID: HA-1

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-47pah

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REPORT

OREGON STATE CERTIFIED LAB #015	Date Reported: 05/31/00
PWS#:	Date Collected: 04/26/00
PWS Name:	Time Collected: 6:20 PM
Sampled At:	Sampled By: D Katz

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-2 0'-1'
P.O. Box 85	GNC-AOC-R-5
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200427-48
Sample ID: HA-2

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-48pah

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/26/00
Time Collected: 6:30 PM
Sampled By: D Katz

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-3 0'-1'
P.O. Box 85	GNC-AOC-R-5
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200427-49
Sample ID: HA-3

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-49pah

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/26/00
Time Collected: 6:40 PM
Sampled By: D Katz

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-4 0'-1'
P.O. Box 85	GNC-AOC-R-5
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200427-50
Sample ID: HA-4

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	17.5	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	1.05	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	10.1	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	1.10	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-50pah

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/28/00
Time Collected: 4:20 PM
Sampled By: TCT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-26 0-0.2'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2745

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200428-78
Sample ID: HA-26

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	1.48	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-78pah

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/19/00
Date Collected: 04/28/00
Time Collected: 4:20 PM
Sampled By: TCT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-26 0-0.2'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2745

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: 200428-78
Sample ID: HA-26

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082	ND@1.0	mg/kg		05/12/00	TDL

MCL - Maximum Contaminant Level
ND = None Detected

Approved By:

200428-78pcb

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/18/00
Date Collected: 04/28/00
Time Collected: 4:20 PM
Sampled By: AME/TT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-26 0-0.2'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2745

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-78
Sample ID: HA-26

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Oil Detected				
Gasoline	NWTPH-HCID	ND	mg/kg		05/18/00	*
Diesel	NWTPH-HCID	ND	mg/kg		05/18/00	*
Oil	NWTPH-HCID	7300	mg/kg		05/18/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		76	%		05/18/00	*
O-terphenyl		120	%		05/18/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-78tphd

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/30/00
Date Collected: 04/28/00
Time Collected: 3:30 PM
Sampled By: TCT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	HA-26
Riddle, OR 97469	Invoice# 2744

Metals #1 — Matrix: Soil

URC Sample #: 200428-78
Sample ID: HA-26

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
TOTAL METALS						
Arsenic	EPA 7060	3.62	mg/kg		05/10/00	JMR
Cadmium	EPA 6010	0.164	mg/kg		05/03/00	JMR
Chromium	EPA 6010	544	mg/kg		05/03/00	JMR
Lead	EPA 200.9	0.359	mg/kg		05/05/00	JMR
Manganese	EPA 200.9	1330	mg/kg		05/03/00	JMR
Mercury	EPA 7470	6.84	mg/kg		05/19/00	JMR
Nickel	EPA 200.9	10,100	mg/kg		05/03/00	JMR

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-78m

626 N.E. Division St. Myrtle Creek, OR 97457
Phone: (541) 863-5201 - Fax: (541) 863-6199

OREGON STATE CERTIFIED LAB #015

Date Received: 04/26/00

COMINCO Ltd., Glenbrook Operations
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

Date Reported: 05/31/00
Results in (ppb)
Method: EPA 8260B

Volatile Organic Compounds - GC/MS - 8260B

URC Sample #	200428-54	200428-72	200428-78	200428-86	200504-1
Sample ID	GP-19 2'-6'	SG-1 Grab	HA-26	PW-1	Shedding
Matrix	Soil	Soil	Soil	Water	Water tank
MONITORING COMPOUNDS					
Fluorobenzene	109.6%	99.6%	95.4%	116.9%	89.8%
2-Bromo-1-chloropropane	104.6%	109.8%	94.5%	114.3%	83.5%
Dichlorodifluoromethane	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0
Chloromethane	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0
Vinyl chloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromomethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chloroethane	ND@5.0	ND@5.0	82.9	ND@5.0	ND@5.0
Trichlorofluoromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Acetone	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0
1,1-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Methylene chloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Acrylonitrile	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
trans-1,2-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1-Dichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Methyl ethyl ketone	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0
cis-1,2-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
2,2-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chloroform	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromochloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,1-Trichloroethane	ND@1.0	ND@1.0	3.2	ND@1.0	ND@1.0
1,2-Dichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1_Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Carbon tetrachloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Benzene	ND@1.0	ND@1.0	2.8	ND@1.0	ND@1.0
Trichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Dibromomethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromodichloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
cis-1,3-Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Toluene	ND@1.0	ND@1.0	3.0	1.4	ND@1.0
Units:	ug/kg	ug/kg	ug/kg	ug/L	ug/L

ND = None Detected

620 N.E. Division St. Myrtle Creek, OR 97457
Phone: (541) 863-5201 - Fax: (541) 863-6199

Volatile Organic Compounds - GC/MS - 8260B

URC Sample #	200428-54	200428-72	200428-78	200428-86	200504-1
Sample ID	GP-19 2'-6'	SG-1 Grab	HA-26	PW-1	Shedding
Matrix	Soil	Soil	Soil	Water	Water tank
trans-1,3-Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,2-Trichloroethane	ND@1.0	ND@1.0	18.1	ND@1.0	ND@1.0
1,3-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Dibromochloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Tetrachloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dibromoethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,1,2-Tetrachloroethane	ND@1.0	ND@1.0	1.5	ND@1.0	ND@1.0
Ethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
m,p-Xylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Styrene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
o-Xylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromoform	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,2,2-Tetrachloroethane	ND@1.0	ND@1.0	7.1	ND@1.0	ND@1.0
1,2,3-Trichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
n-Propylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
2-Chlorotoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
4-Chlorotoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3,5-Trimethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
tert-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,4-Trimethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
sec-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,4-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
4-Isopropyltoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
n-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dibromo-3-chloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,4-Trichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Naphthalene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,3-Trichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Cyclohexanes & derivatives			>500		
Various Alkanes			>200		
Units:	ug/kg	ug/kg	ug/kg	ug/kg	ug/L
Analysis Date:	5/8/00	5/8/00	5/8/00	5/8/00	5/8/00
Analyst:	BKO	BKO	BKO	BKO	BKO

ND – None Detected

 Approved By

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015 PWS#: Source Name: Sampled At:	Date Reported: 05/19/00 Date Collected: 04/28/00 Time Collected: 09:40-15:00 Sampled By: TCT/DK
COMINCO Ltd., Glenbrook Operation P.O. Box 85 5093 Riddle By-pass Road Riddle, OR 97469	HA-25 0-0.5' GNC Riddle JA003.35 Invoice# 2745
Total Lead	Matrix: Soil

		Analyte:	Total Lead
		Code/Method:	EPA 6010
		Units:	mg/kg
URC Sample#	Sample ID		Results
200428-73	HA-21		ND@0.02
200428-74	HA-22		0.033
200428-75	HA-23		0.443
200428-76	HA-24		6.03
200428-77	HA-25		0.748
		Date Analyzed:	05/05/00
		Analyst:	JMR

MCL = Maximum Contaminant Level

Approved By:

200428-73-77

UMPQUA Research Company
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Myrtle Creek, OR 97457
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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/28/00
Time Collected: 4:00 PM
Sampled By: AME/TT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	HA-32 0-1' Invoice#
Riddle, OR 97469	2744

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200428-60
Sample ID: HA-32

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-60pah

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Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/28/00
Time Collected: 4:05 PM
Sampled By: AME/TT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	HA-33 0-1' Invoice#
Riddle, OR 97469	2744

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200428-61
Sample ID: HA-33

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-61pah

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Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/28/00
Time Collected: 4:10 PM
Sampled By: AME/TT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	HA-34 0-1'
Riddle, OR 97469	Invoice# 2744

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200428-62
Sample ID: HA-34

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	0.98	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	2.06	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	1.03	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	4.09	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	3.12	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	2.53	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	18.4	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	1.98	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	1.02	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	6.45	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	2.78	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	3.39	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	1.01	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	1.48	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	0.35	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-62pah

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Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/28/00
Time Collected: 4:10 PM
Sampled By: AME/TT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	HA-35 1.0-1.5' Invoice#
Riddle, OR 97469	2744

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200428-63
Sample ID: HA-35

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-63pah

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/28/00
Time Collected: 2:35 PM
Sampled By: AME/TT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	HA 36 0-0.5' Invoice#
Riddle, OR 97469	2744

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200428-64
Sample ID: HA-36

CDL 6/20/00

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	~~1.70~~ ND	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	~~4.19~~ ND	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-64pah

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P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/28/00
Time Collected: 2:40 PM
Sampled By: AME/TT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	HA 37 0-0.5'
Riddle, OR 97469	Invoice# 2744

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200428-65
Sample ID: HA-37

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/18/00	BKO
Acenaphthylene	EPA 8310	1.70	mg/kg		05/18/00	BKO
Anthracene	EPA 8310	1.19	mg/kg		05/18/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/18/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/18/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/18/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/18/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/18/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/18/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/18/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/18/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/18/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/18/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/18/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/18/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/18/00	BKO

MCL - Maximum Contaminant Level
ND = None Detected

Approved By: [signature] 5/31/00

200428-65pah

UMPQUA Research Company
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Myrtle Creek, OR 97457
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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/28/00
Time Collected: 2:45 PM
Sampled By: AME/TT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	HA 38 0-0.5' Invoice#
Riddle, OR 97469	2744

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200428-66
Sample ID: HA-38

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-66pah

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/26/00
Time Collected: 2:25 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-1 2.0-4.0
P.O. Box 85	GNC AOC-R-10
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200427-31
Sample ID: GP-1

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	1.88	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	1.19	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	4.76	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	1.91	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-31pah

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/26/00
Time Collected: 2:25 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-1 2.0-4.0
P.O. Box 85	GNC AOC-R-10
5093 Riddle By-pass Road	JA003.35
Riddle, OR 97469	Invoice# 2731

NWTPH-HCID — Matrix: Soil

URC Sample #: 200427-31
Sample ID: GP-1

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Diesel Detected				
Gasoline	NWTPH-Dx	ND	mg/kg		05/25/00	*
Diesel	NWTPH-Dx	900	mg/kg		05/25/00	*
Oil	NWTPH-Dx	180	mg/kg		05/25/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		106	%		05/25/00	*
O-terphanyl		104	%		05/25/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-31tph

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/26/00
Time Collected: 3:10 PM
Sampled By: AME/TT

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC AOC-R-10
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	GP-2 8.0-10.0 Invoice#
Riddle, OR 97469	2731

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200427-32
Sample ID: GP-2

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-32pah

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/17/00
Date Collected: 04/26/00
Time Collected: 3:10 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-2 8.0-10.0
P.O. Box 85	GNC AOC-R-10
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

NWTPH-HCID — Matrix: Soil

URC Sample #: 200427-32
Sample ID: GP-2

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/09/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		95	%		05/09/00	*
O-terphanyl		95	%		05/09/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-32tph

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/26/00
Time Collected: 3:45 PM
Sampled By: T C Tones

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-3 8.0-10.0
P.O. Box 85	GNC AOC-R-10
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200427-33
Sample ID: GP-3

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-33pah

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/17/00
Date Collected: 04/26/00
Time Collected: 3:45 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-3 8.0-10.0
P.O. Box 85	GNC AOC-R-10
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

NWTPH-HCID — Matrix: Soil

URC Sample #: 200427-33
Sample ID: GP-3

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/09/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		96	%		05/09/00	*
O-terphanyl		99	%		05/09/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-33tphd

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/26/00
Time Collected: 4:05 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-4 4.0-6.0
P.O. Box 85	GNC AOC-R-10
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200427-34
Sample ID: GP-4

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL - Maximum Contaminant Level
ND = None Detected

Approved By:

200427-34pah

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported:
Date Collected: 04/26/00
Time Collected: 4:05 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-4 4.0-6.0
P.O. Box 85	GNC AOC-R-10
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

NWTPH-HCID — Matrix: Soil

URC Sample #: 200427-34
Sample ID: GP-4

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/09/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		84	%		05/09/00	*
O-terphanyl		92	%		05/09/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By: JEC

200427-34tph

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/26/00
Time Collected: 4:50 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-5 8.0-10.0
P.O. Box 85	GNC AOC-R-10
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200427-35
Sample ID: GP-5

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	1.01	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	1.05	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	2.69	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	1.27	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By: T E Wells

200427-35pah

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/26/00
Time Collected: 4:50 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-5 8.0-10.0
P.O. Box 85	GNC AOC-R-10
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

NWTPH-HCID — Matrix: Soil

URC Sample #: 200427-35
Sample ID: GP-5

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Diesel Detected				
Gasoline	NWTPH-Dx	ND	mg/kg		05/17/00	*
Diesel	NWTPH-Dx	1100	mg/kg		05/17/00	
Oil	NWTPH-Dx	ND	mg/kg		05/17/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		93	%		05/17/00	*
O-terphanyl		95	%		05/17/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-35tphd

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/26/00
Time Collected: 5:15 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-6 6.0-8.0
P.O. Box 85	GNC AOC-R-10
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200427-36
Sample ID: GP-6

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-36pah

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Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/17/00
Date Collected: 04/26/00
Time Collected: 5:15 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-6 6.0-8.0
P.O. Box 85	GNC AOC-R-10
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

NWTPH-HCID — Matrix: Soil

URC Sample #: 200427-36
Sample ID: GP-6

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/09/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		91	%		05/09/00	*
O-terphanyl		100	%		05/09/00	*

*Tested by Oregon Analytical Laboratory

MCL Maximum Contaminant Level
ND = None Detected

Approved By:

200427-36tph

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/26/00
Time Collected: 5:25 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-7 0-2.0
P.O. Box 85	GNC AOC-R-10
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200427-37
Sample ID: GP-7

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	1.55	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-37pah

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/26/00
Time Collected: 5:25 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-7 0-2.0
P.O. Box 85	GNC AOC-R-10
5093 Riddle By-pass Road	JA003.35
Riddle, OR 97469	Invoice# 2731

NWTPH-HCID — Matrix: Soil

URC Sample #: 200427-37
Sample ID: GP-7

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Diesel & Oil Detected				
Gasoline	NWTPH-Dx	ND	mg/kg		05/18/00	*
Diesel	NWTPH-Dx	3300	mg/kg		05/18/00	*
Oil	NWTPH-Dx	520	mg/kg		05/18/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		132	%		05/18/00	*
O-terphanyl		60	%		05/18/00	*

*Tested by Oregon Analytical Laboratory

MCL Maximum Contaminant Level
ND = None Detected

Approved By:

200427-37tphd

UMPQUA Research Company
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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/26/00
Time Collected: 6:30 PM
Sampled By: T C Tomes

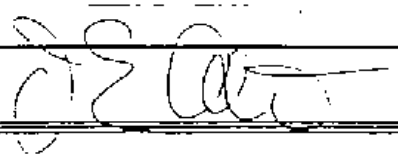
Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-8 8.0-10.0
P.O. Box 85	GNC AOC-R-10
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200427-38
Sample ID: GP-8

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By: 

200427-38pah

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/17/00
Date Collected: 04/26/00
Time Collected: 6:30 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-8 8.0-10.0
P.O. Box 85	GNC AOC-R-10
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

NWTPH-HCID — Matrix: Soil

URC Sample #: 200427-38
Sample ID: GP-8

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/09/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		99	%		05/09/00	*
O-terphanyl		101	%		05/09/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-38tphd

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/26/00
Time Collected: 5:55 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GO-9 4.0-6.0
P.O. Box 85	GNC AOC-R-10
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200427-39
Sample ID: GP-9

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	2.23	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	1.39	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	1.43	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	2.19	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	1.43	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	1.02	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	6.08	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	0.52	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-39pah

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/26/00
Time Collected: 5:55 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GO-9 4.0-6.0
P.O. Box 85	GNC AOC-R-10
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

NWTPH-HCID — Matrix: Soil

URC Sample #: 200427-39
Sample ID: GP-9

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Diesel Detected				
Gasoline	NWTPH-Dx	ND	mg/kg		05/19/00	*
Diesel	NWTPH-Dx	8400	mg/kg		05/19/00	
Oil	NWTPH-Dx	ND	mg/kg		05/19/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		MI **	%		05/19/00	*
O-terphanyl		131	%		05/19/00	*

*Tested by Oregon Analytical Laboratory
**Matrix Interference

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-39tphd

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/26/00
Time Collected: 6:50 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-10 6.0-8.0
P.O. Box 85	GNC AOC-R-10
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200427-40
Sample ID: GP-10

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	1.02	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	0.53	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-40pah

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/26/00
Time Collected: 6:50 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-10 6.0-8.0
P.O. Box 85	GNC AOC-R-10
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

NWTPH-HCID — Matrix: Soil

URC Sample #: 200427-40
Sample ID: GP-10

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Diesel Detected				
Gasoline	NWTPH-Dx	ND	mg/kg		05/18/00	*
Diesel	NWTPH-Dx	190	mg/kg		05/18/00	
Oil	NWTPH-Dx	ND	mg/kg		05/18/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		66	%		05/18/00	*
O-terphanyl		92	%		05/18/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-40tph

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 9:15 AM
Sampled By: D Katz

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-11
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

Polynuclear Aromatic Hydrocabons — Matrix: Water

URC Sample #: 200428-2
Sample ID: GP-11

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8270	0.019	mg/kg		05/18/00	BKO
Acenaphthylene	EPA 8270	ND@0.005	mg/kg		05/18/00	BKO
Anthracene	EPA 8270	0.079	mg/kg		05/18/00	BKO
Benzo(a)anthracene	EPA 8270	ND@0.005	mg/kg		05/18/00	BKO
Benzo(a)pyrene	EPA 8270	0.007	mg/kg		05/18/00	BKO
Benzo(b)fluoranthene	EPA 8270	0.008	mg/kg		05/18/00	BKO
Benzo(ghi)perylene	EPA 8270	ND@0.005	mg/kg		05/18/00	BKO
Benzo(k)fluoranthene	EPA 8270	ND@0.005	mg/kg		05/18/00	BKO
Chrysene	EPA 8270	ND@0.005	mg/kg		05/18/00	BKO
Dibenzo(ah)anthracene	EPA 8270	ND@0.005	mg/kg		05/18/00	BKO
Fluoranthene	EPA 8270	ND@0.005	mg/kg		05/18/00	BKO
Fluorene	EPA 8270	ND@0.005	mg/kg		05/18/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8270	ND@0.005	mg/kg		05/18/00	BKO
Naphthalene	EPA 8270	ND@0.005	mg/kg		05/18/00	BKO
Phenanthrene	EPA 8270	ND@0.005	mg/kg		05/18/00	BKO
Pyrene	EPA 8270	0.022	mg/kg		05/18/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-2pah

626 N.E. Division St. Myrtle Creek, OR 97457
Phone: (541) 863-5201 - Fax: (541) 863-6199

OREGON STATE CERTIFIED LAB #015

Date Received: 05/26/09

COMINCO Ltd., Glenbrook Operations
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

Date Reported: 05/31/09
Results in (ppb)
Method: EPA 8260B

Volatile Organic Compounds - GC/MS - 8260B

URC Sample #	200426-10	200426-11	200426-12	200426-13	200428-2
Sample ID	GP-3	1	2	3	GP-11
Matrix	Water	Water	Water	Water	Water
MONITORING COMPOUNDS					
Fluorobenzene	119.3%	112.5%	115.1%	94.0%	86.6%
2-Bromo-1-chloropropane	102.1%	103.1%	93.8%	93.0%	71.6%
Dichlorodifluoromethane	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0
Chloromethane	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0
Vinyl chloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromomethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chloroethane	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0
Trichlorofluoromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Acetone	ND@5.0	90.0	ND@5.0	ND@5.0	ND@5.0
1,1-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Methylene chloride	ND@1.0	37.6	ND@1.0	ND@1.0	ND@1.0
Acrylonitrile	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
trans-1,2-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1-Dichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Methyl ethyl ketone	ND@1.0	85.8	ND@1.0	ND@1.0	ND@1.0
cis-1,2-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
2,2-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chloroform	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromochloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,1-Trichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichloroethane	ND@1.0	6.6	ND@1.0	ND@1.0	ND@1.0
1,1 Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Carbon tetrachloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Benzene	ND@1.0	1.1	ND@1.0	ND@1.0	ND@1.0
Trichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Dibromomethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromodichloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
cis-1,3-Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Toluene	ND@1.0	15.4	1.4	ND@1.0	ND@1.0
Units:	ug/L	ug/L	ug/L	ug/L	ug/L

ND = None Detected

626 N.E. Division St. Myrtle Creek, OR 97457
Phone: (541) 863-5200 - Fax: (541) 863-6199

Volatile Organic Compounds - GC/MS - 8260B

URC Sample #	200426-10	200426-11	200426-12	200426-13	200428-2
Sample ID	GP-3	Dup 1	Dup 2	Dup 3	GP-11
Matrix	Water	Water	Water	Water	Water
trans-1,3-Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,2-Trichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Dibromochloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Tetrachloroethylene	ND@1.0	ND@1.0	1.3	ND@1.0	ND@1.0
1,2-Dibromoethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,1,2-Tetrachloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	1.2
Ethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
m,p-Xylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Styrene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
o-Xylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromoform	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,2,2-Tetrachloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,3-Trichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
n-Propylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
2-Chlorotoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
4-Chlorotoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3,5-Trimethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
tert-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,4-Trimethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
sec-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,4-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
4-Isopropyltoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
n-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dibromo-3-chloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,4-Trichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Naphthalene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	2.4
1,2,3-Trichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Units:	ug/kg	ug/kg	ug/kg	ug/kg	ug/L
Analysis Date:	5/8/00	5/8/00	5/8/00	5/8/00	5/8/00
Analyst:	BKO	BKO	BKO	BKO	BKO

ND = None Detected

 Approved By:

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015	Date Reported: 05/31/00
PWS#:	Date Collected: 04/26/00
PWS Name:	Time Collected: 1:50 PM
Sampled At:	Sampled By: D Katz

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	TP-1 10'-12'
P.O. Box 85	GNC-AOC-R-11
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200427-41
Sample ID: TP-1

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-41pah

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/17/00
Date Collected: 04/26/00
Time Collected: 1:50 PM
Sampled By: D Katz

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	TP-1 10'-12'
P.O. Box 85	GNC-AOC-R-11
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

NWTPH-HCID — Matrix: Soil

URC Sample #: 200427-41
Sample ID: TP-1

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/09/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		95	%		05/09/00	*
O-terphanyl		97	%		05/09/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-41tphd

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/26/00
Time Collected: 2:00 PM
Sampled By: D Katz

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	TP-1 10'-12'
P.O. Box 85	GNC-AOC-R-11
5093 Riddle By-pass Road	JA003.35 Invoice# 2731
Riddle, OR 97469	

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: **200427-42**
Sample ID: TP-2

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-42pah

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/17/00
Date Collected: 04/26/00
Time Collected: 2:00 PM
Sampled By: AME/D Katz

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	TP-1 10'-12'
P.O. Box 85	G
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

NWTPH-HCID — Matrix: Soil

URC Sample #: **200427-42**
Sample ID: TP-2

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/09/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		88	%		05/09/00	*
O-terphanyl		95	%		05/09/00	*

*Tested by Oregon Analytical Laboratory

MCL - Maximum Contaminant Level
ND = None Detected

Approved By: DEOL

200427-42tphd

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/26/00
Time Collected: 2:10 PM
Sampled By: D Katz

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	TP-1 10'-12'
P.O. Box 85	GNC-AOC-R-11
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200427-43
Sample ID: TP-3

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL - Maximum Contaminant Level
ND = None Detected

Approved By:

200427-43pah

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015	Date Reported: 05/17/00
PWS#:	Date Collected: 04/26/00
PWS Name:	Time Collected: 2:10 PM
Sampled At:	Sampled By: AME/D Katz

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	TP-1 10'-12'
P.O. Box 85	GNC-AOC-R-11
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

NWTPH-HCID — Matrix: Soil

URC Sample #: 200427-43

Sample ID: TP-3

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/09/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		94	%		05/09/00	*
O-terphanyl		95	%		05/09/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-43tphd

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/26/00
Time Collected: 2:15 PM
Sampled By: D Katz

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	TP-1 10'-12'
P.O. Box 85	GNC-AOC-R-11
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200427-44
Sample ID: TP-4

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-44pah

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/17/00
Date Collected: 04/26/00
Time Collected: 2:15 PM
Sampled By: D Katz

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	TP-1 10'-12'
P.O. Box 85	GNC-AOC-R-11
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

NWTPH-HCID — Matrix: Soil

URC Sample #: 200427-44
Sample ID: TP-4

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/09/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		82	%		05/09/00	*
O-terphanyl		88	%		05/09/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By: [signature] 5/17/00

200427-44tphd

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/26/00
Time Collected: 2:25 PM
Sampled By: D Katz

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	TP-1 10'-12'
P.O. Box 85	GNC-AOC-R-11
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200427-45
Sample ID: TP-5

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-45pah

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015	Date Reported: 05/17/00
PWS#:	Date Collected: 04/26/00
PWS Name:	Time Collected: 2:25 PM
Sampled At:	Sampled By: D Katz

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	TP-1 10'-12'
P.O. Box 85	GNC-AOC-R-11
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

NWTPH-HCID Matrix: Soil

URC Sample #: 200427-45
Sample ID: TP-5

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/11/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		95	%		05/11/00	*
O-terphanyl		97	%		05/11/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-45tphd

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/26/00
Time Collected: 2:35 PM
Sampled By: D Katz

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	TP-1 10'-12'
P.O. Box 85	GNC-AOC-R-11
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200427-46
Sample ID: TP-6

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-46pah

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/17/00
Date Collected: 04/26/00
Time Collected: 2:35 PM
Sampled By: D Katz

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	TP-1 10'-12'
P.O. Box 85	GNC-AOC-R-11
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2731

NWTPH-HCID — Matrix: Soil

URC Sample #: 200427-46
Sample ID: TP-6

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/11/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		98	%		05/11/00	*
O-terphanyl		100	%		05/11/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200427-46tphd

UMPQUA Research Company
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Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/28/00
Time Collected: 1:15 PM
Sampled By: AMETT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	HA 39 0-1.1' Invoice#
Riddle, OR 97469	2744

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200428-67
Sample ID: HA-39

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-67pah

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/18/00
Date Collected: 04/28/00
Time Collected: 1:15 PM
Sampled By: AME/TT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	JA 003.35
5093 Riddle By-pass Road	HA-39 0'-1.1' Invoice#
Riddle, OR 97469	2744

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-67
Sample ID: HA-39

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/12/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		86	%		05/12/00	*
O-terphenyl		85	%		05/12/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-67tphd

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/28/00
Time Collected: 1:20 PM
Sampled By: AME/TT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	HA 40 0-1.1'
Riddle, OR 97469	Invoice# 2744

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200428-68
Sample ID: HA-40

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	6.65	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	5.04	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-68pah

UMPQUA Research Company
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Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/28/00
Time Collected: 1:20 PM
Sampled By: AME/TT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	HA-40 0'-1.1'
Riddle, OR 97469	Invoice# 2744

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-68
Sample ID: HA-40

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Oil Detected				
Gasoline	NWTPH-HCID	ND	mg/kg		05/19/00	*
Diesel	NWTPH-HCID	ND	mg/kg		05/19/00	*
Oil	NWTPH-HCID	8400	mg/kg		05/19/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		69	%		05/12/00	*
O-terphenyl		119	%		05/12/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-68tphd

UMPQUA Research Company
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Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/23/00
Date Collected: 04/28/00
Time Collected: 8:05 AM
Sampled By: AME/TT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	GP-16 0'-4'
Riddle, OR 97469	Invoice# 2743

Metals #1 — Matrix: Soil

URC Sample #: 200428-50
Sample ID: GP-16

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
TOTAL METALS						
Arsenic	EPA 7060	23.1	mg/kg		05/02/00	JMR
Cadmium	EPA 6010	ND@0.01	mg/kg		05/03/00	JMR
Chromium	EPA 6010	79.2	mg/kg		05/03/00	JMR
Lead	EPA 200.9	18.8	mg/kg		05/05/00	JMR
Manganese	EPA 200.9	858	mg/kg		05/03/00	JMR
Mercury	EPA 7470	ND@0.01	mg/kg		05/19/00	JMR
Nickel	EPA 200.9	1190	mg/kg		05/03/00	JMR

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-51m

UMPQUA Research Company
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Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/28/00
Time Collected: 8:05 AM
Sampled By: TCT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-16 0'-4'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice# 2743
Riddle, OR 97469	

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200428-51
Sample ID: GP-16

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-51pah

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/23/00
Date Collected: 04/28/00
Time Collected: 8:30 AM
Sampled By: AME/TT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	GP-17 2'-6'
Riddle, OR 97469	Invoice# 2743

Metals #1 — Matrix: Soil

URC Sample #: 200428-50
Sample ID: GP-17

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
TOTAL METALS						
Arsenic	EPA 7060	240	mg/kg		05/02/00	JMR
Cadmium	EPA 6010	ND@0.01	mg/kg		05/03/00	JMR
Chromium	EPA 6010	43.2	mg/kg		05/03/00	JMR
Lead	EPA 200.9	13.6	mg/kg		05/05/00	JMR
Manganese	EPA 200.9	857	mg/kg		05/03/00	JMR
Mercury	EPA 7470	ND@0.01	mg/kg		05/19/00	JMR
Nickel	EPA 200.9	98.2	mg/kg		05/03/00	JMR

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-52m

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(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/28/00
Time Collected: 8:30 AM
Sampled By: TCT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-17 2'-6'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2743

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200428-52
Sample ID: GP-17

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-52pah

UMPQUA Research Company
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Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/23/00
Date Collected: 04/28/00
Time Collected: 8:50 AM
Sampled By: AME/TT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd.. Glenbrook Operation	GNC Riddle
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	GP-18 4'-6' Invoice#
Riddle, OR 97469	2743

Metals #1 — Matrix: Soil

URC Sample #: 200428-53
Sample ID: GP-18

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
TOTAL METALS						
Arsenic	EPA 7060	20.9	mg/kg		05/02/00	JMR
Cadmium	EPA 6010	ND@0.01	mg/kg		05/03/00	JMR
Chromium	EPA 6010	40.1	mg/kg		05/03/00	JMR
Lead	EPA 200.9	14.1	mg/kg		05/05/00	JMR
Manganese	EPA 200.9	216	mg/kg		05/03/00	JMR
Mercury	EPA 7470	ND@0.01	mg/kg		05/19/00	JMR
Nickel	EPA 200.9	98.4	mg/kg		05/03/00	JMR

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-53m

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/28/00
Time Collected: 8:50 AM
Sampled By: TCT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-18 4'-6'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2743

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200428-53
Sample ID: GP-18

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-53pah

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/23/00
Date Collected: 04/28/00
Time Collected: 9:05 AM
Sampled By: AME/TT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	GP-19 2'-6'
Riddle, OR 97469	Invoice# 2743

Metals #1 — Matrix: Soil

URC Sample #: 200428-54
Sample ID: GP-19

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
TOTAL METALS						
Arsenic	EPA 7060	150	mg/kg		05/02/00	JMR
Cadmium	EPA 6010	ND@0.01	mg/kg		05/03/00	JMR
Chromium	EPA 6010	214	mg/kg		05/03/00	JMR
Lead	EPA 200.9	0.196	mg/kg		05/05/00	JMR
Manganese	EPA 200.9	476	mg/kg		05/03/00	JMR
Mercury	EPA 7470	ND@0.01	mg/kg		05/19/00	JMR
Nickel	EPA 200.9	1910	mg/kg		05/03/00	JMR

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-54m

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P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/28/00
Time Collected: 9:05 AM
Sampled By: TCT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-19 2'-6'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2743

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200428-54
Sample ID: GP-19

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-54pah

626 N.E. Division St. Myrtle Creek, OR 97457
Phone: (541) 863-5201 - Fax: (541) 863-6199

OREGON STATE CERTIFIED LAB #015

Date Received: 04/28/00

COMINCO Ltd., Glenbrook Operations
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

Date Reported: 05/31/00
Results in (ppb)
Method: EPA 8260B

Volatile Organic Compounds - GC/MS - 8260B

URC Sample #	200428-49	200428-50	200428-51	200428-52	200428-53
Sample ID	GP-14 9'-11'	GP-15 7'-10'	GP-16 0'-4'	GP-17 2'-6'	GP-18 4'-6'
Matrix	Soil	Soil	Soil	Soil	Soil
MONITORING COMPOUNDS					
Fluorobenzene	119.1%	117.9%	120.4%	118.4%	84.3%
2-Bromo-1-chloropropane	112.8%	115.4%	117.2%	119.2%	94.7%
Dichlorodifluoromethane	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0
Chloromethane	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0
Vinyl chloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromomethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chloroethane	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0
Trichlorofluoromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Acetone	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0
1,1-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Methylene chloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Acrylonitrile	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
trans-1,2-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1-Dichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Methyl ethyl ketone	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
cis-1,2-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
2,2-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chloroform	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromochloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,1-Trichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1_Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Carbon tetrachloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Benzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Trichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Dibromomethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromodichloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
cis-1,3-Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Toluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Units:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg

ND = None Detected

626 N.E. Division St. Myrtle Creek, OR 97457
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Volatile Organic Compounds - GC/MS - 8260B

URC Sample #	200428-49	200428-50	200428-51	200428-52	200428-53
Sample ID	GP-14 9'-11'	GP-15 7'-10'	GP-16 0'-4'	GP-17 2'-6'	GP-18 4'-6'
Matrix	Soil	Soil	Soil	Soil	Soil
trans-1,3-Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,2-Trichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Dibromochloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Tetrachloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dibromoethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,1,2-Tetrachloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Ethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
m,p-Xylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Styrene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
o-Xylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromoform	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,2,2-Tetrachloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,3-Trichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
n-Propylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
2-Chlorotoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
4-Chlorotoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3,5-Trimethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
tert-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,4-Trimethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
sec-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,4-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
4-Isopropyltoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
n-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dibromo-3-chloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,4-Trichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Naphthalene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,3-Trichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Units:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Analysis Date:	5/8/00	5/8/00	5/8/00	5/8/00	5/8/00
Analyst:	BKO	BKO	BKO	BKO	BKO

ND = None Detected

 Approved By:

626 N.E. Division St. Myrtle Creek, OR 97457
Phone: (541) 863-5201 - Fax: (541) 863-6199

OREGON STATE CERTIFIED LAB #015

Date Received: 04 26 00
Date Reported: 05 31 00

COMINCO Ltd., Glenbrook Operations
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

Results in (ppb)
Method: EPA 8260B

Volatile Organic Compounds - GC/MS - 8260B

URC Sample #	200428-54	200428-72	200428-78	200428-86	200504-1
Sample ID	GP-19 2'-6'	SG-1 Grab	HA-26	PW-1	Shedding
Matrix	Soil	Soil	Soil	Water	Water tank
MONITORING COMPOUNDS					
Fluorobenzene	109.6%	99.6%	95.4%	116.9%	89.8%
2-Bromo-1-chloropropane	104.6%	109.8%	94.5%	114.3%	83.5%
Dichlorodifluoromethane	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0
Chloromethane	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0
Vinyl chloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromomethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chloroethane	ND@5.0	ND@5.0	82.9	ND@5.0	ND@5.0
Trichlorofluoromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Acetone	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0
1,1-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Methylene chloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Acrylonitrile	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
trans-1,2-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1-Dichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Methyl ethyl ketone	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0
cis-1,2-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
2,2-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chloroform	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromochloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,1-Trichloroethane	ND@1.0	ND@1.0	3.2	ND@1.0	ND@1.0
1,2-Dichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1_Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Carbon tetrachloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Benzene	ND@1.0	ND@1.0	2.8	ND@1.0	ND@1.0
Trichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Dibromomethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromodichloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
cis-1,3-Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Toluene	ND@1.0	ND@1.0	3.0	1.4	ND@1.0
Units:	ug/kg	ug/kg	ug/kg	ug/L	ug/L

ND = None Detected

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Volatile Organic Compounds - GC/MS - 8260B

URC Sample #	200428-54	200428-72	200428-78	200428-86	200504-1
Sample ID	GP-19 2'-6'	SG-1 Grab	HA-26	PW-1	Shedding
Matrix	Soil	Soil	Soil	Water	Water tank
trans-1,3-Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,2-Trichloroethane	ND@1.0	ND@1.0	18.1	ND@1.0	ND@1.0
1,3-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Dibromochloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Tetrachloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dibromoethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,1,2-Tetrachloroethane	ND@1.0	ND@1.0	1.5	ND@1.0	ND@1.0
Ethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
m,p-Xylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Styrene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
o-Xylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromoform	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,2,2-Tetrachloroethane	ND@1.0	ND@1.0	7.1	ND@1.0	ND@1.0
1,2,3-Trichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
n-Propylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
2-Chlorotoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
4-Chlorotoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3,5-Trimethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
tert-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,4-Trimethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
sec-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,4-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
4-Isopropyltoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
n-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dibromo-3-chloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,4-Trichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Naphthalene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,3-Trichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Cyclohexanes & derivatives			>500		
Various Alkanes			>200		
Units:	ug/kg	ug/kg	ug/kg	ug/kg	ug/L
Analysis Date:	5/8/00	5/8/00	5/8/00	5/8/00	5/8/00
Analyst:	BKO	BKO	BKO	BKO	BKO

ND = None Detected

Approved By:

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015	Date Reported: 05/31/00
PWS#:	Date Collected: 04/28/00
PWS Name:	Time Collected: 9:45 AM
Sampled At:	Sampled By: TCT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-13 4'-6'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2743

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200428-48

Sample ID: GP-13

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-48pah

UMPQUA Research Company
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Myrtle Creek, OR 97457
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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/18/00
Date Collected: 04/28/00
Time Collected: 9:45 AM
Sampled By: AME/TT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-13 4'-6'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2743

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-48
Sample ID: GP-13

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/12/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		91	%		05/12/00	*
O-terphenyl		95	%		05/12/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-48tphd

UMPQUA Research Company
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Myrtle Creek, OR 97457
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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/18/00
Date Collected: 04/28/00
Time Collected: 11:05 AM
Sampled By: AME/TT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	TP-7 12'-15'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	AOL-4-15 2746

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-82
Sample ID: TP-7

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/12/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		111	%		05/12/00	*
O-terphenyl		102	%		05/12/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By: JS Cols

200428-82tphd

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/19/00
Date Collected: 04/28/00
Time Collected: 11:05 AM
Sampled By: TCT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	TP-7 12'-15'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	AOL-4-15 2746

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: 200428-82
Sample ID: TP-7

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082	ND@1.0	mg/kg		05/12/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-82pcb

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/28/00
Time Collected: 11:05 AM
Sampled By: TCT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	TP-7 12'-15'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	AOL-4-15 2746

BTEX by EPA 502.2 — Matrix: Soil

URC Sample #: 200428-82
Sample ID: TP-7

Analyte	Results	Units	MCL	Date Analyzed	Analyst
Benzene	ND@0.001	mg/kg		05/09/00	BKO/TDL
Toluene	ND@0.001	mg/kg		05/09/00	BKO/TDL
Ethylbenzene	ND@0.001	mg/kg		05/09/00	BKO/TDL
Xylenes	ND@0.001	mg/kg		05/09/00	BKO/TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-82btex

UMPQUA Research Company
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Myrtle Creek, OR 97457
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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/18/00
Date Collected: 04/28/00
Time Collected: 11:10 AM
Sampled By: AME/TT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	TP-8 12'-15
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	AOL-R-15 2746

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-83
Sample ID: TP-8

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/12/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		112	%		05/12/00	*
O-terphenyl		112	%		05/12/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-83tphd

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/19/00
Date Collected: 04/28/00
Time Collected: 11:10 AM
Sampled By: TCT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	TP-8 12'-15
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	AOL-R-15 2746

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: 200428-83
Sample ID: TP-8

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082	ND@1.0	mg/kg		05/12/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-83pcb

UMPQUA Research Company
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Myrtle Creek, OR 97457
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REPORT

OREGON STATE CERTIFIED LAB #015	Date Reported: 05/31/00
PWS#:	Date Collected: 04/28/00
PWS Name:	Time Collected: 11:10 AM
Sampled At:	Sampled By: TCT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	TP-8 12'-15
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	AOL-R-15 2746

BTEX by EPA502.2 — Matrix: Soil

URC Sample #: 200428-83

Sample ID: TP-8

Analyte	Results	Units	MCL	Date Analyzed	Analyst
Benzene	ND@0.001	mg/kg		05/09/00	BKO/TDL
Toluene	ND@0.001	mg/kg		05/09/00	BKO/TDL
Ethylbenzene	ND@0.001	mg/kg		05/09/00	BKO/TDL
Xylenes	ND@0.001	mg/kg		05/09/00	BKO/TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-83btex

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Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/18/00
Date Collected: 04/28/00
Time Collected: 11:15 AM
Sampled By: AME/TT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	TP-9 12'-15'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	AOL-R-15 2746

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-84
Sample ID: TP-9

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/12/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		52	%		05/12/00	*
O-terphenyl		59	%		05/12/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-84tphd

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/19/00
Date Collected: 04/28/00
Time Collected: 11:15 AM
Sampled By: TCT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	TP-9 12'-15'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	AOL-R-15 2746

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: 200428-84
Sample ID: TP-9

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082	ND@1.0	mg/kg		05/12/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-84pcb

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REPORT

OREGON STATE CERTIFIED LAB #015	Date Reported: 05/31/00
PWS#:	Date Collected: 04/28/00
PWS Name:	Time Collected: 11:15 AM
Sampled At:	Sampled By: TCT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	TP-9 12'-15'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	AOL-R-15 2746

BTEX by EPA502.2 — Matrix: Soil

URC Sample #: **200428-84**

Sample ID: TP-9

Analyte	Results	Units	MCL	Date Analyzed	Analyst
Benzene	ND@0.001	mg/kg		05/09/00	BKO/TDL
Toluene	ND@0.001	mg/kg		05/09/00	BKO/TDL
Ethylbenzene	ND@0.001	mg/kg		05/09/00	BKO/TDL
Xylenes	ND@0.001	mg/kg		05/09/00	BKO/TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-84btex

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/18/00
Date Collected: 04/28/00
Time Collected: 11:20 AM
Sampled By: AME/TT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	TP-10 12'-15'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003,35 Invoice#
Riddle, OR 97469	AOL-R-15 2746

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-85
Sample ID: TP-10

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/12/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		110	%		05/12/00	*
O-terphenyl		105	%		05/12/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-85tphd

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Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/19/00
Date Collected: 04/28/00
Time Collected: 11:20 AM
Sampled By: TCT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	TP-10 12'-15'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	AOL-R-15 2746

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: 200428-85
Sample ID: TP-10

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082	ND@1.0	mg/kg		05/12/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-85pcb

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/28/00
Time Collected: 11:20 AM
Sampled By: TCT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	TP-10 12'-15'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	AOL-R-15 2746

BTEX by EPA502.2 — Matrix: Soil

URC Sample #: 200428-85
Sample ID: TP-10

Analyte	Results	Units	MCL	Date Analyzed	Analyst
Benzene	ND@0.001	mg/kg		05/09/00	BKO/TDL
Toluene	ND@0.001	mg/kg		05/09/00	BKO/TDL
Ethylbenzene	ND@0.001	mg/kg		05/09/00	BKO/TDL
Xylenes	ND@0.001	mg/kg		05/09/00	BKO/TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-85btex

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/23/00
Date Collected: 04/28/00
Time Collected: 3:00 PM
Sampled By: AME/TT/DC

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	GP-21
Riddle, OR 97469	Invoice# 2744

Metals #1 — Matrix: Soil

URC Sample #: 200428-56
Sample ID: GP-21

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
TOTAL METALS						
Arsenic	EPA 7060	1.5	mg/kg		05/02/00	JMR
Cadmium	EPA 6010	ND@0.001	mg/kg		05/03/00	JMR
Chromium	EPA 6010	4.63	mg/kg		05/03/00	JMR
Lead	EPA 200.9	0.156	mg/kg		05/05/00	JMR
Manganese	EPA 200.9	13.5	mg/kg		05/03/00	JMR
Mercury	EPA 7470	ND@0.001	mg/kg		05/12/00	JMR
Nickel	EPA 200.9	80.7	mg/kg		05/03/00	JMR
DISSOLVED METALS						
Arsenic	EPA 7060	ND@0.01	mg/kg		05/02/00	JMR
Cadmium	EPA 6010	ND@0.001	mg/kg		05/03/00	JMR
Chromium	EPA 6010	ND@0.02	mg/kg		05/03/00	JMR
Lead	EPA 200.9	ND@0.002	mg/kg		05/05/00	JMR
Manganese	EPA 200.9	0.668	mg/kg		05/03/00	JMR
Mercury	EPA 7470	ND0.001	mg/kg		05/12/00	JMR
Nickel	EPA 200.9	0.291	mg/kg		05/03/00	JMR

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-56m

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/08/00
Date Collected: 04/27/00
Time Collected: 3:25 PM
Sampled By: D Katz

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	
5093 Riddle By-pass Road	JA 003.35 Invoice# 2733
Riddle, OR 97469	

Metals #2 — Matrix: Water

URC Sample #: 200428-4
Sample ID: GP-23

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
TOTAL METALS						
Aluminum	EPA 7060	279	mg/L		05/05/00	JMR
Chromium	EPA 6010	7.17	mg/L		05/01/00	JMR
Manganese	EPA 6010	10.9	mg/L		05/03/00	JMR
Nickel	EPA 200.9	8.30	mg/L		05/03/00	JMR
Silver	EPA 200.9	0.061	mg/L		05/05/00	JMR
DISSOLVED METALS						
Aluminum	EPA 7060	13.0	mg/L		05/05/00	JMR
Chromium	EPA 6010	ND@0.02	mg/L		05/01/00	JMR
Manganese	EPA 6010	0.111	mg/L		05/05/00	JMR
Nickel	EPA 200.9	0.038	mg/L		05/03/00	JMR
Silver	EPA 200.9	ND@0.01	mg/L		05/05/00	JMR

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-5

UMPQUA Research Company
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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/08/00
Date Collected: 04/27/00
Time Collected: 3:45 PM
Sampled By: D Katz

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	
5093 Riddle By-pass Road	JA 003.35 Invoice# 2733
Riddle, OR 97469	

Metals #2 — Matrix: Water

URC Sample #: 200428-4
Sample ID: GP-22

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
TOTAL METALS						
Aluminum	EPA 7060	273	mg/L		05/05/00	JMR
Chromium	EPA 6010	9.56	mg/L		05/01/00	JMR
Manganese	EPA 6010	15.4	mg/L		05/03/00	JMR
Nickel	EPA 200.9	2.32	mg/L		05/03/00	JMR
Silver	EPA 200.9	0.020	mg/L		05/05/00	JMR
DISSOLVED METALS						
Aluminum	EPA 7060	0.137	mg/L		05/05/00	JMR
Chromium	EPA 6010	ND@0.02	mg/L		05/01/00	JMR
Manganese	EPA 6010	3.96	mg/L		05/03/00	JMR
Nickel	EPA 200.9	0.010	mg/L		05/03/00	JMR
Silver	EPA 200.9	ND@0.01	mg/L		05/05/00	JMR

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-4

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/19/00
Date Collected: 04/27/00
Time Collected: 12:10 PM
Sampled By: AME/D Katz

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	Invoice#
Riddle, OR 97469	2733

Metals #1 — Matrix: Water

URC Sample #: 2000428-3
Sample ID: GP-12

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
TOTAL METALS						
Arsenic	EPA 7060	0.388	mg/L		05/02/00	JMR
Cadmium	EPA 6010	ND@0.001	mg/L		05/03/00	JMR
Chromium	EPA 6010	7.00	mg/L		05/01/00	JMR
Lead	EPA 200.9	0.075	mg/L		05/01/00	JMR
Manganese	EPA 200.9	2.36	mg/L		05/03/00	JMR
Mercury	EPA 7470	ND@0.001	mg/L		05/12/00	JMR
Nickel	EPA 200.9	0.279	mg/L		05/03/00	JMR
DISSOLVED METALS						
Arsenic	EPA 7060	ND@0.01	mg/L		05/02/00	JMR
Cadmium	EPA 6010	ND@0.001	mg/L		05/03/00	JMR
Chromium	EPA 6010	ND@0.02	mg/L		05/01/00	JMR
Lead	EPA 200.9	ND@0.002	mg/L		05/01/00	JMR
Manganese	EPA 200.9	3.16	mg/L		05/03/00	JMR
Mercury	EPA 7470	ND@0.001	mg/L		05/12/00	JMR
Nickel	EPA 200.9	0.033	mg/L		05/03/00	JMR

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-3

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/17/00
Date Collected: 04/27/00
Time Collected: 12:10 PM
Sampled By: AME/D Katz

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-12
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice# 2733
Riddle, OR 97469	

NWTPH-HCID — Matrix: Water

URC Sample #: 200428-3
Sample ID: GP-12

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/11/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		81	%		05/11/00	*
O-terphenyl		85	%		05/11/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-3tphd

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 12:10 PM
Sampled By: D Katz

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GP-12
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35
Riddle, OR 97469	Invoice# 2733

Polynuclear Aromatic Hydrocabons — Matrix: Water

URC Sample #: **200428-3**
Sample ID: GP-12

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8270	ND@0.001	mg/L		05/12/00	BKO
Acenaphthylene	EPA 8270	ND@0.001	mg/L		05/12/00	BKO
Anthracene	EPA 8270	ND@0.001	mg/L		05/12/00	BKO
Benzo(a)anthracene	EPA 8270	ND@0.001	mg/L		05/12/00	BKO
Benzo(a)pyrene	EPA 8270	ND@0.001	mg/L		05/12/00	BKO
Benzo(b)fluoranthene	EPA 8270	ND@0.001	mg/L		05/12/00	BKO
Benzo(ghi)perylene	EPA 8270	ND@0.001	mg/L		05/12/00	BKO
Benzo(k)fluoranthene	EPA 8270	ND@0.001	mg/L		05/12/00	BKO
Chrysene	EPA 8270	ND@0.001	mg/L		05/12/00	BKO
Dibenzo(ah)anthracene	EPA 8270	ND@0.001	mg/L		05/12/00	BKO
Fluoranthene	EPA 8270	ND@0.001	mg/L		05/12/00	BKO
Fluorene	EPA 8270	ND@0.001	mg/L		05/12/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8270	ND@0.001	mg/L		05/12/00	BKO
Naphthalene	EPA 8270	ND@0.001	mg/L		05/12/00	BKO
Phenanthrene	EPA 8270	ND@0.001	mg/L		05/12/00	BKO
Pyrene	EPA 8270	ND@0.001	mg/L		05/12/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-3pah

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/18/00
Date Collected: 04/27/00
Time Collected: 1:50 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-1 1.5-2.0'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: 200428-6
Sample ID: HA-1

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082	ND@1.0	mg/kg		05/12/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-6pcb

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 1:50 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-1 1.5-2.0'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-6
Sample ID: HA-1

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/11/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		95	%		05/11/00	*
O-terphenyl		95	%		05/11/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-6tphd

UMPQUA Research Company
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Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/18/00
Date Collected: 04/27/00
Time Collected: 12:00 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-2 1.5-2.0'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: 200428-7
Sample ID: HA-2

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082	ND@1.0	mg/kg		05/12/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-7pcb

UMPQUA Research Company
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Myrtle Creek, OR 97457
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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 2:05 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-2 1.5-2.0'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-7
Sample ID: HA-2

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/11/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		94	%		05/11/00	*
O-terphenyl		96	%		05/11/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-7tphd

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/18/00
Date Collected: 04/27/00
Time Collected: 2:10 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-3 1.5-2.0'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice# 2733
Riddle, OR 97469	

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: 200428-8
Sample ID: HA-3

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082					
A1254		3900	mg/kg		05/12/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-8pcb

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 2:10 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-3 1.5-2.0'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

NWTPH-HCID Matrix: Soil

URC Sample #: 200428-8
Sample ID: HA-3

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Diesel Detected				
Gasoline	NWTPH-HCID	ND	mg/kg		05/11/00	*
Diesel	NWTPH-HCID	13,000	mg/kg		05/19/00	*
Oil	NWTPH-HCID	ND	mg/kg		05/11/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		68	%		05/19/00	*
O-terphenyl		98	%		05/19/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-8tphd

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P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/18/00
Date Collected: 04/27/00
Time Collected: 2:40 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-4 1.5-2.0'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: 200428-9
Sample ID: HA-4

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082					
A1254		277	mg/kg		05/12/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-9pcb

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 2:40 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-4 1.5-2.0'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-9
Sample ID: HA-4

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/11/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		96	%		05/11/00	*
O-terphenyl		97	%		05/11/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-9tphd

UMPQUA Research Company
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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/18/00
Date Collected: 04/27/00
Time Collected: 2:45 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-5 1.5-2.0'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice# 2733
Riddle, OR 97469	

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: 200428-10
Sample ID: HA-5

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082					
A1254		357	mg/kg		05/12/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-10pcb

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(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 2:45 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-5 1.5-2.0'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-10
Sample ID: HA-5

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Diesel Detected				
Gasoline	NWTPH-HCID	ND	mg/kg		05/11/00	*
Diesel	NWTPH-HCID	55	mg/kg		05/24/00	*
Oil	NWTPH-HCID	ND	mg/kg		05/11/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		70	%		05/24/00	*
O-terphenyl		91	%		05/24/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-10tphd

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/18/00
Date Collected: 04/27/00
Time Collected: 2:50 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-6 1.5-2.0'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: 200428-11
Sample ID: HA-6

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082					
A1254		30.0	mg/kg		05/12/00	TDL

MCL – Maximum Contaminant Level
ND = None Detected

Approved By:

200428-11pcb

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 2:50 PM
Sampled By: AME/T Tones

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-6 1.5-2.0'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

NWTPH-HCID Matrix: Soil

URC Sample #: 200428-11
Sample ID: HA-6

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/11/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		97	%		05/11/00	*
O-terphenyl		100	%		05/11/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-11tphd

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/18/00
Date Collected: 04/27/00
Time Collected: 3:40 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-7 1.0-1.5
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: 200428-12
Sample ID: HA-7

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082	ND@1.0	mg/kg		05/12/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-12pcb

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 3:40 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-7 1.0-1.5
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-12
Sample ID: HA-7

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/11/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		102	%		05/11/00	*
O-terphenyl		97	%		05/11/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-12tphd

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/19/00
Date Collected: 04/27/00
Time Collected: 3:45 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-8 1.0-1.5
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: **200428-13**
Sample ID: HA-8

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082	ND@1.0	mg/kg		05/12/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-13pcb

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 3:45 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-8 1.0-1.5
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-13
Sample ID: HA-8

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Oil Detected				
Gasoline	NWTPH-HCID	ND	mg/kg		05/11/00	*
Diesel	NWTPH-HCID	ND	mg/kg		05/19/00	*
Oil	NWTPH-HCID	740	mg/kg		05/24/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		71	%		05/24/00	*
O-terphenyl		95	%		05/24/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-13tphd

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/19/00
Date Collected: 04/27/00
Time Collected: 3:50 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-9 1.0-1.5
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: 200428-14
Sample ID: HA-9

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082	ND@1.0	mg/kg		05/12/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-14pcb

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 3:50 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-9 1.0-1.5
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-14
Sample ID: HA-9

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Oil Detected				
Gasoline	NWTPH-HCID	ND	mg/kg		05/11/00	*
Diesel	NWTPH-HCID	ND	mg/kg		05/11/00	*
Oil	NWTPH-HCID	4,500	mg/kg		05/19/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		69	%		05/19/00	*
O-terphenyl		100	%		05/19/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-14tphd

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/19/00
Date Collected: 04/27/00
Time Collected: 3:55 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-10 1.0-1.5
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: 200428-15
Sample ID: HA-10

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082	ND@1.0	mg/kg		05/12/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-15pcb

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Myrtle Creek, OR 97457
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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 3:55 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-10 1.0-1.5
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-15
Sample ID: HA-10

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Diesel Detected				
Gasoline	NWTPH-HCID	ND	mg/kg		05/11/00	*
Diesel	NWTPH-HCID	940	mg/kg		05/11/00	*
Oil	NWTPH-HCID	ND	mg/kg		05/18/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		74	%		05/18/00	*
O-terphenyl		103	%		05/18/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-15tphd

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/19/00
Date Collected: 04/27/00
Time Collected: 4:35 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-11 1.0-1.5
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	Revised Report: 5/22/00 2733

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: 200428-16
Sample ID: HA-11

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082	ND@1.0	mg/kg		05/12/00	TDL

MCL - Maximum Contaminant Level
ND = None Detected

Approved By:

200428-16pcb

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 4:35 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-10 11 1.0-1.5 ox
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-16
Sample ID: HA-11

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Diesel Detected				
Gasoline	NWTPH-HCID	ND	mg/kg		05/11/00	*
Diesel	NWTPH-HCID	390	mg/kg		05/18/00	*
Oil	NWTPH-HCID	ND	mg/kg		05/11/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		50	%		05/18/00	*
O-terphenyl		77	%		05/18/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-16tphd

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Myrtle Creek, OR 97457
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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/19/00
Date Collected: 04/27/00
Time Collected: 4:40 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-12 0.5-1.0'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: 200428-17
Sample ID: HA-12

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082	ND@1.0	mg/kg		05/12/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-17pcb

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 4:40 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-12 0.5-1.0'
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-17
Sample ID: HA-12

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/12/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		104	%		05/12/00	*
O-terphenyl		97	%		05/12/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-17tphd

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/19/00
Date Collected: 04/27/00
Time Collected: 4:45 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-13 0.5-1.0
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: 200428-18
Sample ID: HA-13

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082	ND@1.0	mg/kg		05/12/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-18pcb

UMPQUA Research Company
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Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 4:45 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-13 0.5-1.0
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-18
Sample ID: HA-13

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/12/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		93	%		05/12/00	*
O-terphenyl		97	%		05/12/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-18tphd

UMPQUA Research Company
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Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/19/00
Date Collected: 04/27/00
Time Collected: 4:50 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-14 0.5-1.0
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: 200428-19
Sample ID: HA-14

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082	ND@1.0	mg/kg		05/12/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-19pcb

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
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(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 4:50 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-14 0.5-1.0
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

NWTPH-HCID Matrix: Soil

URC Sample #: 200428-19
Sample ID: HA-14

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/12/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		123	%		05/12/00	*
O-terphenyl		119	%		05/12/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-19tphd

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/19/00
Date Collected: 04/27/00
Time Collected: 4:55 PM
Sampled By: T C Tonics

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-15 0.5-1.0
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: 200428-20
Sample ID: HA-15

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082	ND@1.0	mg/kg		05/12/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-20pcb

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 4:55 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-15 0.5-1.0
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-20
Sample ID: HA-15

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Oil Detected				
Gasoline	NWTPH-HCID	ND	mg/kg		05/12/00	*
Diesel	NWTPH-HCID	ND	mg/kg		05/12/00	*
Oil	NWTPH-HCID	200	mg/kg		05/24/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		66	%		05/24/00	*
O-terphenyl		86	%		05/24/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-20tphd

UMPQUA Research Company
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Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/19/00
Date Collected: 04/27/00
Time Collected: 5:05 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-16 0.5-1.0
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: 200428-21
Sample ID: HA-16

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082	ND@1.0	mg/kg		05/12/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-21pcb

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 5:05 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-16 0.5-1.0
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-21
Sample ID: HA-16

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/12/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		102	%		05/12/00	*
O-terphenyl		108	%		05/12/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-21tphd

UMPQUA Research Company
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Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/19/00
Date Collected: 04/27/00
Time Collected: 5:30 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-17 0.5-1.0
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: 200428-22
Sample ID: HA-17

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082	ND@1.0	mg/kg		05/12/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-22pcb

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 5:30 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-17 0.5-1.0
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-22
Sample ID: HA-17

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Oil Detected				
Gasoline	NWTPH-HCID	ND	mg/kg		05/12/00	*
Diesel	NWTPH-HCID	ND	mg/kg		05/12/00	*
Oil	NWTPH-HCID	16,000	mg/kg		05/19/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		58	%		05/19/00	*
O-terphenyl		114	%		05/19/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-22tphd

UMPQUA Research Company
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Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/19/00
Date Collected: 04/27/00
Time Collected: 5:35 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-18 0.5-1.0
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: 200428-23
Sample ID: HA-18

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082	ND@1.0	mg/kg		05/12/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-23pcb

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Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 5:35 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-18 0.5-1.0
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-23
Sample ID: HA-18

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Oil Detected				
Gasoline	NWTPH-HCID	ND	mg/kg		05/12/00	*
Diesel	NWTPH-HCID	ND	mg/kg		05/12/00	*
Oil	NWTPH-HCID	4,700	mg/kg		05/25/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		68	%		05/25/00	*
O-terphenyl		98	%		05/25/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-23tphd

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Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/19/00
Date Collected: 04/27/00
Time Collected: 5:40 PM
Sampled By: T C Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-19 0.5-1.0
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: 200428-24
Sample ID: HA-19

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082	ND@1.0	mg/kg		05/12/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-24pcb

UMPQUA Research Company
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Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 5:40 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-19 0.5-1.0
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-24
Sample ID: HA-19

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Oil Detected				
Gasoline	NWTPH-HCID	ND	mg/kg		05/12/00	*
Diesel	NWTPH-HCID	ND	mg/kg		05/12/00	*
Oil	NWTPH-HCID	840	mg/kg		05/19/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		62	%		05/19/00	*
O-terphenyl		93	%		05/19/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-24tphd

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Myrtle Creek, OR 97457
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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/19/00
Date Collected: 04/27/00
Time Collected: 17:45
Sampled By: AME/Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-~~19~~ 20 0.5-1.0
P.O. Box 85	GNC Riddle cdc
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

Polychlorinated Biphenyls — Matrix: Soil

URC Sample #: 200428-25
Sample ID: HA-20

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
PCB	EPA 8082	ND@1.0	mg/kg		05/12/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-25pcb

UMPQUA Research Company
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Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 5:45 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	HA-19 20 0.5-1.0 ok
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	2733

NWTPH-HCID — Matrix: Soil

URC Sample #: 200428-25
Sample ID: HA-20

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Oil Detected				
Gasoline	NWTPH-HCID	ND	mg/kg		05/12/00	*
Diesel	NWTPH-HCID	ND	mg/kg		05/12/00	*
Oil	NWTPH-HCID	490	mg/kg		05/19/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		69	%		05/19/00	*
O-terphenyl		94	%		05/19/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-25tphd

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/27/00
Time Collected: 13:50 -17:45
Sampled By: AME/TCT

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P O Box 85	JA003.35
5093 Riddle By-pass Road	HA-1 - HA-20
Riddle OR 97469	Revised Report: 5/31/00

Invoice# 2733

Test Name — Matrix: Soil

Analyte: 1,1,1,-Trichloroethane
Method: EPA 8260B

URC Sample #	Sample ID	Results	Units	MCL	Date Analyzed	Analyst
200428-6	HA-1 1.5 - 2.0'	ND@0.001	mg/kg		05/09/00	TDL
200428-7	HA-2 1.5 - 2.0'	ND@0.001	mg/kg		05/09/00	TDL
200428-8	HA-3 1.5 - 2.0'	ND@0.001	mg/kg		05/09/00	TDL
200428-9	HA-4 1.5 - 2.0'	ND@0.001	mg/kg		05/09/00	TDL
200428-10	HA-5 1.5 - 2.0'	ND@0.001	mg/kg		05/09/00	TDL
200428-11	HA-6 1.5 - 2.0'	ND@0.001	mg/kg		05/09/00	TDL
200428-12	HA-7 1.0 - 1.5'	ND@0.001	mg/kg		05/09/00	TDL
200428-13	HA-8 1.0 - 1.5'	ND@0.001	mg/kg		05/09/00	TDL
200428-14	HA-9 1.0 - 1.5'	0.0098	mg/kg		05/09/00	TDL
200428-15	HA-10 1.0 - 1.5'	ND@0.001	mg/kg		05/09/00	TDL
200428-16	HA-11 1.0 - 1.5'	ND@0.001	mg/kg		05/09/00	TDL
200428-17	HA-12 .5 - 1.0'	ND@0.001	mg/kg		05/09/00	TDL
200428-18	HA-13 .5 - 1.0'	ND@0.001	mg/kg		05/09/00	TDL
200428-19	HA-14 .5 - 1.0'	ND@0.001	mg/kg		05/09/00	TDL
200428-20	HA-15 .5 - 1.0'	ND@0.001	mg/kg		05/09/00	TDL
200428-21	HA-16 .5 - 1.0'	ND@0.001	mg/kg		05/09/00	TDL
200428-22	HA-17 1.0 - 1.5'	ND@0.001	mg/kg		05/09/00	TDL
200428-23	HA-18 .5 - 1.0'	0.0087	mg/kg		05/09/00	TDL
200428-24	HA-19 1.0 - 1.5'	ND@0.001	mg/kg		05/09/00	TDL
200428-25	HA-20 .5 - 1.0'	ND@0.001	mg/kg		05/09/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-6-15 111tce

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015 PWS#: Source Name: Sampled At:	Date Reported: 06/21/00 Date Collected: 06/06/00 Time Collected: 12:00 PM Sampled By: AME/T Tomes
COMINCO Ltd., Glenbrook Operation P.O. Box 85 5093 Riddle By-pass Road Riddle, OR 97469	GNC Riddle JA003.35 Invoice# 3076

PCB's (Soil) — Matrix: Soil

Analyte:		PCB's			PCB's
Code/Method:		EPA 8082			EPA 8082
Units:		mg/kg			mg/kg
URC Sample#	Sample ID	Results	URC Sample #	Sample ID	Results
200607-46	b-1 2.0	ND@1.0	200607-70	b-13 2.0	ND@1.0
200607-47	b-1 4.0	ND@1.0	200607-71	b-13 4.0	ND@1.0
200607-48	b-2 2.0	ND@1.0	200607-72	b-14 2.0	ND@1.0
200607-49	b-2 4.0	ND@1.0	200607-73	b-14 4.0	ND@1.0
200607-50	b-3 2.0	ND@1.0	200607-74	b-15 2.0	ND@1.0
200607-51	b-3 4.0	ND@1.0	200607-75	b-15 4.0	ND@1.0
200607-52	b-4 2.0	ND@1.0	200607-76	b-16 2.0	ND@1.0
200607-53	b-4 4.0	ND@1.0	200607-77	b-16 4.0	ND@1.0
200607-54	b-5 2.0	ND@1.0	200607-78	b-17 2.0	ND@1.0
200607-55	b-5 4.0	ND@1.0	200607-79	b-17 4.0	ND@1.0
200607-56	b-6 2.0	ND@1.0	200607-80	b-18 2.0	ND@1.0
200607-57	b-6 4.0	ND@1.0	200607-81	b-18 4.0	ND@1.0
200607-58	b-7 2.0	ND@1.0	200607-82	b-19 2.0	ND@1.0
200607-59	b-7 4.0	ND@1.0	200607-83	b-19 4.0	ND@1.0
200607-60	b-8 2.0	ND@1.0	200607-84	b-20 2.0	ND@1.0
200607-61	b-8 4.0	ND@1.0	200607-85	b-20 4.0	ND@1.0
200607-62	b-9 2.0	ND@1.0			
200607-63	b-9 4.0	ND@1.0			
200607-64	b-10 2.0	ND@1.0			
200607-65	b-10 4.0	ND@1.0			
200607-66	b-11 2.0	ND@1.0			
200607-67	b-11 4.0	ND@1.0			
200607-68	b-12 2.0	ND@1.0			
200607-69	b-12 4.0	ND@1.0			
	Date Analyzed:	06/16/00			06/16/00
	Analyst:	TDL			TDL

MCL = Maximum Contaminant Level

Approved By:

200607-46

UMPQUA Research Company
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Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 06/09/00
Date Collected: 54/27
Time Collected: 18:00-18:15
Sampled By: AME/D Katz

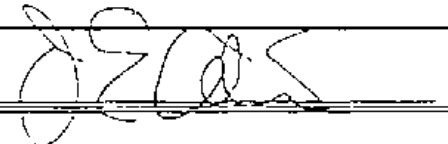
Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	Invoice#
Riddle, OR 97469	2733

Polychlorinated Biphenyls — Matrix: Wipe

Analyte: Polychlorinated Biphenyls
Method: EPA 8080

URC Sample #	Sample ID	Results	Units	MCL	Date Analyzed	Analyst
200428-26	W-1	ND@1.0	mg/kg		05/17/00	TDL
200428-27	W-2	ND@1.0	mg/kg		05/17/00	TDL
200428-28	W-3	ND@1.0	mg/kg		05/17/00	TDL
200428-29	W-4	ND@1.0	mg/kg		05/17/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By: 

200428-26-29pcb

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/23/00
Date Collected: 04/28/00
Time Collected: 3:00 PM
Sampled By: AME/TT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	GP-20
Riddle, OR 97469	Invoice# 2744

Metals #1 — Matrix: ~~Soil~~ Water

URC Sample #: 200428-55
Sample ID: GP-20

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
TOTAL METALS						
Arsenic	EPA 7060	0.342	~~mg/kg~~ µg/L		05/02/00	JMR
Cadmium	EPA 6010	ND@0.001	mg/kg		05/03/00	JMR
Chromium	EPA 6010	2.05	mg/kg		05/03/00	JMR
Lead	EPA 200.9	0.237	mg/kg		05/05/00	JMR
Manganese	EPA 200.9	8.97	mg/kg		05/03/00	JMR
Mercury	EPA 7470	ND@0.001	mg/kg		05/12/00	JMR
Nickel	EPA 200.9	15.2	mg/kg		05/03/00	JMR
DISSOLVED METALS						
Arsenic	EPA 7060	ND@0.01	mg/kg		05/02/00	JMR
Cadmium	EPA 6010	ND@0.002	mg/kg		05/03/00	JMR
Chromium	EPA 6010	ND@0.02	mg/kg		05/03/00	JMR
Lead	EPA 200.9	ND@0.002	mg/kg		05/05/00	JMR
Manganese	EPA 200.9	0.357	mg/kg		05/03/00	JMR
Mercury	EPA 7470	ND@0.001	mg/kg		05/12/00	JMR
Nickel	EPA 200.9	0.065	mg/kg		05/03/00	JMR

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-55

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
Source Name:
Sampled At:

Date Reported: 05/19/00
Date Collected: 04/28/00
Time Collected: 12:05 PM
Sampled By: TCT/DK

COMINCO Ltd., Glenbrook Operation
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

GNC Riddle
JA003.35

Invoice# 2744

TOTAL METALS — Matrix: Soil

URC Sample#	Units	200428-69 HA-41 Results	200428-70 HA-42 Results	Method	Date Analyzed	Analyst
TOTAL METALS						
Nickel	mg/kg	22,000	20,000	EPA 200.9	05/03/00	JMR
Chromium	mg/kg	440	395	EPA 6010	05/03/00	JMR
Manganese	mg/kg	1800	1680	EPA 200.9	05/03/00	JMR

= Maximum Contaminant Level
ND = None Detected At Level Indicated

Approved By:

200428-69-70

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Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/30/00
Date Collected: 04/28/00
Time Collected: 12:05 PM
Sampled By: AME/TT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	GNC Riddle
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	HA-43 Invoice#
Riddle, OR 97469	2744a

TCLP METALS — Matrix: solid

URC Sample #: 200428-71
Sample ID: HA-43

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Chromium	EPA 7000A	ND@0.02	mg/L		05/26/00	JMR
Nickel	EPA 200.9	5.34	mg/L		05/25/00	JMR
Manganese	EPA 200.9	ND@0.01	mg/L		05/24/00	JMR
pH	SM 4500H+	6.2	mg/L		05/04/00	MH

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-71

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 06/02/00
Date Collected: 04/28/00
Time Collected: 10:05 AM
Sampled By: D Katz

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	Shedding Water Tank
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	Invoice#
Riddle, OR 97469	2780

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200504-1
Sample ID: HA-44 CDL

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8270	ND@0.001	mg/L		05/25/00	BKO
Acenaphthylene	EPA 8270	0.0017	mg/L		05/25/00	BKO
Anthracene	EPA 8270	0.001	mg/L		05/25/00	BKO
Benzo(a)anthracene	EPA 8270	ND@0.001	mg/L		05/25/00	BKO
Benzo(a)pyrene	EPA 8270	ND@0.001	mg/L		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8270	ND@0.001	mg/L		05/25/00	BKO
Benzo(ghi)perylene	EPA 8270	ND@0.001	mg/L		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8270	ND@0.001	mg/L		05/25/00	BKO
Chrysene	EPA 8270	ND@0.001	mg/L		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8270	ND@0.001	mg/L		05/25/00	BKO
Fluoranthene	EPA 8270	0.001	mg/L		05/25/00	BKO
Fluorene	EPA 8270	0.0015	mg/L		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8270	ND@0.001	mg/L		05/25/00	BKO
Naphthalene	EPA 8270	ND@0.001	mg/L		05/25/00	BKO
Phenanthrene	EPA 8270	ND@0.001	mg/L		05/25/00	BKO
Pyrene	EPA 8270	ND@0.001	mg/L		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200504-1pah

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/28/00
Time Collected: 10:05 AM
Sampled By: AME/D Katz

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation P.O. Box 85 5093 Riddle By-pass Road Riddle, OR 97469	Invoice# 2780

NWTPH-HCID — Matrix: Soil

URC Sample #: 200504-1
Sample ID: HA-44 COC

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Diesel Detected				
Gasoline	NWTPH-HCID	ND	mg/kg		05/18/00	*
Diesel	NWTPH-HCID	2800	mg/kg		05/18/00	*
Oil	NWTPH-HCID	ND	mg/kg		05/18/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		136	%		05/18/00	*
O-terphenyl		79	%		05/18/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200504-1tphd

UMPQUA Research Company
626 N.E. Division St. Myrtle Creek, OR 97457
Phone: (541) 863-5201 - Fax: (541) 863-6199

OREGON STATE CERTIFIED LAB #015

Date Received: 04/26/00

COMINCO Ltd., Glenbrook Operations
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

Date Reported: 05/31/00
Results in (ppb)
Method: EPA 8260B

Volatile Organic Compounds - GC/MS - 8260B

HA-44 cc

URC Sample #	200428-54	200428-72	200428-78	200428-86	200504-1
Sample ID	GP-19 2'-6'	SG-1 Grab	HA-26	PW-1	Shedding
Matrix	Soil	Soil	Soil	Water	Water tank
MONITORING COMPOUNDS					
Fluorobenzene	109.6%	99.6%	95.4%	116.9%	89.8%
2-Bromo-1-chloropropane	104.6%	109.8%	94.5%	114.3%	83.5%
Dichlorodifluoromethane	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0
Chloromethane	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0
Vinyl chloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromomethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chloroethane	ND@5.0	ND@5.0	82.9	ND@5.0	ND@5.0
Trichlorofluoromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Acetone	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0
1,1-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Methylene chloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Acrylonitrile	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
trans-1,2-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1-Dichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Methyl ethyl ketone	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0
cis-1,2-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
2,2-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chloroform	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromochloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,1-Trichloroethane	ND@1.0	ND@1.0	3.2	ND@1.0	ND@1.0
1,2-Dichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1 Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Carbon tetrachloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Benzene	ND@1.0	ND@1.0	2.8	ND@1.0	ND@1.0
Trichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Dibromomethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromodichloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
cis-1,3-Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Toluene	ND@1.0	ND@1.0	3.0	1.4	ND@1.0
Units:	ug/kg	ug/kg	ug/kg	ug/L	ug/L

ND = None Detected

UMPQUA Research Company
626 N.E. Division St. Myrtle Creek, OR 97457
Phone: (541) 863-5281 - Fax: (541) 863-6199

Volatile Organic Compounds - GC/MS - 8260B

HA-44 cont.

URC Sample #	200428-54	200428-72	200428-78	200428-86	200504-1
Sample ID	GP-19 2'-6'	SG-1 Grab	HA-26	PW-1	Shedding
Matrix	Soil	Soil	Soil	Water	Water tank
trans-1,3-Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,2-Trichloroethane	ND@1.0	ND@1.0	18.1	ND@1.0	ND@1.0
1,3-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Dibromochloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Tetrachloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dibromoethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,1,2-Tetrachloroethane	ND@1.0	ND@1.0	1.5	ND@1.0	ND@1.0
Ethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
m,p-Xylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Styrene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
o-Xylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromoform	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,2,2-Tetrachloroethane	ND@1.0	ND@1.0	7.1	ND@1.0	ND@1.0
1,2,3-Trichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
n-Propylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
2-Chlorotoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
4-Chlorotoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3,5-Trimethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
tert-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,4-Trimethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
sec-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,4-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
4-Isopropyltoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
n-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dibromo-3-chloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,4-Trichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Naphthalene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,3-Trichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Cyclohexanes & derivatives			>500		
Various Alkanes			>200		
Units:	ug/kg	ug/kg	ug/kg	ug/kg	ug/L
Analysis Date:	5/8/00	5/8/00	5/8/00	5/8/00	5/8/00
Analyst:	BKO	BKO	BKO	BKO	BKO

ND = None Detected

 Approved By:

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/28/00
Time Collected: 4:35 PM
Sampled By: TCT/DK

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	PW-1
P.O. Box 85	GNC Riddle
5093 Riddle By-pass Road	JA003.35 Invoice#
Riddle, OR 97469	AOI-R-23 2746

Polynuclear Aromatic Hydrocabons — Matrix: Water

URC Sample #: 200428-86
Sample ID: PW-1

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200428-86pah

Environmental Research Company
626 N.E. Division St. Myrtle Creek, OR 97457
Phone: (541) 863-5281 - Fax: (541) 863-6199

OREGON STATE CERTIFIED LAB #015

Date Received: 04/26/00

COMINCO Ltd., Glenbrook Operations
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

Date Reported: 05/31/00
Results in (ppb)
Method: EPA 8260B

Volatile Organic Compounds - GC/MS - 8260B

URC Sample #	200428-54	200428-72	200428-78	200428-86	200504-1
Sample ID	GP-19 2'-6'	SG-1 Grab	HA-26	PW-1	Shedding
Matrix	Soil	Soil	Soil	Water	Water tank
MONITORING COMPOUNDS					
Fluorobenzene	109.6%	99.6%	95.4%	116.9%	89.8%
2-Bromo-1-chloropropane	104.6%	109.8%	94.5%	114.3%	83.5%
Dichlorodifluoromethane	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0
Chloromethane	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0
Vinyl chloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromomethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chloroethane	ND@5.0	ND@5.0	82.9	ND@5.0	ND@5.0
Trichlorofluoromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Acetone	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0
1,1-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Methylene chloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Acrylonitrile	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
trans-1,2-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1-Dichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Methyl ethyl ketone	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0
cis-1,2-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
2,2-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chloroform	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromochloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,1-Trichloroethane	ND@1.0	ND@1.0	3.2	ND@1.0	ND@1.0
1,2-Dichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1_Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Carbon tetrachloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Benzene	ND@1.0	ND@1.0	2.8	ND@1.0	ND@1.0
Trichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Dibromomethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromodichloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
cis-1,3-Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Toluene	ND@1.0	ND@1.0	3.0	1.4	ND@1.0
Units:	ug/kg	ug/kg	ug/kg	ug/L	ug/L

ND = None Detected

626 N.E. Division St. Myrtle Creek, OR 97457
Phone: (541) 863-5201 - Fax: (541) 863-6199

Volatile Organic Compounds - GC/MS - 8260B

URC Sample #	200428-54	200428-72	200428-78	200428-86	200504-1
Sample ID	GP-19 2'-6'	SG-1 Grab	HA-26	PW-1	Shedding
Matrix	Soil	Soil	Soil	Water	Water tank
trans-1,3-Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,2-Trichloroethane	ND@1.0	ND@1.0	18.1	ND@1.0	ND@1.0
1,3-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Dibromochloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Tetrachloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dibromoethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,1,2-Tetrachloroethane	ND@1.0	ND@1.0	1.5	ND@1.0	ND@1.0
Ethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
m,p-Xylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Styrene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
o-Xylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromoform	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,2,2-Tetrachloroethane	ND@1.0	ND@1.0	7.1	ND@1.0	ND@1.0
1,2,3-Trichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
n-Propylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
2-Chlorotoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
4-Chlorotoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3,5-Trimethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
tert-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,4-Trimethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
sec-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3 Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,4-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
4-Isopropyltoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
n-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dibromo-3-chloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,4-Trichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Naphthalene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,3-Trichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Cyclohexanes & derivatives			>500		
Various Alkanes			>200		
Units:	ug/kg	ug/kg	ug/kg	ug/kg	ug/L
Analysis Date:	5/8/00	5/8/00	5/8/00	5/8/00	5/8/00
Analyst:	BKO	BKO	BKO	BKO	BKO

ND = None Detected

 Approved By:

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/18/00
Date Collected: 04/25/00
Time Collected: 12:00-13:25
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	August Mack/Attn: D. Linebuck
P.O. Box 85	Glenbrook Nickel Co
5093 Riddle By-pass Road	Port Operations AOC-CB-1 Invoice#
Riddle, OR 97469	Project Name: GNC Coos Bay/JA003-35 2702

Metals #1 — Matrix: Soil

	URC Sample #:	200426-5	200426-6			
	Sample ID:	GP-1 2.0'-4.0'	GP-2 0'-2.0'			
Analyte	Method	Results		Units	Date Analyzed	Analyst
Arsenic	EPA 7060	641	269	mg/kg	05/02/00	JMR
Cadmium	EPA 6010	ND@0.01	ND@0.01	mg/kg	04/28/00	JMR
Chromium	EPA 6010	ND@0.2	ND@0.2	mg/kg	05/01/00	JMR
Lead	EPA 200.9	5.15	4.57	mg/kg	05/01/00	JMR
Mercury	EPA 7470	0.073	0.298	mg/kg	05/04/00	JMR
Manganese	EPA 200.9	166	624	mg/kg	04/28/00	JMR
Nickel	EPA 200.9	3.44	38.2	mg/kg	04/28/00	JMR

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200426-5-6

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/25/00
Time Collected: 12:00 PM
Sampled By: D Linebuck

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	Glenbrook Nickel Co
P.O. Box 85	Port Operations AOC-CB-1
5093 Riddle By-pass Road	GP-1 2.0'-4.0' Invoice#
Riddle, OR 97469	JA003.35 2702

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200426-5
Sample ID: GP-1 2.0'-4.0'

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200426-5pah

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/17/00
Date Collected: 04/25/00
Time Collected: 12:00 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	Glenbrook Nickel Co
P.O. Box 85	Port Operations AOC-CB-1
5093 Riddle By-pass Road	GP-1 2.0'-4.0' Invoice#
Riddle, OR 97469	JA003.35 2702

NWTPH-HCID — Matrix: Soil

URC Sample #: 200426-5
Sample ID: GP-1 2.0'-4.0'

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/09/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		98	%		05/09/00	*
O-terphenyl		100	%		05/09/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By: JE Oals

200426-5tph

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P.O. Box 609 - 626 Division Street
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REPORT

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PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/25/00
Time Collected: 12:00 PM
Sampled By: D Linebuck

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	Glenbrook Nickel Co
P.O. Box 85	Port Operations AOC-CB-1
5093 Riddle By-pass Road	GP-2 0-2.0' Invoice#
Riddle, OR 97469	JA003.35 2702

Polynuclear Aromatic Hydrocabons Matrix: solid

URC Sample #: 200426-6
Sample ID: GP-2

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200426-6pah

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/17/00
Date Collected: 04/25/00
Time Collected: 1:25 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	Glenbrook Nickel Co
P.O. Box 85	Port Operations AOC-CB-1
5093 Riddle By-pass Road	GP-2 0-2.0' Invoice#
Riddle, OR 97469	JA003.35 2702

NWTPH-HCID — Matrix: Soil

URC Sample #: 200426-6
Sample ID: GP-2

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/09/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		97	%		05/09/00	*
O-terphenyl		94	%		05/09/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By: DEGLS

200426-6tphd

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/18/00
Date Collected: 04/25/00
Time Collected: 12:50-13:45
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	August Mack/Attn: D. Linebuck
P.O. Box 85	Glenbrook Nickel Co
5093 Riddle By-pass Road	Port Operations AOC-CB-1 Invoice#
Riddle, OR 97469	Project Name: GNC Coos Bay/JA003-35 2702

Metals #1 — Matrix: Soil

	URC Sample #:	200426-7	200426-8			
	Sample ID:	GP-3 4.0'-06.0'	GP-4 0'-2.0'			
Analyte	Method	Results	Results	Units	Date Analyzed	Analyst
Arsenic	EPA 7060	669	360	mg/kg	05/02/00	JMR
Cadmium	EPA 6010	ND@0.01	ND@0.01	mg/kg	04/28/00	JMR
Chromium	EPA 6010	ND@0.2	ND@0.2	mg/kg	05/01/00	JMR
Lead	EPA 200.9	5.59	0.335	mg/kg	05/01/00	JMR
Mercury	EPA 7470	0.270	0.062	mg/kg	05/04/00	JMR
Manganese	EPA 200.9	418	279	mg/kg	04/28/00	JMR
Nickel	EPA 200.9	8.89	17.4	mg/kg	04/28/00	JMR

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200426-7-8

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/25/00
Time Collected: 12:50 PM
Sampled By: AME/TT

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	Glenbrook Nickel Co
P.O. Box 85	Port Operations AOC-CB-1
5093 Riddle By-pass Road	GP-3 4.0-6.0 Invoice#
Riddle, OR 97469	JA003.35 2702

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200426-7
Sample ID: GP-3

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200426-7pah

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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/25/00
Time Collected: 12:50 PM
Sampled By: AME/TCT

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	Glenbrook Nickel Co
P.O. Box 85	Port Operations AOC-CB-1
5093 Riddle By-pass Road	GP-3 4.0-6.0 Invoice#
Riddle, OR 97469	JA003.35 2702

NWTPH-HCID Matrix: Soil

URC Sample #: 200426-7
Sample ID: GP-3

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Oil Detected				
Diesel	NWTPH-HCID	ND	mg/kg		05/23/00	*
Oil	NWTPH-HCID	590	mg/kg		05/24/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		55	%		05/24/00	*
O-terphenyl		91	%		05/24/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200426-7tphd

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/25/00
Time Collected: 12:00 PM
Sampled By: AME/TT

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	Glenbrook Nickel Co
P.O. Box 85	Port Operations AOC-CB-1
5093 Riddle By-pass Road	GP-4 0-2.0 Invoice#
Riddle, OR 97469	JA003.35 2702

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200426-8
Sample ID: GP-4

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200426-8pah

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/25/00
Time Collected: 1:45 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	Glenbrook Nickel Co
P.O. Box 85	Port Operations AOC-CB-1
5093 Riddle By-pass Road	GP-4 0-2.0 Invoice#
Riddle, OR 97469	JA003.35 2702

NWTPH-HCID Matrix: Soil

URC Sample #: 200426-8
Sample ID: GP-4

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Diesel & Oil Detected				
Gasoline	NWTPH-Dx	ND	mg/kg		05/09/00	*
Diesel	NWTPH-Dx	210	mg/kg		05/17/00	*
Oil	NWTPH-Dx	110	mg/kg		05/17/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		85	%		05/17/00	*
O-terphenyl		96	%		05/17/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By: DE Cole

200426-8tphd

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/19/00
Date Collected: 04/25/00
Time Collected: 12:15 PM
Sampled By: AME/T Tomes

Mailing Address for Report

COMINCO Ltd., Glenbrook Operation
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

Sample Information

Port Operations AOC-CB-1
JA003.35

Invoice#
2702

Metals #1

Matrix: Water

URC Sample #: 200426-9 Field Filtered 0.45 micron
Sample ID: GP-1

Analyte	Method	Results	Results		Date Analyzed	Analyst
TOTAL METALS						
Arsenic	EPA 7060	2.12	mg/L		05/02/00	JMR
Cadmium	EPA 6010	ND@0.001	mg/L		04/28/00	JMR
Chromium	EPA 6010	1.24	mg/L		05/01/00	JMR
Lead	EPA 200.9	0.193	mg/L		05/01/00	JMR
Manganese	EPA 200.9	3.14	mg/L		04/28/00	JMR
Mercury	EPA 7470	ND@0.001	mg/L		05/12/00	JMR
Nickel	EPA 200.9	0.072	mg/L		05/03/00	JMR
DISSOLVED METALS - Filtered						
Arsenic	EPA 7060	0.028	mg/L		05/02/00	JMR
Cadmium	EPA 6010	ND@0.001	mg/L		04/28/00	JMR
Chromium	EPA 6010	ND@0.02	mg/L		05/01/00	JMR
Lead	EPA 200.9	ND@0.002	mg/L		05/01/00	JMR
Manganese	EPA 200.9	1.76	mg/L		04/28/00	JMR
Mercury	EPA 7470	ND@0.001	mg/L		05/12/00	JMR
Nickel	EPA 200.9	0.069	mg/L		04/28/00	JMR

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200426-9

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/25/00
Time Collected: 12:15 PM
Sampled By: AME/TT

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	Glenbrook Nickel Co
P.O. Box 85	Port Operations AOC-CB-1
5093 Riddle By-pass Road	GP-1 Invoice#
Riddle, OR 97469	JA003.35 2702

Polynuclear Aromatic Hydrocabons — Matrix: Water

URC Sample #: 200426-9
Sample ID: GP-1

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Acenaphthylene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Anthracene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Benzo(a)anthracene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Benzo(a)pyrene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Benzo(b)fluoranthene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Benzo(ghi)perylene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Benzo(k)fluoranthene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Chrysene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Dibenzo(ah)anthracene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Fluoranthene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Fluorene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Naphthalene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Phenanthrene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Pyrene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200426-9pah

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
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(541) 863-5201 Fax: (541) 863-6199

REPORT

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PWS#:
PWS Name:
Sampled At:

Date Reported: 05/19/00
Date Collected: 04/25/00
Time Collected: 1:10 PM
Sampled By: amelt Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	Port Operations AOC-CB-1
P.O. Box 85	JA003.35
5093 Riddle By-pass Road	Invoice#
Riddle, OR 97469	2702

Metals #1 — Matrix: Water

URC Sample #: 200426-10 — Field Filtered 0.45 micron
Sample ID: GP-3

Analyte	Method	Results	Results		Date Analyzed	Analyst
TOTAL METALS						
Arsenic	EPA 7060	4.57	mg/L		05/02/00	JMR
Cadmium	EPA 6010	ND@0.001	mg/L		04/28/00	JMR
Chromium	EPA 6010	ND@0.02	mg/L		05/01/00	JMR
Lead	EPA 200.9	0.274	mg/L		05/01/00	JMR
Manganese	EPA 200.9	9.58	mg/L		04/28/00	JMR
Mercury	EPA 7470	ND@0.001	mg/L		05/11/00	JMR
Nickel	EPA 200.9	0.190	mg/L		05/03/00	JMR
DISSOLVED METALS						
Arsenic	EPA 7060	ND@0.01	mg/L		05/02/00	JMR
Cadmium	EPA 6010	ND@0.001	mg/L		04/28/00	JMR
Chromium	EPA 6010	ND@0.02	mg/L		05/01/00	JMR
Lead	EPA 200.9	ND@0.002	mg/L		05/01/00	JMR
Manganese	EPA 200.9	4.00	mg/L		04/28/00	JMR
Mercury	EPA 7470	ND@0.001	mg/L		05/12/00	JMR
Nickel	EPA 200.9	0.059	mg/L		04/28/00	JMR

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200426-10

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/25/00
Time Collected: 1:10 PM
Sampled By: AME/TT

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	Glenbrook Nickel Co
P.O. Box 85	Port Operations AOC-CB-1
5093 Riddle By-pass Road	GP-3 Invoice#
Riddle, OR 97469	JA003.35 2702

Polynuclear Aromatic Hydrocabons — Matrix: Water

URC Sample #: 200426-10
Sample ID: GP-3

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Accnaphthene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Acenaphthylene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Anthracene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Benzo(a)anthracene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Benzo(a)pyrene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Benzo(b)fluoranthene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Benzo(ghi)perylene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Benzo(k)fluoranthene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Chrysene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Dibenzo(ah)anthracene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Fluoranthene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Fluorene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Naphthalene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Phenanthrene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL
Pyrene	EPA 8310	ND@0.001	mg/L		04/28/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200426-10pah

Utah QC Research Company
626 N.E. Division St. Myrtle Creek, OR 97457
Phone: (541) 863-5201 - Fax: (541) 863-6199

OREGON STATE CERTIFIED LAB #015

Date Received: 05/26/00

COMINCO Ltd., Glenbrook Operations
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

Date Reported: 05/31/00
Results in (ppb)
Method: EPA 8260B

Volatile Organic Compounds - GC/MS - 8260B

URC Sample #	200426-5	200426-6	200426-7	200426-8	200426-9
Sample ID	GP-1 2'-4'	GP-2 0'-2'	GP-3 4'-6'	GP-4 0'-2'	GP-1
Matrix	Soil	Soil	Soil	Soil	Water
MONITORING COMPOUNDS					
Fluorobenzene	102.9%	110.0%	109.3%	106.4%	101.1%
2-Bromo-1-chloropropane	90.5%	99.1%	91.2%	104.1%	117.7%
Dichlorodifluoromethane	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0
Chloromethane	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0
Vinyl chloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromomethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chloroethane	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0
Trichlorofluoromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Acetone	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0
1,1-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Methylene chloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Acrylonitrile	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
trans-1,2-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1-Dichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Methyl ethyl ketone	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
cis-1,2-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
2,2-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chloroform	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromochloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,1-Trichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1_Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Carbon tetrachloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Benzene	2.5	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Trichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Dibromomethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromodichloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
cis-1,3-Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Toluene	4.9	1.2	2.4	ND@1.0	ND@1.0
Units:	ug/kg	ug/kg	ug/kg	ug/kg	ug/L

ND = None Detected

626 N.E. Division St. Myrtle Creek, OR 97457
Phone: (541) 863-5201 - Fax: (541) 863-6199

Volatile Organic Compounds - GC/MS - 8260B

URC Sample #	200426-5	200426-6	200426-7	200426-8	200426-9
Sample ID	GP-1 2'-4'	GP-2 0'-2'	GP-3 4'-6'	GP-4 0'-2'	GP-1
Matrix	Soil	Soil	Soil	Soil	Water
trans-1,3-Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,2-Trichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Dibromochloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Tetrachloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dibromoethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,1,2-Tetrachloroethane	ND@1.0	ND@1.0	ND@1.0	23.3	ND@1.0
Ethylbenzene	1.7	ND@1.0	ND@1.0	ND@1.0	ND@1.0
m,p-Xylene	1.8	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Styrene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
o-Xylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromoform	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,2,2-Tetrachloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,3-Trichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
n-Propylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
2-Chlorotoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
4-Chlorotoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3,5-Trimethylbenzene	1.5	ND@1.0	ND@1.0	ND@1.0	ND@1.0
tert-Butylbenzene	1.1	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,4-Trimethylbenzene	1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
sec-Butylbenzene	1.7	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,4-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
4-Isopropyltoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
n-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dibromo-3-chloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,4-Trichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Naphthalene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,3-Trichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Cyclohexanes				>250	
Octane & Derivatives	>50			>150	
Units:	ug/kg	ug/kg	ug/kg	ug/kg	ug/L
Analysis Date:	5/8/00	5/8/00	5/8/00	5/8/00	5/8/00
Analyst:	BKO	BKO	BKO	BKO	BKO

ND = None Detected

 Approved By:

CAS Quality Research Company
626 N.E. Division St. Myrtle Creek, OR 97457
Phone: (541) 863-5201 - Fax: (541) 863-6199

OREGON STATE CERTIFIED LAB #015

Date Received: 04/26/00

COMINCO Ltd., Glenbrook Operations
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

Date Reported: 05/31/00
Results in (ppb)
Method: EPA 8260B

Volatile Organic Compounds - GC/MS - 8260B

URC Sample #	200426-10	200426-11	200426-12	200426-13	200428-2
Sample ID	GP-3	1	2	3	GP-11
Matrix	Water	Water	Water	Water	Water
MONITORING COMPOUNDS					
Fluorobenzene	119.3%	112.5%	115.1%	94.0%	86.6%
2-Bromo-1-chloropropane	102.1%	103.1%	93.8%	93.0%	71.6%
Dichlorodifluoromethane	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0
Chloromethane	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0
Vinyl chloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromomethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chloroethane	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0
Trichlorofluoromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Acetone	ND@5.0	90.0	ND@5.0	ND@5.0	ND@5.0
1,1-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Methylene chloride	ND@1.0	37.6	ND@1.0	ND@1.0	ND@1.0
Acrylonitrile	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
trans-1,2-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1-Dichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Methyl ethyl ketone	ND@1.0	85.8	ND@1.0	ND@1.0	ND@1.0
cis-1,2-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
2,2-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chloroform	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromochloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,1-Trichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichloroethane	ND@1.0	6.6	ND@1.0	ND@1.0	ND@1.0
1,1_Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Carbon tetrachloride	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Benzene	ND@1.0	1.1	ND@1.0	ND@1.0	ND@1.0
Trichloroethylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Dibromomethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromodichloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
cis-1,3-Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Toluene	ND@1.0	15.4	1.4	ND@1.0	ND@1.0
Units:	ug/L	ug/L	ug/L	ug/L	ug/L

ND = None Detected

Utah QA Research Company
626 N.E. Division St. Myrtle Creek, OR 97457
Phone: (541) 863-5201 - Fax: (541) 863-6199

Volatile Organic Compounds - GC/MS - 8260B

URC Sample #	200426-10	200426-11	200426-12	200426-13	200428-2
Sample ID	GP-3	Dup 1	Dup 2	Dup 3	GP-11
Matrix	Water	Water	Water	Water	Water
trans-1,3-Dichloropropene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,2-Trichloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Dibromochloromethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Tetrachloroethylene	ND@1.0	ND@1.0	1.3	ND@1.0	ND@1.0
1,2-Dibromoethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Chlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,1,2-Tetrachloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	1.2
Ethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
m,p-Xylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Styrene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
o-Xylene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromoform	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,2,2-Tetrachloroethane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,3-Trichloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Bromobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
n-Propylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
2-Chlorotoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
4-Chlorotoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3,5-Trimethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
tert-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,4-Trimethylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
sec-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,3-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,4-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
4-Isopropyltoluene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
n-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-Dibromo-3-chloropropane	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2,4-Trichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Naphthalene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	2.4
1,2,3-Trichlorobenzene	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
Units:	ug/kg	ug/kg	ug/kg	ug/kg	ug/L
Analysis Date:	5/8/00	5/8/00	5/8/00	5/8/00	5/8/00
Analyst:	BKO	BKO	BKO	BKO	BKO

ND = None Detected

Approved By:

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/18/00
Date Collected: 04/25/00
Time Collected: 6:05 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	Glenbrook Nickel Co
P.O. Box 85	Port Operations AOC-CB-1
5093 Riddle By-pass Road	GP-9 Invoice#
Riddle, OR 97469	JA003.35 2702

Effluent Tests — Matrix: Water

URC Sample #: 200426-20 — Field Filtered 0.45 micron
Sample ID: GP-9

Analyte	Method	Results	Units		Date Analyzed	Analyst
pH	SM 4500-H-B	7.0	pH Units		04/26/00	CO
Nitrate+Nitrite as N	EPA 300.0	ND@0.1	mg/L		05/11/00	JMR
Kjeldahl Nitrogen, Total	SM 4400N	64.2	mg/L		04/28/00	MH

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200426-20

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/18/00
Date Collected: 04/25/00
Time Collected: 6:05 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation P.O. Box 85 5093 Riddle By-pass Road Riddle, OR 97469	Port Operations AOC-CB-1 Invoice# JA003.35 2702

Metals #1 — Matrix: Water

URC Sample #: 200426-20 — Field Filtered 0.45 micron
Sample ID: GP-9

Analyte	Method	Results	Units	Date Analyzed	Analyst
TOTAL METALS					
Arsenic	EPA 7060	ND@0.01	mg/L	05/02/00	JMR
Cadmium	EPA 6010	ND@0.001	mg/L	04/28/00	JMR
Chromium	EPA 6010	0.796	mg/L	05/01/00	JMR
Lead	EPA 200.9	0.063	mg/L	05/01/00	JMR
Manganese	EPA 200.9	2.67	mg/L	04/28/00	JMR
Mercury	EPA 7470	0.001	mg/L	05/04/00	JMR
Nickel	EPA 200.9	0.037	mg/L	04/28/00	JMR
DISSOLVED METALS - Filtered					
Arsenic	EPA 7060	ND@0.01	mg/L	05/02/00	JMR
Cadmium	EPA 6010	ND@0.001	mg/L	04/28/00	JMR
Chromium	EPA 6010	ND@0.02	mg/L	05/01/00	JMR
Lead	EPA 200.9	ND@0.002	mg/L	05/01/00	JMR
Manganese	EPA 200.9	1.94	mg/L	04/28/00	JMR
Mercury	EPA 7470	0.001	mg/L	05/04/00	JMR
Nickel	EPA 200.9	0.031	mg/L	04/28/00	JMR

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200426-20M

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015

PWS#:

PWS Name:

Sampled At:

Date Reported: 05/18/00
Date Collected: 04/25/00
Time Collected: 6:35 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	
P.O. Box 85	August Mack/Attn: D. Linebuck
5093 Riddle By-pass Road	GP-10 Invoice#
Riddle, OR 97469	Port Operations AOC-CB-1 2702

Effluent Tests — Matrix: Water

URC Sample #: 200426-21 | Field Filtered 0.45 micron

Sample ID: GP-10

Analyte	Method	Results	Units	Date Analyzed	Analyst
pH	SM 4500-H-B	8.7	pH Units	04/26/00	CO
Nitrate+Nitrite as N	EPA 300.0	ND@0.1	mg/L	05/11/00	JMR
Kjeldahl Nitrogen, Total	SM 4400N	538	mg/L	04/28/00	MH

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200426-21

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/18/00
Date Collected: 04/25/00
Time Collected: 6:35 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation P.O. Box 85 5093 Riddle By-pass Road Riddle, OR 97469	Port Operations AOC-CB-1 Invoice# JA003.35 2702

Metals #1 — Matrix: Water

URC Sample #: 200426-21 — Field Filtered 0.45 micron
Sample ID: GP-10

Analyte	Method	Results	Units	Date Analyzed	Analyst
TOTAL METALS					
Arsenic	EPA 7060	0.446	mg/L	05/02/00	JMR
Cadmium	EPA 6010	ND@0.001	mg/L	04/28/00	JMR
Chromium	EPA 6010	2.67	mg/L	05/01/00	JMR
Lead	EPA 200.9	0.064	mg/L	05/01/00	JMR
Manganese	EPA 200.9	0.500	mg/L	04/28/00	JMR
Mercury	EPA 7470	ND@0.001	mg/L	05/04/00	JMR
Nickel	EPA 200.9	0.057	mg/L	04/28/00	JMR
DISSOLVED METALS - Filtered					
Arsenic	EPA 7060	0.022	mg/L	05/02/00	JMR
Cadmium	EPA 6010	ND@0.001	mg/L	04/28/00	JMR
Chromium	EPA 6010	ND@0.02	mg/L	05/01/00	JMR
Lead	EPA 200.9	ND@0.002	mg/L	05/01/00	JMR
Manganese	EPA 200.9	0.118	mg/L	04/28/00	JMR
Mercury	EPA 7470	ND@0.001	mg/L	05/04/00	JMR
Nickel	EPA 200.9	0.034	mg/L	04/28/00	JMR

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200426-21M

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/25/00
Time Collected: 6:05 PM
Sampled By: AME/TT

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	Glenbrook Nickel Co
P.O. Box 85	Port Operations AOC-CB-1
5093 Riddle By-pass Road	CP-11 Invoice#
Riddle, OR 97469	JA003.35 2702

BTEX by EPA502.2 — Matrix: water

URC Sample #: 200426-22
Sample ID: GP-11

Analyte	Results	Units	MCL	Date Analyzed	Analyst
Benzene	ND@0.001	mg/L		05/08/00	TDL
Toluene	0.0045	mg/L		05/08/00	TDL
Ethylbenzene	ND@0.001	mg/L		05/08/00	TDL
Xylenes	ND@0.001	mg/L		05/08/00	TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200426-22btex

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected:
Time Collected: 4:48 PM
Sampled By: AME/TT

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	0.753472222
P.O. Box 85	August Mack/Attn: D. Linebuck
5093 Riddle By-pass Road	Glenbrook Nickel Co Invoice#
Riddle, OR 97469	Port Operations AOC-CB-1 2702

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200426-22
Sample ID: GP-11

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200426-22pah

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/17/00
Date Collected: 04/25/00
Time Collected: 6:05 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	
P.O. Box 85	August Mack/Attn: D. Linebuck
5093 Riddle By-pass Road	Glenbrook Nickel Co — Invoice#
Riddle, OR 97469	Port Operations AOC-CB-1 — 2702

NWTPH-HCID — Matrix: Soil

URC Sample #: 200426-22
Sample ID: GP-11

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/09/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		89	%		05/09/00	*
O-terphenyl		93	%		05/09/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200426-22tphd

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/25/00
Time Collected: 6:05 PM
Sampled By: AME/TT

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	Glenbrook Nickel Co
P.O. Box 85	Port Operations AOC-CB-1
5093 Riddle By-pass Road	GP-12 Invoice#
Riddle, OR 97469	JA003.35 2702

BTEX by EPA 502.2 — Matrix: Soil

URC Sample #: 200426-23
Sample ID: GP-12

Analyte	Results	Units	MCL	Date Analyzed	Analyst
Benzene	ND@0.001	mg/kg		05/09/00	BKO/TDL
Toluene	ND@0.001	mg/kg		05/09/00	BKO/TDL
Ethylbenzene	ND@0.001	mg/kg		05/09/00	BKO/TDL
Xylenes	ND@0.001	mg/kg		05/09/00	BKO/TDL

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200426-23btex

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/31/00
Date Collected: 04/25/00
Time Collected: 6:05 PM
Sampled By: AME/TT

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	Glenbrook Nickel Co
P.O. Box 85	Port Operations AOC-CB-1
5093 Riddle By-pass Road	GP-12 Invoice#
Riddle, OR 97469	JA003.35 2702

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200426-23
Sample ID: GP-12-

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Acenaphthylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(a)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(b)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(ghi)perylene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Benzo(k)fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Chrysene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Dibenzo(ah)anthracene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluoranthene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Fluorene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Naphthalene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Phenanthrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO
Pyrene	EPA 8310	ND@1.0	mg/kg		05/25/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200426-23pah

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/17/00
Date Collected: 04/25/00
Time Collected: 6:05 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	Glenbrook Nickel Co
P.O. Box 85	Port Operations AOC-CB-1
5093 Riddle By-pass Road	GP-12 Invoice#
Riddle, OR 97469	JA003.35 2702

NWTPH-HCID — Matrix: Soil

URC Sample #: 200426-23
Sample ID: GP-12

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND	mg/kg		05/09/00	*
% Surrogate Recovery						
2-Fluorobiphenyl		89	%		05/09/00	*
O-terphenyl		93	%		05/09/00	*

*Tested by Oregon Analytical Laboratory

MCL = Maximum Contaminant Level
ND = None Detected

Approved By: DEC

200426-23tphd

UMPQUA Research Company
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Myrtle Creek, OR 97457
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REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/11/00
Date Collected: 04/25/00
Time Collected: 5:30 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation P.O. Box 85 5093 Riddle By-pass Road Riddle, OR 97469	Port Operations AOC-CB-1 Invoice# JA003.35 2702

Metals #1 — Matrix: Water

URC Sample #: 200426-19 | Field Filtered 0.45 micron
Sample ID: GP-8

Analyte	Method	Results	Results			
TOTAL METALS						
Chromium	EPA 200.9	0.543	mg/L		05/03/00	JMR
Manganese	EPA 200.9	6.15	mg/L		04/28/00	JMR
Nickel	EPA 200.9	0.252	mg/L		04/28/00	JMR
Silver	EPA 200.9	0.049	mg/L		05/05/00	JMR
Aluminum	EPA 200.9	179	mg/L		05/05/00	JMR
DISSOLVED METALS (Filtered)						
Chromium	EPA 200.9	ND@0.02	mg/L		05/03/00	JMR
Manganese	EPA 200.9	6.02	mg/L		04/28/00	JMR
Nickel	EPA 200.9	0.074	mg/L		04/28/00	JMR
Silver	EPA 200.9	0.020	mg/L		05/05/00	JMR
Aluminum	EPA 200.9	3.00	mg/L		05/05/00	JMR

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200426-19m

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/08/00
Date Collected: 04/25/00
Time Collected: 4:55 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation P.O. Box 85 5093 Riddle By-pass Road Riddle, OR 97469	Port Operations AOC-CB-1 JA 003.35 Invoice# 2702

Metals #1 — Matrix: Water

URC Sample #: 200426-18 — Field Filtered 0.45 micron
Sample ID: GP-7

Analyte	Method	Results	Results			
TOTAL METALS						
Chromium	EPA 200.9	2.05	mg/L		05/03/00	JMR
Manganese	EPA 200.9	9.03	mg/L		04/28/00	JMR
Nickel	EPA 200.9	2.00	mg/L		04/28/00	JMR
Silver	EPA 200.9	0.046	mg/L		05/05/00	JMR
Aluminum	EPA 200.9	449	mg/L		05/05/00	JMR
DISSOLVED METALS (Filtered)						
Chromium	EPA 200.9	ND@0.02	mg/L		05/03/00	JMR
Manganese	EPA 200.9	1.01	mg/L		04/28/00	JMR
Nickel	EPA 200.9	0.162	mg/L		04/28/00	JMR
Silver	EPA 200.9	0.013	mg/L		05/05/00	JMR
Aluminum	EPA 200.9	0.382	mg/L		05/05/00	JMR

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200426-18m

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/08/00
Date Collected: 04/25/00
Time Collected: 12:00 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation P.O. Box 85 5093 Riddle By-pass Road Riddle, OR 97469	Port Operations AOC-CB-1 Invoice# JA003.35 2702

Metals #1 — Matrix: Water

URC Sample #: 200426-17 — Field Filtered 0.45 micron
Sample ID: GP-6

Analyte	Method	Results	Results		
TOTAL METALS					
Chromium	EPA 200.9	0.917	mg/L	05/03/00	JMR
Iron	EPA 200.9	794	mg/L	05/01/00	JMR
Manganese	EPA 200.9	268	mg/L	04/28/00	JMR
Nickel	EPA 200.9	0.119	mg/L	04/28/00	JMR
DISSOLVED METALS					
Chromium	EPA 200.9	ND@0.02	mg/L	05/03/00	JMR
Iron	EPA 200.9	471	mg/L	05/01/00	JMR
Manganese	EPA 200.9	28.6	mg/L	04/28/00	JMR
Nickel	EPA 200.9	0.13	mg/L	04/28/00	JMR

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200426-17m

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 05/08/00
Date Collected: 04/25/00
Time Collected: 3:15 PM
Sampled By: AME/T Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation P.O. Box 85 5093 Riddle By-pass Road Riddle, OR 97469	Port Operations AOC-CB-1 Invoice# JA003.35 2702

Metals #1 — Matrix: Water

URC Sample #: 200426-16 — Field Filtered 0.45 micron
Sample ID: GP-5

Analyte	Method	Results	Results		
TOTAL METALS					
Chromium	EPA 200.9	0.392	mg/L	05/03/00	JMR
Iron	EPA 200.9	327	mg/L	05/01/00	JMR
Manganese	EPA 200.9	7.09	mg/L	04/28/00	JMR
Nickel	EPA 200.9	0.074	mg/L	04/28/00	JMR
DISSOLVED METALS					
Chromium	EPA 200.9	ND@0.02	mg/L	05/03/00	JMR
Iron	EPA 200.9	91.6	mg/L	05/01/00	JMR
Manganese	EPA 200.9	5.47	mg/L	04/28/00	JMR
Nickel	EPA 200.9	0.041	mg/L	04/28/00	JMR

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200426-16m

UMPQUA Research Company
626 N.E. Division St. Myrtle Creek, OR 97457
Phone: (541) 863-5201 - Fax: (541) 863-6199

OREGON STATE CERTIFIED LAB #015

Date Received: 04 26 00

COMINCO Ltd., Glenbrook Operations
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

Date Reported: 05 31 00
Results in (ppb)
Method: EPA 8260B

Volatile Organic Compounds - GC/MS - 8260B

URC Sample #	Trip	Trip	Method	Lab	Matrix
Sample ID	Blank	Blank	Blank	Control	Spike
	26-Apr	28-Apr	Results	% of TV	% of TV
MONITORING COMPOUNDS					
Fluorobenzene	102.9%	110.0%	86.6%	111.5%	103.4%
2-Bromo-1-chloropropane	90.5%	99.1%	93.5%	127.4%	109.9%
Dichlorodifluoromethane	ND@2.0	ND@2.0	ND@2.0	85.0%	88.8%
Chloromethane	ND@2.0	ND@2.0	ND@2.0	119.4%	104.5%
Vinyl chloride	ND@1.0	ND@1.0	ND@1.0	93.9%	108.3%
Bromomethane	ND@1.0	ND@1.0	ND@1.0	91.6%	107.8%
Chloroethane	ND@5.0	ND@5.0	ND@5.0	108.5%	110.3%
Trichlorofluoromethane	ND@1.0	ND@1.0	ND@1.0	103.3%	113.6%
Acetone	ND@5.0	ND@5.0	ND@5.0	120.9%	118.8%
1,1-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	96.6%	105.3%
Methylene chloride	ND@1.0	ND@1.0	ND@1.0	99.4%	104.2%
Acrylonitrile	ND@1.0	ND@1.0	ND@1.0	99.6%	102.7%
trans-1,2-Dichloroethylene	ND@1.0	ND@1.0	ND@1.0	99.4%	106.9%
1,1-Dichloroethane	ND@1.0	ND@1.0	ND@1.0	96.0%	102.4%
Methyl ethyl ketone	ND@1.0	ND@1.0	ND@1.0	87.5%	87.2%
cis-1,2-Dichloroethylene	ND@5.0	ND@5.0	ND@5.0	98.0%	103.8%
2,2-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	96.9%	104.4%
Chloroform	ND@1.0	ND@1.0	ND@1.0	87.0%	90.9%
Bromochloromethane	ND@1.0	ND@1.0	ND@1.0	99.8%	104.9%
1,1,1 Trichloroethane	ND@1.0	ND@1.0	ND@1.0	95.7%	103.2%
1,2-Dichloroethane	ND@1.0	ND@1.0	ND@1.0	92.5%	97.2%
1,1_Dichloropropene	ND@1.0	ND@1.0	ND@1.0	94.5%	102.0%
Carbon tetrachloride	ND@1.0	ND@1.0	ND@1.0	92.2%	96.7%
Benzene	ND@1.0	ND@1.0	ND@1.0	94.6%	100.7%
Trichloroethylene	ND@1.0	ND@1.0	ND@1.0	99.0%	100.3%
1,2-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	97.5%	98.6%
Dibromomethane	ND@1.0	ND@1.0	ND@1.0	93.5%	100.0%
Bromodichloromethane	ND@1.0	ND@1.0	ND@1.0	93.3%	98.1%
cis-1,3-Dichloropropene	ND@1.0	ND@1.0	ND@1.0	95.1%	98.3%
Toluene	ND@1.0	ND@1.0	ND@1.0	98.6%	102.1%

ND = None Detected

UMPQUA Research Company
626 N.E. Division St. Myrtle Creek, OR 97457
Phone: (541) 863-5201 - Fax: (541) 863-6199

Volatile Organic Compounds - GC/MS - 8260B

URC Sample # Sample ID	Trip Blank 26-Apr	Trip Blank 28-Apr	Method Blank Results	Lab Control % of TV	Matrix Spike % of TV
trans-1,3-Dichloropropene	ND@1.0	ND@1.0	ND@1.0	88.3%	91.5%
1,1,2-Trichloroethane	ND@1.0	ND@1.0	ND@1.0	96.0%	98.8%
1,3-Dichloropropane	ND@1.0	ND@1.0	ND@1.0	95.2%	96.8%
Dibromochloromethane	ND@1.0	ND@1.0	ND@1.0	92.5%	95.7%
Tetrachloroethylene	ND@1.0	ND@1.0	ND@1.0	99.8%	106.8%
1,2-Dibromoethane	ND@1.0	ND@1.0	ND@1.0	98.5%	99.1%
Chlorobenzene	ND@1.0	ND@1.0	ND@1.0	99.5%	99.1%
1,1,1,2-Tetrachloroethane	ND@1.0	ND@1.0	ND@1.0	99.9%	97.3%
Ethylbenzene	ND@1.0	ND@1.0	ND@1.0	93.9%	98.7%
m,p-Xylene	ND@1.0	ND@1.0	ND@1.0	94.0%	97.1%
Styrene	ND@1.0	ND@1.0	ND@1.0	94.0%	98.7%
o-Xylene	ND@1.0	ND@1.0	ND@1.0	95.1%	97.1%
Bromoform	ND@1.0	ND@1.0	ND@1.0	87.4%	89.3%
1,1,2,2-Tetrachloroethane	ND@1.0	ND@1.0	ND@1.0	96.3%	98.5%
1,2,3-Trichloropropane	ND@1.0	ND@1.0	ND@1.0	85.5%	86.9%
Bromobenzene	ND@1.0	ND@1.0	ND@1.0	97.6%	95.8%
n-Propylbenzene	ND@1.0	ND@1.0	ND@1.0	91.7%	96.4%
2-Chlorotoluene	ND@1.0	ND@1.0	ND@1.0	94.7%	91.8%
4-Chlorotoluene	ND@1.0	ND@1.0	ND@1.0	95.6%	97.5%
1,3,5-Trimethylbenzene	ND@1.0	ND@1.0	ND@1.0	89.5%	92.5%
tert-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	82.9%	81.5%
1,2,4-Trimethylbenzene	ND@1.0	ND@1.0	ND@1.0	90.8%	92.3%
sec-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	93.5%	95.7%
1,3-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	93.4%	96.3%
1,4-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	85.3%	87.9%
4-Isopropyltoluene	ND@1.0	ND@1.0	ND@1.0	97.0%	97.1%
1,2-Dichlorobenzene	ND@1.0	ND@1.0	ND@1.0	99.0%	94.1%
n-Butylbenzene	ND@1.0	ND@1.0	ND@1.0	91.8%	90.7%
1,2-Dibromo-3-chloropropane	ND@1.0	ND@1.0	ND@1.0	92.4%	95.2%
1,2,4-Trichlorobenzene	ND@1.0	ND@1.0	ND@1.0	100.8%	97.1%
Naphthalene	ND@1.0	ND@1.0	ND@1.0	93.8%	90.7%
1,2,3-Trichlorobenzene	ND@1.0	ND@1.0	ND@1.0	130.0%	107.7%
Average Monitoring Cmpds.:	102.9%	110.0%	86.6%	111.5%	103.4%
Average % of TV:				96.2%	98.5%
Analysis Date:	5/8/00	5/8/00	5/8/00	5/8/00	5/8/00
Analyst:	BKO	BKO	BKO	BKO	BKO

ND = None Detected

 Approved By:

August Mack Environmental In
2200 Greene Way Suite 100
Louisville Ky 40220

CHAIN OF CUSTODY RECORD

UMPQUA RESEARCH COMPANY
626 N.E. DIVISION ST. - P.O. BOX 609
MYRTLE CREEK, OR 97457
Ph (541) 863-5201 Fax (541) 863-6199

NAME: Glenbrook Nickel Company

Address: Coos Bay Oregon

Port Operations AOC - CB-1

OREGON STATE CERTIFIED LABORATORY # 015

Date 4-25-00 Page 1 of 1

PROJECT NAME GNC Coos Bay
PWS # JA0003.35
PROJECT CONTACT: Doug Linebuck (AME)
TELEPHONE: 502 - 671-7712
SAMPLE COLLECTOR

Lab Use Only	SAMPLE INFORMATION			NUMBER OF	SAMPLE TYPE		ANALYSIS
URC SAMPLE #	LOCATION	DATE	TIME	CONTAINERS	WATER	SOIL	REQUIRED
	GP-1 2.0'-4.0'	4-25-00	12:00	1		✓	VOCs 8260, PAH 8310 TPH-D metals As, Cd Cr, Pb, MN, Hg, Ni
	GP-2 0-2.0'	4-25-00	13:25	2		✓	"
	GP-3 4.0-6.0	4-25-00	12:50	2		✓	"
	GP-4 0-2.0	4-25-00	13:45	2		✓	"
	GP-1	4-25-00	12:15	4	✓		VOCs 8260, PAH 8270 7 Metals Total
	GP-1	4-25-00	12:15	1	✓		As, Cd, Cr, Pb, MN, Hg, Ni
	GP-1	4-25-00	12:15	1	✓		7 metals Dissolved Field Filtered 0.45 u
	GP-3	4-25-00	13:10	4	✓		"
	GP-3	4-25-00	13:10	1	✓		"
	GP-3	4-25-00	13:10	1	✓		"
	Duplicate	4-25-00	11:00	3	✓		VOCs 8260

Relinquished By Signature: Tabby To 4/26/00 9:45	Received By Signature		Date/Time
Relinquished By Signature	Received By Signature		Date/Time
Dispatched By: Signature / Date/Time	Ship'd Via	Rec'd By Signature: Linda K Harmon Laboratory	Date/Time 4/26/00 0753

Send results Normal TAT to Doug Linebuck AME

Form CUSTODY.FRM

August Mack Environmental Inc
2200 Greene Way, Suite 100
Louisville KY 40220

CHAIN OF CUSTODY RECORD

UMPQUA RESEARCH COMPANY
626 N.E. DIVISION ST. - P.O. BOX 609
MYRTLE CREEK, OR 97457
Ph (541) 863-5201 Fax (541) 863-6199

NAME: Glenbrook Nickel Company

Address: Coos Bay Oregon

Port Operations AOC CB-2

OREGON STATE CERTIFIED LABORATORY # 015

Date 4-25-00 Page 1 of 1

PROJECT NAME GNC Coos Bay

PWS # JA003.35

PROJECT CONTACT: Doug Linebach (AME)

TELEPHONE: 502-671-7712

SAMPLE COLLECTOR

Lab Use Only	SAMPLE	INFORMATION		NUMBER OF	SAMPLE TYPE		ANALYSIS
URC SAMPLE #	LOCATION	DATE	TIME	CONTAINERS	WATER	SOIL	REQUIRED
	GP-9	4-25-00	18:05	3	✓		7 metals Total / Dissolved Field Filtered
	"	"			✓		As, Cd, Cr, Pb, MN Hg, Ni
	"	"			✓		PH
	"	"			✓		Nitrate - Nitrogen Kjeldahl Nitrate
	GP-10	4-25-00	18:35	3	✓		" "
	"	"			✓		" "
	"	"			✓		" "
	"	"			✓		" "

Relinquished By Signature: Tally Tomo 4/26/00 9:45	Received By Signature		Date Time
Relinquished By Signature	Received By Signature		Date Time
Dispatched By Signature / Date/Time	Shipd Via	Rec'd By Signature / Laboratory: Linda K Garmon	Date Time: 4/26/00 0950

Send results to Doug Linebach AME Normal TAT

Form CUSTODY.FRM

AUGUST MACK ENVIRONMENTAL, INC
2200 GREENE WAY, SUITE 100
LOUISVILLE, KY 40220

CHAIN OF CUSTODY RECORD

UMPQUA RESEARCH COMPANY
626 N.E. DIVISION ST. - P.O. BOX 609
MYRTLE CREEK, OR 97457
Ph (541) 863-5201 Fax (541) 863-6199

NAME: GLENBROOK NICKEL COMPANY
Address: COOS BAY, OREGON
PORT OPERATIONS AOC - CB-3

OREGON STATE CERTIFIED LABORATORY # 015

Date 4/25/00 Page 1 of 1

PROJECT NAME GNC COOS BAY	PROJECT CONTACT: DOUG LINEBACH	SAMPLE	COLLECTOR
PWS # JA003 35	TELEPHONE: 502-671-7712		

Lab Use Only	SAMPLE	INFORMATION		NUMBER OF	SAMPLE TYPE		ANALYSIS
URC SAMPLE #	LOCATION	DATE	TIME	CONTAINERS	WATER	SOIL	REQUIRED
	GP-11 0'-1'	4/25/00	18:05	2		✓	BTEX, PAH, TPH (8310) (TPH-D)
	GP-12 0'-1'	4/25/00	18:05	2		✓	SOIL B "

Relinquished By Signature	Received By Signature	Date Time
Tally Tom 4/26/00 9:45		
Relinquished By Signature	Received By Signature	Date Time
Dispatched By Signature / Date/Time	Ship'd Via / Rec'd By Signature / Laboratory: R. Harmon	Date Time 4/26/00 0757

SEND RESULTS TO DOUG LINEBACH (AME FAX 502-671-7717); NORMAL TAT.

Form CUSTODY.FRM

AUGUST MACK ENVIRO...
2200 GREENE WAY, S... 00
LOUISVILLE, KY 40220

CHAIN OF CUSTODY RECORD

UMPQUA RESEARCH COMPANY
626 N.E. DIVISION ST. - P.O. BOX 609
MYRTLE CREEK, OR 97457
Ph (541) 863-5201 Fax (541) 863-6199

NAME: GLENBROOK NICKEL COMPANY

Address: COOS BAY, OREGON

PORT OPERATIONS AOC CB-4

OREGON STATE CERTIFIED LABORATORY # 015

Date 4/25/00 Page 1 of 1

PROJECT NAME GNC COOS BAY	PROJECT CONTACT: Doug Linebach	SAMPLE	COLLECTOR
PWS # JA003.35	TELEPHONE: 502-671-7712		

Lab Use Only	SAMPLE	INFORMATION		NUMBER OF	SAMPLE TYPE		ANALYSIS
URC SAMPLE #	LOCATION	DATE	TIME	CONTAINERS	WATER	SOIL	REQUIRED
	GP-8	4/25/00	17:30	2	✓		N, Cr, Mn, Ag, Al (TOTAL & DISSOLVED) ↑ FIELD FILTERED TO 0.45m CRM

Relinquished By Signature	Received By Signature	Date Time
Tally To 4/26/00 9:45		
Relinquished By Signature	Received By Signature	Date Time
Dispatched By Signature / Date/Time	Ship'd Via / Rec'd By Signature / Laboratory: Linda K. Garnon	Date Time 4/26/00 0950

SEND RESULTS (NORMAL TAT) TO DOUG LINEBACH (AME Fax 502-671-7717)

Form CUSTODY.FRM

August Mack Environmental Inc
2200 Greene Way Suite 100
Louisville Ky 40220

CHAIN OF CUSTODY RECORD

UMPQUA RESEARCH COMPANY
626 N.E. DIVISION ST. - P.O. BOX 609
MYRTLE CREEK, OR 97457
Ph (541) 863-5201 Fax (541) 863-6199

NAME: Glenbrook Nickel Company

Address: Coos Bay Oregon

Port Operations AOC-CB-5

OREGON STATE CERTIFIED LABORATORY # 015

Date 4-25-00 Page 1 of 1

PROJECT NAME GNC Coos Bay

PWS # JA 003.35

PROJECT CONTACT: Doug Linebach (AME)

TELEPHONE: 502-671-7712

SAMPLE COLLECTOR

Lab Use Only	SAMPLE	INFORMATION		NUMBER OF	SAMPLE TYPE		ANALYSIS
URC SAMPLE #	LOCATION	DATE	TIME	CONTAINERS	WATER	SOIL	REQUIRED
	GP-7	4-25-00	16:55	2	✓		5 metals, Total / Dissolved Field Filtered
	"	"	"	"	✓		0.45 micron Ni, Cr, MN, Ag, AL

Relinquished By Signature Tal & To 4/24/00 9:45		Received By Signature		Date Time
Relinquished By Signature		Received By Signature		Date Time
Dispatched By Signature	Date/Time	Ship'd Via	Rec'd By Signature Linda K Harmon Laboratory	Date/Time 4/26/00 0950

Send results Normal TAT to Doug Linebach AME

Form CUSTODY.FRM

AUGUST MACK ENVIRO[illegible] INC
2200 GREENE WAY, Su[illegible]/00
LOUISVILLE, KY 40220

CHAIN OF CUSTODY RECORD

UMPQUA RESEARCH COMPANY
626 N.E. DIVISION ST. - P.O. BOX 609
MYRTLE CREEK, OR 97457
Ph (541) 863-5201 Fax (541) 863-6199

NAME: GLENBROOK NICKEL COMPANY

Address: COOS BAY, OREGON

PORT OPERATIONS AOC - CB-6

OREGON STATE CERTIFIED LABORATORY # 015

Date 4/25/00 Page 1 of 1

PROJECT NAME: GNC COOS BAY

PWS # JA0003 35

PROJECT CONTACT: DOUG LINEBACH

TELEPHONE: 502- 671-7712

SAMPLE COLLECTOR

Lab Use Only URC SAMPLE #	SAMPLE INFORMATION LOCATION	DATE	TIME	NUMBER OF CONTAINERS	SAMPLE TYPE WATER	SOIL	ANALYSIS REQUIRED
	GP-6	4/25/00	15:45	2	✓		METALS: Ni, Cr, Mn, Fe Total & Dissolved (Field Filtered to 0.45 microns)

Relinquished By Signature: Tally Te	4/26/00 9:45	Received By Signature		Date Time
Relinquished By Signature		Received By Signature		Date Time
Dispatched By Signature	Date/Time	Ship'd Via	Rec'd By Signature: L. Harmon Laboratory	Date Time 4/26/00 0950

SEND RESULTS (NORMAL TAT) to DOUG LINEBACH (AMC Fax 502-671-7717)

Form CUSTODY.FRM

Augustinack Environmental Inc
2200 Greene Way Suite 100
Louisville Ky 40220

CHAIN OF CUSTODY RECORD

UMPQUA RESEARCH COMPANY
626 N.E. DIVISION ST. - P.O. BOX 609
MYRTLE CREEK, OR 97457
Ph (541) 863-5201 Fax (541) 863-6199

NAME: Glenbrook Nickel Company

Address: Coos Bay Oregon

Port Operations AOC-CB-7

OREGON STATE CERTIFIED LABORATORY # 015

Date 4-25-00 Page 1 of 1

PROJECT NAME GNC Coos Bay	PROJECT CONTACT: Doug Linebuck AME	SAMPLE COLLECTOR
PWS # JA 003.35	TELEPHONE: 502-671-7712	

Lab Use Only	SAMPLE INFORMATION			NUMBER OF	SAMPLE TYPE		ANALYSIS
URC SAMPLE #	LOCATION	DATE	TIME	CONTAINERS	WATER	SOIL	REQUIRED
	GP-5	4-25-00	15:15	2	✓		Metals Total / Dissolved Field Filtered 0.45 micron — Ni, Cr, Mn, Fe
	Trip Blank	4-25-00		2	✓		VOC's 8260

Relinquished By Signature	Tally To 4/26/00 9:45	Received By Signature		Date/Time
Relinquished By Signature		Received By Signature		Date/Time
Dispatched By Signature	Date/Time	Ship'd Via	Rec'd By Signature / Laboratory	Date/Time
			Linda J Harmon	4/26/00 09:30

Send results Normal TAT To Doug Linebuck (AME)

Form CUSTODY.FRM

August [illegible]
2200 Greene Wm Suite 100
Louisville Ky 40220

CHAIN OF CUSTODY RECORD

UMPQUA RESEARCH COMPANY
626 N.E. DIVISION ST. - P.O. BOX 609
MYRTLE CREEK, OR 97457
Ph (541) 863-5201 Fax (541) 863-6199

NAME: Glenbrook Nickel Company

Address: Riddle Oregon Facility

OREGON STATE CERTIFIED LABORATORY # 015

Date Page of

PROJECT NAME GNC AOC-R-10	PROJECT CONTACT: Doug Linebach AME	SAMPLE COLLECTOR
PWS # JA003.35	TELEPHONE: 502-671-7712	Talbot C Tomes

Lab Use Only	SAMPLE	INFORMATION		NUMBER OF	SAMPLE TYPE		ANALYSIS
URC SAMPLE #	LOCATION	DATE	TIME	CONTAINERS	WATER	SOIL	REQUIRED
200427-31	GP-1 2.0-4.0'	4-26-00	14:25	1		✓	TPH - TPH D PAH 8310
32	GP-2 8.0-10.0'		15:10	1		✓	" "
33	GP-3 8.0-10.0'		15:45	1		✓	" "
34	GP-4 4.0-6.0'		16:05	1		✓	" "
35	GP-5 8.0-10.0'		16:50	1		✓	" "
36	GP-6 6.0-8.0		17:15	1		✓	" "
37	GP-7 0-2.0'		17:25	1		✓	" "
38	GP-8 8.0-10.0'		18:30	1		✓	" "
39	GP-9 4.0-6.0'		17:55	1		✓	" "
40	GP-10 6.0-8.0'		18:50	1		✓	" "

Relinquished By Signature Tally T[illegible] 4/27/00 16:15	Received By Signature	Date Time
Relinquished By Signature	Received By Signature	Date Time
Dispatched By Signature / Date/Time	Ship'd Via / Rec'd By Signature [signature] Laboratory	Date Time 1610 4-27-00

Form CUSTODY.FRM

AUGUST MACK ENVI[illegible]
2200 GREENE WAY, SUITE 100
LOUISVILLE, KY 40220

CHAIN OF CUSTODY RECORD

UMPQUA RESEARCH COMPANY
626 N.E. DIVISION ST. - P.O. BOX 609
MYRTLE CREEK, OR 97457
Ph (541) 863-5201 Fax (541) 863-6199

NAME: ~~GNC AOC R-11~~
GLENBROOK NICKEL COMPANY
Address: RIDDLE, OREGON FACILITY

OREGON STATE CERTIFIED LABORATORY # 015

Date 4/26/00 Page 1 of 1

PROJECT NAME: GNC-AOC-R-11 | PROJECT CONTACT: DOUG LINEBACH | SAMPLE COLLECTOR: DAVID KATZ
PWS #: JA0033 35 | TELEPHONE: 502-671-7712

Lab Use Only URC SAMPLE #	SAMPLE LOCATION		INFORMATION DATE	TIME	NUMBER OF CONTAINERS	SAMPLE TYPE WATER	SOIL	ANALYSIS REQUIRED
200427-41	TP-1	10'-12'	4/26/00	13:50	1		✓	PAH (8310) TCLP (6010 TOTAL)
• 42	TP-2	10'-12'	4/26/00	14:00	1		✓	"
• 43	TP-3	10'-12'	4/26/00	14:10	1		✓	"
• 44	TP-4	10'-12'	4/26/00	14:15	1		✓	"
• 45	TP-5	10'-12'	↓	14:25	1		✓	"
• 46	TP-6	10'-12'	↓	14:35	1		✓	"

Relinquished By Signature: [signature] 4/27/00 16:15		Received By Signature	Date/Time
Relinquished By Signature		Received By Signature	Date/Time
Dispatched By Signature	Date/Time	Ship'd Via	Rec'd By Signature: [signature] Courier	Date/Time 1610 4-27-00

SEND RESULTS TO DOUG LINEBACH (NORMAL TAT)
AME FAX 502-671-7717

Form CUSTODY.FRM

AUGUST MACK ENV
2200 GREENE WAY, S
LOUISVILLE, KY 40220

CHAIN OF CUSTODY RECORD

UMPQUA RESEARCH COMPANY
626 N.E. DIVISION ST. - P.O. BOX 609
MYRTLE CREEK, OR 97457
Ph (541) 863-5201 Fax (541) 863-6199

NAME: GLENBROOK NICKEL COMPANY

Address: RIDDLE, OREGON FACILITY

OREGON STATE CERTIFIED LABORATORY # 015

Date 4/26/00 Page 1 of 1

PROJECT NAME: GNC AOC - R-5	PROJECT CONTACT: Doug LINEBAUGH	SAMPLE COLLECTOR
PWS # 2A003 35	TELEPHONE: 502-671-7712	DAVID KATZ

Lab Use Only	SAMPLE INFORMATION			NUMBER OF	SAMPLE TYPE		ANALYSIS
URC SAMPLE #	LOCATION	DATE	TIME	CONTAINERS	WATER	SOIL	REQUIRED
200427-47	HA-1 0'-1'	4/26/00	18:10	1		✓	PAH (Method 8310)
48	HA-2 0'-1'	↓	18:20	1		✓	"
49	HA-3 0'-1'	↓	18:30	1		✓	"
50	HA-4 0'-1'	↓	18:40	1		✓	"

Relinquished By Signature: [signature] 4/27/00 1615	Received By Signature		Date Time
Relinquished By Signature	Received By Signature		Date Time
Dispatched By Signature / Date Time	Shipped Via	Rec'd By Signature / Laboratory	Date Time 1610 4-27-00

SEND RESULTS TO DOUG LINEBAUGH (NORMAL TAT)
ALSO FAX 502-671-7717

Form CUSTODY.FRM

CHAIN OF CUSTODY RECORD

Auger & Rock Coring Inc
2200 Greene Way Suite 100
Louisville KY 40220

IPQUA RESEARCH COMPANY
N.E. DIVISION ST. - P.O. BOX 609
RTLE CREEK, OR 97457
541) 863-5201 Fax (541) 863-6199

NAME: Glenbrook Nickel Company

Address: Riddle Oregon

Riddle Facility AOC - R-10

EGON STATE CERTIFIED LABORATORY # 015

Date 4-27-00 Page 1 of 1

OJECT NAME GNC Riddle	PROJECT CONTACT: Doug Linebach	SAMPLE COLLECTOR: David Katz
AS # JA0035.35	TELEPHONE: 502-671-7712	

Lab Use Only	SAMPLE	INFORMATION		NUMBER OF	SAMPLE TYPE		ANALYSIS
RG. SAMPLE #	LOCATION	DATE	TIME	CONTAINERS	WATER	SOIL	REQUIRED
200428 2	GP-11	4-27-00	9115	3	✓		VOCs 8260 PAH 8270

Relinquished By Signature: David Katz	4-28-00 9:15	Received By Signature			Date/Time
Relinquished By Signature		Received By Signature			Date/Time
Relinquished By Signature	Date/Time	Ship'd Via	Received By Laboratory: Linda Pless URC		Date/Time 4-28-00 915

CUSTODY FRM

Send results to Doug Linebach ASAP
Fax 502-671-7717

August Mack C[illegible]
2200 Green C Way, Suite 100
Louisville KY 40220

CHAIN OF CUSTODY RECORD

MPQUA RESEARCH COMPANY
N.E. DIVISION ST. - P.O. BOX 609
RTLE CREEK, OR 97457
(541) 863-5201 Fax (541) 863-6199

NAME: Glenbrook Nickel Company

Address: Riddle Oregon

Riddle Facility AOC-R-17
AOC-R-18

EGON STATE CERTIFIED LABORATORY # 015

Date 4-27-00 Page 1 of 1

PROJECT NAME GNC Riddle	PROJECT CONTACT Doug Linebach AME	SAMPLE	COLLECTOR
WS # JA003.35	TELEPHONE: 502-671-7712		David Katz

Lab Use Only	SAMPLE	INFORMATION		NUMBER OF	SAMPLE TYPE		ANALYSIS
URC SAMPLE #	LOCATION	DATE	TIME	CONTAINERS	WATER	SOIL	REQUIRED
200427-4	GP-22 ..	4-27-00	15:45	2	✓		Metals total Ni, Cr, MN, Ag, AL
	" Rush Lab Filter	"	"		✓		Dissolved metals above Rush Lab Filter
-5	GP-23 ..	4-27-00	15:25	2	✓		Metals Total Ni, Cr, MN, Ag, AL
	" Rush Lab Filter	"			✓		Dissolved metals Above

Relinquished By Signature [signature] 4-28-00 9:15		Received By Signature		Date Time
Relinquished By Signature		Received By Signature		Date Time
Dispatched By Signature	Date/Time	Ship'd Via	Rec'd By Signature [signature] Laboratory URC	Date Time 4-28-00 915

Send results Normal TAT to Doug Linebach
FAX 502-671-7712

m CUSTODY FRM

August Mack Environ...
2200 Greene Way Suite 100
Louisville Ky 40220

CHAIN OF CUSTODY RECORD

IPQUA RESEARCH COMPANY
N.E. DIVISION ST. - P.O. BOX 609
RTLE CREEK, OR 97457
541) 863-5201 Fax (541) 863-6199

NAME: Glenbrook Nickel Company
Address: Riddle Oregon
Riddle Facility AOC-19

GON STATE CERTIFIED LABORATORY # 015

Date 4-27-00 Page ___ of ___

OJECT NAME GNC Riddle	PROJECT CONTACT: Doug Linebach	SAMPLE COLLECTOR
VS # JA003.35	TELEPHONE: 502-671-7717	David Katz

ab Use Only	SAMPLE	INFORMATION		NUMBER OF	SAMPLE TYPE		ANALYSIS
RC SAMPLE #	LOCATION	DATE	TIME	CONTAINERS	WATER	SOIL	REQUIRED
200428-3	GP-12	4-27-00	12:10	4	✓		PAH 8310, TPHD 8270
	"	↓	↓		✓		Total Metals As, Cd, Cr, Pb, Mn, Hg, Ni
	Rush Lab Filter	↓	↓		✓		Dissolved Metals Above

...ished By ...ure [signature] 4-28-00 9:15	Received By Signature		Date Time
...ished By ...ure	Received By Signature		Date Time
...ished By ...ure	Date/Time	Ship'd Via	Rec'd By Signature [signature] Laboratory URC	Date Time 4-28-00 915

Send results Normal TAT to Doug Linebach AME

CUSTODY FRM

August [illegible]
2200 Greene Way [illegible] 100
Louisville KY 40220

CHAIN OF CUSTODY RECORD

MPQUA RESEARCH COMPANY
N.E. DIVISION ST. - P.O. BOX 609
RTLE CREEK, OR 97457
(541) 863-5201 Fax (541) 863-6199

NAME: Glenbrook Nickel Company
Address: Riddle Oregon
Riddle Facility AOC R-20

EGON STATE CERTIFIED LABORATORY # 015

Date 4-27-00 Page 1 of 2

PROJECT NAME GNC Riddle	PROJECT CONTACT: Doug Linebach AME	SAMPLE COLLECTOR
WS # JA003.35	TELEPHONE: 502-671-7712	Talbot C Tomes

Lab Use Only	SAMPLE	INFORMATION		NUMBER OF	SAMPLE TYPE		ANALYSIS
ORC SAMPLE #	LOCATION	DATE	TIME	CONTAINERS	WATER	SOIL	REQUIRED
200428- 6	HA-1 1.5-2.0'	4-27-00	13:50	1		✓	Pcb 8080, TPH D III TCE 8260
7	HA-2 1.5-2.0'	"	14:05	1		✓	" "
8	HA-3 1.5-2.0'	"	14:10	1		✓	" "
9	HA-4 1.5-2.0'	"	14:40	1		✓	" "
10	HA-5 1.5-2.0'	"	14:45	1		✓	" "
11	HA-6 1.5-2.0'	"	14:50	1		✓	" "
12	HA-7 1.0-1.5	"	15:40	1		✓	" "
13	HA-8 1.0-1.5	"	15:45	1		✓	" "
14	HA-9 1.0-1.5	"	15:50	1		✓	" "
15	HA-10 1.0-1.5	"	15:55	1		✓	" "

Relinquished By Signature [signature] 4-28-00 9:15	Received By Signature		Date Time
Relinquished By Signature	Received By Signature		Date Time
Relinquished By Signature	Date/Time	Ship'd Via	Rec'd By Signature [signature] Laboratory ORC Date Time 4-28-00 915

Send results Normal TAT to Doug Linebach AME

m CUSTODY FRM

Fax 502-671-7712

August Mack Environ[illegible] Inc
2200 Greene Way Suite 100
Louisville KY 40220

CHAIN OF CUSTODY RECORD

MPQUA RESEARCH COMPANY
6 N.E. DIVISION ST. - P.O. BOX 609
YRTLE CREEK, OR 97457
(541) 863-5201 Fax (541) 863-6199

NAME: Glenbrook Nickel Company

Address: Riddle Oregon

Riddle Facility AOC-R-20

REGON STATE CERTIFIED LABORATORY # 015

Date 4-27-00 Page 2 of 2

PROJECT NAME GNC Riddle

PROJECT CONTACT: Doug Linebach

TELEPHONE: 502-671-7712

SAMPLE COLLECTOR: Talbot Clemes

WS # JA003.35

Lab Use Only	SAMPLE	INFORMATION		NUMBER OF	SAMPLE TYPE		ANALYSIS
URC SAMPLE #	LOCATION	DATE	TIME	CONTAINERS	WATER	SOIL	REQUIRED
200428-16	HA-11 1.0-1.5'	4-27-00	16:35	1		✓	Pcb 8080 TPH D 111 TCE 8260
17	HA-12 .5-1.0'	"	16:40	1		✓	" "
18	HA-13 .5-1.0'	"	16:45	1		✓	" "
19	HA-14 .5-1.0'	"	16:50	1		✓	" "
20	HA-15 .5-1.0'	"	16:55	1		✓	" "
21	HA-16 .5-1.0'	"	17:05	1		✓	" "
22	HA-17 1.0-1.5'	"	17:30	1		✓	" "
23	HA-18 .5-1.0	"	17:35	1		✓	" "
24	HA-19 1.0-1.5	"	17:40	1		✓	" "
25	HA-20 .5-1.0	"	17:45	1		✓	" "

Relinquished By Signature: [signature] 4-28-00 9:15 | Received By Signature | Date/Time

Relinquished By Signature | Received By Signature | Date/Time

Relinquished By Signature | Date/Time | Ship'd Via | Rec'd By Signature: [signature] | Date/Time 4-28-00 915

Send results to Doug Linebach AME Normal TAT

FAX 502 671-7712

m CUSTODY.FRM

August [illegible]
2200 Greene Way Suite [illegible]
Louisville KY 40220

CHAIN OF CUSTODY RECORD

MPQUA RESEARCH COMPANY
N.E. DIVISION ST. - P.O. BOX 609
YRTLE CREEK, OR 97457
(541) 863-5201 Fax (541) 863-6199

NAME: Glenbrook Nickel Company

Address: Riddle Oregon

Riddle Facility AOC R-20

EGON STATE CERTIFIED LABORATORY # 015

Date 4-27-00 Page 1 of 1

ROJECT NAME GNC Riddle	PROJECT CONTACT: Doug Linebach	SAMPLE	COLLECTOR
WS # JA 003.35	TELEPHONE 502-671-7712		

ab Use Only	SAMPLE	INFORMATION		NUMBER OF	SAMPLE	TYPE	ANALYSIS
URC SAMPLE #	LOCATION	DATE	TIME	CONTAINERS	WATER	Wipe	REQUIRED
200428-26	W-1	4-27-00	18:00	1		✓	PCb 8080
27	W-2	"	18:05	1		✓	" "
28	W-3	"	18:10	1		✓	" "
29	W-4	"	18:15	1		✓	" "

Originated By Signature [signature] 4-28-00 9:15	Received By Signature		Date Time
Originated By Signature	Received By Signature		Date Time
Dispatched By Signature	Date/Time	Ship'd Via	Rec'd By Signature [signature] ORC	Date Time 4-28-00 915

Send Results to Doug Linebach FAX 502-671-7717 Normal TAT

n CUSTODY FRM

Above Samples obtained using Sterile gauze Hexane [illegible]

August Mack Environmental, Inc.
2200 Gravaire Way Suite 100
Louisville KY 40220

CHAIN OF CUSTODY RECORD

UMPQUA RESEARCH COMPANY
[illegible] N.E. DIVISION ST. - P.O. BOX 609
MYRTLE CREEK, OR 97457
(541) 863-5201 Fax (541) 863-6199

NAME: Glenbrook Nickel Company

Address: Riddle Oregon

Riddle Facility AOC R-20

OREGON STATE CERTIFIED LABORATORY # 015

Date 4-27-00 Page 1 of 1

PROJECT NAME: GNC Riddle
WS #: JA003.35
PROJECT CONTACT: Doug Linebach
TELEPHONE: 502-671-1712
SAMPLER: [illegible] COLLECTOR

Lab Use Only	SAMPLE	INFORMATION		NUMBER OF	SAMPLE TYPE		ANALYSIS
UMC SAMPLE #	LOCATION	DATE	TIME	CONTAINERS	WATER	Wipe	REQUIRED
200428-26	W-1	4-27-00	18:00	1		✓	PCB 8080
27	W-2	"	18:05	1		✓	" "
28	W-3	"	18:10	1		✓	" "
29	W-4	"	18:15	1		✓	" "

Relinquished By Signature: [signature] 4-28-00 9:15		Received By Signature		Date/Time
Relinquished By Signature		Received By Signature		Date/Time
Relinquished By Signature	Date/Time	Ship'd Via	Rec'd By Signature: [signature] ORC	Date/Time 4-28-00 915

Send Results to Doug Linebach Fax 502-671-1717 Normal TAT

Form CUSTODY FRM

Above Samples obtained using Sterile gauze Hexane [illegible]

RUSH Dissolved Metals Filter on GP20 & GP21

CHAIN OF CUSTODY RECORD

2200 Greene Way S 100
Louisville KY 40220

MPQUA RESEARCH COMPANY
6 N.E. DIVISION ST. - P.O. BOX 609
RTLE CREEK, OR 97457
(541) 863-5201 Fax (541) 863-6199

NAME: Glenbrook Nickel Company

Address: Riddle Oregon

Riddle Facility

EGON STATE CERTIFIED LABORATORY # 015

AOL-R- 4, 14, 13, 16, 21

Date 4-28-00 Page 1 of 1

ROJECT NAME GNC Riddle	PROJECT CONTACT: Doug Linebach AMC	SAMPLE	COLLECTOR Talbot C Tomes David Katz
WS # JA003.35	TELEPHONE: 502-671-7712		

ab Use Only	SAMPLE		INFORMATION		NUMBER OF	SAMPLE TYPE		ANALYSIS
URC SAMPLE #	LOCATION		DATE	TIME	CONTAINERS	WATER	SOIL	REQUIRED
	GP-13	4'-6'	4-28-00	9:45	1		✓	PAH (8310) TPH (TPH-D)
	GP-14	9'-11'	↓	10:35	2		✓	PAH (8310), VOC (8260) As, Cd, Cr, Pb, Mn, Hg, Ni
	GP-15	6'-10'		10:55	2		✓	↓
	GP-16	0'-4'		8:05	2		✓	
	GP-17	2'-6'		8:30	2		✓	
	GP-18	4'-6'		8:50	2		✓	
	GP-19	2'-6'		9:05	2		✓	↓
	GP-20			15:00	2	✓		TOTAL & DISSOLVED METALS As, Cd, Cr, Pb, Mn, Hg, Ni
	GP-21		↓	11:50	2	✓		↓

Relinquished By Signature: Tally Tomes 4/28/00 16:35	Received By Signature		Date Time
Relinquished By Signature	Received By Signature		Date Time
Dispatched By Signature	Date/Time	Ship'd Via	Rec'd By Signature: [signature] Laboratory: ORC	Date Time 4-28-00 1635

Send results Normal TAT to Doug Linebach

m CUSTODY FRM

CHAIN OF [illegible]STODY RECORD

2200 Greene Way [illegible] 100
Louisville KY 40[illegible]

MPQUA RESEARCH COMPANY
N.E. DIVISION ST. - P.O. BOX 609
RTLE CREEK, OR 97457
(541) 863-5201 Fax (541) 863-6199

NAME: Glenbrook Nickel Company

Address: Riddle Oregon

Riddle Facility

EGON STATE CERTIFIED LABORATORY # 015

Date 4-28-00 Page 1 of 1

OJECT NAME GNC Riddle - AOL-R-15	PROJECT CONTACT: Doug Linebach AME	SAMPLE	COLLECTOR Talbot Tomes David Katz
WS # JA003.35	TELEPHONE: 502-671-7712		

ab Use Only	SAMPLE		INFORMATION		NUMBER OF	SAMPLE TYPE		ANALYSIS
URC SAMPLE #	LOCATION		DATE	TIME	CONTAINERS	WATER	SOIL	REQUIRED
	TP-7	12'-15'	4-28-00	11:05	3		✓	PCB (8080), TPH-G, TPH BTEX (8021 B)
	TP-8	12'-15'	↓	11:10	3		✓	↓
	TP-9	12'-15'	↓	11:15	3		✓	↓
	TP-10	12'-15'	↓	11:20	3		✓	↓

Relinquished By Signature Talbot Tomes 4/28/00 16:35	Received By Signature		Date Time
Relinquished By Signature	Received By Signature		Date Time
Dispatched By Signature	Date/Time	Ship'd Via	Rec'd By Signature Kathi Otero URC Laboratory	Date Time 4-28-00 1635

Send results Normal TAT to Doug Linebach

FAX 502-671-7717

m CUSTODY.FRM

2200 Greene Way
Louisville KY 40220

CHAIN OF CUSTODY RECORD

MPQUA RESEARCH COMPANY
6 N.E. DIVISION ST. - P.O. BOX 609
YRTLE CREEK, OR 97457
(541) 863-5201 Fax (541) 863-6199

NAME: Glenbrook Nickel Company

Address: Riddle Oregon

Riddle Facility AOC - R-12, R-22

REGON STATE CERTIFIED LABORATORY # 015

Date 4-28-00 Page of

ROJECT NAME GNC Riddle	PROJECT CONTACT: Doug Linebach AME	SAMPLE	COLLECTOR Talbot Clomes David Katz
WS # JA003.35	TELEPHONE: 502-671-7712		

Lab Use Only	SAMPLE		INFORMATION		NUMBER OF	SAMPLE TYPE		ANALYSIS
URC SAMPLE #	LOCATION		DATE	TIME	CONTAINERS	WATER	SOIL	REQUIRED
	HA-39	0'-1.1'	4-28-00	13:15	1		✓	TPH-D PAH 8310
	HA-40	0'-1.1'	↓	13:20	1		✓	TPH D PAH 8310
	HA-41	0'-0.5'	↓	12:05	1		✓	3 total metals Ni, Cr, MN
	HA-42	0'-0.5'	↓	12:05	1		✓	3 total metals Ni, Cr, MN
	HA-43	0'-0.5'	↓	12:05	1		✓	TCLP

Relinquished By Signature Talbot Tomes 4/28/00 16:25	Received By Signature		Date Time
Relinquished By Signature	Received By Signature		Date Time
Dispatched By Signature	Date/Time	Ship'd Via	Rec'd By Signature Kathe Otero Laboratory URC	Date Time 4-28-00 1635

Send results Normal TAT to Doug Linebach

rm CUSTODY.FRM

August ... 2200 Greene W. suite 100 Louisville Ky 40220

CHAIN OF CUSTODY RECORD

MPQUA RESEARCH COMPANY
6 N.E. DIVISION ST. - P.O. BOX 609
YRTLE CREEK, OR 97457
(541) 863-5201 Fax (541) 863-6199

NAME: Glenbrook Nickel Company

Address: Riddle Oregon

Riddle Facility AOC - R-7, R-8, R-9

REGON STATE CERTIFIED LABORATORY # 015

Date 4-28-00 Page of

PROJECT NAME GNC Riddle

PWS # JA003.35

PROJECT CONTACT Doug Linebach AME

TELEPHONE 502-671-7212

SAMPLE COLLECTOR Talbot C Tomes David Katz

Lab Use Only	SAMPLE		INFORMATION		NUMBER OF	SAMPLE TYPE		ANALYSIS
URC SAMPLE #	LOCATION		DATE	TIME	CONTAINERS	WATER	SOIL	REQUIRED
	HA-29	GRAB	4-28-00	14:15	1		✓	Total Pb 6010
	HA-30	↓	↓	14:25	1		✓	Total Pb 6010
	HA-31	↓	↓	14:30	1		✓	Total Pb 6010
	HA-32	0 - 1'	↓	16:00	1		✓	PAH 8310
	HA-33	0 - 1'	↓	16:05	1		✓	PAH 8310
	HA-34	1.0 - 1.5'	↓	16:10	1		✓	PAH 8310
	HA-35	1.0 - 1.5'	↓	16:15	1		✓	PAH 8310
	HA-36	0 - 0.5'	↓	14:35	1		✓	PAH 8310
	HA-37	0 - 0.5'	↓	14:40	1		✓	PAH 8310
	HA-38	0 - 0.5'	↓	14:45	1		✓	PAH 8310

Relinquished By Signature: Tally To... 4-28-00 16:35 | Received By Signature | Date Time

Relinquished By Signature | Received By Signature | Date Time

Dispatched By Signature | Date/Time | Ship'd Via | Rec'd By Signature: Kathi Otero | Laboratory: URC | Date Time 1635 4-28-00

Send results to Doug Linebach Normal TAT

Fax 502 671-7717

rm CUSTODY.FRM

CHAIN OF CUSTODY RECORD

2200 Greene Way [illegible] 100
Louisville KY 40220

MPQUA RESEARCH COMPANY
6 N.E. DIVISION ST. - P.O. BOX 609
YRTLE CREEK, OR 97457
(541) 863-5201 Fax (541) 863-6199

NAME: Glen brook Nickel Company

Address: Riddle Oregon

Riddle Facility AOC - R-1, R-2, R-3, R-6, R

EGON STATE CERTIFIED LABORATORY # 015

Date 4-28-00 Page of

PROJECT NAME: GNC Riddle	PROJECT CONTACT: Doug Line bach AME	SAMPLE	COLLECTOR: Talbot C Tomes David Katz
WS # JA 003.35	TELEPHONE: 502-671-7712		

Lab Use Only	SAMPLE		INFORMATION		NUMBER OF	SAMPLE TYPE		ANALYSIS
URC SAMPLE #	LOCATION		DATE	TIME	CONTAINERS	WATER	SOIL	REQUIRED
	SG-1	Grab	4-28-00	15:50	2		✓	VOCS 8260 PAH 8310 7 metals AS, Cd, Cr, Pb, MN, H
	HA-21	0-.5'		9:40	1		✓	Total Pb 6010
	HA-22	0-.5'		9:45	1		✓	Total Pb 6010
	HA-23	0-.5		9:50	1		✓	Total Pb 6010
	HA-24	0'-0.5'		14:55	1		✓	Total Pb 6010
	HA-25	0'-0.5'		15:00	1		✓	Total Pb 6010
	HA-26	0-0.2'		16:20	3		✓	TPH-D, PAH 8310 VOCS 8260, Pcb 8080
	"	↓		↓	"		✓	7 Total metals AS, Cd, Cr, Pb, MN, Hg, Ni
	HA-27	GRAB		14:10	1		✓	Total Pb 6010
	HA-28	GRAB	↓	14:20	1		✓	Total Pb 6010

Relinquished By Signature: Talbot T[illegible] 4/28/00 16:35		Received By Signature		Date Time
Relinquished By Signature		Received By Signature		Date Time
Relinquished By Signature	Date/Time	Ship'd Via	Rec'd By Signature [illegible] Laboratory URC	Date Time 1635 4-28-00

Send results Normal TAT to Doug Line bach AME

Fax 502-671-7717

rm CUSTODY FRM

CHAIN OF CUSTODY RECORD

2200 Greene Way
Louisville KY 402

MPQUA RESEARCH COMPANY
N.E. DIVISION ST. - P.O. BOX 609
RTLE CREEK, OR 97457
(541) 863-5201 Fax (541) 863-6199

NAME: Glenbrook Nickel Company

Address: Riddle Oregon

Riddle Facility

EGON STATE CERTIFIED LABORATORY # 015

Date 4-28-00 Page of

OJECT NAME GNC Riddle AOL-R-23	PROJECT CONTACT: Doug Lineback AME	SAMPLE	COLLECTOR Talbot Tomes David Katz
WS # JA003.35	TELEPHONE: 502-671-7712		

ab Use Only	SAMPLE	INFORMATION		NUMBER OF	SAMPLE TYPE		ANALYSIS
URC SAMPLE #	LOCATION	DATE	TIME	CONTAINERS	WATER	SOIL	REQUIRED
	PW-1	4-28-00		1	✓		PAH (8270)
	PW-1	↓		2	✓		VOC (8260)
	TRIP	↓		1	✓		↓

Relinquished By Signature Talbot Tomes 4/28/00 16:35		Received By Signature		Date Time
Relinquished By Signature		Received By Signature		Date Time
Relinquished By Signature	Date/Time	Ship'd Via	Received By Signature Lab Name URC	Date Time 1635 4-28-00

Send results Normal TAT to Doug Lineback

FAX 502-671-7717

m CUSTODY.FRM

2200 Greene Way S 100
Louisville KY 40222

CHAIN OF CUSTODY RECORD

MPQUA RESEARCH COMPANY
N.E. DIVISION ST. - P.O. BOX 609
RTLE CREEK, OR 97457
(541) 863-5201 Fax (541) 863-6199

NAME: Glenbrook Nickel Company

Address: Riddle Oregon

Riddle Facility

EGON STATE CERTIFIED LABORATORY # 015

Date 4-28-00 Page 1 of 1

OJECT NAME GNC Riddle - AOL-R-15	PROJECT CONTACT: Doug Linebach AMB	SAMPLE	COLLECTOR Talbot CTomes David Katz
VS # JA003.35	TELEPHONE: 502-671-7712		

ab Use Only	SAMPLE	INFORMATION		NUMBER OF	SAMPLE TYPE		ANALYSIS
URC SAMPLE #	LOCATION	DATE	TIME	CONTAINERS	WATER	SOIL	REQUIRED
200428-82	TP-7 ••• 12'-15'	4-28-00	11:05	3 240 115 115 220	690	✓	PCB (8080), TPH-G, TPH-D BTEX (8021B)
83	TP-8 ••• 12'-15'	↓	11:10	3	690	✓	↓
84	TP-9 ••• 12'-15'	↓	11:15	3	690	✓	↓
85	TP-10 ••• 12'-15'	↓	11:20	3	690	✓	↓

Relinquished By Signature Talbot Tomes 4/28/00 16:35	Received By Signature	2760	Date Time
Relinquished By Signature	Received By Signature		Date Time
Relinquished By Signature / Date/Time	Ship'd Via	Rec'd By Signature Kathi Otero Laboratory URC	Date Time 4-28-00 1635

m CUSTODY FRM

Send results Normal TAT to Doug Linebach

FAX 502-671-7717

CHAIN OF CUSTODY RECORD

2200 Greenwood Suite 102
Louisville Ky 40206

UMPQUA RESEARCH COMPANY
626 N.E. DIVISION ST. - P.O. BOX 609
MYRTLE CREEK, OR 97457
Ph (541) 863-5201 Fax (541) 863-6199

NAME: Glenbrook Nickel Company

Address: 5093 Riddle By-Pass Road

Riddle Oregon 97469

OREGON STATE CERTIFIED LABORATORY # 015

Date 6/6/00 Page of

PROJECT NAME: GNC Riddle
PWS #: JA003,35
PROJECT CONTACT: Doug Linebach
TELEPHONE: 502-671-7712
SAMPLE COLLECTOR: Talbot & Tomes AME

Lab Use Only	SAMPLE		INFORMATION		NUMBER OF	SAMPLE TYPE		ANALYSIS
URC SAMPLE #	LOCATION		DATE	TIME	CONTAINERS	WATER	SOIL	REQUIRED
200607-46	B-1	2.0'	6/6/00	11:35	1		✓	Pcbs 8082
47	B-1	4.0'	6/6/00	11:40	1		✓	
48	B-2	2.0'	6/6/00	11:45	1		✓	
49	B-2	4.0'	6/6/00	11:48	1		✓	
50	B-3	2.0'	6/6/00	11:50	1		✓	
51	B-3	4.0'	6/6/00	11:55	1		✓	
52	B-4	2.0'	6/6/00	11:58	1		✓	
53	B-4	4.0'	6/6/00	12:00	1		✓	
54	B-5	2.0'	6/6/00 6/7/00	9:35	1		✓	
55	B-5	4.0'	6/6/00 6/7/00	9:40	1		✓	
56	B-6	2.0'	6/6/00	14.30	1		✓	

Relinquished By Signature		Received By Signature	Date/Time
Relinquished By Signature		Received By Signature	Date/Time
Dispatched By Signature: Talbot Tomes	Date/Time 15:30 6/7/00	Ship'd Via	Rec'd By Signature / Laboratory: R Harmon	Date/Time 6/7/00 1530

Rush results ASAP !!
To Doug Linebach
502 671-7717

Note Ground surface has been sprayed with herbicides
Diuret Karmex 8 lbs/ac

Form CUSTODY.FRM

CHAIN OF CUSTODY RECORD

2200 Greene Way Ste 120
Louisville Ky 40220

UMPQUA RESEARCH COMPANY
626 N.E. DIVISION ST. - P.O. BOX 609
MYRTLE CREEK, OR 97457
Ph (541) 863-5201 Fax (541) 863-6199

NAME: Glenbrook Nickel Company

Address: 5093 Riddle By-Pass Road

Riddle Oregon 97469

OREGON STATE CERTIFIED LABORATORY # 015

Date 6/6/00 Page 1 of 1

PROJECT NAME: GNC Riddle
PWS #: SA003,35
PROJECT CONTACT: Doug Linebuch
TELEPHONE: 502-671-7712
SAMPLE COLLECTOR: Talbot C Tomes AME

Lab Use Only URC SAMPLE #	SAMPLE LOCATION		INFORMATION DATE	TIME	NUMBER OF CONTAINERS	SAMPLE TYPE WATER	SOIL	ANALYSIS REQUIRED
57	B-6	4.0'	6/6/00	14:35	1		✓	Pcbs 8082
58	B-7	2.0'	6/6/00	14:40	1		✓	
59	B-7	4.0'	6/6/00	14:45	1		✓	
60	B-8	2.0'	6/6/00	14:50	1		✓	
61	B-8	4.0'	6/6/00	14:55	1		✓	
62	B-9	2.0'	6/6/00	15:00	1		✓	
63	B-9	4.0'	6/6/00	15:05	1		✓	
64	B-10	2.0'	6/6/00	15:10	1		✓	
65	B-10	4.0'	6/6/00	15:15	1		✓	
66	B-11	2.0'	6/6/00	15:20	1		✓	
67	B-11	4.0'	6/6/00	15:25	1		✓	

Relinquished By Signature		Received By Signature	Date/Time
Relinquished By Signature		Received By Signature	Date/Time
Dispatched By Signature: Talbot Tomes	Date/Time 6/7/00 15:30	Ship'd Via	Rec'd By Signature / Laboratory: Linda K Garmon	Date/Time 6/7/00 1530

Form CUSTODY.FRM

"Rush results ASAP"
To Doug Linebuch
Env 502-671-7717

Note Ground surface has been sprayed with herbicides oust, Karmex Roundup

CHAIN OF CUSTODY RECORD

2200 Greene Way Ste 100
Louisville KY 40220

UMPQUA RESEARCH COMPANY
626 N.E. DIVISION ST. - P.O. BOX 609
MYRTLE CREEK, OR 97457
Ph (541) 863-5201 Fax (541) 863-6199

NAME: Glenbrook Nickel Company

Address: 5093 Riddle By Pass Road

Riddle Oregon 97469

OREGON STATE CERTIFIED LABORATORY # 015

Date 6/6/00 Page of

PROJECT NAME: GNC Riddle
PWS # JA 003.35

PROJECT CONTACT: Doug Linebuch AME
TELEPHONE: 502-671-7712

SAMPLE COLLECTOR: AME
Talbot Counts

Lab Use Only	SAMPLE	INFORMATION		NUMBER OF	SAMPLE TYPE		ANALYSIS
UPC SAMPLE #	LOCATION	DATE	TIME	CONTAINERS	WATER	SOIL	REQUIRED
68	B-12 2.0'	6/6/00	16:10	1		✓	Pcbs 8082
69	B-12 4.0'	6/6/00	16:15	1		✓	
70	B-13 2.0'	6/6/00	16:20	1		✓	
71	B-13 4.0'	6/6/00	16:25	1		✓	
72	B-14 2.0'	6/6/00	16:30	1		✓	
73	B-14 4.0'	6/6/00	16:35	1		✓	
74	B-15 2.0'	6/6/00	16:40	1		✓	
75	B-15 4.0'	6/6/00	16:45	1		✓	
76							

Relinquished By Signature		Received By Signature	Date/Time
Relinquished By Signature		Received By Signature	Date/Time
Relinquished By Signature: Talbot Counts	Date/Time 6/7/00 15:30	Ship'd Via	Rec'd By Signature: L. Harmon Laboratory	Date/Time 6/7/00 1530

Form CUSTODY.FRM

11 Rush results ASAP 11
To Doug Linebuch AME
Fax 502-671-7717

Note Ground Surface has been sprayed with herbicides Oust, Krummex, Roundup

CHAIN OF CUSTODY RECORD

UMPQUA RESEARCH COMPANY
626 N.E. DIVISION ST. - P.O. BOX 609
MYRTLE CREEK, OR 97457
Ph (541) 863-5201 Fax (541) 863-6199

2200 Greene Way Ste 100
Louisville KY 40220

NAME: Glenbrook Nickel Company

Address: 5093 Riddle By Pass Road
Riddle Oregon 97469

OREGON STATE CERTIFIED LABORATORY # 015

Date 6/7/00 Page of

PROJECT NAME: GNC Riddle	PROJECT CONTACT: Doug Linebach AME	SAMPLE COLLECTOR: Talbot & Tomes AME
PWS # JA003,35	TELEPHONE: 502-671-7712	

Lab Use Only	SAMPLE	INFORMATION		NUMBER OF	SAMPLE TYPE		ANALYSIS
ERC SAMPLE #	LOCATION	DATE	TIME	CONTAINERS	WATER	SOIL	REQUIRED
76	B-16 2.0'	6-7-00	10:35	1		✓	Pcbs 8082
77	B-16 4.0'	6-7-00	10:40	1		✓	
78	B-17 2.0'	6-7-00	10:15	1		✓	
79	B-17 4.0'	6-7-00	10:20	1		✓	
80	B-18 2.0'	6-7-00	10:45	1		✓	
81	B-18 4.0'	6-7-00	10:50	1		✓	
82	B-19 2.0'	6-7-00	11:10	1		✓	
83	B-19 4.0'	6-7-00	11:15	1		✓	
84	B 20 2.0'	6-7-00	11:50	1		✓	
85	B-20 4.0'	6-7-00	11:55	1		✓	↓

Relinquished By Signature		Received By Signature		Date/Time
Relinquished By Signature		Received By Signature		Date/Time
Dispatched By Signature: Talbot Tomes	Date/Time 15:30 6-7-00	Ship'd Via	Rec'd By Signature: L. Harmon Laboratory	Date/Time 6/7/00 1530

"Rush results ASAP"
To Doug Linebach AME
Fax 502-671-7717

Form: CUSTODY.FRM

APPENDIX D

LABORATORY REPORTS – PHYSICAL ANALYSES

AGRA
ENVIRONMENTAL CONSULTANTS

August Mack Environmental, Inc
2200 Greene Way Suite 100
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Attn: Mr. Doug Lineback

AGRA Earth &
Environmental, Inc
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Fax (503) 620-7892

LABORATORY REPORT

SOILS & AGGREGATE

Project Name:	Glenbrook Nickel	Job No.:	0-61m-10554-0		
Sample Number:	B1 @3' - 5'	Lab Number:	4195		
Location /Source:	Borings	Test Date:	05/16/2000	Day:	Tuesday
Material Description:	silty clay	Tech:	KE		

Sieve Analysis ASTM C117, C136

Sieve Size	Percent Passing	Specs
1"	100	
3/4"	97	
1/2"	95	
3/8"	93	
1/4"	89	
#4	87	
#8	79	
#10	76	
#16	69	
#30	61	
#40	57	
#50	54	
#100	44	
#200	35.7	

Additional Tests & Results

Water Content ASTM D2216

Sample ID			
Water Content (%)			
Sample ID			
Water Content (%)			
Sample ID			
Apparent Specific Gravity (%)			
Bulk Specific Gravity			
SSD Bulk Specific Gravity			
Absorption (%)			
Fine Specific Gravity ASTM C128			

Laboratory Maximum Density	Test Method	Dry Density (pcf)	Optimum Moisture (%)
ASTM D1557			
ASTM D698			
Percent Oversize Material			

Atterberg Limits ASTM D 4318			Specs
Liquid Limit	52.8		
Plastic Limit	23.8		
Plasticity Index	29.0		
Classification	CH		
Fine Durability, ASTM D3744			
Coarse Durability, ASTM D3477			

LA Abrasion ASTM C131		
Grading	% Loss	Specs
@100 Revolutions		
@500 Revolutions		

Comments:

Reviewed By:

AGRA Earth & Environmental, Inc.

PROJECT: GLENBROOK NICKEL #1195
LOCATION:
MATERIAL:
SAMPLE SOURCE: B-1
SAMPLE PREP:

JOB NO: 3-81M-10554
WORK ORDER NO: 1
LAB NO: 1
DATE SAMPLED: 4/27/00

MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER (ASTM 5084-90) "CV" METHOD C

AVERAGE PERMEABILITY			7.08E-07	cm/sec
INITIAL LENGTH OF SPECIMEN			7.47	cm
INITIAL DIAMETER OF SPECIMEN			7.16	cm
INITIAL WATER CONTENT			24.9	%
INITIAL DRY UNIT WEIGHT			98.2	pcf
INITIAL VOLUME			18.35	cu.in
PERMEANT LIQUID			BOTTLED WATER	
MAGNITUDE OF TOTAL BACK PRESSURE			65	psi
EFFECTIVE CONSOLIDATION STRESS			5	psi
RANGE OF HYDRAULIC GRADIENT USED	6.2	to	5.2	
FINAL LENGTH OF SPECIMEN			7.46	cm
FINAL DIAMETER OF SPECIMEN			7.21	cm
FINAL WATER CONTENT			26.4	%
FINAL DRY UNIT WEIGHT			96.9	pcf
FINAL VOLUME			18.59	cu.in
DEGREE OF SATURATION (BEFORE AND AFTER TEST)	94%	and	96%	
SPECIFIC GRAVITY USED IN CALCULATIONS OF SATURATION			2.701	

TIME INTERVAL	K	K
sec	cm/sec	ft/yr.
265	6.24E-07	0.54
323	1.21E-06	1.25
388	5.38E-07	0.55
421	5.02E-07	0.58

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Louisville, KY 40220

attn: Mr. Doug Linebach

LABORATORY REPORT

SOILS & AGGREGATE

Project Name:	Glenbrook Nickel		Job No.:	0-61m-10554-0	
Sample Number:	B2 @3' - 5'		Lab Number:	4195	
Location /Source:	Borings		Test Date:	05/16/2000	Day: Tuesday
Material Description:	silty clay		Tech:	KE	

Sieve Analysis ASTM C117, C136		
Sieve Size	Percent Passing	Specs -
1"	100	
3/4"	97	
1/2"	94	
3/8"	94	
1/4"	91	
#4	89	
#8	82	
#10	80	
#16	75	
#30	70	
#40	67	
#50	65	
#100	61	
#200	53.3	

Additional Tests & Results

Water Content ASTM D2216			
Sample ID			
Water Content (%)			
Sample ID			
Water Content (%)			
Sample ID			
Apparent Specific Gravity (%)			
Bulk Specific Gravity			
SSD Bulk Specific Gravity			
Absorption (%)			
Fine Specific Gravity ASTM C128			
Laboratory Maximum Density	Test Method	Dry Density (pcf)	Optimum Moisture (%)
ASTM D1557			
ASTM D698			
Percent Oversize Material			

Atterberg Limits ASTM D 4318			Specs
Liquid Limit	42.5		
Plastic Limit	25.8		
Plasticity Index	16.7		
Classification	CL		
Fine Durability, ASTM D3744			
Coarse Durability, ASTM D3477			
LA Abrasion ASTM C131			
Grading _____		% Loss	Specs
@100 Revolutions			
@500 Revolutions			

Comments:

Reviewed By:

AGRA Earth & Environmental, Inc.

PROJECT: GLENBROOK NICKEL #4195
LOCATION:
MATERIAL:
SAMPLE SOURCE: B-2
SAMPLE PREP: SLEEVE SAMPLES

JOB NO: 0-61M-10554
WORK ORDER NO: 1
LAB NO: 2
DATE SAMPLED: 04/27/00

MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER (ASTM D5084) METHOD "C"

AVERAGE PERMEABILITY			1.22E-03	cm/sec
INITIAL LENGTH OF SPECIMEN			7.75	cm
INITIAL DIAMETER OF SPECIMEN			7.24	cm
INITIAL WATER CONTENT			24.3	%
INITIAL DRY UNIT WEIGHT			92.4	pcf
INITIAL VOLUME			319.1	cu.cm
PERMEANT LIQUID			BOTTLED WATER	
MAGNITUDE OF TOTAL BACK PRESSURE			0.0	psi
EFFECTIVE CONSOLIDATION STRESS			5.0	psi
RANGE OF HYDRAULIC GRADIENT USED	5.8	to	6.0	
FINAL LENGTH OF SPECIMEN			7.71	cm
FINAL DIAMETER OF SPECIMEN			7.25	cm
FINAL WATER CONTENT			27.6	%
FINAL DRY UNIT WEIGHT			92.7	pcf
FINAL VOLUME			318.3	cu.cm
DEGREE OF SATURATION (BEFORE AND AFTER TEST)	80%	and	91%	
SPECIFIC GRAVITY USED IN CALCULATIONS OF SATURATION			2.701	

TIME INTERVAL (sec)	K (cm/sec)	K (ft/yr)
109	1.32E-03	1383
123	1.30E-03	1343
136	1.29E-03	1337
1,235	9.73E-04	1007

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Louisville, KY 40220

attn: Mr. Doug Lineback

LABORATORY REPORT
SOILS & AGGREGATE

Project Name:	Glenbrook Nickel	Job No.:	0-61m-10554-0		
Sample Number:	B3 @3' - 5'	Lab Number:	4195		
Location /Source:	Borings	Test Date:	05/16/2000	Day:	Tuesday
Material Description:	silty clay	Tech:	KE		

Sieve Analysis ASTM C117, C136		
Sieve Size	Percent Passing	Specs
1"		
3/4"		
1/2"		
3/8"		
1/4"		
#4	100	
#8	96	
#10	93	
#16	86	
#30	78	
#40	75	
#50	72	
#100	65	
#200	49.4	

Additional Tests & Results

Water Content ASTM D2216			
Sample ID			
Water Content (%)			
Sample ID			
Water Content (%)			
Sample ID			
Apparent Specific Gravity (%)			
Bulk Specific Gravity			
SSD Bulk Specific Gravity			
Absorption (%)			
Fine Specific Gravity ASTM C128			
Laboratory Maximum Density	Test Method	Dry Density (pcf)	Optimum Moisture (%)
ASTM D1557			
ASTM D698			
Percent Oversize Material			

Atterberg Limits ASTM D 4318			Specs
Liquid Limit	34.2		
Plastic Limit	19.6		
Plasticity Index	14.6		
Classification	CL		
Fine Durability, ASTM D3744			
Coarse Durability, ASTM D3477			
LA Abrasion ASTM C131			
Grading		% Loss	Specs
@100 Revolutions			
@500 Revolutions			

Comments:

Reviewed By:

AGRA Earth & Environmental, Inc.

PROJECT: GLENBROOK NICKEL #4105
LOCATION:
MATERIAL:
SAMPLE SOURCE: B-3
SAMPLE PREP:

JOB NO. 0-81M-10354
WORK ORDER NO: 1
LAB NO: 3
DATE SAMPLED: 4/27/00

MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER (ASTM 5084-90) "CV" METHOD C

AVERAGE PERMEABILITY			2.71E-06	cm/sec
INITIAL LENGTH OF SPECIMEN			7.20	cm
INITIAL DIAMETER OF SPECIMEN			7.09	cm
INITIAL WATER CONTENT			20.1	%
INITIAL DRY UNIT WEIGHT			101.6	pcf
INITIAL VOLUME			17.35	cu.in
PERMEANT LIQUID			BOTTLED WATER	
MAGNITUDE OF TOTAL BACK PRESSURE			65.2	psi
EFFECTIVE CONSOLIDATION STRESS			5	psi
RANGE OF HYDRAULIC GRADIENT USED	5.6	to	5.2	
FINAL LENGTH OF SPECIMEN			7.02	cm
FINAL DIAMETER OF SPECIMEN			7.08	cm
FINAL WATER CONTENT			22.5	%
FINAL DRY UNIT WEIGHT			104.5	pcf
FINAL VOLUME			16.87	cu.in
DEGREE OF SATURATION (BEFORE AND AFTER TEST)	52%	and	99%	
SPECIFIC GRAVITY USED IN CALCULATIONS OF SATURATION			2.701	

TIME INTERVAL	K	K
sec	cm/sec	ft/yr
84	2.52E-06	2.91
97	2.37E-06	2.66
108	2.39E-06	2.82
122	2.32E-06	2.71

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ENGINEERING GLOBAL SOLUTIONS

Report of Remedial Actions

Eleven Areas of Concern

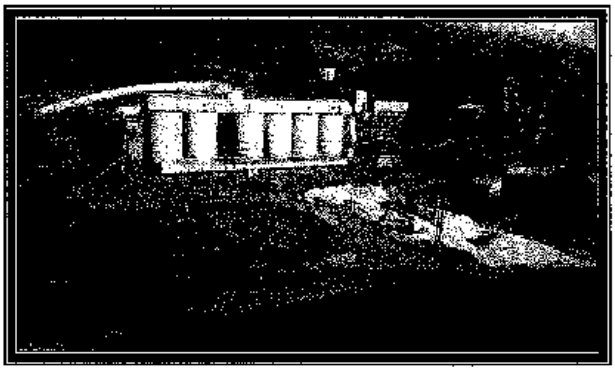
Prepared by Linebach Funkhouser, Inc.

Prepared for Glenbrook Nickel Company

June 2002

REPORT OF REMEDIAL ACTIONS
ELEVEN AREAS OF CONCERN

GLENBROOK NICKEL FACILITY
RIDDLE, OREGON



PREPARED FOR:

Glenbook Nickel Company
Riddle, Oregon

Prepared by:

Linebach ▪ Funkhouser, Inc.
environmental compliance & consulting

2898

teckcominco

Ms. Amanda Spencer, PE
Oregon Dept. of Environmental Quality
Western Region
1102 Lincoln St., Suite 210
Eugene, OR 97401

June 18, 2002

Dear Ms. Spencer:

Re: Teck Cominco Glenbrook Operations
Report of Remedial Actions/Request for No Further Action Determination

Please find enclosed two copies of Glenbrook's revised Report/Request cited above. It is our belief that this revision has addressed your comments to the original Draft Version, and provides a complete report of conditions and remedial efforts at the Riddle facility.

If you have any questions regarding our report, please call either John Schultz (503-226-8647) or me at your convenience. We look forward to discussing the report after you have had time to review our revision.

Sincerely,

Greg M. Schoen
Environmental Affairs Manager

GMS/dac

cc: John Schultz, AterWynne
Dulcy Berri, PBS
D. Linebach, LFI

RECEIVED
JUN 25 2002
WESTERN REGION / EUGENE
DEPT ENVIRONMENTAL QUALITY

Teck Cominco American Incorporated
15918 East Euclid Avenue, Spokane, WA 99216
PO Box 3087, Spokane, WA 99220 ▪ telephone: (509) 747-6111 ▪ fax: (509) 922-8767

CERTIFICATION

The material and data presented in this report were prepared under the supervision and direction of the undersigned:

Dulcy Berri
Signature

6/19/02
Date

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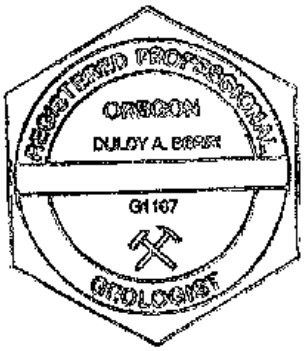
Portland, OR 97201
(503) 248-1939



Charles D. Linebach
Signature

6/18/02
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Roy V. Funkhouser
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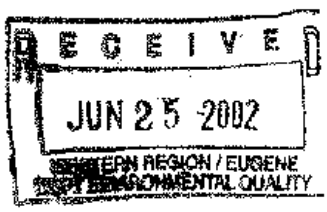

REPORT OF REMEDIAL ACTIONS
ELEVEN AREAS OF CONCERN
GLENBROOK NICKEL FACILITY
RIDDLE, OREGON

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1.0 INTRODUCTION

Glenbrook Nickel Company (Glenbrook) formerly operated a nickel mine and smelter ("facility") in Riddle, Oregon (Figure 1). The mine and smelter were developed and operated from the late 1940s until the mid-1980s. Glenbrook purchased the smelter property from Nickel Mountain Resources in 1989 and operated the mine for a short time only. Glenbrook operated the smelter (using imported ore from New Caledonia) intermittently from 1991 until it closed the smelter operations in March, 1998. The Glenbrook operations are now owned by Teck Cominco Metals, Limited ("TCML"), but throughout this report we will continue to refer to Glenbrook as the operator of the smelter.

In January 2000, a portion of the smelter property was sold to Arden Development, Inc. TCML intends to divest its remaining property. Attached is a map of the smelter facility showing the remaining TCML property outlined in black. In association with this divestiture, Glenbrook's overall goals are to:

- Assure that the facility does not pose an unacceptable risk to human health and the environment.
- Limit potential long-term environmental liabilities associated with the facility.

To meet these goals, a strategy to address environmental issues was developed by personnel formerly with August Mack Environmental and now with Linebach Funkhouser, Inc. (Glenbrook's environmental consultant), Glenbrook, and Ater Wynne LLP (Glenbrook's outside legal counsel), and based on that strategy the following steps were completed:

1. Evaluation of the site and identification of potential areas of concern (AOCs).
2. Development of a Confirmation Sampling Plan (CSP) to eliminate potential AOCs, as practicable.
3. Implementation of the CSP.
4. Preparation of a report of the CSP findings and incorporation of those results into a Preliminary Remedial Action Plan.

5. Implementation of the Preliminary Remedial Action Plan.

6. Review of analytical data and completion of additional field work to fill data gaps identified. A report of findings was prepared.

7. Submittal of results to DEQ (by way of this report) to obtain No Further Action Letter.

8. The initial strategy for the site included the potential preparation of a Final Remedial Action Plan with subsequent implementation, if necessary, to address AOCs requiring long-term action. *This step of the strategy was not necessary because no AOCs required long-term action.*

The first step of the strategy identified 23 potential AOCs at the facility. All of the AOCs were associated with the smelting operations. None were identified at the mine site on Nickel Mountain. Figure 2 shows the location of each potential AOC.

The findings of confirmation sampling at the 23 potential AOCs are presented in August Mack's *Report of Confirmation Sampling*, dated August 10, 2000. Nine AOCs, impacted by diesel-related constituents and/or arsenic, were identified by the confirmation sampling and warranted further action; therefore, a preliminary remedial action plan was implemented to address those AOCs. During the course of implementing remedial actions, two additional AOCs were identified, bringing the total number of AOCs to be addressed to eleven. The remedial actions consisted of soil excavation and confirmation sampling.

This report includes the findings of the remedial actions for the AOCs (completion of the aforementioned strategy steps 6 and 7).

2.0 BACKGROUND AND OBJECTIVES

The following sections present a description of the facility and the previous studies that have been performed.

2.1 Facility Description

The facility was operated by Hanna Nickel Smelting Company ("Hanna") as a nickel mine and smelter for approximately 40 years, beginning in the late 1940s. Glenbrook Nickel Company purchased the facility in 1989 from Nickel Mountain Resources, a salvage company. Glenbrook operated the smelter intermittently from 1991 to 1998. The smelting operations of the facility consisted of a large smelter building, various office buildings, laboratory, maintenance and storage facilities, and associated structures including dryers, storage silos, and an electrical substation. Hanna mining operations took place at the top of Nickel Mountain, at elevations of approximately 3,000 feet (National Geodetic Vertical Datum of 1929 (NGVD)), on land leased from private landowners. Glenbrook's limited mining operation took place below the top of the mountain at a location known as the "lower ore body" at an elevation of approximately 2,000 feet NGVD.

The smelting operations were located approximately two miles south-southeast of the mine at approximately 1,200 feet (NGVD). A tramway was once used to transport ore from the mine down to the smelter. Power for the smelter was provided by an on-site Bonneville Power Administration (BPA) substation, located just south of the smelter building. Four above-ground fuel-oil storage tanks and a vehicle fueling station were located west of the smelter building. A rail spur ran along the northern edge of the smelter building and storage tanks. Dryers, the ferro-silicon bag house, and several storage silos were located to the north, across the rail spur. Office and laboratory buildings were located east of the smelter building. Large areas of mine tailings are located to the south and west of the smelter area on land not currently owned by Glenbrook or TCML, and thus are not part of the facility. Riddle By-Pass Road and Cow Creek are located approximately one mile south of the smelter.

Nickel smelting operations ceased in March of 1998, and current activities at the facility primarily consist of demolition and/or sale of equipment and facilities.

2.2 Previous Studies

Initial sampling activities were conducted at the Riddle facility (smelter operations) on April 26-28, 2000, and additional sampling around the capacitor banks in the electrical substation was conducted on June 6 and 7, 2000. A summary of the number of samples collected at each potential AOC and the laboratory analyses performed are included in the following table. Sampling and decontamination procedures used in the field were in general accordance with those described in August Mack's March 30, 2000 *Confirmation Sampling Plan.*

Sampling and Analysis at the Original 23 Potential Areas of Concern

Area	Description	Media Sampled	No. of Samples	Analyses
1. Sand Blast Area	Slag (Green Diamond granules) used for sand blast cleaning of equipment and parts. *Potential lead paint waste.*	Soil	3	Lead
2. Lab Drain Line Discharge Point	Discharge point of drain line from sinks and drains in the laboratory. *Potential discharge of lab chemicals down drain. Discharge is routed to surface ditch as part of NPDES middle pond system.*	Sediment	1	VOCs PAHs Metals
3. Former Sand Blast Area	Former area used for sand blasting (same as #2 above). *Potential lead paint waste.*	Soil	2	Lead
4. Sanitary Sand Filter Beds	Sand filter beds that received sanitary waste from the site's septic tanks. *Potential discharge of chemicals into sanitary system. Septic tank system receives water from sinks, showers and toilets, except from the lab.*	Soil	2	VOCs PAHs Metals
5. Granulation Ladle Tilt Station Hydraulic System	Hydraulic fluid used in the operation of the Granulation Ladle. *Soil staining beneath each of the four Granulation Tilt Ladle units.*	Soil	4	PAHs
6. Lube Oil Storage Shed	Drum storage of lube oils and greases in shed and one outside AST for used oil storage. *No signs of cracks in concrete floor of shed. Signs of spills and staining outside at used oil AST.*	Soil	1	TPH-D PCBs VOCs PAHs Metals
7. Ferro Silicon Bag House	Air emission control equipment. *Accumulation of dusts around the bag house.*	Dust/Soil	2	Lead
8. Calciner Lube Oil	Lube oils used in the operation of the calciners. *Signs of releases and staining at pillars supporting the calciners.*	Soil	1	PAHs
9. #3 Dryer	Lube oils used in the operation of the dryer. *Signs of releases and staining beneath the dryer.*	Soil	3	PAHs
10. Diesel Fueling Station and Line Area	Fueling station and product distribution lines under the roadway. *Signs of releases and staining at the fueling station, and potential releases along product distribution lines.*	Soil Groundwater	10 1	TPH-D PAHs
11. AST Area	Diesel fuel and bunker-C ASTs. *Signs of releases within earthen secondary containment structure around tanks.*	Soil	6	TPH-D PAHs

12. Pilot Plant Fuel Oil Tank	Fuel oil AST. *Signs of releases and no concrete floor within secondary containment structure.*	Soil	2	TPH-D PAHs
13. Vehicle Maintenance and Washdown Area	Concrete pad, sump, and drains used for washing and maintenance of facility equipment. *Potential oils and cleaners entering sump and drains.*	Soil	2	PAHs VOCs Metals
14. Generator Shed	Small shed housing generators/motors behind skull plant. *Signs of releases and staining inside and outside of the shed.*	Soil	1	TPH-D PAHs
15. USTs at Mine Site	3,000 gallon gasoline and 10,000 gallon used oil USTs at mine site (top of mountain). *Potential releases from the USTs. To insure that all potential constituents were addressed, PCBs were also analyzed.*	Soil	4	TPH-G TPH-D BTEX PAHs PCBs
16. Near Creek above Smelter Building	Creek running down mountain. Evaluate groundwater for levels of total and dissolved metals.	Groundwater	1	Metals
17. Below Two Middle Ponds	Part of the NPDES Discharge system for the facility. Evaluate groundwater for levels of total and dissolved metals.	Groundwater	1	Metals
18. Below Lower Pond	Part of the NPDES Discharge System for the facility. Evaluate groundwater for levels of total and dissolved metals.	Groundwater	1	Metals
19. Below AST Area	Area downgradient from Diesel fuel and Bunker-C ASTs. Evaluate groundwater for impacts from the ASTs.	Groundwater	1	TPH-D PAHs Metals
20. BPA Substation	Bonneville Power Administration substation including transformers and capacitors. *Potential releases of PCBs from electrical equipment.*	Soil Equipment Wipe	60 6	PCBs TPH-D 1,1,1-TCA PCBs
21. Below New Caledonia Ore Pile	Area downgradient from New Caledonia Ore Pile. Evaluate groundwater for levels of total and dissolved metals.	Groundwater	1	Metals
22. New Caledonia Ore Pile	Stockpile of New Caledonia Ore northwest of smelter building. Evaluate ore for levels of total and dissolved metals.	Ore	3	Nickel Chromium Manganese
23. Shotting Water Tank	Location of former water storage tank, added as AOC. Not in original Confirmation Sampling Plan. *Potential impact by hydrocarbons observed during site sampling activities.*	Soil	1	TPH-D PAHs VOCs

Notes:

AST – Aboveground Storage Tank
UST – Underground Storage Tank
TPH-D – Total Petroleum Hydrocarbons – Diesel Fuel
TPH-G – Total Petroleum Hydrocarbons – Gasoline
PAH – Polynuclear Aromatic Hydrocarbons
PCBs – Polychlorinated Biphenyls
BTEX – Benzene, Toluene, Ethylbenzene, Xylenes
VOCs – Volatile Organic Compounds

The sampling activities included soil sampling from Geoprobe borings and test pits, and the collection of water samples from temporary groundwater monitoring wells. The temporary groundwater monitoring wells were advanced for quick and efficient collection of groundwater

samples to determine if there were any impacts possibly resulting from the nearby ponds, ore piles, or other features. Soil samples were not collected from these borings. Wipe samples were also collected from equipment in the electrical substation.

The confirmation sampling identified the following nine AOCs, of the original 23, that warranted further action due to diesel and oil-related constituents and metals in soil:

- Sanitary Sand Filter Beds (AOC-R-4)
- Granulation Ladle Tilt Station Hydraulic System (AOC-R-5)
- Lube Oil Storage Area (AOC-R-6)
- Calciner Lube Oil Area (AOC-R-8)
- Diesel Fueling Station and Fuel Line Area (AOC-R-10)
- Pilot Plant Fuel Oil AST (AOC-R-12)
- Vehicle Maintenance and Washdown Area (AOC-R-13)
- BPA Substation (AOC-R-20)
- Shotting Water Tank (AOC-R-23)

In addition, the two following areas of concern, which were not identified in the original 23 potential AOCs and were not included in the *Confirmation Sampling Plan*, were identified later and addressed with the nine aforementioned AOCs:

- Lower Ore Body
- Baghouse AST Area

2.3 Soils, Geology, and Groundwater Setting

In addition to confirmation sampling, data on groundwater conditions and soil permeability were also collected (boring locations are shown on Figure 2). Information obtained for the preliminary groundwater evaluation included:

- Depth to the uppermost groundwater producing zone.
- Impact to groundwater by potential past releases.
- Presence of non-aqueous phase liquids (free-product) on the water table.

Information gathered for the soil permeability evaluation included:

- Grain size
- Atterberg Limits
- Average permeability

The principal ore deposit is lateritic nickel in the form of garnierite. The soft laterite residue, which forms a soil mantle over the vicinity, contains insoluble nickel as a by-product of mineral decomposition. The past mining operations occurred from a deeply-weathered peridotite body.

Investigation at the facility identified a relatively homogenous thickness of reddish-brown silty clay to depths of 20 feet below ground surface. Soil permeability tests were conducted on soil samples collected from three locations shown in Figure 2 (B-1, B-2, and B-3). Each of the three soil samples was collected from a depth of approximately 3 to 5 feet below ground level. Test results indicated that soil consisted of clay with a permeability range of 10^{-6} to 10^{-7}cm/sec. Geotechnical soil test results for grain size, Atterberg limits, and average permeability were reported in the August 10, 2000 report (no geologic logs were prepared).

Located within the Klamath Mountains physiographic province, the area is a complex terrain of metamorphosed marine and volcanic sediments, overlain by successions of younger sediments with volcanic and plutonic activity as well.

Depth to groundwater at the facility is approximately 28 feet, based on the static water level at the guard shack well. The guard shack well is the only domestic well identified in the vicinity of the Glenbrook facility. Well logs show that water was first encountered during drilling of the guard shack well at 75 feet below ground surface. The 28-foot static water level may be representative of the equilibrated potentiometric surface. The well log indicates 49 feet of brown clay with gravel or boulders, overlying blue clay and sandstone that extends to 260 feet below ground surface. The well casing is perforated between 20 and 40 feet below ground surface.

Five Geoprobe borings (temporary groundwater monitoring wells) at the facility encountered water representative of perched conditions (above the regional aquifer) ranging from 3 feet to 6

feet below ground surface. Other borings were dry or encountered free product only. The borings were advanced directly to groundwater by pushing the screened sampling tip into the saturated zone. Following sample collection, the boring rods were removed and the boreholes were sealed with bentonite pellets. Detailed boring logs were not compiled.

Geoprobe borings were located downgradient from facility operations that posed the highest potential for groundwater impacts (see Figure 2). The shallow water in the Geoprobe borings is believed to represent perched groundwater due to its discontinuous and sporadic occurrence across the site. In addition to all impacted soil being removed to below cleanup objectives, as discussed in the following sections, soil permeability tests at the facility indicate that the soil is generally regarded as relatively impermeable. Therefore, due to the depth of groundwater at the facility and due to the fact that clay overlies the uppermost groundwater producing zone, impeding the migration of chemical constituents, impacts to groundwater are not considered a continuing issue at the Riddle facility.

2.4 Soil Matrix Calculation

A Soil Matrix calculation was performed for the facility by PBS Environmental (Oregon DEQ-licensed Soil Matrix Supervisor). The total Soil Matrix score for the facility is 24, representing cleanup levels of 130 parts per million (ppm) for gasoline-range petroleum and 1,000 ppm for diesel/mixed heavy oil-range petroleum. The PBS Environmental Soil Matrix calculation and score sheet is included in Appendix A.

2.5 Cleanup Objectives

Cleanup levels from the following sources were used during the confirmation sampling phase to help identify AOCs requiring further action and during the preliminary remedial phase to help determine when cleanup objectives were met:

- Numeric Soil Cleanup Levels – OAR 340-122-0045 and Appendix 1.

- Level 1 (the most conservative) soil matrix cleanup listed by DEQ for releases from petroleum underground storage tanks (USTs). (Although Level 1 was used as a guide, the facility is actually classified as the significantly less conservative Level 3 (see Section 2.4). These soil matrix levels are often used by DEQ as guidance for determining appropriate protective levels in soil for cleanups of petroleum releases from above ground tanks and other non-UST sources).

- Background levels of arsenic. (Background levels were determined based on collection and analysis of samples from an area of the facility that had not been impacted by facility operations, in accordance with DEQ guidelines for determining background concentrations). Laboratory data and related information regarding the determination of naturally occurring background arsenic levels is provided in Appendix B.

The aforementioned cleanup level criteria were selected because the number and nature of the contaminants of concern have been assessed and only exist in soil. The extent of the contamination has also been determined and the impacted soil has been removed; therefore, surface water or sensitive environments will not be adversely affected. The following cleanup levels are applicable to the arsenic and petroleum-related constituents identified at the eleven areas of concern, and were used to determine if cleanup objectives were met during the remedial actions. Cominco's self-imposed cleanup goal for TPH constituents (diesel and oil) was 100 ppm. This goal was met throughout the facility, with the exception of a few areas where additional excavation was not feasible due to the close proximity of facility structures. In these areas, the DEQ cleanup level of 1,000 ppm (based on the Soil Matrix) was used.

Constituent	**Cleanup Level**
➢ Polynuclear Aromatic Hydrocarbons (PAH)	Various*
➢ Diesel	100/1000 ppm
➢ Oil	100/1000 ppm
➢ Arsenic	24.87 ppm

**Industrial cleanup level, individual PAH compounds per OAR 340-122-045 Appendix 1.*

Samples collected during the remedial activities were not analyzed for constituents commonly associated with gasoline, i.e. benzene, toluene, ethyl benzene, and xylenes (BTEX) because diesel fuel was the primary petroleum material handled at the site. Gasoline-related fuels were only used sparingly at the facility, and samples collected during initial assessment activities that

were analyzed for volatile organic compounds (VOCs) did not reveal significant BTEX concerns, as presented in the August 10, 2000 report.

3.0 PRELIMINARY REMEDIAL ACTIVITIES

Based on the constituents identified at the AOCs and the limited extent of those constituents detected during the confirmation sampling, the preliminary remedial actions consisted of soil excavation and off-site disposal. The soil excavation and disposal activities primarily occurred between August 2000 and September 2001. The amount of soil initially excavated at each AOC was based on field observations and field screening instruments.

Following removal of impacted soil, confirmation soil samples were collected for laboratory analysis. Analytical methods included; PAH by EPA Method 8270M, TPH-DRO by Method NWTPH-Dx, and arsenic by EPA Method 6010B. Samples were collected from the bottom and side walls of the excavations. Side wall samples were typically collected from the midway point of the wall, or at approximately 5-foot intervals in the deeper excavations. If laboratory results indicated that impacted soil remained above the DEQ cleanup levels set out in section 2.5 of this report, additional soil was excavated followed by additional rounds of confirmation sampling and analysis until removal of all impacted soil was confirmed. Two or more rounds of excavation and confirmation sampling occurred at several of the AOCs.

The following sections describe the soil excavation, disposal, and cleanup confirmation sampling at each of the eleven AOCs. Tables showing the laboratory results for each AOC are included at the end of the report and laboratory data is included in the corresponding appendices.

3.1 Sanitary Sand Filter Beds (AOC-R-4)

Elevated levels of arsenic were identified in soil in the two Sanitary Sand Filter Beds based on results of the April 2000 sampling. This area was sampled because the sand filter beds had the potential to receive chemicals inadvertently discharged to the sanitary system. The sand filter material and approximately two feet of adjacent soil on the walls and bottom was excavated from

each bed (see Figure 3). A total of 24 samples were collected from the walls and bottom of the beds to confirm removal of the arsenic impacted material. Side wall samples were collected from the approximate midway point of the walls. Results are included in Table 3.1.

3.2 Granulation Ladle Tilt Station Hydraulic System (AOC-R-5)

Elevated levels of PAH constituents were identified at one of the four Granulation Ladle Tilt Station Hydraulic System units (unit #4) based on results of the April 2000 sampling. Hydraulic fluid used in the unit had been released to the underlying soil. An area of visually impacted soil, approximately 12 feet x 12 feet and 2 feet deep, was excavated at the base of unit #4 (see Figure 4). One sample was collected from the bottom of the excavation to confirm removal of the PAH impacted soil. Results are included in Table 3.2.

3.3 Lube Oil Storage Area (AOC-R-6)

Elevated levels of TPH constituents (oil) were identified in soil around the used-oil AST on the east side of the Lube Oil Storage Area, based on results of the April 2000 sampling. These elevated levels were probably due to minor spills and overfilling. An area of visually impacted soil, approximately 12 feet x 16 feet and 1.5 feet deep, was excavated (see Figure 5). Two samples were collected from the bottom of the excavation to confirm removal of the TPH impacted soil. Two additional samples were collected during a second round of sampling and analyzed for TPH and PAH constituents. Results are included in Table 3.3

3.4 Calciner Lube Oil Area (AOC-R-8)

Elevated levels of PAH constituents were identified in soil around one of the four Calciner Lube Oil Areas (pillars) based on results of the April 2000 sampling. These elevated levels were probably due to minor leakage and spills. An area of visually impacted soil, covering a radius of approximately 6 feet around the pillar and extending to a depth of approximately 4 feet was excavated (see Figure 6). Four samples were collected to confirm removal of the PAH impacted soil. Results are included in Table 3.4.

3.5 Diesel Fueling Station and Fuel Line Area (AOC-R-10)

Elevated levels of TPH constituents were identified in soil around the Diesel Fueling Station and along the Fuel Line Area based on results of the April 2000 sampling. Leaks, spills, and overfilling of diesel fuel from the tanks, transfer station, and underground transfer lines had occurred through the operating years of the facility. Excavation began in the diesel fueling station area and continued north to the railroad tracks. The excavation activities extended along the south and north sides of the railroad tracks west and south to the Arden Development, Inc. property line, and east to the smelter building (see Figure 7). The excavation extended to depths of 25 feet in some areas. Sixteen rounds of excavation and sampling occurred between September 2000 and September 2001, and a total of 334 soil samples were collected from the bottom and side walls to confirm removal of the impacted soil. Side wall samples were collected from approximately 5-foot depth intervals. Free product discovered in some of the geoprobe borings advanced during the initial sampling activities in this area (boring logs and lab data in Appendix A), was removed during the excavation activities.

4 RBCs for all paths

Results of PAH and TPH analyses are included in Table 3.5A. BTEX results of sample #CS-27 are included in Table 3.5B, and PCB results of sample #CS-182 are included in Table 3.5C. Also, results of soil stockpile sample #3 for landfill disposal are included in Table 3.5D.

Geoprobe Assessment Beneath Rail Line

Impacted soil was removed along the north and south sides of the railroad tracks from the western property boundary to the smelter building. Soil beneath the tracks was also impacted by the diesel constituents, but could not be removed due to the risk of compromising the integrity of the rail line.

To identify the vertical extent of impacted soil beneath the tracks and to confirm levels of diesel in the soil, Geoprobe borings were advanced along the rail line and soil samples were collected. The vertical extent soil sampling activities were conducted during March of 2001 and included the following scope of work:

- Thirteen soil borings were advanced along the rail line using Geoprobe equipment. The borings were located between the railroad ties and extended to a depth of 20 feet (see Figure 7).

- Soil samples were collected from each boring at the two- to four-foot interval to identify the general concentrations of diesel in the soil. *Based on sampling and excavation that had occurred along the tracks, it was anticipated that the most significantly impacted soil would likely be in the upper few feet beneath the tracks.*

- Each two-foot interval below ten feet was screened in the field for organic vapors. Based on the field screening results, samples were collected from soil that was anticipated to be below the vertical extent of the diesel-impacted soil.

- The samples were analyzed for TPH and PAH.

Results of the Geoprobe assessment are included in Table 3.5E, boring logs and the laboratory report are included in Appendix C.

3.6 Pilot Plant Fuel Oil AST (AOC-R-12)

Elevated levels of TPH and PAH constituents were identified in soil beneath the Pilot Plant Fuel Oil AST after its removal, based on results of the April 2000 sampling. These levels were due to previous leaks and spills. Soil beneath the former AST, an area approximately 33 feet x 24 feet and 3 feet deep, was excavated (see Figure 8). Four samples were collected to confirm removal of the impacted soil. Results are included in Table 3.6.

3.7 Vehicle Maintenance and Washdown Area (AOC-R-13)

Elevated levels of arsenic were identified in soil around the Vehicle Maintenance and Washdown Area based on results of the April 2000 sampling. Later, during excavation and confirmation sampling for the arsenic impacted soil, elevated levels of PAH and TPH constituents were also identified. The area was used for washing and maintenance of facility equipment, resulting in the release of oils, grease and detergents to the sump, drains, and surrounding soil. A concrete basin and surrounding soil, an area approximately 28 feet x 47 feet and 4 feet deep, was excavated (see Figure 9). Four rounds of excavation and sampling were conducted and a total of

40 soil samples were collected to confirm removal of the impacted soil. TPH and arsenic results are included in Table 3.7A. Results of the soil stockpile sample for landfill disposal are included in Table 3.7B, and PAH results are included in Table 3.7C.

3.8 BPA Substation (AOC-R-20)

Due to minor leakage from electrical equipment, elevated levels of TPH constituents were detected around some of the equipment pads in the former BPA Substation based on results of the June 2000 sampling. Two rounds of excavation and sampling were conducted and a total of 21 samples were collected to confirm removal of the impacted soil (see Figure 10). Results are included in Table 3.8.

An area of soil in the northwest corner of the former BPA Substation, at the location of two capacitor banks, had been impacted by polychlorinated biphenyls (PCBs), based on the June 2000 sampling. This area was remediated (excavated) separately from the remaining portions of the BPA Substation. The PCB remedial activities and results are included in August Mack's *Report of PCB Removal Actions,* dated April 25, 2001. A "No Further Action" determination for the substation area was issued by DEQ on October 3, 2001, and is included in Appendix O.

3.9 Shotting Water Tank (AOC-R-23)

Elevated levels of TPH constituents were identified in soil beneath the Shotting Water Tank during the initial sampling activities in April 2000. A release of diesel fuel, possibly from a truck transferring water to or from the tank, resulted in the impacted soil. Soil beneath the former AST, an area approximately 26 feet x 26 feet and 3 feet deep was excavated (see Figure 11). Two rounds of excavation and sampling were conducted and a total of seven samples were collected. Results are included in Table 3.9.

3.10 Lower Ore Body

A former fueling area (one diesel above ground storage tank (AST)) at the Lower Ore Body (located approximately one mile north of the smelter facility at an approximate elevation of 2000 feet NGVD) was identified as an additional potential area of concern based on visual observations made during remedial activities at the previously identified AOCs. Minor leaks or spills through the years of operation likely resulted in the impacted soil around the former fueling area. Two rounds of excavation and sampling were conducted and a total of eight samples were collected (see Figure 12). Results are included in Table 3.10.

3.11 Baghouse AST Area

Due to evidence of minor spills or overfilling, a former AST area located approximately 100 feet west of the baghouse structure (AOC-R-7) was identified as an additional potential area of concern during remedial activities at the previously identified AOCs. An area approximately 27 feet x 60 feet was excavated to a depth of approximately two feet (see Figure 13). A total of eleven samples were collected and analyzed for TPH and PAH constituents. Results are included in Table 3.11.

4.0 SOIL DISPOSAL

Soil excavation activities occurred over an approximately thirteen-month period, from August 2000 to August 2001. Initial excavation at each AOC was based on the results of our original confirmation sampling (see *Report of Confirmation Sampling*, dated August 10, 2000), visual observations, and field screening instruments. Following the initial soil removal at each AOC, confirmation samples were collected and analyzed. If the laboratory results indicated that impacted soils had been removed and the clean-up objectives had been met, the area was backfilled. If laboratory results indicated that impacted soil remained, additional soil was excavated followed by additional rounds of confirmation sampling and analysis until removal of all impacted soil was confirmed.

Soil contaminants at each AOC primarily consisted of either petroleum-related compounds or arsenic. All soil excavated from the ten AOCs was disposed of at the following facility:

Valley Landfills, Inc.
28972 Coffin Butte Road
Corvallis, Oregon 97330
(541) 745-2018

A total of approximately 37,420 cubic yards of petroleum impacted soil were disposed of from the following AOCs:

- Granulation Ladle Tilt Station Hydraulic System (AOC-R-5)
- Lube Oil Storage Area (AOC-R-6)
- Calciner Lube Oil Area (AOC-R-8)
- Diesel Fueling Station and Fuel Line Area (AOC-R-10)
- Pilot Plant Fuel Oil AST (AOC-R-12)
- BPA Substation (AOC-R-20)
- Shotting Water Tank (AOC-R-23)
- Lower Ore Body
- Baghouse AST Area

A total of approximately 2,240 cubic yards of arsenic impacted soil were disposed of from the following AOCs:

- Sanitary Sand Filter Beds (AOC-R-4)
- Vehicle Maintenance and Washdown Area (AOC-R-13)

5.0 BACKFILLING OF EXCAVATIONS

The excavations at the AOCs were backfilled following receipt of the final sampling results and confirmation that the clean-up objectives had been achieved. The excavations were backfilled with crushed (three-inch) quartz road aggregate from an off-site quarry (Quartz Mountain, near Tiller, Oregon). The areas were then covered with a layer of overburden rock from the mine that was not passed through the smelter due to low nickel content. Several stockpiles of overburden rock are located throughout the site and are generally used for backfilling, contouring, etc.

6.0 SUMMARY AND CONCLUSION

Based on the extensive soil excavation activities and results of the confirmation sampling at the eleven areas of concern, LFI has developed the following summary and conclusions:

- Remedial activities consisting of soil excavation and off-site disposal were implemented at eleven areas of concern identified at the Glenbrook facility. A total of approximately 39,660 cubic yards of impacted soil were removed.

- Approximately 486 confirmation soil samples were collected from the excavated areas to confirm removal of the impacted soil. All final confirmation sample results met DEQ cleanup levels (Soil Matrix Levels for TPH, DEQ Numeric Soil Cleanup Levels for PAH, and site-specific naturally occurring background levels for arsenic).

6.1 Conclusion

- Based on the extensive soil excavation activities and findings of the confirmation sampling, DEQ cleanup levels have been achieved at all eleven areas of concern, and a No Further Action determination for the facility by DEQ is warranted.

Tables

Table 1
Sampling and Analysis at the Original 23 Areas of Concern

Area	Description	Media Sampled	No. of Samples	Analyses
1. Sand Blast Area	Slag (Green Diamond granules) used for sand blast cleaning of equipment and parts. *Potential lead paint waste.*	Soil	3	Lead
2. Lab Drain Line Discharge Point	Discharge point of drain line from sinks and drains in the laboratory. *Potential discharge of lab chemicals down drain. Discharge is routed to surface ditch as part of NPDES middle pond system.*	Sediment	1	VOCs PAHs Metals
3. Former Sand Blast Area	Former area used for sand blasting (same as #2 above). *Potential lead paint waste.*	Soil	2	Lead
4. Sanitary Sand Filter Beds	Sand filter beds that received sanitary waste from the site's septic tanks. *Potential discharge of chemicals into sanitary system. Septic tank system receives water from sinks, showers and toilets, except from the lab.*	Soil	2	VOCs PAHs Metals
5. Granulation Ladle Tilt Station Hydraulic System	Hydraulic fluid used in the operation of the Granulation Ladle. *Soil staining beneath each of the four Granulation Tilt Ladle units.*	Soil	4	PAHs
6. Lube Oil Storage Shed	Drum storage of lube oils and greases in shed and one outside AST for used oil storage. *No signs of cracks in concrete floor of shed. Signs of spills and staining outside at used oil AST.*	Soil	1	TPH-D PCBs VOCs PAHs Metals
7. Ferro Silicon Bag House	Air emission control equipment. *Accumulation of dusts around the bag house.*	Dust/Soil	2	Lead
8. Calciner Lube Oil	Lube oils used in the operation of the calciners. *Signs of releases and staining at pillars supporting the calciners.*	Soil	1	PAHs
9. #3 Dryer	Lube oils used in the operation of the dryer. *Signs of releases and staining beneath the dryer.*	Soil	3	PAHs
10. Diesel Fueling Station and Line Area	Fueling station and product distribution lines under the roadway. *Signs of releases and staining at the fueling station, and potential releases along product distribution lines.*	Soil Groundwater	10 1	
11. AST Area	Diesel fuel and bunker-C ASTs. *Signs of releases within earthen secondary containment structure around tanks.*	Soil	6	TPH-D PAHs
12. Pilot Plant Fuel Oil Tank	Fuel oil AST. *Signs of releases and no concrete floor within secondary containment structure.*	Soil	2	TPH-D PAHs
13. Vehicle Maintenance and Washdown Area	Concrete pad, sump, and drains used for washing and maintenance of facility equipment. *Potential oils and cleaners entering sump and drains.*	Soil	2	PAHs VOCs Metals
14. Generator Shed	Small shed housing generators/motors behind skull plant. *Signs of releases and staining inside and outside of the shed.*	Soil	1	TPH-D PAHs
15. USTs at Mine Site	3,000 gallon gasoline and 10,000 gallon used oil USTs at mine site (top of mountain). *Potential releases from the USTs.*	Soil	4	TPH-G TPH-D BTEX PAHs PCBs
16. Near Creek above Smelter Building	Creek running down mountain. Evaluate groundwater for levels of total and dissolved metals.	Groundwater	1	Metals

Table 1 - Continued
Sampling and Analysis at the Original 23 Areas of Concern

Area	Description	Media Sampled	No. of Samples	Analyses
17. Below Two Middle Ponds	Part of the NPDES Discharge system for the facility. Evaluate groundwater for levels of total and dissolved metals.	Groundwater	1	Metals
18. Below Lower Pond	Part of the NPDES Discharge System for the facility. Evaluate groundwater for levels of total and dissolved metals.	Groundwater	1	Metals
19. Below AST Area	Area downgradient from Diesel fuel and Bunker-C ASTs. Evaluate groundwater for impacts from the ASTs.	Groundwater	1	TPH-D PAHs Metals
20. BPA Substation	Bonneville Power Administration substation including transformers and capacitors. *Potential releases of PCBs from electrical equipment.*	Soil Equipment Wipe	60 6	PCBs TPH-D 1,1,1-TCA PCBs
21. Below New Caledonia Ore Pile	Area downgradient from New Caledonia Ore Pile. Evaluate groundwater for levels of total and dissolved metals.	Groundwater	1	Metals
22. New Caledonia Ore Pile	Stockpile of New Caledonia Ore northwest of smelter building. Evaluate ore for levels of total and dissolved metals.	Ore	3	Nickel Chromium Manganese
23. Shotting Water Tank	Location of former water storage tank, added as AOC. Not in original Confirmation Sampling Plan. *Potential impact by hydrocarbons observed during site sampling activities.*	Soil	1	TPH-D PAHs VOCs

Notes:

AST – Aboveground Storage Tank
UST – Underground Storage Tank
TPH-D – Total Petroleum Hydrocarbons - Diesel Fuel
TPH-G – Total Petroleum Hydrocarbons – Gasoline
PAH – Polynuclear Aromatic Hydrocarbons
PCBs – Polychlorinated Biphenyls
BTEX – Benzene, Toluene, Ethylbenzene, Xylenes
VOCs – Volatile Organic Compounds

Table 3.1 Sanitary Sand Filter Beds
(Cleanup Confirmation Sample Results)

TABLE 3.1
SANITARY SAND FILTER BEDS (AOC-R-4)
CLEANUP CONFIRMATION SAMPLE RESULTS
Soil Samples Collected on 3/27/01

Sample #	Arsenic
CS-1	<0.40
CS-1D	<0.40
CS-2	<0.40
CS-2D	<0.12
CS-3	<0.40
CS-4	<0.40
CS-5	<0.40
CS-5D	<0.40
CS-6	<0.40
CS-6D	<0.40
CS-7	<0.40
CS-8	<0.40
CS-9	<0.40
CS-9D	<0.40
CS-10	<0.40
CS-10D	<0.40
CS-11	<0.40
CS-11D	4.1
CS-12	<0.40
CS-12D	<0.40
CS-13	<0.40
CS-14	<0.40
CS-15	<0.40
CS-16	<0.40

Arsenic analysis by ICP EPA Methods 200.7/6010B
Cleanup Level is naturally-occurring background level: 24.87 mg/Kg

These results triggered 25 mg/kg is not background!

Table 3.2 Granulation Ladle Tilt Station Hydraulic System (Cleanup Confirmation Sample Results)

TABLE 3.2
GRANULATION LADLE TILT STATION HYDRAULIC SYSTEM (AOC-R-5)
CLEANUP CONFIRMATION SAMPLE RESULTS
Soil Sample Collected on 8/30/00

Sample #	PAHs	Cleanup Level
4A	All <0.10	1.0

PAH analysis by EPA Method 8270; results in mg/Kg.
Cleanup Level per OAR 340-122-045 Appendix 1; 1.0 mg/Kg lowest Industrial cleanup level for PAHs.

Table 3.3 Lube Oil Storage Area
(Cleanup Confirmation Sample Results)

See Analysis/Lab Report for AOC-6 and 11/21/00 e-mail

TABLE 3.3
LUBE OIL STORAGE AREA (AOC-R-6)
CLEANUP CONFIRMATION SAMPLE RESULTS
Soil Samples Collected on 8/30/00

Sample #	TPH-Identification	Diesel-Heavy Oil	PAHs	Cleanup Level
AOC-6A	Diesel-Heavy Oil	1,250	Nt	1000 total/1.0
AOC-6B	None Detected	Nt	Nt	
HA-1 AOC-R-6	Nt ND	Nt	All <1.0	
HA-2 AOC-R-6	Nt ND	Nt	All <1.0	

TPH-Identification by NWTPH-HCID.
Diesel-Heavy Oil analysis by NWTPH-Dx; result in mg/Kg.
PAH analysis by EPA Method 8270; result in mg/Kg.
Cleanup Levels: 1000 mg/Kg diesel-heavy oil per OAR 340-122-335 Soil Matrix Cleanup Level 3.
1.0 mg/Kg lowest Industrial-cleanup level for PAHs, per OAR-340-122-045 Appendix 1.
(exceedances in boldface)

Table 3.4 Calciner Lube Oil Area
(Cleanup Confirmation Sample Results)

TABLE 3.4
CALCINER LUBE OIL AREA (AOC-R-8)
CLEANUP CONFIRMATION SAMPLE RESULTS
Soil Samples Collected on 9/19/01

Sample #	TPH		PAHs	Cleanup Level
	Diesel	Heavy Oil		
CS-1-South*	37	149	All <0.0081	1000 total/1.0
CS-2-East	38	<100	All <0.00935	
CS-3-North	<25	<100	All <0.0099	
CS-4-West	<25	<100	All <0.01445	

Diesel-Heavy Oil analysis by NWTPH-Dx; results in mg/Kg.
PAH analysis by EPA Method 8270; results in mg/Kg.
Cleanup Levels: 1000 mg/Kg total diesel-heavy oil per OAR 340-122-335 Soil Matrix Cleanup Level 3.
1.0 mg/Kg per OAR 340-122-045 Appendix 1; lowest industrial cleanup level for PAHs.
*Excavation limited due to proximity of facility structures; however, DEQ Soil Matrix Level 3 (1,000 mg/Kg) achieved.

Table 3.5A Diesel Fueling Station and Fuel Line Area
(Cleanup Confirmation Sample Results)

Table 3.5A
Confirmation Soil Sampling Results
Diesel Fueling Station and Fuel Line Area (AOC-R-10)

Soil Sample Number	Date Collected	PAHs																TPH		
		Acenaphthene	* Acenaphthylene	Anthracene	Benzo (a) Anthracene	Benzo (a) Pyrene	Benzo (b) Pyrene	* Benzo (ghi) Perylene	Benzo (k) Fluoranthene	Chrysene	Dibenzo (ah) Anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) Pyrene	Naphthalene	* Phenanthrene	Pyrene	Gas	Diesel	Heavy Oil
Cleanup Levels (all mg/Kg)		100,000	*	600,000	1	1	*	*	1	1	1	80,000	80,000	1	8,000	*	60,000	130	total 1,000	
CS-1	9/7/2000	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	ND
CS-2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	ND
CS-3		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	ND
CS-4		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	ND
CS-5		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	ND
CS-6		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	ND
CS-7		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	ND
CS-8		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	ND
CS-9		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	ND
CS-10		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	ND
CS-11		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	ND
CS-12		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	56.4
CS-13		<1.0	<1.0	<1.0	**5.1**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.2	<1.0	<1.0	<1.0	<1.0	ND	ND	543
CS-14		<1.0	<1.0	<1.0	**5.3**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	2.9	1.4	<1.0	<1.0	2.6	<1.0	ND	ND	603
CS-15		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	ND
CS-16		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	ND
CS-17	9/19/2000	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	ND
CS-18		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	ND
CS-19		<1.0	<1.0	4.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	2.7	1.1	<1.0	<1.0	2.9	1.9	ND	**1063**	
CS-20		<1.0	<1.0	4.8	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	<1.0	<1.0	3.0	<1.0	ND	**1155**	
CS-21		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	ND
CS-22		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	ND
CS-23		<1.0	1.0	4.4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	2.6	1.1	<1.0	<1.0	3.2	1.8	ND	516	
CS-24	9/20/2000	0.32	0.10	0.12	0.015	<0.02	<0.02	<0.02	<0.02	0.034	<0.03	0.038	0.51	<0.04	0.8	1.2	0.064	NT	**2200**	**<500**
CS-25		0.34	0.11	0.16	<0.005	<0.02	<0.02	<0.05	<0.02	0.028	<0.03	0.048	0.82	<0.04	0.55	1.4	0.069	NT	**2500**	**<500**
CS-26		0.40	0.16	0.18	0.009	<0.02	<0.02	<0.05	<0.02	0.024	<0.03	0.046	0.69	<0.04	0.61	1.6	0.073	NT	**3100**	**<1000**
CS-27		0.86	0.25	0.37	0.026	<0.02	<0.02	<0.05	<0.02	0.081	<0.03	0.092	2.2	<0.04	3.8	3.1	0.23	NT	**8300**	**<1000**
CS-28		0.68	0.29	0.24	0.013	<0.02	<0.02	<0.05	<0.02	0.040	<0.03	0.043	1.6	<0.04	2.3	2.5	0.15	NT	**6700**	**<1000**
CS-29		0.73	0.33	0.23	0.013	<0.02	<0.02	<0.05	<0.02	0.033	<0.03	0.080	1.9	<0.04	4.2	2.6	0.13	NT	**7200**	**<1000**
CS-30		0.44	0.19	0.18	<0.005	<0.02	<0.02	<0.05	<0.02	0.017	<0.03	0.034	1.1	<0.04	2.0	1.7	0.069	NT	**4300**	**<1000**
CS-31		0.51	0.22	0.21	0.008	<0.02	<0.02	<0.05	<0.02	0.028	<0.03	0.029	1.4	<0.04	2.4	1.9	0.090	NT	**5500**	**<1000**
CS-24A	9/27/2000	0.23	0.16	0.090	0.011	0.008	0.010	0.008	0.005	0.019	0.021	0.009	0.30	0.010	0.40	1.1	0.029	NT	**1700**	**160**
CS-24B		0.37	0.16	0.22	0.028	0.021	0.015	0.009	0.022	0.028	0.013	0.063	0.32	0.094	0.24	1.7	0.11	NT	**4900**	**<1000**
CS-25A		0.29	0.12	0.13	0.016	0.009	0.007	<0.005	0.009	0.027	<0.005	0.034	0.71	<0.005	0.51	1.2	0.073	NT	**1900**	**190**
CS-25B		0.51	0.18	0.19	0.024	0.006	0.006	<0.005	0.006	0.022	0.006	0.054	1.2	<0.005	2.8	1.6	0.10	NT	**2700**	**320**
CS-26A		0.42	0.22	0.21	0.010	<0.005	<0.005	<0.005	0.005	0.014	<0.005	0.059	1.2	<0.005	1.8	1.7	0.055	NT	**4300**	**<1000**
CS-27A		0.70	0.16	0.26	0.010	<0.005	<0.005	<0.005	<0.005	0.021	<0.005	0.046	2.2	<0.005	7.7	2.6	0.11	NT	**9800**	**<1000**

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Soil Sample Number	Date Collected	PAHs																TPH		
		Acenaphthene	Acenaphthylene	Anthracene	Benzo (a) Anthracene	Benzo (a) Pyrene	Benzo (b) Pyrene	Benzo (ghi) Perylene	Benzo (k) Fluoranthene	Chrysene	Dibenzo (ah) Anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) Pyrene	Naphthalene	Phenanthrene	Pyrene	Gas	Diesel	Heavy Oil
Cleanup Levels (all mg/Kg)		100,000	*	600,000	1	1	*	*	1	1	1	80,000	80,000	1	8,000	*	60,000	130	total 1,000	
CS-28A		0.59	0.26	0.23	0.008	<0.005	<0.005	<0.005	<0.005	0.009	<0.005	0.076	1.9	<0.005	5.7	2.1	0.069	NT	**7800**	**<1000**
CS-28B		0.58	0.23	0.24	0.009	<0.005	<0.005	<0.005	<0.005	0.009	<0.005	0.078	1.9	<0.005	5.3	2.1	0.069	NT	**7200**	**<1000**
CS-29A		0.52	0.08	0.19	0.074	<0.005	0.064	<0.005	0.006	0.12	<0.005	0.40	0.73	<0.005	0.090	0.90	0.34	NT	790	<100
CS-30A		0.37	0.13	0.17	0.009	<0.005	<0.005	<0.005	<0.005	0.012	<0.005	0.035	0.15	<0.005	0.76	1.7	0.051	NT	**2600**	**290**
CS-30B		0.36	0.15	0.14	<0.005	<0.005	<0.005	<0.005	<0.005	0.009	<0.005	0.014	1.1	<0.005	1.1	1.5	0.056	NT	**2200**	**200**
CS-32	10/10/00	<0.005	<0.005	<0.005	0.013	0.009	0.010	0.006	0.009	0.020	<0.005	0.036	<0.005	<0.005	<0.005	0.017	0.041	NT	<25	75
CS-33		0.018	<0.005	0.16	0.17	0.082	0.091	0.033	0.090	0.25	0.016	0.17	0.029	0.021	<0.005	0.14	0.14	NT	<25	<100
CS-34		<0.005	<0.005	0.006	<0.005	<0.005	<0.005	<0.005	0.008	<0.005	0.009	<0.005	<0.005	<0.005	0.005	0.014	0.007	NT	110	110
CS-35		<0.005	<0.005	0.008	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.011	<0.005	<0.005	0.006	0.009	0.008	NT	<25	<100
CS-36		0.24	0.008	7.5	0.65	0.79	0.41	0.43	0.74	**1.9**	0.2	1.4	0.84	0.34	0.022	2.8	1.1	NT	<25	<100
CS-37		<0.005	<0.005	0.13	0.046	0.042	0.048	0.037	0.038	0.057	0.013	0.12	0.008	0.027	0.022	0.085	0.11	NT	<25	<100
CS-38		0.007	<0.005	0.036	0.007	0.005	<0.005	<0.005	<0.005	0.010	<0.005	0.022	0.006	<0.005	<0.005	0.026	0.023	NT	<25	<100
CS-39		<0.005	<0.005	0.010	0.009	<0.005	<0.005	0.009	<0.005	0.021	<0.005	0.019	<0.005	<0.005	<0.005	0.031	0.027	NT	<25	<100
CS-40		0.010	0.008	0.038	0.010	<0.005	<0.005	<0.005	<0.005	0.014	<0.005	0.027	0.024	<0.005	<0.005	0.042	0.033	NT	180	<100
CS-41		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-42		0.014	0.015	0.042	0.006	0.012	0.010	0.013	0.017	0.025	0.008	0.017	0.012	0.009	0.020	0.036	0.018	NT	<25	<100
CS-43		0.14	0.026	0.067	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	<0.005	<0.005	0.15	<0.005	0.13	0.50	0.014	NT	**1600**	**160**
CS-44		<0.005	<0.005	0.017	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.011	0.006	NT	25	110
CS-45		<0.005	<0.005	0.028	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	0.097	0.005	NT	71	<100
CS-46		0.79	0.40	0.17	0.028	0.009	0.019	0.014	0.016	0.028	0.009	0.033	0.38	0.01	0.63	2.2	0.071	NT	**3600**	**430**
CS-47		0.23	0.066	0.082	<0.005	<0.005	<0.005	<0.005	<0.005	0.008	<0.005	0.009	0.056	<0.005	0.066	0.28	0.017	NT	**1000**	**140**
CS-48		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-49		0.12	0.032	0.069	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	0.33	<0.005	0.035	0.64	0.021	NT	720	120
CS-50		0.017	0.013	0.029	0.014	0.008	0.013	0.011	0.015	0.012	0.010	0.014	0.014	0.005	0.019	0.035	0.018	NT	<25	<100
CS-51		0.046	0.012	0.015	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.039	<0.005	0.005	0.14	0.005	NT	240	<100
CS-52		<0.005	<0.005	0.031	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.034	<0.005	NT	40	<100
CS-53		0.018	0.008	0.036	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	<0.005	0.018	0.066	<0.005	<0.005	0.14	0.013	NT	170	<100
CS-54		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-55		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-56		0.031	<0.005	0.030	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.013	0.12	<0.005	0.009	0.17	0.008	NT	240	<100
CS-57		0.28	0.040	0.106	0.010	<0.005	<0.005	<0.005	<0.005	0.013	<0.005	0.057	0.47	<0.005	0.028	0.90	0.056	NT	**1300**	**180**
CS-58		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-59		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-44D		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-60	10/26/2000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-60D		0.012	<0.005	0.007	0.009	<0.005	<0.005	<0.005	<0.005	0.008	<0.005	0.043	0.011	<0.005	0.009	0.025	0.054	NT	180	<100
CS-61		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	<0.005	0.022	<0.005	NT	<25	<100
CS-62		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	NT	<25	<100
CS-63		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	<0.005	NT	94	98
CS-63D		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100

(See Final Page for Notation Explanations)

Soil Sample Number	Date Collected	PAHs																TPH		
		Acenaphthene	Acenaphthylene	Anthracene	Benzo (a) Anthracene	Benzo (a) Pyrene	Benzo (b) Pyrene	Benzo (ghi) Perylene	Benzo (k) Fluoranthene	Chrysene	Dibenzo (ah) Anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) Pyrene	Naphthalene	Phenanthrene	Pyrene	Gas	Diesel	Heavy Oil
Cleanup Levels (all mg/Kg)		100,000	*	600,000	1	1	*	*	1	1	1	80,000	80,000	1	8,000	*	60,000	130	total 1,000	
CS-64		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-64D		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.014	<0.005	<0.005	0.066	0.005	NT	120	<100
CS-65		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.026	<0.005	NT	35	<100
CS-66		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-67		<0.005	<0.005	0.007	0.037	0.023	0.017	0.014	0.018	0.058	<0.005	0.18	<0.005	0.009	0.028	0.030	0.18	NT	570	390
CS-67D		<0.005	<0.005	<0.005	0.008	<0.005	<0.005	<0.005	<0.005	0.009	<0.005	0.022	<0.005	<0.005	0.005	0.007	0.032	NT	64	<100
CS-68		0.033	0.006	0.017	0.022	0.012	0.015	0.010	0.014	0.026	<0.005	0.078	0.073	0.005	0.021	0.19	0.081	NT	610	360
CS-68D		0.027	0.006	0.014	0.009	<0.005	0.005	<0.005	<0.005	0.010	<0.005	0.040	0.038	<0.005	0.007	0.095	0.043	NT	460	110
CS-69		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-70		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.008	<0.005	<0.005	0.038	0.020	NT	<25	<100
CS-71		0.012	0.017	0.041	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	0.007	0.13	<0.005	<0.005	0.48	0.028	NT	820	140
CS-71D		0.023	0.013	0.015	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.10	<0.005	<0.005	0.28	0.016	NT	650	120
CS-72		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.019	<0.005	NT	130	<100
CS-72D		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.008	<0.005	<0.005	0.009	<0.005	NT	<25	<100
CS-73		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.007	<0.005	NT	40	<100
CS-73D		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-74		<0.005	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.080	<0.005	NT	110	<100
CS-75		<0.005	<0.005	0.006	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	0.006	<0.005	<0.005	0.020	0.009	NT	170	<100
CS-75D		0.006	<0.005	0.007	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	<0.005	<0.005	0.036	<0.005	NT	50	<100
CS-76		<0.005	<0.005	0.008	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.007	<0.005	<0.005	0.066	<0.005	NT	70	<100
CS-77		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.009	<0.005	NT	25	<100
CS-78		0.017	0.021	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.037	<0.005	<0.005	0.17	0.008	NT	430	<100
CS-79		0.008	0.020	0.030	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.021	<0.005	<0.005	0.008	0.012	NT	750	<100
CS-79D		0.076	0.025	0.040	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.008	0.034	<0.005	0.024	0.14	0.016	NT	740	<100
CS-80		0.047	0.029	0.068	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	0.017	<0.005	0.007	0.40	0.013	NT	730	<100
CS-81		0.071	0.022	0.035	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.007	0.053	<0.005	0.046	0.29	0.010	NT	680	<100
CS-82		<0.005	<0.005	0.010	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.039	<0.005	NT	85	<100
CS-82D		0.053	0.041	0.057	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.06	0.034	<0.005	0.035	0.46	0.019	NT	**1200**	**120**
CS-83		0.067	0.19	0.12	0.015	<0.005	<0.005	<0.005	<0.005	0.017	<0.005	0.044	0.13	<0.005	0.31	2.1	0.074	NT	**5400**	**430**
CS-84		0.019	0.020	0.021	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	0.020	<0.005	0.024	0.29	0.008	NT	660	<100
CS-85		0.008	0.012	0.008	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.007	<0.005	0.007	0.042	0.010	NT	380	<100
CS-86		0.011	0.010	0.040	0.19	0.14	0.20	0.10	0.084	0.23	0.037	0.39	0.011	0.079	0.010	0.088	0.39	NT	420	160
CS-86D		0.014	0.013	0.037	0.085	0.059	0.084	0.042	0.063	0.097	0.02	0.23	0.014	0.031	0.013	0.090	0.21	NT	390	130
CS-87		<0.005	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.020	0.005	NT	64	<100
CS-88		<0.005	<0.005	<0.005	0.088	0.062	0.011	0.019	0.011	0.18	0.009	0.007	<0.005	0.010	<0.005	<0.005	0.075	NT	<25	<100
CS-89		0.017	0.030	0.088	0.25	0.18	0.17	0.13	0.12	0.36	0.045	0.68	0.036	0.091	0.011	0.12	0.68	NT	**1500**	**460**
CS-89D		<0.005	<0.005	<0.005	0.028	0.018	0.009	0.012	0.012	0.040	<0.005	0.040	<0.005	0.006	<0.005	0.011	0.086	NT	67	<100
CS-90		<0.005	<0.005	<0.005	0.012	0.009	0.012	<0.005	0.012	0.019	<0.005	0.059	0.013	<0.005	<0.005	0.013	0.064	NT	36	<100
CS-91	11/14/2000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-92		<0.005	<0.005	0.027	0.015	0.005	0.006	<0.005	0.006	0.017	<0.005	0.12	<0.005	<0.005	<0.005	0.10	0.088	NT	<25	<100

(See Final Page for Notation Explanations)

Soil Sample Number	Date Collected	PAHs																TPH		
		Acenaphthene	Acenaphthylene	Anthracene	Benzo (a) Anthracene	Benzo (a) Pyrene	Benzo (b) Pyrene	Benzo (ghi) Perylene	Benzo (k) Fluoranthene	Chrysene	Dibenzo (ah) Anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) Pyrene	Naphthalene	Phenanthrene	Pyrene	Gas	Diesel	Heavy Oil
Cleanup Levels (all mg/Kg)		100,000	*	600,000	1	1	*	*	1	1	1	80,000	80,000	1	8,000	*	60,000	130	total 1,000	
CS-93		0.059	0.014	0.022	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.26	0.012	NT	320	<100
CS-94		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	31	<100
CS-95		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-96		<0.005	<0.005	0.009	0.006	<0.005	<0.005	<0.005	<0.005	0.007	<0.005	0.042	<0.005	<0.005	<0.005	0.037	0.029	NT	<25	<100
CS-97		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-98		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-99		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-100		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-101		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-102		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-103		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	69	<100
CS-104		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	0.006	0.010	<0.005	NT	55	<100
CS-105		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-106		0.016	<0.005	0.033	0.025	0.10	0.031	0.012	0.029	0.027	0.006	0.048	0.007	0.013	<0.005	0.35	0.040	NT	430	<100
CS-107		<0.005	<0.005	<0.005	0.005	0.006	0.006	<0.005	<0.005	<0.005	<0.005	0.010	<0.005	<0.005	<0.005	<0.005	0.007	NT	<25	<100
CS-108		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-109		<0.005	<0.005	<0.005	0.013	<0.005	0.006	<0.005	<0.005	0.009	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	0.010	NT	<25	<100
CS-110		<0.005	<0.005	<0.005	0.014	<0.005	0.005	<0.005	<0.005	0.011	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.011	NT	<25	<100
CS-111		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-112		<0.005	<0.005	<0.005	0.006	<0.005	<0.005	<0.005	<0.005	0.006	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	NT	<25	<100
CS-113		<0.005	<0.005	<0.005	0.007	<0.005	<0.005	<0.005	<0.005	0.006	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	NT	<25	<100
CS-114		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-115		<0.005	<0.005	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-116		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-117		<0.005	<0.005	0.007	0.009	<0.005	0.008	<0.005	0.005	<0.005	<0.005	0.013	<0.005	<0.005	0.005	0.008	0.013	NT	<25	<100
CS-118		<0.005	<0.005	<0.005	0.013	0.006	0.008	<0.005	<0.005	0.009	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.011	NT	<25	<100
CS-119		<0.005	<0.005	<0.005	0.013	0.005	0.005	<0.005	<0.005	0.008	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.010	NT	<25	<100
CS-120		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-121		<0.005	<0.005	<0.005	0.007	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.007	NT	<25	<100
CS-122		<0.005	<0.005	0.006	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	<0.005	NT	<25	<100
CS-123		<0.005	<0.005	0.006	0.007	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.007	0.007	NT	<25	<100
CS-124		<0.005	<0.005	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	0.006	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	NT	<25	<100
CS-126	11/28/2000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-126D		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-127		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-127D		0.076	<0.005	0.068	0.032	0.010	0.015	0.005	0.017	0.054	<0.005	0.12	0.18	<0.005	<0.005	1.1	0.13	NT	**2000**	**1300**
CS-128		0.007	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.047	<0.005	<0.005	0.24	0.009	NT	<25	<100
CS-128D		0.007	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.047	<0.005	<0.005	0.24	0.009	NT	420	330
CS-129		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-129D		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100

(See Final Page for Notation Explanations)

Soil Sample Number	Date Collected	PAHs																TPH		
		Acenaphthene	Acenaphthylene	Anthracene	Benzo (a) Anthracene	Benzo (a) Pyrene	Benzo (b) Pyrene	Benzo (ghi) Perylene	Benzo (k) Fluoranthene	Chrysene	Dibenzo (ah) Anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) Pyrene	Naphthalene	Phenanthrene	Pyrene	Gas	Diesel	Heavy Oil
Cleanup Levels (all mg/Kg)		100,000	*	600,000	1	1	*	*	1	1	1	80,000	80,000	1	8,000	*	60,000	130	total 1,000	
CS-130		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-130D		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-131		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-132		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-133		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-134		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-125	11/29/2000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-134D	10/13/2000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.008	0.006	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	NT	<25	<100
CS-135D		<0.005	<0.005	0.007	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.05	0.007	NT	66	<100
CS-136D	1/11/2001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-137D		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	53	<100
CS-138		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	340	300
CS-139		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-140		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	44	140
CS-141		0.011	0.011	0.11	0.025	0.033	0.013	0.023	0.020	0.043	<0.005	0.083	0.032	0.014	0.020	0.094	0.12	NT	140	160
CS-142		<0.005	<0.005	<0.005	0.0086	<0.005	<0.005	0.0098	<0.005	0.014	<0.005	0.038	0.022	<0.005	<0.005	0.050	0.030	NT	**320**	**740**
CS-143		0.14	<0.005	1.2	0.35	0.065	<0.005	1.1	<0.005	1.1	0.31	0.22	0.22	1	0.12	0.12	1.6	NT	**16,000**	**38,500**
CS-144		<0.005	<0.005	<0.005	<0.005	<0.005	0.0054	<0.005	0.0074	<0.005	<0.005	0.014	0.0057	<0.005	<0.005	0.017	0.012	NT	75	210
CS-145		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.012	<0.005	NT	54	220
CS-146		0.0083	<0.005	<0.005	0.0074	<0.005	0.0060	<0.005	<0.005	0.0061	<0.005	0.027	0.014	<0.005	<0.005	0.029	0.025	NT	86	240
CS-147		0.024	0.059	0.019	0.071	0.055	0.12	0.12	0.086	0.12	0.045	0.32	0.13	0.11	0.046	0.19	0.38	NT	**4600**	**2200**
CS-148		0.011	<0.005	<0.005	0.012	0.009	0.010	0.019	0.015	0.014	0.011	0.036	0.016	0.012	<0.005	0.020	0.029	NT	<25	<100
CS-150	1/24/2001	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.059	<0.05	<0.05	<0.05	0.035	<0.05	NT	400	110
CS-152		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	41	<100
CS-153		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	220	120
CS-154		0.08	<0.05	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.07	0.26	<0.05	<0.05	0.54	0.06	NT	340	670
CS-155		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-156		0.21	<0.05	0.19	0.07	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.37	0.35	<0.05	<0.05	1.2	0.24	NT	660	210
CS-157		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	0.05	<0.05	<0.05	0.13	<0.05	NT	87	<100
CS-158		0.40	<0.05	0.30	0.12	0.06	<0.05	<0.05	0.05	0.16	<0.05	0.67	0.82	<0.05	0.05	3.0	0.51	NT	**1400**	**610**
CS-159		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.08	<0.05	<0.05	<0.05	0.13	0.08	NT	54	<100
CS-160		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-161		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-162		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-163		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-164		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	68	110
CS-165		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-166		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-167		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-168		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100

(See Final Page for Notation Explanations)

Soil Sample Number	Date Collected	PAHs																TPH		
		Acenaphthene	Acenaphthylene	Anthracene	Benzo (a) Anthracene	Benzo (a) Pyrene	Benzo (b) Pyrene	Benzo (ghi) Perylene	Benzo (k) Fluoranthene	Chrysene	Dibenzo (ah) Anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) Pyrene	Naphthalene	Phenanthrene	Pyrene	Gas	Diesel	Heavy Oil
Cleanup Levels (all mg/Kg)		100,000	*	600,000	1	1	*	*	1	1	1	80,000	80,000	1	8,000	*	60,000	130	total 1,000	
CS-169		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-170		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-171		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-172		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	58	<100
CS-173		<0.05	<0.05	0.32	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.11	0.06	<0.05	<0.05	<0.05	0.11	NT	210	200
CS-176		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-177		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-178		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-179		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-180		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-181		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-174	1/24/2001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	NT	<25	230
CS-175		<0.01	<0.01	<0.01	<0.01	<0.04	<0.04	<0.1	<0.04	<0.01	<0.06	0.028	0.026	<0.08	<0.01	0.033	0.026	NT	81	120
CS-182	2/7/2001	<0.012	<0.012	<0.012	<0.012	<0.047	<0.047	<0.12	<0.047	<0.012	<0.071	<0.012	<0.012	<0.095	<0.012	<0.012	<0.012	NT	96	290
CS-182D		<0.016	<0.016	<0.016	<0.016	<0.016	<0.062	<0.062	<0.16	<0.062	<0.016	<0.093	<0.016	<0.12	<0.016	<0.016	<0.016	NT	27	110
CS-186		<0.015	<0.015	<0.015	<0.015	<0.059	<0.059	<0.15	<0.059	<0.015	<0.088	<0.015	<0.015	<0.12	<0.015	<0.015	<0.015	NT	<25	<100
CS-186D		<0.026	<0.026	<0.026	<0.026	<0.10	<0.10	<0.26	<0.10	<0.026	<0.16	<0.026	<0.026	<0.21	<0.026	<0.026	<0.026	NT	<25	<100
CS-183		<0.013	<0.013	<0.013	<0.013	<0.051	<0.051	<0.13	<0.051	<0.013	<0.076	0.016	<0.013	<0.10	<0.013	0.025	<0.013	NT	<25	<100
CS-184		<0.012	<0.012	<0.012	<0.012	<0.05	<0.05	<0.12	<0.05	<0.012	0.075	<0.012	<0.012	<0.10	<0.012	<0.012	<0.012	NT	<25	<100
CS-185		<0.0097	<0.0097	<0.0097	<0.0097	<0.039	<0.039	<0.097	<0.039	<0.0097	<0.058	<0.0097	<0.0097	<0.078	<0.0097	<0.0097	<0.0097	NT	<25	<100
CS-185D		<0.012	<0.012	<0.012	<0.012	<0.046	<0.046	<0.12	<0.046	<0.012	<0.069	<0.012	<0.012	<0.092	<0.012	<0.012	<0.012	NT	<25	<100
CS-187		<0.017	<0.017	<0.017	<0.017	<0.068	<0.068	<0.17	<0.068	<0.017	<0.10	<0.017	<0.017	<0.14	<0.017	<0.017	<0.017	NT	<25	<100
CS-188		<0.02	<0.02	<0.02	<0.02	<0.08	<0.08	<0.2	<0.08	<0.02	<0.12	<0.02	<0.02	<0.16	<0.02	<0.02	<0.02	NT	<25	<100
CS-189		<0.014	<0.014	<0.014	<0.014	<0.056	<0.056	<0.14	<0.056	<0.014	<0.084	<0.014	<0.014	<0.11	<0.014	<0.014	<0.014	NT	<25	<100
CS-189D		<0.014	<0.014	<0.014	<0.014	<0.058	<0.058	<0.14	<0.058	<0.014	<0.087	<0.014	<0.014	<0.12	<0.014	<0.014	<0.014	NT	<25	<100
CS-138A		<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	NT	<25	<100
CS-144A		<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	NT	<25	<100
CS-144AD		<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	NT	<25	<100
CS-142A		<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	NT	84	240
CS-147A		0.031	<0.025	0.093	0.48	0.59	0.72	0.41	0.67	0.53	0.11	0.58	0.10	0.31	<0.025	0.12	0.47	NT	**2100**	**8700**
CS-147AD		<0.025	<0.025	<0.025	0.047	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	NT	56	300
CS-141A		<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	NT	<25	<100
CS-140A		<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	NT	<25	<100
CS-143A		<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	NT	<25	120
CS-143AD		<0.025	<0.025	<0.025	0.075	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	NT	27	170
CS-145A		<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	NT	<25	<100
CS-145AD		<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	NT	<25	<100
CS-146A		<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	NT	<25	<100
CS-146AD		<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.039	<0.025	<0.025	<0.025	<0.025	<0.025	NT	<25	<100
CS-190		<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	NT	<25	<100

(See Final Page for Notation Explanations)

Soil Sample Number	Date Collected	PAHs																TPH		
		Acenaphthene	Acenaphthylene	Anthracene	Benzo (a) Anthracene	Benzo (a) Pyrene	Benzo (b) Pyrene	Benzo (ghi) Perylene	Benzo (k) Fluoranthene	Chrysene	Dibenzo (ah) Anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) Pyrene	Naphthalene	Phenanthrene	Pyrene	Gas	Diesel	Heavy Oil
Cleanup Levels (all mg/Kg)		100,000	*	600,000	1	1	*	*	1	1	1	80,000	80,000	1	8,000	*	60,000	130	total 1,000	
CS-190D		<0.025	<0.025	0.046	0.16	0.057	0.27	0.091	0.031	0.026	<0.025	0.028	0.062	0.071	<0.025	<0.025	0.21	NT	**3500**	**11,000**
CS-143BD	3/6/2001	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-147B		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-147BD		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-142B		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	99	274
CS-191A		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-191AD		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-192		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-193		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-194		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-195		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	114	<100
CS-196		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-197		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-198		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-199		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	102	346
CS-200		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-201		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	38	<100
CS-202		0.056	0.027	0.179	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.047	0.197	<0.05	<0.05	0.346	0.136	NT	**1600**	**450**
CS-203		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-204		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-205		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-206		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.069	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-207		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-208		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-209		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-210		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	280	<100
CS-211		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	287	<100
CS-212		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	296	<100
CS-213		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	195	<100
CS-214		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	52	<100
CS-215		<0.05	0.13	0.15	0.052	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.056	0.33	NT	**8180**	**301**
CS-216		0.83	0.20	7.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.058	0.19	<0.05	0.68	8.0	0.78	NT	**7578**	**111**
CS-217	3/7/2001	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-218		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	28	<100
CS-219		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-142C	3/28/2001	0.028	<0.005	0.096	0.027	0.040	0.024	0.013	0.024	0.017	0.013	0.027	0.071	0.016	0.032	0.11	0.033	NT	**820**	**1300**
CS-195B		<0.005	<0.005	0.037	0.030	0.020	0.020	0.021	0.029	0.023	0.026	<0.005	<0.005	0.019	0.049	0.024	<0.005	NT	29	<100
CS-199B		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-202B		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
CS-220		<0.005	<0.005	0.064	<0.005	0.039	<0.005	<0.005	<0.005	<0.005	<0.005	0.10	<0.005	<0.005	<0.005	<0.005	0.074	NT	300	310

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Soil Sample Number	Date Collected	PAHs																TPH		
		Acenaphthene	Acenaphthylene	Anthracene	Benzo (a) Anthracene	Benzo (a) Pyrene	Benzo (b) Pyrene	Benzo (ghi) Perylene	Benzo (k) Fluoranthene	Chrysene	Dibenzo (ah) Anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) Pyrene	Naphthalene	Phenanthrene	Pyrene	Gas	Diesel	Heavy Oil
Cleanup Levels (all mg/Kg)		100,000	*	600,000	1	1	*	*	1	1	1	80,000	80,000	1	8,000	*	60,000	130	total 1,000	
CS-210A		<0.005	<0.005	0.11	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.15	<0.005	NT	110	<100
CS-NRR-1	6/12/2001	<.000012	<.000012	<.000012	<.000012	<.00005	<.00005	<.00012	<.00005	<.000012	<.00007	<.00012	<.000012	<.000098	<.00012	<.000012	<.000012	NT	<25	109
CS-NRR-2		<.00002	<.00002	<.00002	<.00002	<.00006	<.00006	<.0002	<.00006	<.00002	<.0001	<.00002	<.00002	<.00012	<.00002	<.00002	<.00002	NT	<25	<100
CS-NRR-3		<.00002	<.00002	<.00002	<.00002	<.00009	<.00009	<.00023	<.00009	<.00002	<.00013	<.00002	<.00002	<.0002	<.00002	<.00002	<.00002	NT	44	<100
CS-NRR-4		<.00006	<.00006	<.00006	<.00006	<.00022	<.00022	<.0006	<.00022	<.00006	<.00033	<.00006	<.00006	<.00044	<.00006	<.00006	<.00006	NT	<25	<100
CS-NRR-5		<.00002	<.00002	<.00002	<.00002	<.00008	<.00008	<.0002	<.00008	<.00002	<.00012	<.00002	<.00002	<.0002	<.00002	<.00002	<.00002	NT	<25	<100
CS-NRR-6		<.00001	<.00001	<.00001	<.00001	<.00006	<.00006	<.00014	<.00006	<.00001	<.00008	<.00001	<.00001	<.00011	<.00001	<.00001	<.00001	NT	<25	<100
CS-NRR-7		<.00001	<.00001	<.00001	<.00001	<.00006	<.00006	<.00014	<.00006	<.00001	<.00009	<.00001	<.00001	<.00011	<.00001	<.00001	<.00001	NT	<25	<100
CS-NRR-8		<.00001	<.00001	<.00001	<.00001	<.00005	<.00005	<.00012	<.00005	<.00001	<.00007	<.00001	<.00001	<.00009	<.00001	<.00001	<.00001	NT	**1100**	**<100**
CS-NRR-9		<.00001	<.00001	<.00001	<.00001	<.00006	<.00006	<.00014	<.00006	<.00001	<.00009	<.00001	<.00001	<.00012	<.00001	<.00001	<.00001	NT	<25	<100
CS-NRR-10		<.000005	<.000005	<.000005	<.000005	<.00002	<.00002	<.00005	<.00002	<.000005	<.00003	<.000005	<.000005	<.00004	<.000005	<.000005	<.000005	NT	<25	<100
CS-NRR-11		<.00002	<.00002	<.00002	<.00002	<.00006	<.00006	<.00016	<.00006	<.00002	<.00009	<.00002	<.00002	<.00013	<.00002	<.00002	<.00002	NT	<25	133
CS-NRR-12		<.00002	<.00002	<.00002	<.00002	<.00009	<.00009	<.00021	<.00009	<.00002	<.00013	<.00002	<.00002	<.00017	<.00002	<.00002	<.00002	NT	650	<100
CS-NRR-13		<.00002	<.00002	<.00002	<.00002	<.00006	<.00006	<.00016	<.00006	<.00002	<.00009	<.00002	<.00002	<.00012	<.00002	<.00002	<.00002	NT	<25	<100
CS-NRR-14		<.00002	<.00002	<.00002	<.00002	<.00008	<.00008	<.0002	<.00008	<.00002	<.00012	<.00002	<.00002	<.00017	<.00002	<.00002	<.00002	NT	<25	<100
CS-NRR-15		<.00002	<.00002	<.00002	<.00002	<.00009	<.00009	<.00024	<.00009	<.00002	<.00014	<.00002	<.00002	<.00019	<.00002	<.00002	<.00002	NT	<25	<100
CS-NRR-16		<.00001	<.00001	<.00001	<.00001	<.00004	<.00004	<.00011	<.00004	<.00001	<.00007	<.00001	<.00001	<.00008	<.00001	<.00001	<.00001	NT	<25	<100
CS-NRR-17		<.00002	<.00002	<.00002	<.00002	<.00009	<.00009	<.00024	<.00009	<.00002	<.00014	<.00002	<.00002	<.0002	<.00002	<.00002	<.00002	NT	<25	<100
CS-NRR-18		<.00003	<.00003	<.00003	<.00003	<.00013	<.00013	<.00034	<.00013	<.00003	<.0002	<.00003	<.00003	<.00027	<.00003	<.00003	<.00003	NT	<25	<100
CS-NRR-19		<.00002	<.00002	<.00002	<.00002	<.00007	<.00007	<.00017	<.00007	<.00002	<.0001	<.00002	<.00002	<.00014	<.00002	<.00002	<.00002	NT	<25	<100
CS-NRR-20		<.00002	<.00002	<.00002	<.00002	<.00007	<.00007	<.0002	<.00007	<.00002	<.00012	<.00002	<.00002	<.00015	<.00002	<.00002	<.00002	NT	<25	<100
CS-NRR-21		<.00003	<.00003	<.00003	<.00003	<.00011	<.00011	<.0003	<.00011	<.00003	<.00016	<.00003	<.00003	<.00022	<.00003	<.00003	<.00003	NT	<25	<100
CS-NRR-22		<.00002	<.00002	<.00002	<.00002	<.00007	<.00007	<.00018	<.00007	<.00002	<.00011	<.00002	<.00002	<.00015	<.00002	<.00002	<.00002	NT	<25	<100
CS-NRR-23		<.00001	<.00001	<.00001	<.00001	<.00005	<.00005	<.00012	<.00005	<.00001	<.00007	<.00001	<.00001	<.00009	<.00001	<.00001	<.00001	NT	106	<100
CS-NRR-24		0.315	0.691	1.366	<.00002	<.00008	<.00008	<.0002	<.00008	<.00002	<.00012	0.041	0.231	<.00016	0.104	1.771	0.061	NT	**2200**	**<100**
CS-NRR-25		0.029	0.065	0.273	<.00002	<.00009	<.00009	<.00024	<.00009	<.00002	<.00014	<.00002	0.226	<.00019	<.00002	0.092	<.00002	NT	640	<100
CS-NRR-26		<.00001	<.00001	<.00001	<.00001	<.00004	<.00004	<.00011	<.00005	<.00001	<.00007	<.00001	<.00001	<.00009	<.00001	<.00001	<.00001	NT	<25	<100
CS-NRR-27		<.00002	<.00002	<.00002	<.00002	<.00009	<.00009	<.00023	<.00009	<.00002	<.00013	<.00002	<.00002	<.0002	<.00002	<.00002	<.00002	NT	40	<100
CS-NRR-28		0.303	0.537	0.817	<.00001	<.00006	<.00006	<.00016	<.00006	<.00002	<.00010	<.00002	0.319	<.00013	0.083	1.554	0.065	NT	**2800**	**<100**
CS-NRR-29		0.372	0.232	1.024	<.00003	<.00011	<.00011	<.0003	<.00011	<.00003	<.00017	<.00003	0.639	<.00023	0.788	1.326	0.034	NT	**2200**	**<100**
CS-NRR-30		<.00002	<.00002	0.040	<.00002	<.00008	<.00008	<.0002	<.00008	<.00002	<.00012	<.00002	<.00002	<.00016	<.00002	<.00002	<.00002	NT	270	<100
CS-NRR-31		<.00002	<.00002	<.00002	<.00002	<.00007	<.00007	<.0002	<.00007	<.00002	<.00011	<.00002	<.00002	<.00015	<.00002	<.00002	<.00002	NT	<25	<100
CS-NRR-32		<.00002	<.00002	<.00002	<.00002	<.00007	<.00007	<.00012	<.00007	<.00002	<.0001	<.00002	<.00002	<.00014	<.00002	<.00002	<.00002	NT	<25	<100
CS-NRR-33		<.00002	<.00002	<.00002	<.00002	<.0007	<.0007	<.00017	<.00007	<.00002	<.0001	<.00002	<.00002	<.00013	<.00002	<.00002	<.00002	NT	<25	<100
CS-NRR034		<.00003	<.00003	<.00003	<.00003	<.0001	<.0001	<.00003	<.0001	<.00003	<.0002	<.00003	<.00003	<.0003	<.00003	<.00003	<.00003	NT	<25	<100
CS-NRR-35		<.00003	<.00003	<.00003	<.00003	<.00013	<.00013	<.0003	<.00013	<.00003	<.00019	<.00003	<.00003	0.00026	<.00003	<.00003	<.00003	NT	<25	<100
CS-NRR-36		<.00002	<.00002	<.00002	<.00002	<.00007	<.00007	<.00019	<.00007	<.00002	<.00011	<.00002	<.00002	<.00015	<.00002	<.00002	<.00002	NT	NT	<100
CS-NRR-37		<.00002	<.00002	<.00002	<.00002	<.00007	<.00007	<.00002	<.00007	<.00002	<.0001	<.00002	<.00002	<.00014	<.00002	<.00002	<.00002	NT	<25	<100
CS-NRR-38		<.00002	<.00002	<.00002	<.00002	<.00008	<.00008	<.00002	<.00008	<.00002	<.00012	<.00002	<.00002	<.00016	<.00002	<.00002	<.00002	NT	86	<100
CS-NNR-39		<.00003	<.00003	<.00003	<.00003	<.00012	<.00012	<.0003	<.00012	<.00003	<.0002	<.00003	<.00003	<.00024	<.00003	<.00003	<.00003	NT	<25	150

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Soil Sample Number	Date Collected	PAHs																TPH		
		Acenaphthene	Acenaphthylene	Anthracene	Benzo (a) Anthracene	Benzo (a) Pyrene	Benzo (b) Pyrene	Benzo (ghi) Perylene	Benzo (k) Fluoranthene	Chrysene	Dibenzo (ah) Anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) Pyrene	Naphthalene	Phenanthrene	Pyrene	Gas	Diesel	Heavy Oil
Cleanup Levels (all mg/Kg)		100,000	*	600,000	1	1	*	*	1	1	1	80,000	80,000	1	8,000	*	60,000	130	total 1,000	
CS-NRR-40		<.00002	<.00002	<.00002	<.00002	<.00008	<.00008	<.00002	<.00008	<.00002	<.00012	<.00002	<.00002	<.00017	<.00002	<.00002	<.00002	NT	<25	<100
CS-NRR-41		<.00002	<.00002	<.00002	<.00002	<.00007	<.00007	<.00019	<.00007	<.00002	<.00011	<.00002	<.00002	<.00014	<.00002	<.00002	<.00002	NT	<25	<100
CS-NRR-42	7/16/2001	<0.03	<0.03	0.09	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	NT	<25	<100
CS-NRR-43		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	NT	<25	<100
CS-NRR-44		<0.03	<0.03	0.07	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	NT	<25	<100
CS-NRR-45		<0.03	<0.03	0.38	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.17	<0.03	NT	144	<100
CS-NRR-46		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	NT	<25	<100
CS-NRR-47		1.55	0.59	5.50	0.14	0.10	0.05	0.05	0.05	0.15	<0.03	0.14	3.04	<0.03	1.44	3.99	0.41	NT	**7800**	**<100**
CS-NRR-48		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.04	<0.03	NT	<25	<100
CS-NRR-49		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	NT	<25	<100
CS-NRR-50	8/21/2001	<.00001	<.00001	<.00001	<.00001	<.00004	<.00004	<.00013	<.00004	<.00001	<.00007	<.00001	<.00001	<.00009	<.00001	<.00001	<.00001	NT	<25	<100
CS-NRR-51		<.00001	<.00001	<.00001	<.00001	<.00005	<.00005	<.00013	<.00005	<.00001	<.00007	<.00001	0.020	<.00013	<.00001	0.035	<.00001	NT	77	<100
CS-NRR-52		<.00002	<.00002	<.00002	<.00002	<.00006	<.00006	<.00019	<.00006	<.00002	<.00009	<.00002	0.0144	<.00013	<.00002	0.0559	0.0156	NT	350	<100
CS-NRR-53		<.00002	<.00002	<.00002	<.00002	<.00006	<.00006	<.00019	<.00006	<.00002	<.00012	<.00002	<.00002	<.00012	<.00002	<.00002	<.00002	NT	52	<100
CS-NRR-54		<.00002	<.00002	<.00002	<.00002	<.0007	<.0007	<.00017	<.00007	<.00002	<.0001	<.00002	<.00002	0.0013	<.00002	<.00002	<.00002	NT	<25	<100
CS-NRR-55		<.00002	<.00002	<.00002	<.00002	<.00008	<.00008	<.00019	<.00008	<.00002	<.00012	<.00002	<.00002	<.00016	<.00002	<.00002	<.00002	NT	220	<100
CS-NRR-56		<.00003	<.00003	<.00003	<.00003	<.00014	<.00014	<.00034	<.00014	<.00003	<.0002	<.00003	<.00003	<.00027	<.00003	<.00003	<.00003	NT	<25	<100
CS-NRR-57		<.00003	<.00003	<.00003	<.00003	<.00014	<.00014	<.00034	<.00014	<.00003	<.0002	<.00003	<.00003	<.00027	<.00003	<.00003	<.00003	NT	<25	<100
CS-NRR-58		<.00002	<.00002	<.00002	<.00002	<.00007	<.00007	<.00019	<.00007	<.00002	<.00011	<.00002	<.00002	<.00015	<.00002	<.00002	<.00002	NT	<25	<100
CS-NRR-59		<.00004	<.00004	<.00004	<.00004	<.00014	<.00014	<.00035	<.00014	<.00004	<.00021	<.00004	<.00004	<.00028	<.00004	<.00004	<.00004	NT	<25	<100
CS-NRR-60		<.00001	<.00001	<.00001	<.00001	<.00004	<.00004	<.0001	<.00004	<.00001	<.00007	<.00001	<.00001	<.00009	<.00001	<.00001	<.00001	NT	<25	<100
CS-NRR-61		<.00002	<.00002	<.00002	<.00002	<.00007	<.00007	<.00018	<.00007	<.00002	<.00011	<.00002	<.00002	<.00014	<.00002	<.00002	<.00002	NT	<25	<100
CS-NRR-62		<.00002	<.00002	<.00002	<.00002	<.00009	<.00009	<.00023	<.00009	<.00002	<.00014	<.00002	<.00002	<.00018	<.00002	<.00002	<.00002	NT	<25	<100
CS-NNR-63		0.076	0.032	0.252	<.00002	<.00007	<.00007	<.00017	<.00007	<.00002	<.0001	0.015	0.059	<.00014	0.139	1.420	0.046	NT	**1200**	**<100**
CS-NRR-64		<.00005	<.00005	<.00005	<.00005	<.0002	<.0002	<.0005	<.0002	<.00005	<.0003	<.00005	<.00005	<.0004	<.00005	<.00005	<.00005	NT	<25	<100
CS-NRR-65		<.00003	<.00003	<.00003	<.00003	<.00013	<.00013	<.00032	<.00013	<.00003	<.00019	<.00003	<.00003	<.00026	<.00003	<.00003	<.00003	NT	135	<100
CS-NRR-66	9/19/2001	<0.0176	<0.0176	<0.0176	<0.0176	<0.0176	<0.0176	<0.0176	<0.0176	<0.0176	<0.0176	<0.0176	<0.0176	<0.0176	<0.0176	0.019	<0.0176	NT	<25	<100
CS-NRR-67		<.01445	<.01445	<.01445	<.01445	<.01445	<.01445	<.01445	<.01445	<.01445	<.01445	<.01445	<.01445	<.01445	<.01445	<.01445	<.01445	NT	<25	<100
CS-NRR-68		<0.0042	<0.0042	<0.0042	<0.0042	<0.0042	<0.0042	<0.0042	<0.0042	<0.0042	<0.0042	<0.0042	0.007	<0.0042	<0.0042	0.013	<0.0042	NT	58.9	<100
CS-NRR-69		<.00595	0.010	<.00595	<.00595	<.00595	<.00595	<.00595	<.00595	<.00595	<.00595	<.00595	0.017	<.00595	0.013	0.014	0.007	NT	185	<100
CS-NRR-70		<.00505	<.00505	<.00505	<.00505	<.00505	<.00505	<.00505	<.00505	<.00505	<.00505	<.00505	<.00505	<.00506	0.011	<.00505	<.00505	NT	<25	<100
CS-NRR-71		<.00595	<.00595	<.00595	<.00595	<.00595	<.00595	<.00595	<.00595	<.00595	<.00595	<.00595	<.00595	<.00595	<.00595	<.00595	<.00595	NT	<25	<100
CS-NRR-72		<.00685	<.00685	<.00685	<.00685	<.00685	<.00685	<.00685	<.00685	<.00685	<.00685	<.00685	<.00685	<.00685	<.00685	0.008	<.00685	NT	31	<100
CS-NRR-73		<.00555	<.00555	<.00555	<.00555	<.00555	<.00555	<.00555	<.00555	<.00555	<.00555	<.00555	<.00555	<.00555	<.00555	<.00555	<.00555	NT	<25	<100
CS-NRR-74		<0.005	<0.005	0.026	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.015	0.219	<0.005	NT	171	<100
CS-NRR-75		<.00605	<.00605	<.00605	<.00605	<.00605	<.00605	<.00605	<.00605	<.00605	0.007	<.00605	<.00605	<.00605	<.00605	<.00605	<.00605	NT	<25	<100
CS-NRR-76		<.01105	<.01105	<.01105	<.01105	<.01105	<.01105	<.01105	<.01105	<.01105	<.01105	<.01105	<.01105	<.01105	<.01105	<.01105	<.01105	NT	<25	<100
CS-NRR077		<0.0107	<0.0107	<0.0107	<0.0107	<0.0107	<0.0107	<0.0107	<0.0107	<0.0107	<0.0107	<0.0107	<0.0107	<0.0107	<0.0107	<0.0107	<0.0107	NT	<25	<100
CS-NRR-78		<.00775	<.00775	<.00775	<.00775	<.00775	<.00775	<.00775	<.00775	<.00775	<.00775	<.00775	<.00775	<.00775	<.00775	<.00775	<.00775	NT	<25	<100
CS-NRR-79		<0.00675	<.00105	<.00105	<.00105	<.00105	<.00105	<.00105	<.00105	<.00105	<.00105	<.00105	<.00105	<.00105	<.00105	<.00105	<.00105	NT	<25	<100

(See Final Page for Notation Explanations)

Soil Sample Number	Date Collected	PAHs																TPH		
		Acenaphthene	Acenaphthylene	Anthracene	Benzo (a) Anthracene	Benzo (a) Pyrene	Benzo (b) Pyrene	Benzo (ghi) Perylene	Benzo (k) Fluoranthene	Chrysene	Dibenzo (ah) Anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) Pyrene	Naphthalene	Phenanthrene	Pyrene	Gas	Diesel	Heavy Oil
Cleanup Levels (all mg/Kg)		100,000	*	600,000	1	1	*	*	1	1	1	80,000	80,000	1	8,000	*	60,000	130	total 1,000	
CS-NRR-80		<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	0.009	<0.0055	<0.0055	NT	25.3	<100
PAH analysis by EPA Method 8270M (SIM); results in mg/Kg.																				
Diesel/Heavy Oil analysis by NWTPH-Dx; results in mg/Kg.																				
Cleanup Levels: PAHs per OAR 340-122-045 Appendix 1, lowest Industrial cleanup level for PAHs; Diesel/heavy oil per OAR 340-122-335 Soil Matrixl Cleanup Level 3																				
ND - None Detected																				
NT - Not Tested																				
BOLD print indicates levels exceeding DEQ/EPA Cleanup levels																				
* - These compounds, no cleanup level established in OAR 340-122-045 Appendix1; nor in "Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites",																				
Oregon DEQ September 1999, Appendix A; nor in EPA Region 9 Preliminary Remediation Goals																				

(See Final Page for Notation Explanations)

Table 3.5B Diesel Fueling Station and Fuel Line Area
(BTEX Analysis of Sample CS-27)

TABLE 3.5B
DIESEL FUELING STATION AND FUEL LINE AREA (AOC-R-10)
BTEX Analysis of Sample CS-27

Analyte	Detected Level	Cleanup Level
Benzene	0.002	2
Ethylbenzene	0.084	20,000
Toluene	0.17	6,000
Meta- & Para-Xylene	0.10	2,500
Ortho-Xylene	0.20	

See Table 3.5A for PAHs and Diesel-Heavy Oil analyses.
Analysis by EPA Method 8260; results in mg/Kg.
Cleanup Levels per OAR-340-122-045 Appendix 1, Industrial.

Table 3.5C Diesel Fueling Station and Fuel Line Area
(PCBs Analysis of Sample CS-182)

TABLE 3.5C
DIESEL FUELING STATION AND FUEL LINE AREA (AOC-R-10)
PCBs Analysis of Sample GS-182

Analyte	Detected Level	Cleanup Level
PCB-1016	All <0.5	All <0.7
PCB-1221		
PCB-1232		
PCB-1242		
PCB-1248		
PCB-1254		
PCB-1260		

See Table 3.5A for PAHs and Diesel-Heavy Oil analyses.
Analysis by EPA Method 8082; results in mg/Kg.
Cleanup Levels per OAR-340-122-045 Appendix 1, Industrial; in mg/Kg.

Table 3.5D Diesel Fueling Station and Fuel Line Area
(Soil Stockpile Sample #3 Results)

TABLE 3.5D
DIESEL FUELING STATION AND FUEL LINE AREA (AOC-R-10)
Soil Stockpile Sample #3 Results
Sample Collected on 9/28/00

Analyte	Detected Level
BTEX	
Benzene	0.010
Ethylbenzene	0.021
Toluene	0.17
Meta- & Para-Xylene	0.060
Ortho-Xylene	0.027
Diesel	15,000
Heavy Oil	4,500
PAHs	
Acenaphthene	2.8
Acenaphthylene	0.43
Anthracene	1.1
Benzo(a)anthracene	0.41
Benzo(a)pyrene	0.17
Benzo(b)fluoranthene	0.18
Benzo(ghi)perylene	0.12
Benzo(k)fluoranthene	0.18
Chrysene	0.62
Dibenzo(ah)anthracene	0.057
Fluoranthene	2.2
Fluorene	3.0
Indeno(123cd)pyrene	0.071
Naphthalene	0.49
Phenanthrene	4.8
Pyrene	2.1

BTEX analysis by EPA Method 8260; results in mg/Kg.
Diesel-Heavy Oil analysis by NWTPH-Dx; results in mg/Kg.
PAH analysis by EPA Method 8270SIM; results in mg/Kg.

Table 3.5E Geoprobe Assessment Beneath Rail Line
(Sample Results)

Table 3.5E
Geoprobe Assessment Beneath Rail Line

Soil Sample Number	Date Collected	PAHs																TPH		
		Acenaphthene	Acenaphthylene	Anthracene	Benzo (a) Anthracene	Benzo (a) Pyrene	Benzo (b) Fluoranthene	Benzo (ghi) Perylene	Benzo (k) Fluoranthene	Chrysene	Dibenzo (ah) Anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) Pyrene	Naphthalene	Phenanthrene	Pyrene	Gas	Diesel	Heavy Oil
Cleanup Levels (all mg/Kg)		100,000	*	600,000	1	1	*	*	1	1	1	80,000	80,000	1	8,000	*	60,000	130	total 1,000	
GP-RR-1@2	3/6/2001	<0.05	<0.05	0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.2	<0.005	NT	260	<100
GP-RR-1@14		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
GP-RR-2@2		<0.05	<0.05	0.066	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.077	<0.05	<0.05	0.210	<0.05	NT	110	<100
GP-RR-2@14		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
GP-RR-3@2		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	29	<100
GP-RR-3@14		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
GP-RR-4@2	3/7/2001	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	33	<100
GP-RR-4@14		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
GP-RR-5@2		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	29	<100
GP-RR-5@14		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
GP-RR-6@2		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
GP-RR-6@14		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
GP-RR-7@2		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
GP-RR-7@14		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
GP-RR-8@2		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
GP-RR-8@14		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
GP-RR-9@2		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
GP-RR-9@14		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	46	<100
GP-RR-10@2		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	400	<100
GP-RR-10@14		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
GP-RR-11@2	3/8/2001	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
GP-RR-11@14		0.11	0.061	0.35	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.29	<0.05	0.054	1.2	0.071	NT	990	<100
GP-RR-11@18		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	46	<100
GP-RR-12@2		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
GP-RR-12@14		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
GP-RR-13@2		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
GP-RR-13@14		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
GP-RR-15@16		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100

PAH analysis by EPA Method 8270M (SIM); results in mg/Kg.

Diesel/Heavy Oil analysis by NWTPH-Dx; results in mg/Kg.

Cleanup Levels : PAHs from OAR 340-122-045 Appendix 1, lowest Industrial cleanup level; Diesel/heavy oil per OAR 340-122-335 Soil Matrix Cleanup Level 3.

NT - Not Tested

BOLD print indicates levels exceeding DEQ/EPA Cleanup levels

* - These compounds, no regulatory limits established in OAR 340-122-045 Appendix1; nor in "Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites", Oregon DEQ September 1999, Appendix A; nor in EPA Region 9 Preliminary Remediation Goals

Table 3.6 Pilot Plant Fuel Oil AST
(Cleanup Confirmation Sample Results)

TABLE 3.6
PILOT PLANT FUEL OIL AST (AOC-R-12)
CLEANUP CONFIRMATION SAMPLE RESULTS
Soil Samples Collected on 8/29/00

Sample #	TPH-Identification	Diesel-Heavy Oil	PAHs	Cleanup Level
AOC-12A	None Detected	Nt	All <0.1	1000 total/1.0
AOC-12B	None Detected	Nt	All <0.1	
AOC-12C	Heavy Oil	30.1	All <0.1	
AOC-12D	Heavy Oil	26.5	All <0.1	

Nt Not tested
TPH-Identification by NWTPH-HCID
Diesel-Heavy Oil analysis by NWTPH-Dx; results in mg/Kg.
PAH analysis by EPA Method 8310; results in mg/Kg.
Cleanup Levels: 1000 mg/Kg diesel-heavy oil per OAR 340-122-335 Soil Matrix Cleanup Level 3.
1.0 mg/Kg lowest Industrial cleanup level for PAHs, per OAR-340-122-045 Appendix 1.

Table 3.7A Vehicle Maintenance and Washdown Area
(Cleanup Confirmation Sample Results)

and

Table 3.7B Vehicle Maintenance and Washdown Area
(Stockpile Composite Sample Soil Results)

initial Sampling

TABLE 3.7A
VEHICLE MAINTENANCE AND WASHDOWN AREA (AOC-R-13)
CLEANUP CONFIRMATION SAMPLE RESULTS
Soil Samples Collected on 1/25/01

Sample #	TPH		Arsenic	Cleanup Level
	Diesel	Heavy Oil		
CS-1	<25	<100	**27**	1000 total/24.87
CS-2	<25	<100	**31**	
CS-3	<25	<100	**50**	
CS-4	<25	<100	**38**	
CS-5	<25	<100	**46**	
CS-6	<25	<100	**37**	
CS-7	<25	270	**33**	
CS-8	**170**	**1200**	**34**	
CS-9	<25	170	**31**	
CS-10	<25	<100	**30**	
CS-11	<25	180	**32**	
CS-12	<25	170	**32**	
CS-13	**73**	**2300**	**53**	
CS-14	<25	360	**33**	

TABLE 3.7B
VEHICLE MAINTENANCE AND WASHDOWN AREA
STOCKPILE COMPOSITE SOIL SAMPLE

Analyte	Total	TCLP
Arsenic	39	0.01
Barium	130	2.1
Benzene	<0.001	Nt
Ethylbenzene	0.002	Nt
Toluene	0.015	Nt
Meta- & Para-xylene	0.007	Nt
Ortho-xylene	0.004	Nt
Cadmium	<0.03	<0.001
Chromium	81	0.013
Lead	10	0.029
Mercury	<0.01	<0.0003
Selenium	<1.4	<0.04
Silver	<0.03	<0.001

Nt Not tested
Diesel-Heavy Oil analysis by NWTPH-Dx; results in mg/Kg.
Arsenic analysis by ICP EPA Methods 200.7/6010B.
Cleanup Level: 1000 mg/Kg total diesel-heavy oil per OAR 340-122-335 Soil Matrix Cleanup Level 3.
Arsenic cleanup level is naturally-occurring background level: 24.87 mg/Kg.
(exceedances in boldface)
Stockpile Sample: Totals per EPA Methods 200.7/6010B, 8260 and 245.1/7471; TCLP per EPA Method 1311

Table 3.7C Vehicle Maintenance and Washdown Area
(PAH Confirmation Soil Sampling Results)

Table 3.7C
Confirmation Soil Sampling Results
Vehicle Maintenance and Washdown Area (AOC-R-13)

Soil Sample Number	Date Collected	PAHs																TPH		
		Arsenic	Acenaphthene	Acenaphthylene	Anthracene	Benzo (a) Anthracene	Benzo (a) Pyrene	Benzo (b) Fluoranthene	Benzo (ghi) Perylene	Benzo (k) Fluoranthene	Chrysene	Dibenzo (ah) Anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) Pyrene	Naphthalene	Phenanthrene	Pyrene	Gas	Diesel	Heavy Oil
Cleanup Levels		24.87	100,000	*	600,000	1	1	*	*	1	1	1	80,000	80,000	1	8,000	*	60,000	130	total 1,000	
CS-15	3/7/2001	<0.50	NT	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-16		<0.50	NT	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-17		<0.50	NT	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-18		<0.50	NT	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-19		<0.50	NT	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-20		<0.50	NT	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-21		<0.50	NT	<0.05	0.41	0.099	<0.05	0.15	<0.05	<0.05	0.067	<0.05	0.19	0.21	0.078	<0.05	0.45	0.16	NT	85	641
CS-22		<0.50	NT	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	108
CS-23		<0.50	NT	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	34	168
CS-24		<0.50	NT	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	111
CS-25		<0.50	NT	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-26		<0.50	NT	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-27		<0.50	NT	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-28		<0.50	NT	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-29		<0.50	NT	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-30		<0.50	NT	<0.05	<0.05	<0.05	<0.2	<0.2	<0.5	<0.2	<0.05	<0.3	<0.05	<0.05	<0.4	<0.05	<0.05	<0.05	NT	<25	<100
CS-31		<0.50	NT	<0.05	<0.05	<0.05	<0.2	<0.2	<0.5	<0.2	<0.05	<0.3	<0.05	<0.05	<0.4	<0.05	<0.05	<0.05	NT	<25	<100
CS-32		<0.50	NT	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-33		<0.50	NT	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-34		<0.50	NT	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-35		<0.50	NT	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-36		<0.50	NT	<0.05	<0.05	<0.05	<0.2	<0.2	<0.5	<0.2	<0.05	<0.3	<0.05	<0.05	<0.4	<0.05	<0.05	<0.05	NT	<25	<100
CS-37		<0.50	NT	<0.05	<0.05	<0.05	<0.2	<0.2	<0.5	<0.2	<0.05	<0.3	<0.05	<0.05	<0.4	<0.05	<0.05	<0.05	NT	<25	<100
CS-38		<0.50	NT	<0.05	<0.05	<0.05	<0.2	<0.2	<0.5	<0.2	<0.05	<0.3	<0.05	<0.05	<0.4	<0.05	<0.05	<0.05	NT	<25	<100
CS-39		<0.50	NT	<0.05	<0.05	<0.05	<0.2	<0.2	<0.5	<0.2	<0.05	<0.3	<0.05	<0.05	<0.4	<0.05	<0.05	<0.05	NT	<25	<100
CS-40		<0.50	NT	<0.05	<0.05	<0.05	<0.2	<0.2	<0.5	<0.2	<0.05	<0.3	<0.05	<0.05	<0.4	<0.05	<0.05	<0.05	NT	<25	<100
CS-21A		<0.50	NT	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100

Arsenic analysis by EPA Methods 200.7/6010B; results in mg/Kg.
PAH analysis by EPA Method 8270M (SIM); results in mg/Kg.
Diesel/Heavy Oil analysis by NWTPH-Dx; results in mg/Kg.
Cleanup Levels: Arsenic - naturally-occurring background level; PAHs from OAR 340-122-045 Appendix 1, lowest industrial cleanup level; Diesel/heavy oil per OAR 340-122-335 Soil Matrix Cleanup Level 3.A8
NT - Not Tested
BOLD print indicates level exceeds Cleanup Level
* - These compounds, no regulatory limits established in OAR 340-122-045 Appendix1; nor in "Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites", Oregon DEQ September 1999, Appendix A; nor in EPA Region 9 Preliminary Remediation Goals

Table 3.8 BPA Substation
(Cleanup Confirmation Soil Sampling Results)

Table 3.8
Confirmation Soil Sampling Results
BPA Substation (AOC-R-20)

Soil Sample Number	Date Collected	PAHs																TPH		
		Acenaphthene	Acenaphthylene	Anthracene	Benzo (a) Anthracene	Benzo (a) Pyrene	Benzo (b) Fluoranthene	Benzo (ghi) Perylene	Benzo (k) Fluoranthene	Chrysene	Dibenzo (ah) Anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) Pyrene	Naphthalene	Phenanthrene	Pyrene	Gas	Diesel	Heavy Oil
Cleanup Levels		100,000	*	600,000	1	1	*	*	1	1	1	80,000	80,000	1	8,000	*	60,000	130	total 1,000	
CS-BPA-P1-EW	6/13/2001	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	0.08	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-BPA-P1-BTM		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-BPA-P2-NW		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-BPA-P2-EW		<0.05	<0.05	<0.05	<0.05	<0.05	0.067	0.068	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	130.0
CS-BPA-P2-WW		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-BPA-P2-BTM		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	48	<100
CS-BPA-P3-WW		<0.05	<0.05	0.33	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.23	<0.05	<0.05	0.09	<0.05	NT	**3020**	**650**
CS-BPA-P3-EW		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-BPA-P3-SW		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-BPA-P3-BTM		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	34	<100
CS-BPA-P4-NW		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-BPA-P4-WW		<0.05	<0.05	0.061	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.164	<0.05	<0.05	<0.05	<0.05	NT	800	<100
CS-BPA-P4-EW		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-BPA-P4-BTM		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-BPA-P5-NW		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-BPA-P5-EW		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-BPA-P5-WW		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-BPA-P5-BTM		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
CS-BPA-P2-EWA	7/17/2001	0.06	0.02	0.41	0.15	0.26	0.18	0.11	0.10	0.15	<0.02	0.35	0.11	0.09	<0.02	0.42	0.34	NT	<25	<100
CS-BPA-P3-WWA		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	NT	<25	<100
CS-BPA-P4-WWA		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	NT	<25	<100

PAH analysis by EPA Method 8270M (SIM); results in mg/Kg.
Diesel/Heavy Oil analysis by NWTPH-Dx; results in mg/Kg.
Cleanup Levels: PAHs from OAR 340-122-045 Appendix 1, lowest Industrial cleanup level; Diesel/heavy oil per OAR 340-122-335 Soil Matrix Cleanup Level 3.
NT - Not Tested
BOLD print indicates level exceeds Cleanup Level.
* - These compounds, no regulatory limits established in OAR 340-122-045 Appendix1; nor in "Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites", Oregon DEQ September 1999, Appendix A; nor in EPA Region 9 Preliminary Remediation Goals

Table 3.9 Shotting Water Tank
(Cleanup Confirmation Sample Results)

TABLE 3.9
SHOTTING WATER TANK (AOC-R-23)
CLEANUP CONFIRMATION SAMPLE RESULTS
Soil Samples Collected on 8/29/00

Sample #	TPH-Identification	Heavy Oils	PAHs	Cleanup Level
AOC-23 A	Oils	55.0	Nt	1000 total/1.0
AOC-23 B	Oils	26.4	Nt	
AOC-23 C	Oils	233	Nt	
AOC-23 D	Nd	Nt	Nt	
HA-1	Nd	Nt	All <1.0	
HA-2	Nd	Nt	All <1.0	
HA-3	Oils	32.3	All <1.0	

TPH-Identification by NWTPH-HCID.
Diesel-Heavy Oil analysis by NWTPH-Dx; results in mg/Kg.
Nd None detected
Nt Not tested
Cleanup Levels: 1000 mg/Kg Diesel-heavy oil per OAR 340-122-335 Soil Matrix Cleanup Level 3
1.0 mg/Kg lowest Industrial cleanup level for PAHs, per OAR 340-122-045 Appendix 1.

Table 3.10 Lower Ore Body
(Cleanup Confirmation Sample Results)

TABLE 3.10
LOWER ORE BODY
CLEANUP CONFIRMATION SAMPLE RESULTS
Soil Samples Collected on 8/29/00

Sample #	TPH-Identification	Diesel	Heavy Oil	Cleanup Level
Comp A	Oils	Nd	312	1000 total/1.0
Comp B	Diesel and Oils	616		
Comp C	Heavy Oils	Nd	20.2	
Comp D	Oils	Nd	43.5	
Lower Ore Body	Nd	Nt	Nt	
B-2 LOB	Nd	Nt	Nt	
A-1 LOB	Nd	Nt	Nt	
A-2 LOB	Nd	Nt	Nt	

for PAHs which are not included

TPH-Identification by NWTPH-HCID
Diesel-Heavy Oil analysis by NWTPH-Dx; results in mg/Kg.
Nd None detected
Nt Not tested
Cleanup Levels: 1000 mg/Kg Diesel-heavy oil per OAR 340-122-335 Soil Matrix Cleanup Level 3
1.0 mg/Kg lowest Industrial cleanup level for PAHs, per OAR 340-122-045 Appendix 1.

Table 3.11 Baghouse AST Area
(Cleanup Confirmation Soil Sampling Results)

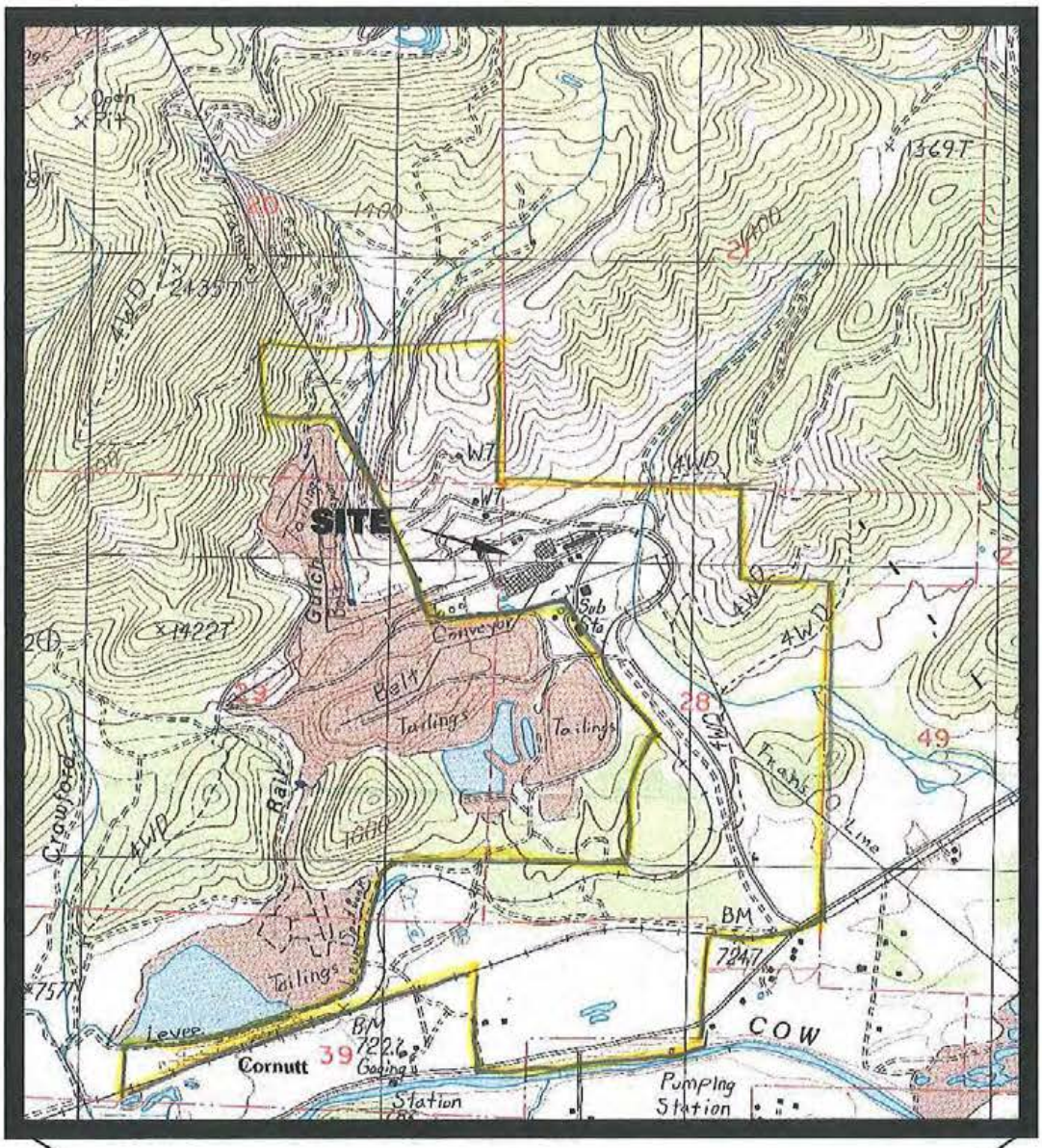
Table 3.11
Confirmation Soil Sampling Results
Baghouse AST Area

Soil Sample Number	Date Collected	PAHs																TPH		
		Acenaphthene	Acenaphthylene	Anthracene	Benzo (a) Anthracene	Benzo (a) Pyrene	Benzo (b) Fluoranthene	Benzo (ghi) Perylene	Benzo (k) Fluoranthene	Chrysene	Dibenzo (ah) Anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) Pyrene	Naphthalene	Phenanthrene	Pyrene	Gas	Diesel	Heavy Oil
Cleanup Levels (all mg/Kg)		100,000	*	600,000	1	1	*	*	1	1	1	80,000	80,000	1	8,000	*	60,000	130	total 1,000	
GS-1	10/27/2000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	33.0	<100
GS-2		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.009	<0.005	NT	<25	<100
GS-3		0.007	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.013	<0.005	0.012	0.023	0.006	NT	<25	<100
GS-4		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
GS-5		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
GS-6		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
GS-7		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
GS-8		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NT	<25	<100
GS-9		<0.005	<0.005	<0.005	0.008	0.008	0.007	0.006	0.007	0.007	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NT	<25	<100
GS-10		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	0.007	<0.005	0.008	<0.005	<0.005	<0.005	<0.005	0.005	NT	<25	<100
GS-11		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.012	0.010	<0.005	NT	<25	<100

PAHs by EPA Method 8270 SIM
Diesel/Heavy Oil analysis by NWTPH-Dx; results in mg/Kg.
Cleanup Levels: Pahs from OAR 340-122-045 Appendix 1, lowest Industrial cleanup level; Diesel/heavy oil per OAR 340-122-335 soil Matrix Cleanup Level 3.
NT - Not Tested
BOLD print indicates levels exceeding DEQ/EPA Cleanup levels
* - These compounds, no regulatory limits established in OAR 340-122-045 Appendix1; nor in "Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites", Oregon DEQ September 1999, Appendix A; nor in EPA Region 9 Preliminary Remediation Goals

Figures

SOURCE: U.S. GEOLOGICAL SURVEY; 7.5 MINUTE SERIES (TOPOGRAPHIC)
NICKEL MOUNTAIN QUADRANGLE, OREGON; DATED 1986

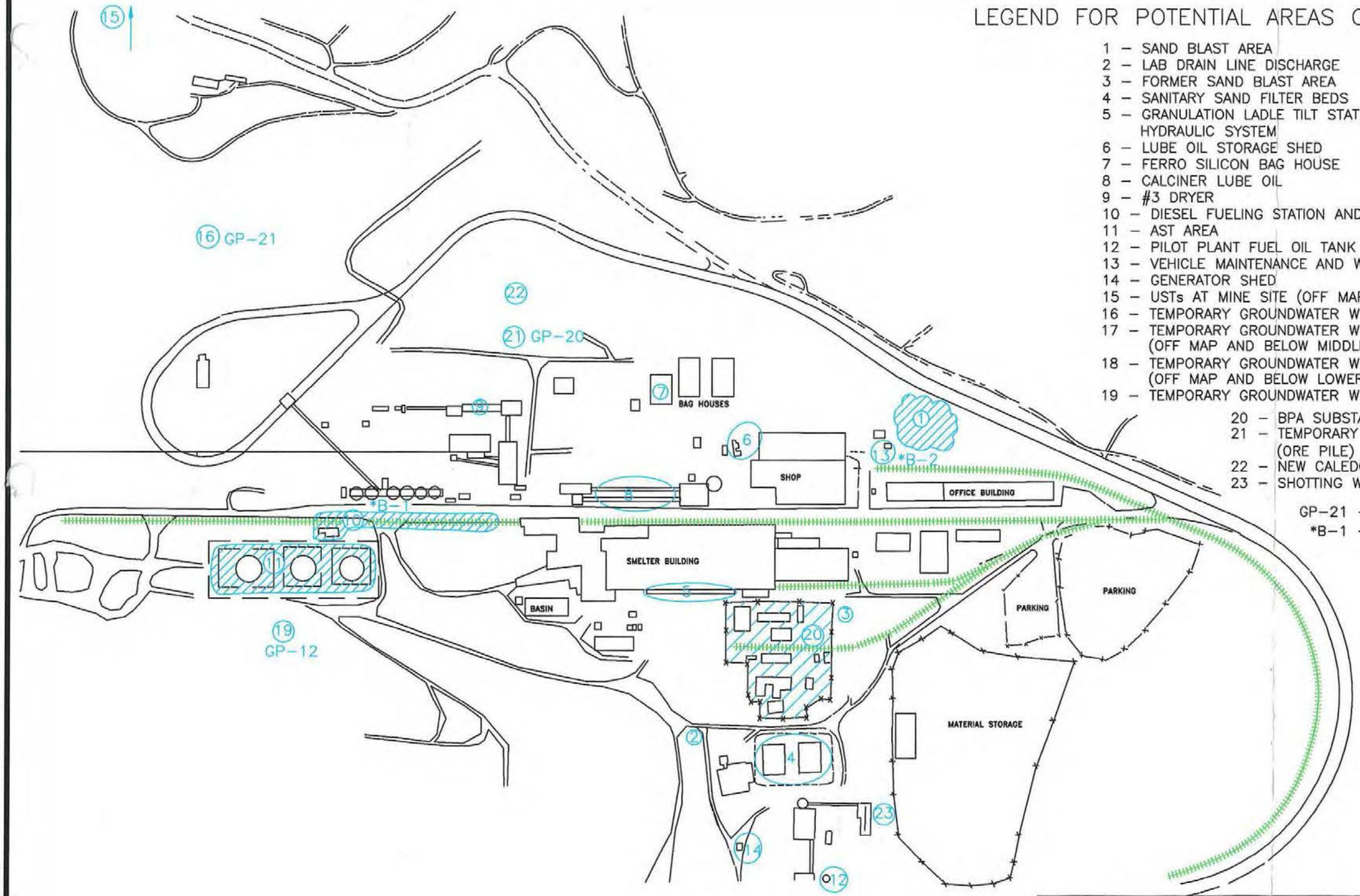


GLENBROOK NICKEL - OREGON RIDDLE FACILITY	AUGUST MACK ENVIRONMENTAL, INC.	2200 GREENE WAY SUITE 100 LOUISVILLE, KENTUCKY 40220	**SITE LOCATION MAP** **RIDDLE**
PROJECT NO: JA036.15 SCALE: -			FILENAME: JA036-1R PLOT DATE: 9/5/01 FIGURE: 1

LEGEND FOR POTENTIAL AREAS OF CONCERN

1 – SAND BLAST AREA
2 – LAB DRAIN LINE DISCHARGE
3 – FORMER SAND BLAST AREA
4 – SANITARY SAND FILTER BEDS
5 – GRANULATION LADLE TILT STATION HYDRAULIC SYSTEM
6 – LUBE OIL STORAGE SHED
7 – FERRO SILICON BAG HOUSE
8 – CALCINER LUBE OIL
9 – #3 DRYER
10 – DIESEL FUELING STATION AND LINE AREA
11 – AST AREA
12 – PILOT PLANT FUEL OIL TANK
13 – VEHICLE MAINTENANCE AND WASHDOWN AREA
14 – GENERATOR SHED
15 – USTs AT MINE SITE (OFF MAP)
16 – TEMPORARY GROUNDWATER WELL (GP–21) (NEAR CREEK)
17 – TEMPORARY GROUNDWATER WELL (GP–23) (OFF MAP AND BELOW MIDDLE PONDS)
18 – TEMPORARY GROUNDWATER WELL (GP–22) (OFF MAP AND BELOW LOWER POND)
19 – TEMPORARY GROUNDWATER WELL (GP–12) (BELOW ASTs)
20 – BPA SUBSTATION
21 – TEMPORARY GROUNDWATER WELL (GP–20) (ORE PILE)
22 – NEW CALEDONIA ORE PILE
23 – SHOTTING WATER TANK

GP–21 – CORRESPONDING BORING NUMBER
*B–1 – GEOTECHNICAL BORING LOCATION



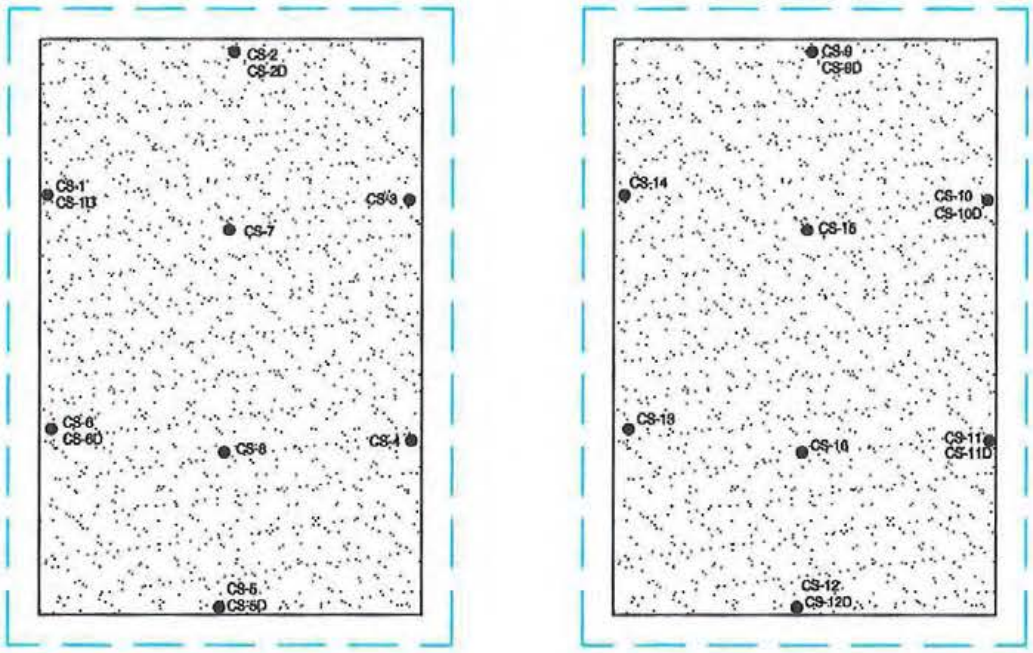
Linebach Funkhouser, Inc.
environmental compliance & consulting

GLENBROOK NICKEL–OREGON
RIDDLE FACILITY

PROJECT No.:	FILENAME:	
012-02	01202-2	
DRAWN BY: CCD	SCALE: 1=60	FIGURE: 2

FACILITY PLAN SHOWING ORIGINAL 23 POTENTIAL AREAS OF CONCERN

PRINT DATE JUN/11/02 10:19PM



LEGEND

- BOUNDARY OF SANITARY SAND FILTER BEDS
- SAND FILTER MEDIA
- AREA OF EXCAVATION
- SAMPLE LOCATIONS

25 0 25

SCALE IN FEET

GLENBROOK NICKEL - OREGON

RIDDLE FACILITY

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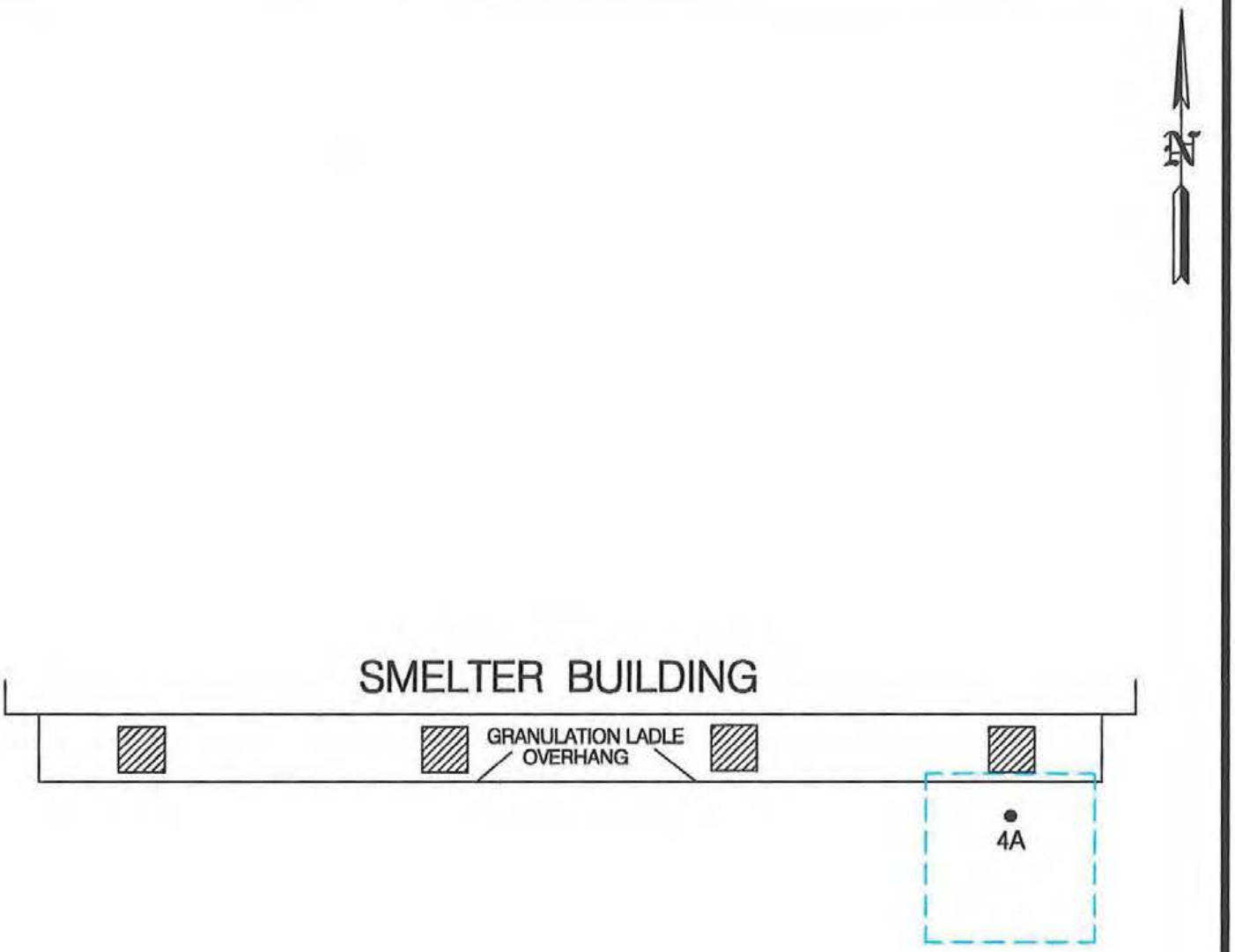
SANITARY SAND FILTER BEDS
AREA OF EXCAVATION

PROJECT NO:	SCALE:	FILENAME:	FIGURE:
012-02	-	01202-3	3
		PLOT DATE: 6/12/02	



LEGEND

GRANULATION LADLE TILT STATION SUPPORT PILLAR

AREA OF EXCAVATION

SAMPLE LOCATION

10 0 10

SCALE IN FEET

GLENBROOK NICKEL - OREGON

RIDDLE FACILITY

PROJECT NO: 012-02

SCALE: -

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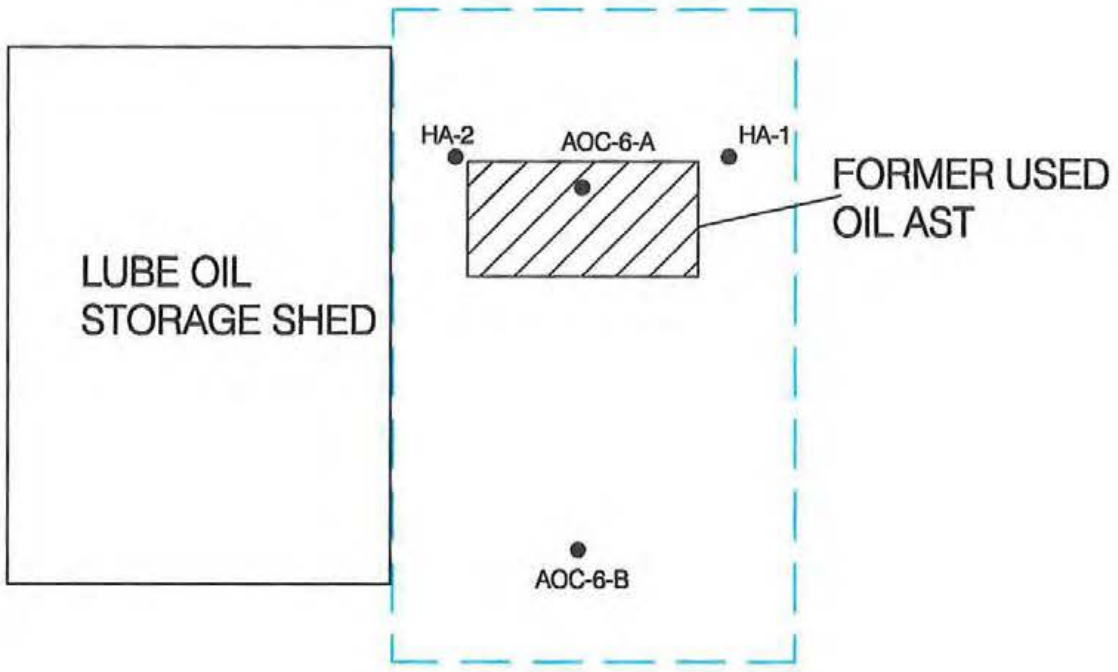
GRANULATION LADLE TILT STATION
HYDRAULIC SYSTEM
AREA OF EXCAVATION

FILENAME: 01202-4

PLOT DATE: 6/12/02

FIGURE: 4



LEGEND

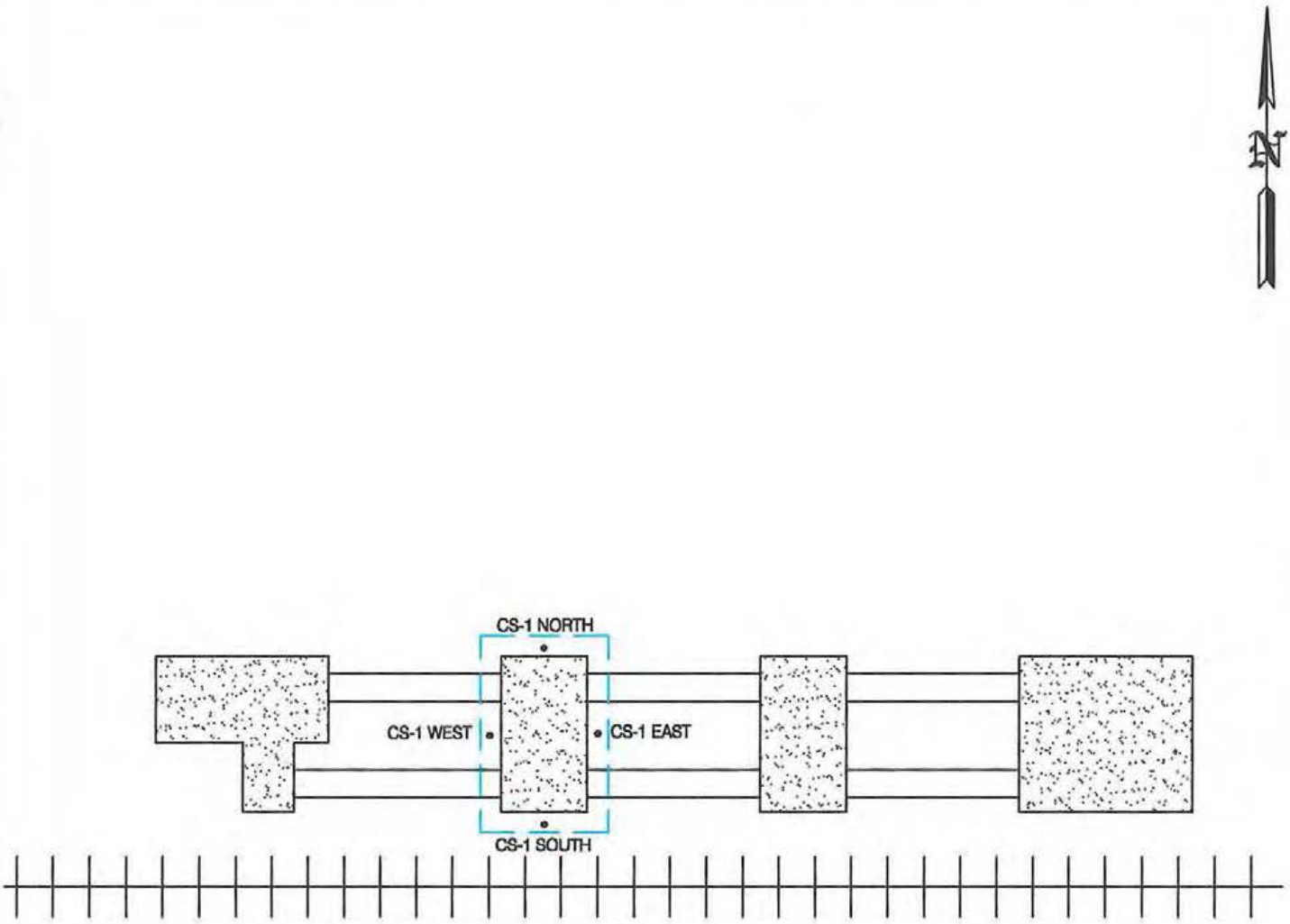
AREA OF EXCAVATION

SAMPLE LOCATIONS

5 0 5

SCALE IN FEET

GLENBROOK NICKEL - OREGON RIDDLE FACILITY	Linebach Funkhouser, Inc. *environmental compliance & consulting*	LUBE OIL STORAGE AREA AREA OF EXCAVATION
PROJECT NO: 012-02 SCALE: -		FILENAME: 01202-5 PLOT DATE: 6/12/02 FIGURE: 5



LEGEND

AREA OF EXCAVATION

CALCINER SUPPORT PILLARS

SAMPLE LOCATIONS

50 0 50

SCALE IN FEET

GLENBROOK NICKEL - OREGON

RIDDLE FACILITY

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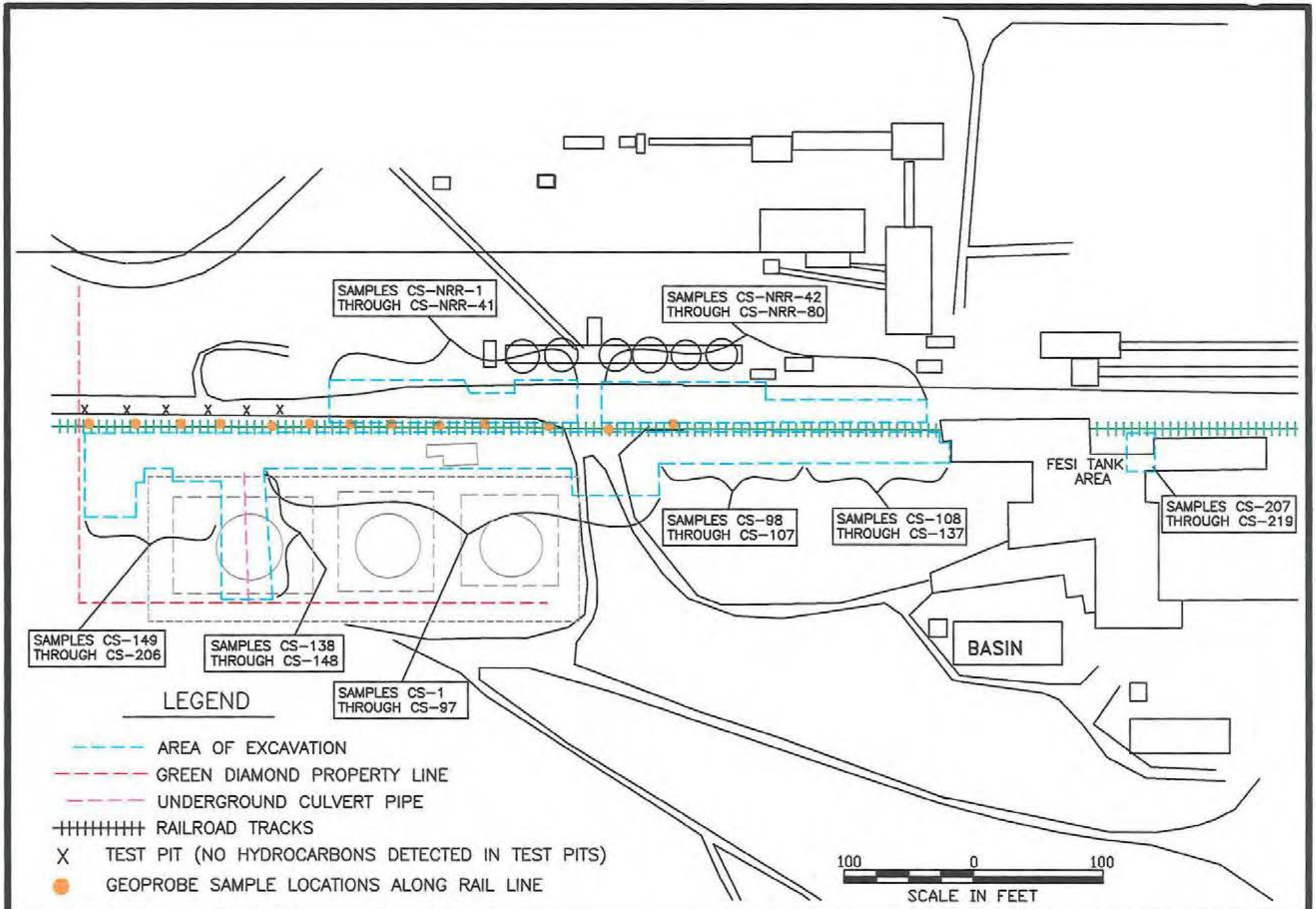
CALCINER LUBE OIL AREA
AREA OF EXCAVATION

PROJECT NO:	SCALE:	FILENAME:	FIGURE:
012-02	-	01202-6	6
		PLOT DATE: 6/12/02	



GLENBROOK NICKEL – OREGON
RIDDLE FACILITY

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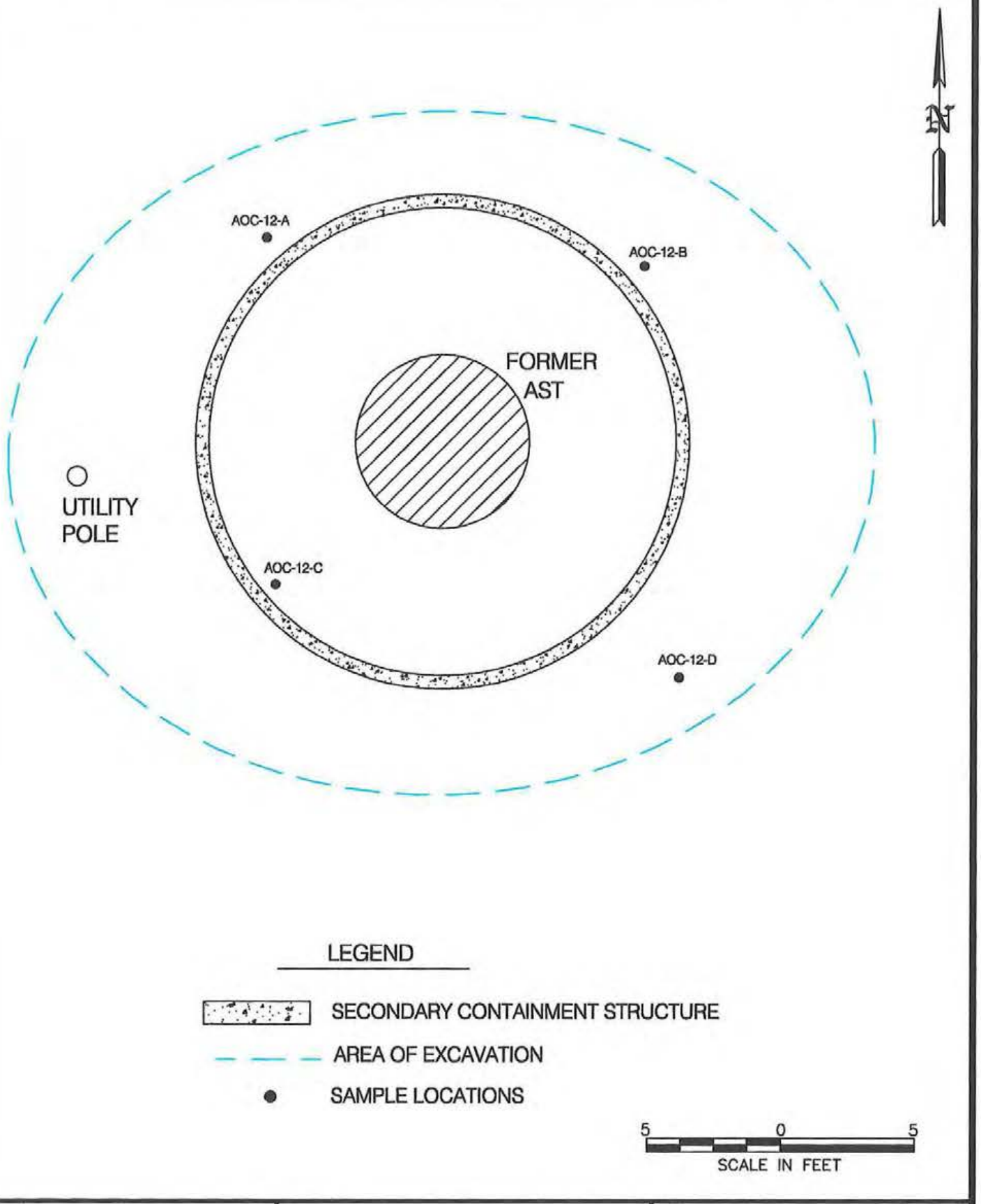
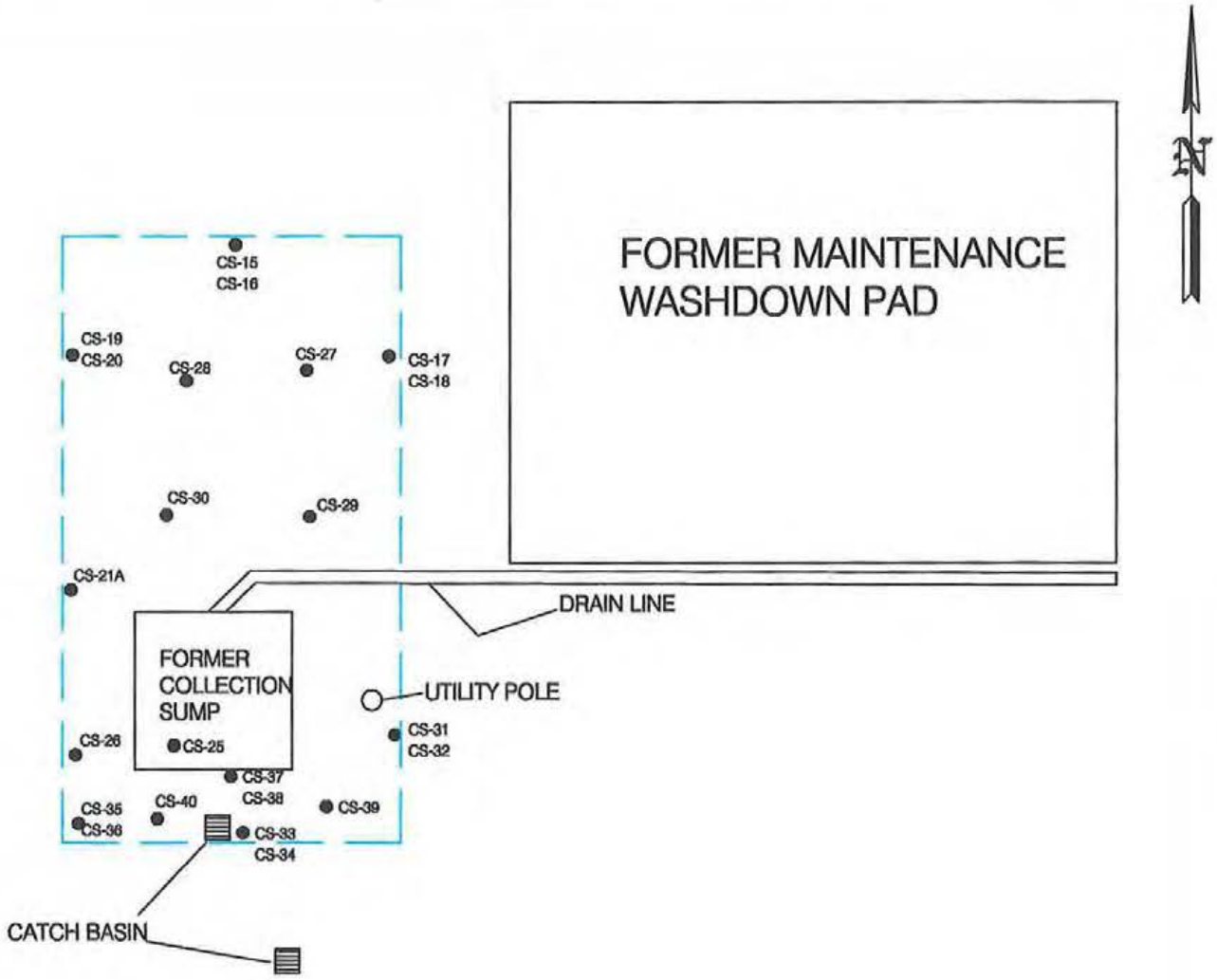
DIESEL FUEL STATION
AND FUEL LINE AREA
AREA OF EXCAVATION

PROJECT No.: 012-02	FILENAME: 01202-7	
DRAWN BY: CCD	SCALE:	FIGURE: 7
PRINT DATE JUN/11/02 10:36PM		



GLENBROOK NICKEL - OREGON RIDDLE FACILITY	Linebach ▪ Funkhouser, Inc. *environmental compliance & consulting*	PILOT PLANT FUEL OIL AST AREA OF EXCAVATION
PROJECT NO: 012-02 / SCALE: -		FILENAME: 01202-8 / PLOT DATE: 6/12/02 / FIGURE: 8



LEGEND

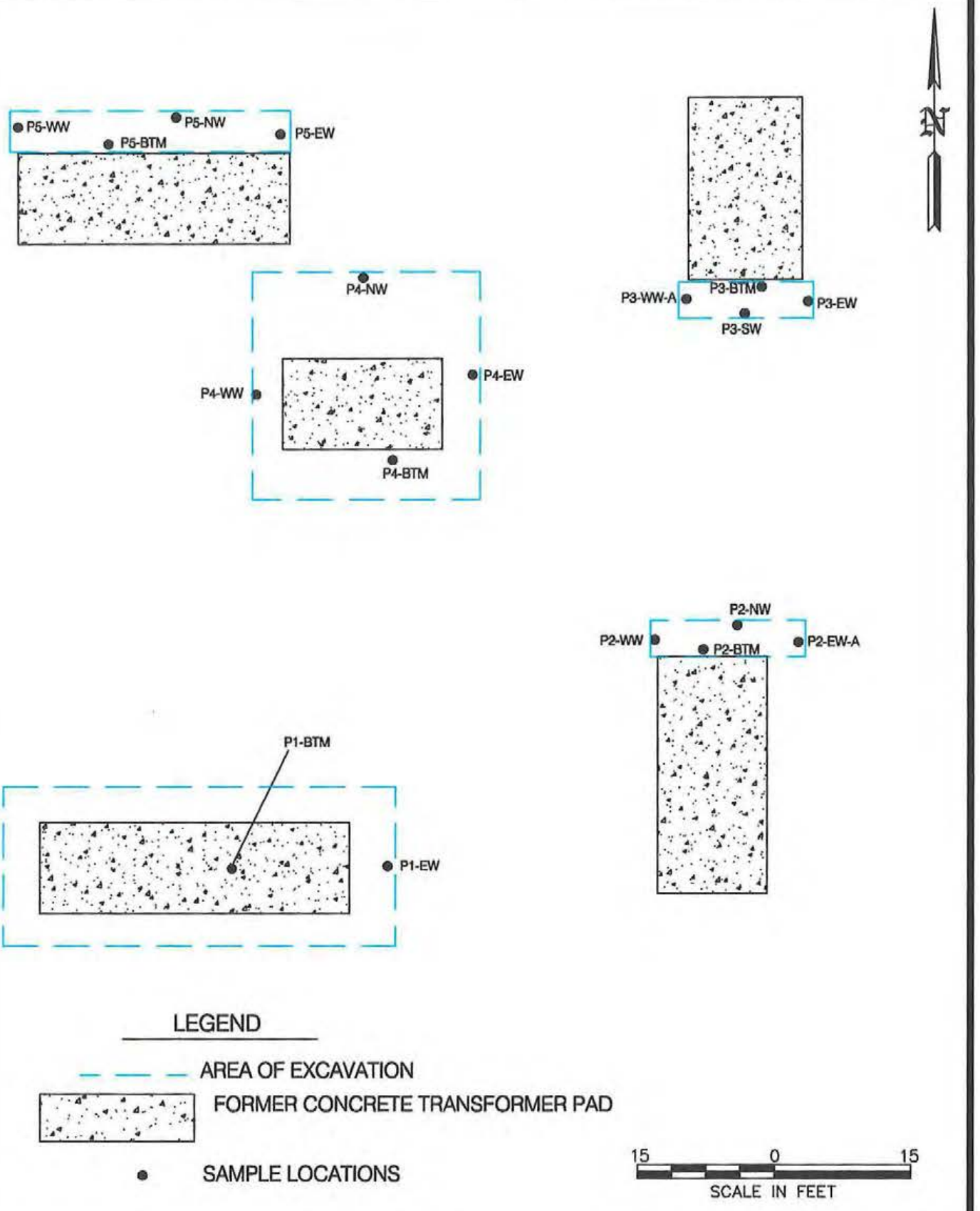
AREA OF EXCAVATION

SAMPLE LOCATIONS

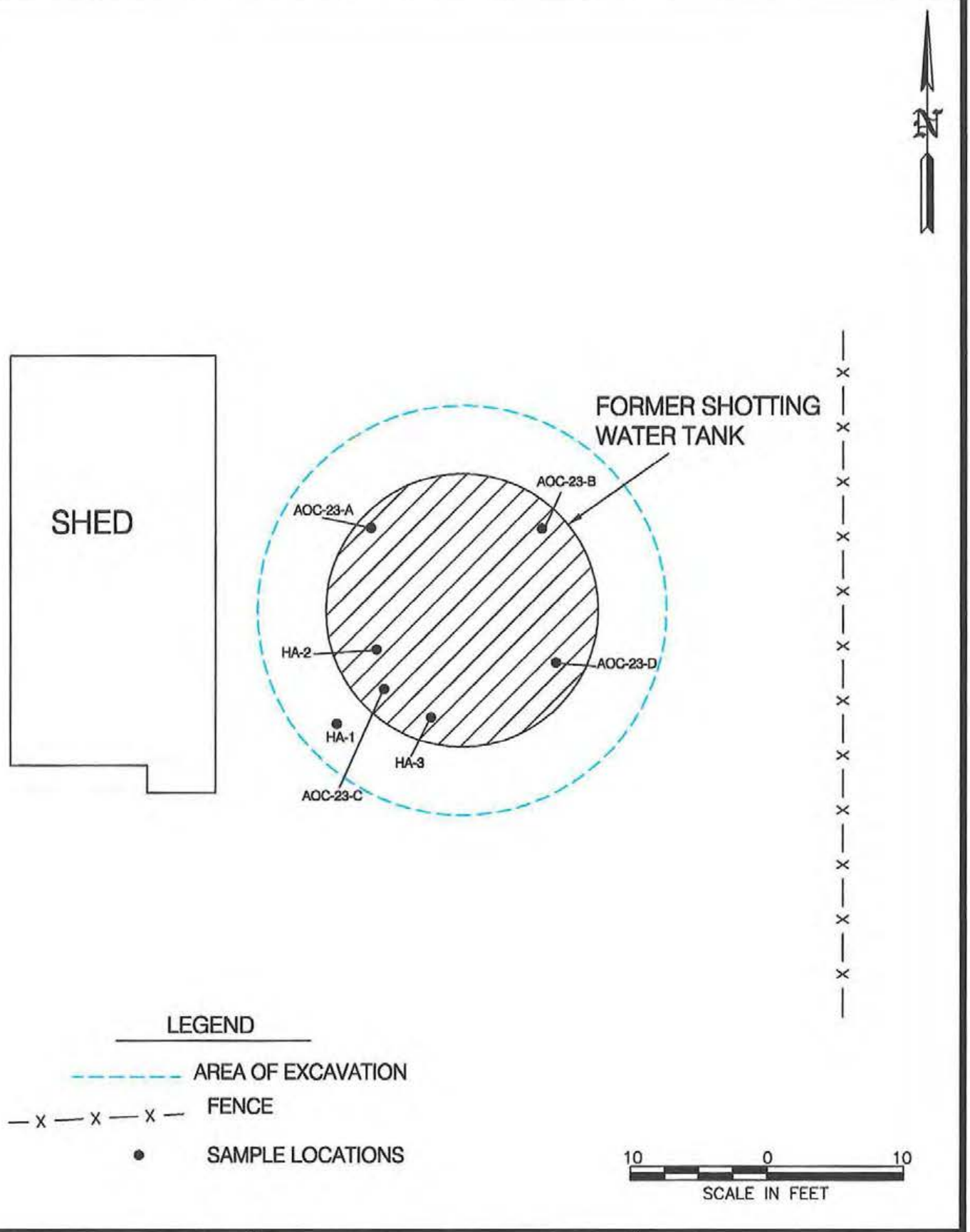
15 0 15

SCALE IN FEET

GLENBROOK NICKEL - OREGON RIDDLE FACILITY	Linebach ▪ Funkhouser, Inc. *environmental compliance & consulting*	VEHICLE MAINTENANCE AND WASHDOWN AREA AREA OF EXCAVATION
PROJECT NO: 012-02 / SCALE: -	FILENAME: 01202-9 / PLOT DATE: 6/12/02	FIGURE: 9



GLENBROOK NICKEL - OREGON RIDDLE FACILITY	Linebach Funkhouser, Inc. *environmental compliance & consulting*	BPA SUBSTATION AREA OF EXCAVATION
PROJECT NO: 012-02 / SCALE: -	FILENAME: 01202-10 PLOT DATE: 6/12/02	FIGURE: 10

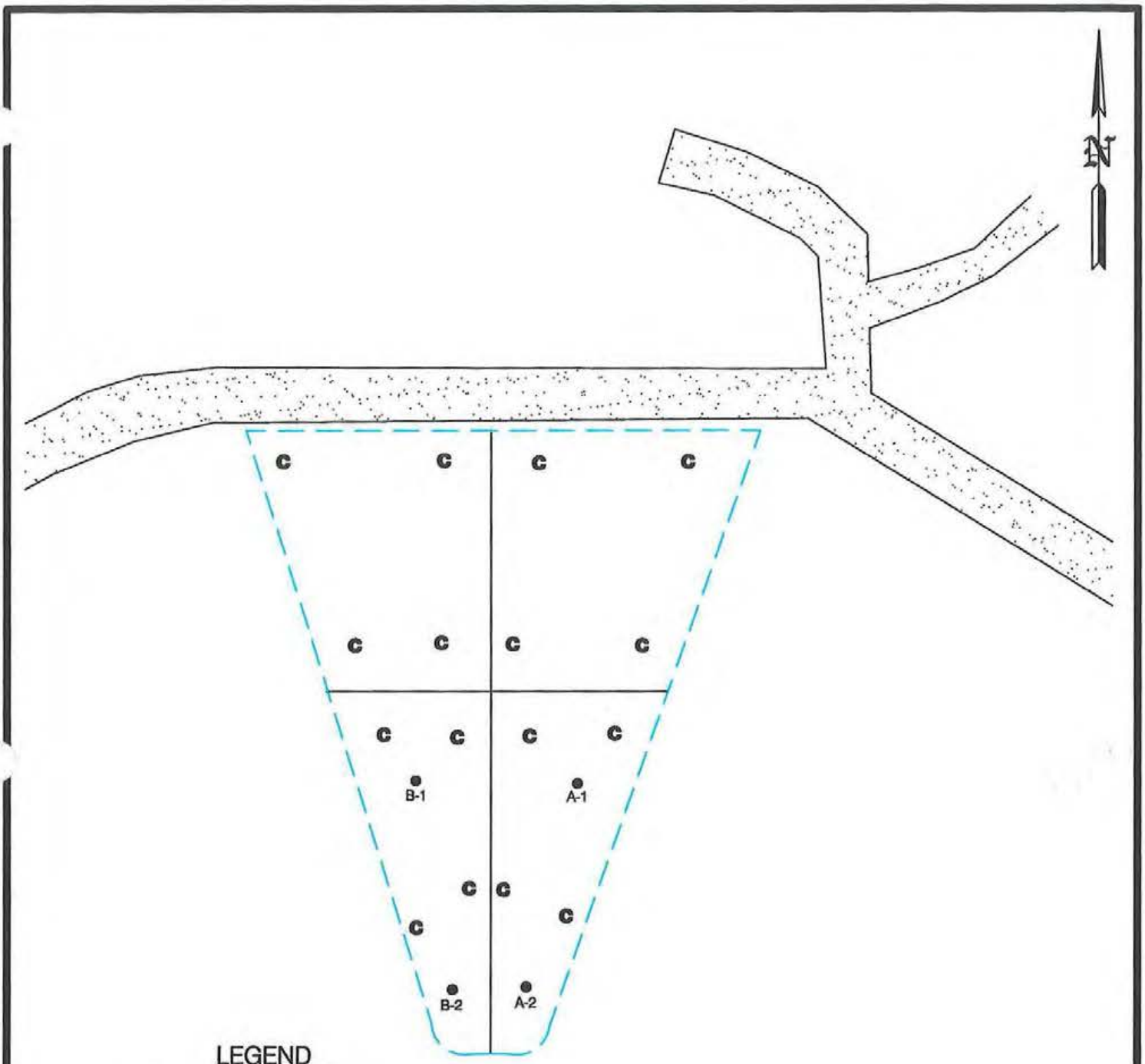


GLENBROOK NICKEL - OREGON
RIDDLE FACILITY

Linebach Funkhouser, Inc.
environmental compliance & consulting

SHOTTING WATER TANK
AREA OF EXCAVATION

PROJECT NO:	SCALE:	FILENAME:	FIGURE:
012-02	-	01202-11	11
		PLOT DATE: 6/12/02	

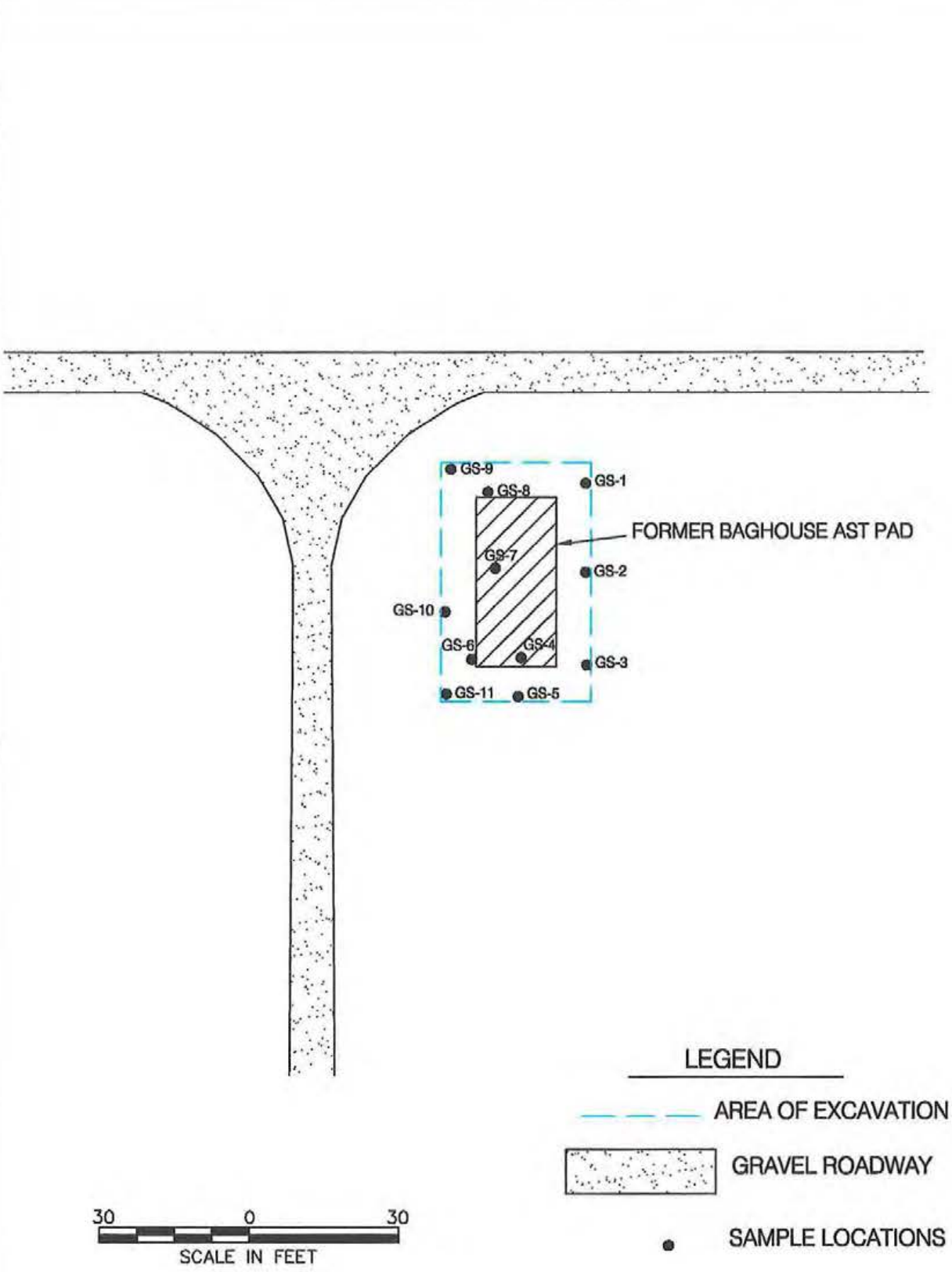


GLENBROOK NICKEL - OREGON
RIDDLE FACILITY

Linebach Funkhouser, Inc.
environmental compliance & consulting

LOWER ORE BODY
AREA OF EXCAVATION

PROJECT NO:	SCALE:	FILENAME:	FIGURE:
012-02	-	01202-12	12
		PLOT DATE: 6/12/02	



GLENBROOK NICKEL - OREGON RIDDLE FACILITY	Linebach ▪ Funkhouser, Inc. *environmental compliance & consulting*	BAGHOUSE AST AREA AREA OF EXCAVATION
PROJECT NO: 012-02 SCALE: -		FILENAME: 01202-13 PLOT DATE: 6/12/02 FIGURE: 13

Appendix A

PBS Environmental
Soil Matrix Calculation

PBS
ENVIRONMENTAL

MEMORANDUM

TO: John Schultz
Ater Wynne

FROM: Dulcy Berri, R.G.

DATE: August 29, 2001

VIA FAX only 503-226-0079

PROJECT NO.: 16511.000

RE: **Diesel Fueling Station Area**
Soil Matrix Scoresheet
Glenbrook Nickel Company
Riddle, Oregon

Attached is an Oregon DEQ Soil Matrix Scoresheet for the Riddle, Oregon, site. Scoring is based on the following:

1. Depth to Groundwater
   This number represents the "highest seasonal elevation of the saturated zone". Of 10 GeoProbe borings completed in the area of interest (GP-1 through GP-10), one encountered groundwater within 10 feet of the surface (GP-7). Others were dry or encountered free product. Based on the sporadic occurrence of water in the area, the shallow water is presumed to be perched and discontinuous, however is nonetheless considered "groundwater" by the DEQ. The shallowest water level depth recorded in the borings was 4.2 feet below surface (GP-7); this value was used in the scoring.

2. Mean Annual Precipitation
   Figure of 38 inches per year obtained from you.

3. Native Soil Type
   Boring logs for GP-1 through GP-10 indicate the primary soil type as Clay or Silty Clay.

4. Sensitivity of Uppermost Aquifer
   "Aquifer" is defined as a saturated geologic unit that can transmit significant quantities of water, therefore the shallow perched water is not considered here, although it would be considered "unpotable" as a result of detected contamination. The local aquifer is generally determined by a search of recorded water well logs at the Oregon Dept. of Water Resources. Only one domestic

well was identified in the vicinity of the Glenbrook facility, is owned by Glenbrook and is located at the facility; this well was confirmed by you as being the "guard shack" well. The well log indicates that water was first encountered during drilling at 75 feet below surface. The static water level was measured well above this level, at 27 feet below surface, suggesting that the aquifer may be confined.

The aquifer is assumed to be potable and currently in use. Water supply for most of the Glenbrook facility is derived from a spring water source, that is not considered "threatened" by this contamination. Therefore, the "Current Potable" with alternate sources readily available, scoring was used.

5. Potential Receptors
   The guard shack well is the closest water well to the contaminated area, and is 0.8 mile away. Although the water-bearing zone for the water well appears to be at 75 feet bgs, it is unknown whether this aquifer is isolated from the shallow perched water in the contaminated area, therefore the guard shack well location was utilized, and scored as "Medium" (0.5 to 2 miles).

   It is believed that there are less than 100 persons utilizing private water wells for domestic water supply within 2 miles of the contaminated area, therefore the score for "Few" was used.

   The combination of these two criteria, "Medium, Few", is given a total score of 1.

The total Soil Matrix score for the site is 24; target cleanup levels are 130 parts per million (ppm) gasoline-range petroleum and 1,000 ppm diesel/mixed heavy oil-range petroleum.

MATRIX SCORE SHEET

1. Depth to Groundwater **< 25 feet (10)** 25-50 feet (7) 51-100 feet (4) > 100 feet (1)	10
2. Mean Annual Precipitation > 45 inches (10) **20-45 inches (5)** < 20 inches (1)	5
3. Native Soil Type Coarse sands, gravels (10) Silts, fine sands (5) **Clays (1)**	1
4. Sensitivity of Uppermost Aquifer Sole Source (10) **Current Potable (7)** Future Potable (4) Non-potable (1)	7
5. Potential Receptors **Medium, Few (1)**	1
TOTAL SCORE =	24

Matrix Score	Cleanup Level in ppm TPH	
	Gasoline	Diesel
Level 1: > 40 pts.	40	100
Level 2: 25-40 pts.	80	500
Level 3: < 25 pts.	**130**	**1000**

Appendix B

Determination of Naturally Occurring Background Arsenic Levels

CERTIFICATE OF ANALYSIS

CLIENT: GLENBROOK NICKEL - SMELTER
5093 RIDDLE BYPASS RD.
RIDDLE OR 97469

PHONE: (541) 874-3171
FAX: (541) 874-3380

DATE SUBMITTED: 02/09/20

PROJECT NAME: GLENBROOK RIDDLE-AOC-13 BACKGROUND PROJECT NUMBER: JA036.015

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
10255-001		02/07/2001	1530	Soil	BG-1 @ 4-5.0'
10255-002		02/07/2001	1540	Soil	BG-2 @ 4-5.0'
10255-003		02/07/2001	1555	Soil	BG-3 @ 4-5.0'
10255-004		02/07/2001	1605	Soil	BG-4 @ 4-5.0'
10255-005		02/07/2001	1610	Soil	BG-5 @ 4-5.0'
10255-006		02/07/2001	1615	Soil	BG-6 @ 4-5.0'
10255-007		02/07/2001	1625	Soil	BG-7 @ 4-5.0'
10255-008		02/07/2001	1630	Soil	BG-8 @ 4-5.0'
10255-009		02/07/2001	1635	Soil	BG-9 @ 4-5.0'

REPORT DATE: 02/12/2001 REPORT NUMBER: 10255

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
BG-1 @ 4-5.0'						
10255-001	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	3.3	mg/Kg	0.3	Greg W 02/10/2001
BG-2 @ 4-5.0'						
10255-002	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	18	mg/Kg	0.30	Greg W 02/10/2001
BG-3 @ 4-5.0'						
10255-003	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	13	mg/Kg	0.30	Greg W 02/10/2001
BG-4 @ 4-5.0'						
10255-004	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	12	mg/Kg	0.30	Greg W 02/10/2001
BG-5 @ 4-5.0'						
10255-005	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	8.5	mg/Kg	0.30	Greg W 02/10/2001
BG-6 @ 4-5.0'						
10255-006	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	7.4	mg/Kg	0.30	Greg W 02/10/2001
BG-7 @ 4-5.0'						
10255-007	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	7.5	mg/Kg	0.30	Greg W 02/10/2001

REVIEWED BY: _____
Martin Little - Quality Manager

CERTIFICATE OF ANALYSIS

REPORT DATE: 02/12/2001 REPORT NUMBER: 10255

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
BG-8 @ 4-5.0'						
10255-008	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	27	mg/Kg	0.30	Greg W 02/10/2001
BG-9 @ 4-5.0'						
10255-009	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	6.5	mg/Kg	0.30	Greg W 02/10/2001

Determination of Background Arsenic Levels
Riddle, Oregon

Levels in ppm for 9 samples collected:

3.3, 6.5, 7.4, 7.5, 8.5, 12, 13, 18, 27

Mean:

$103.2 \div 9 = 11.4$

Sample Variance (s^2)

$$s^2 = \frac{(3.3-11.4)^2+(6.5-11.4)^2+(7.4-11.4)^2+(7.5-11.4)^2+(8.5-11.4)^2+(12-11.4)^2+(13-11.4)^2+(18-11.4)^2+(27-11.4)^2}{9-1}$$

$$s^2 = \frac{(-8.1)^2 + (-4.9)^2 + (-4)^2 + (-3.9)^2 + (-2.9)^2 + (0.6)^2 + (1.6)^2 + (6.6)^2 + (15.6)^2}{9-1}$$

$$s^2 = \frac{65.61 + 24.01 + 16 + 15.21 + 8.41 + 0.36 + 2.56 + 43.56 + 243.36}{9-1}$$

$s^2 = 419.08 \div 8 = 52.39$

Standard Deviation (s)

s = square root of s^2

s = square root of 52.39

s = 7.24

Coefficient of Variation

= standard deviation ÷ mean

$7.24 \div 11.4 = 0.64$

Upper 95% Confidence Limit

= mean + (t statistic x standard deviation)

= 11.4 + (1.860 x 7.24)

= 11.4 + 13.47

= 24.87 Background Level of Arsenic = 24.87

Note: No outlying observations were identified based on review of ASTM E 178-94 (Standard Practice for Dealing with Outlying Observations)

APPENDIX C

GUIDELINES FOR DETERMINING BACKGROUND CONCENTRATIONS

OAR 340-122-045 (6)

> *If all the criteria in OAR 340-122-045(1), (2), (3), (4), and (5) are met, the responsible party may propose a remedial action which uses Table 1 and Appendix 1 to determine the appropriate cleanup levels. All remedial actions under this rule must meet the appropriate Soil Cleanup Level for volatiles, semi-volatiles or pesticides or the appropriate Leachate Concentration for inorganics as contained in Table 1 unless the responsible party can demonstrate .... that the cleanup level is below background ....*
>
> *(c) The responsible party can demonstrate that the soil cleanup level for the contaminant of concern is below the background level for compounds that occur naturally. The responsible party may in a manner acceptable to the Department determine the representative background concentration and clean up to that level;*

The following guidance has been prepared to assist a responsible party in determining representative site-specific background soil levels. It has been prepared especially for the implementation of the soil cleanup rules, but may also be appropriate for use in other DEQ cleanup programs. All background soil sampling plans should be presented to and approved by DEQ prior to implementation.

The number and locations of background samples at a site will depend upon site-specific characteristics. DEQ prefers that 9 samples be collected at appropriate locations and depths to evaluate background concentrations. This is generally considered the minimum number of samples required to determine whether the data are normally or log normally distributed. If less than 9 samples are collected (a minimum of 5 samples will generally be required) the data must be analyzed using non-parametric methods as described below. More samples may be required where sites cover large areas with varying soil characteristics or where constituent concentrations vary significantly with depth. Professional judgement will be used to determine the number of samples required for background characterization on a site-by-site basis.

Background concentrations of naturally-occurring constituents, such as metals, vary greatly depending upon the source of the soil matrix or depositional environment. The table below provides a summary of the ranges of concentrations of metals in Oregon. The table is provided to illustrate the variation of metal concentrations across the State. Use of countrywide or the statewide background data in this table (or other sources) for site specific background is generally unacceptable. However, background data from other sites may be used provided that: (1) The data were collected and approved during the process of another investigation with oversight by DEQ or EPA;

Post-it® Fax Note 7671	Date 2/7/01	# of pages ▶ 8
To Doug Lineback	From Amanda Spencer	
Co./Dept. August Mack	Co. DEQ	
Phone #	Phone # 541-686-7838	
Fax # 502-671-7717	Fax #	

(2) The data contain no outliers for contaminants of concern; and (3) The reference site is located within the same geologic region and the samples were collected from a unit with the same lithology and characteristics as the strata at the site under investigation.

SOIL CONCENTRATIONS IN OREGON (ppm)							
	ARSENIC	CHROMIUM	COPPER	LEAD	MERCURY	NICKEL	ZINC
Maximum	12	150	200	30	0.70	70	310
Minimum	1.1	3	7	ND	0.01	ND	16
Mean	5.1	66	52.7	14.7	0.1	22.7	70.3
Standard Deviation	2.84	37	46.50	6.29	0.13	13.90	47.61
95% UCL[1]	9.9	129	131	25	.32	46	151
Mean*	1.5	4	3.6	2.6	-3.0	2.9	4.1
Standard Deviation*	0.59	0.75	0.88	0.44	0.92	0.62	0.51
95% UCL1*	2.5	5.27	5.09	3.34	-1.44	3.95	4.96
95% UCL[2]	12	194	162	28	0.24	52	143

[1] 95% UCL = 95% Upper Confidence Limit = Mean + (t_n x Standard Deviation) where t_n = 1.691 based on sample set of 34; except Cr, where t_n = 1.693 based on a sample set of 33.

[*] Calculated on data transformed by taking natural logarithm of concentration.

[2] Antilog of 95% UCL1*.

Background samples are taken to determine the level of a particular compound that naturally occurs in the area of a site. Background samples need not be taken in the event the contaminating material does not naturally occur (e.g., chlorinated solvents, PCBs) since the background concentration for these compounds is assumed to be zero. Background samples should not be collected from areas where other anthropogenic sources may have contributed the same constituents as those encountered at the site in question. Sampling conducted during a site characterization or investigation should determine which naturally-occurring compounds are present at the site. The analytical methods used to evaluate the background samples must be chosen based upon the site investigation results, the type of contamination at the site, and any knowledge of historical activities in the vicinity of the site that could have caused contamination.

1. SAMPLE LOCATION CRITERIA

Criteria for the selection of background sample locations and collection of background soil samples are:

(a) Samples must be taken up-wind and/or topographically up-gradient from known or suspected contaminated area(s). Generally, the background sample location will be at or beyond the site boundary. Historical files, aerial photographs, and tax records may help in determining locations that have not been affected by anthropogenic activities, and

(b) Samples must be taken from geologic strata similar to that in which the samples from the contaminated area are taken. For example, if site characterization includes collection of soil samples at predefined depths (e.g., surface, 1, 3, 10, and 20 feet), then background samples are to be collected at the same depth intervals. At least one sample must be taken at each depth interval and strata medium (soil type), and

(c) Samples shall be collected using the same soil sampling protocols as applied in the previous site characterization or investigation.

2. DATA ANALYSIS

Two methods for evaluating background data are described below. The first method assumes that the data set is large enough that statistically valid analyses can be performed and that the data are either normally or log-normally distributed. The second method is provided for sites where a smaller number of data are collected such that evaluations of normality are not valid. This second method is intended to provide a conservative determination of the background level for small sites where collection of a large number of background samples may not be cost effective. Other statistical approaches to evaluating background data may also be used (e.g., U. S. EPA 1992). Where other methods are used, sufficient documentation must be provided demonstrating the validity of the approach for the site circumstances.

Under both methods, data that indicate non-detectable levels of the constituent of concern should be treated in the evaluation as a value equal to 1/2 of the method detection limit. (Note that where more than 15% of the sample analytical results indicate compounds were not detected, the statistical approaches described in this guidance will likely not be appropriate and other methods will need to be considered.)

Method A – This method may be used at sites where 9 or more background samples have been collected.

Naturally-occurring constituents, such as metals, are usually found in a log norma distribution in soil. Some statistical methods to calculate the mean, standar

deviation, and confidence intervals are valid only when the data are normally distributed. To evaluate whether the data set for naturally occurring substances are normally distributed, an initial screening process should be performed using the following method:

(a) Calculate the mean, standard deviation, and coefficient of variation (standard deviation divided by the mean). Generally, if the coefficient of variation is less than one (1), no data transformations are necessary -- the raw data can be used without transformation. For naturally occurring constituents which have a coefficient of variation greater than one, the data must be transformed. First, calculate the natural logarithm of each concentration (e.g., $\ln(x_1)$, $\ln(x_2)$...$\ln(x_n)$). Then use these log values to calculate the mean and standard deviation of the data set. If the data do not appear to be normally distributed even when logged values are used, Method B described below may be used to calculate background. DEQ should be consulted under these circumstances.

(b) Calculate the upper 95% confidence limit of the transformed or raw data. The upper 95% confidence limit is equal to the mean plus the product of the "t" statistic and the standard deviation. The "t" statistic is dependent on the number of samples and can be obtained from the Table below. For log transformed data sets, take the antilog of the result (e.g., e^x where x = 95% confidence limit of log transformed data). The upper 95% confidence limit is the background cleanup level.

"t" Statistic for 95% Confidence

Number of Samples	"t"	Number of Samples	"t"
2	6.314	12	1.796
3	2.920	13	1.782
4	2.353	14	1.771
5	2.132	15	1.761
6	2.015	16	1.753
7	1.943	17	1.746
8	1.895	18	1.740
9	1.860	19	1.734
10	1.833	20	1.729
11	1.812	infinite	1.645

Wide variations in the concentration of hazardous constituents in the samples used to determine background concentrations are unacceptable. A valid statistical method contained in ASTM Standard E 178-80 (Standard Practice for Dealing with Outlying Observations) can be used to identify data points that lie outside acceptable limits and thus would have a disproportionate effect on the determination of background cleanup levels. If one (or more) of the background samples is determined to be an outlier utilizing the ASTM E 178-80 Method, the result may be rejected from the data set and background cleanup levels calculated using the remaining data. DEQ may require that additional background samples be taken where outliers are identified if the background cleanup level is significantly above the site specific cleanup level or cleanup levels determined on other sites located in the general vicinity of the site.

Method B – This method should be used at sites where fewer than 9 background samples have been collected.

This method involves evaluating the interquartile range (IQR) of the sample set and using this value to estimate the 95% confidence level. The IQR is determined by arranging the data in numerical order from the lowest to highest sample value. The median of the data set is calculated. Without considering the value of the data, the datum that lies halfway between the median and the highest datum is identified. This value is the upper quartile. The datum that lies halfway between the median and the lowest datum is the lower quartile. Where there are an even number of samples, the median and the upper and lower quartiles are determined by calculating an average. For example, if there are 8 samples, the median will be the average of the 4th and 5th data, the lower quartile will be the average of the 2nd and 3rd data, and the upper quartile will be the average of the 6th and 7th data. The IQR is then calculated as the difference between the upper quartile and the lower quartile.

The background value at a 95% confidence level is estimated as the median of the data plus 2 times the IQR. While outlying data should not be excluded from the determination of the IQR, it should not be used to define the background level as provided in 3(b) below. Outliers are defined by data that lies outside the interval defined by the median plus 3 times the IQR.

3. COMPARISON TO SITE DATA

Two methods that may be used to compare the results of the contaminated zone sampling and analysis to that of an acceptable background are:

(a) Compare each hazardous constituent in a contaminated area sample to the background cleanup level as determined by statistical analysis. If it is below that level, then the background cleanup level for that constituent has been achieved.

(b) Compare each hazardous constituent in a contaminated area sample with the maximum concentration in the background samples (assuming it is not an outlier). If it is equal to or less than the maximum background concentration, then the background cleanup level for that constituent has been achieved.

Once the background concentration for a specific hazardous constituent is achieved, no further analyses for that constituent is needed. If the background concentration for a constituent is not achieved, cleanup and testing must continue for that constituent. DEQ may consider the acceptability of constituents concentrations which are only slightly above background levels on a case-by-case basis.

Example 9A

During the remedial investigation conducted at Company A, arsenic was detected in soil samples at concentrations ranging from 8 to 16 ppm which is above the maximum allowable residential soil concentration. Company C maintained that the level of arsenic detected on-site was within the range of naturally occurring arsenic. In order to determine background concentrations for the site, Company C performed an arsenic background study. Twelve samples were collected from four borings at three depths corresponding to the depths at which the on-site samples were collected. The following results were obtained: 8.5 ppm, 11.9 ppm, 17.3 ppm, 12.7 ppm, 11.8 ppm, 7.2 ppm, 40.6 ppm, 20 ppm, 9.7 ppm, 10.4 ppm 100 ppm and 17.3 ppm. The following statistics were calculated:

Number of Samples	12
Mean	22.28 ppm
Standard Deviation	26.04
Coefficient of Variation (Std. Dev./Mean)	1.17

Since the Coefficient of Variation was greater than one, the data were transformed prior to further evaluation using a log normal distribution. The transformed data, calculated by taking the natural log of each concentration, were as follows: 2.14, 2.47, 2.85, 2.54 2.47, 1.97, 3.70, 3.00, 2.27, 2.34, 4.61, 2.85. In order to determine if any of the values were outliers, the data were evaluated using ASTM Standard E 178-80, Standard Practice for Dealing with Outlying Observations. The following statistics were calculated:

Number of Samples	12
Mean	2.768
Standard Deviation	0.738
Maximum Value	4.61
Test Criterion ($T_n = (x_{max} - x_{mean})$/Std. Dev.)	2.49

The value of T_n was compared to the values of T provided in Table 1 of the ASTM Standard for a 95% significance level. For 12 samples, T critical (T_{crit}) was determined to be 2.285. Since $T_n > T_{crit}$, the arsenic concentration of 100 ppm is considered an outlier even assuming a log-normal distribution.

Example 9A – Continued

The untransformed data were re-evaluated without using the value of 100 ppm and the following statistics were calculated:

Number of Samples	11
Mean	15.22
Standard Deviation	9.32
Coefficient of Variation (Std. Dev./Mean)	0.612

Since the Coefficient of Variation was less than one, no transformation of the data is required. However, the data were evaluated once again using ASTM Standard E 178-80 to determine if any values were outliers. The following Statistics were calculated:

Maximum Value	40.6
Test Criterion (T_n = (x_{max} - x_{mean})/Std. Dev.)	2.74

For eleven samples the critical value of T obtained at the 95% significance level from Table 1 of ASTM Standard E 178-80 was 2.234. Since $T_n > T_{crit}$, the value of 40.6 is also considered an outlier.

The evaluation was repeated, rejecting both the 100 and 40.6 arsenic concentrations. The following statistics were calculated:

Number of Samples	10
Mean	12.68
Standard Deviation	4.21
Coefficient of Variation (Std. Dev./Mean)	0.332
Maximum Value	20.0
Test Criterion (T_n = (x_{max} - x_{mean})/Std. Dev.)	1.74

Since the Coefficient of Variation was less than one, no transformation of the data was required. The critical value of T at the 95% significance level from Table 1 of ASTM Standard E 178-80 for ten samples was 2.176. Since $T_n < T_{crit}$, the maximum value of 20.4 was not considered an outlier.

Since more than nine samples were utilized to calculate the coefficient of variation, the test was considered valid and the data were determined to be normally distributed. The 95% upper confidence limit (UCL) of the data was calculated for the sample set of 10 values using the following formula:

$$95\%\ \text{Upper Confidence Limit} = x_{mean} + (t \times \text{Std. Dev.})$$

The "t" statistic for 9 degrees of freedom (degrees of freedom = n-1) was determined to be 1.8331 and the 95% UCL was calculated as 20.4 ppm. Since on-site arsenic concentrations did not exceed 20.4 ppm, it was determined that the arsenic detected on-site was naturally occurring and no arsenic cleanup was required.

Example Scenario 9B -- Variance 3: Use of Background Concentrations

During the remedial investigation conducted at Company A, arsenic was found to be present in soil samples analyzed for total metals at concentrations ranging from 3 to 7 ppm. Since these concentrations exceeded Appendix I levels, arsenic was identified as a potential contaminant of concern at the site. Company A could find no historical source of arsenic on the property and believed the concentrations might reflect naturally-occurring levels in the area. The area east of the property owned by Company A was undeveloped and historical aerial photographs indicated that there had been no known industrial activity there. DEQ approved this area for collection of background samples. Access to the property was obtained for the collection of background samples.

The results of the initial sampling at the site had indicated that the majority of the contamination was limited to the top 5 feet of soil. Consequently, background samples were taken only from this upper zone. Two hand-augured borings were constructed 20 feet apart along the eastern, and one hand-augured boring was constructed on the northern property boundary at the western corner, and soil samples were collected at 6 inches and 5 feet below the surface. Analysis of the samples gave the following arsenic concentrations: 1 ppm, 4 ppm, 9 ppm, 2.2 ppm, 1.5 ppm, and 1.6 ppm. Since only 6 samples were collected, Method B was used to estimate the background concentration as follows:

a) The data were arranged in numerical order: 1, 1.5, 1.6, 2.2, 4, 9
b) The median was calculated as the average of 1.6 and 2.2: 1.9
c) The IQR extended from 1.5 to 4: 2.5
d) The background value was estimated as the median + (2 X IQ): 6.9
e) An evaluation of outliers was made by calculating the median + (3 X IQ): 9.4

No data were determined to be outliers.

Although one of the samples from the contaminated area was above the background value estimated by the IQR calculation, it was determined that the arsenic was naturally-occurring because all of the results fell below the highest level within the background data set. Consequently, cleanup levels for arsenic were not developed for this site.

EPA, Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance, Office of Solid Waste, Permits and State Programs Division, June 1992.

Appendix C

Geoprobe Laboratory Data and Soil Boring Logs

CERTIFICATE OF ANALYSIS

ORIGINAL

CLIENT: GLENBROOK NICKEL - SMELTER
5093 RIDDLE BYPASS RD.
RIDDLE OR 97469

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DATE SUBMITTED: 03/09/2001

PROJECT NAME: GLENBROOK, RIDDLE - GEOPROBE PROJECT NUMBER: JB021.35

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
10392-001		03/06/2001	1325	Soil	GP-RR-1 @ 2'-4'
10392-002		03/06/2001	1423	Soil	GP-RR-1 @ 14'-16'
10392-003		03/06/2001	1450	Soil	GP-RR-2 @ 2'-4'
10392-004		03/06/2001	1615	Soil	GP-RR-2 @ 14'-16'
10392-005		03/06/2001	1647	Soil	GP-RR-3 @ 2'- 4'
10392-006		03/06/2001	1754	Soil	GP-RR-3 @ 14'-16'
10392-007		03/07/2001	0822	Soil	GP-RR-4 @ 2'- 4'
10392-008		03/07/2001	0906	Soil	GP-RR-4 @ 14'-16'
10392-009		03/07/2001	0928	Soil	GP-RR-5 @ 2'- 4'
10392-010		03/07/2001	1017	Soil	GP-RR-5 @ 14'-16'
10392-011		03/07/2001	1045	Soil	GP-RR-6 @ 2'- 4'
10392-012		03/07/2001	1206	Soil	GP-RR-6 @ 14'-16'
10392-013		03/07/2001	1252	Soil	GP-RR-7 @ 2'- 4'
10392-014		03/07/2001	1326	Soil	GP-RR-7 @ 14'-16'
10392-015		03/07/2001	1346	Soil	GP-RR-8 @ 2'- 4'
10392-016		03/07/2001	1432	Soil	GP-RR-8 @ 14'-16'
10392-017		03/07/2001	1451	Soil	GP-RR-9 @ 2'- 4'
10392-018		03/07/2001	1548	Soil	GP-RR-9 @ 14'-16'
10392-019		03/07/2001	1620	Soil	GP-RR-10 @ 2'- 4'
10392-020		03/07/2001	1720	Soil	GP-RR-10 @ 14'-16'
10392-021		03/08/2001	0739	Soil	GP-RR-11 @ 2'- 4'
10392-022		03/08/2001	0935	Soil	GP-RR-11 @ 14'-16'
10392-023		03/08/2001	0833	Soil	GP-RR-12 @ 2'- 4'
10392-024		03/08/2001	0943	Soil	GP-RR-12 @ 14'-16'
10392-025		03/08/2001	1007	Soil	GP-RR-13 @ 2'- 4'
10392-026		03/08/2001	1122	Soil	GP-RR-13 @ 14'-16'
10392-027		03/08/2001	1057	Soil	GP-RR-14 @ 2'- 4'
10392-028		03/08/2001	1139	Soil	GP-RR-14 @ 14'-16'
10392-029		03/08/2001	1202	Soil	GP-RR-15 @ 2'- 4'
10392-030		03/08/2001	1303	Soil	GP-RR-15 @ 14'-16'
10392-031		03/08/2001	1319	Soil	GP-RR-16 @ 2'- 4'
10392-032		03/08/2001	1353	Soil	GP-RR-16 @ 14'-16'

REPORT DATE: 04/02/2001 REPORT NUMBER: 10392 PAGE: 1 OF 17

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
GP-RR-1 @ 2'-4'						
10392-001	NWTPH-Dx	DIESEL	260	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	132	%RECOVERY	50%-150%	

REVIEWED BY:
Martin Little - Quality Manager

CERTIFICATE OF ANALYSIS

ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
GP-RR-1 @ 2'-4'						
10392-001	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/24/2001
		ANTHRACENE	0.50	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	0.20	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	57	%RECOVERY	50%-150%	
GP-RR-1 @ 14'-16'						
10392-002	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	95	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/24/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	74	%RECOVERY	50%-150%	
GP-RR-2 @ 2'-4'						
10392-003	NWTPH-Dx	DIESEL	110	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	103	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS ORIGINA

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
GP-RR-2 @ 2'-4'						
10392-003	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/24/2001
		ANTHRACENE	0.066	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	0.077	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	0.21	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	55	%RECOVERY	50%-150%	
GP-RR-2 @ 14'-16'						
10392-004	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	77	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/24/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	54	%RECOVERY	50%-150%	
GP-RR-3 @ 2'- 4'						
10392-005	NWTPH-Dx	DIESEL	29	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	57	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
GP-RR-3 @ 2'- 4'						
10392-005	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/24/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	109	%RECOVERY	50%-150%	
GP-RR-3 @ 14'-16'						
10392-006	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	77	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/24/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	54	%RECOVERY	50%-150%	
GP-RR-4 @ 2'- 4'						
10392-007	NWTPH-Dx	DIESEL	33	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	51	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
GP-RR-4 @ 2'- 4'						
10392-007	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/24/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	108	%RECOVERY	50%-150%	
GP-RR-4 @ 14'-16'						
10392-008	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	54	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/24/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	118	%RECOVERY	50%-150%	
GP-RR-5 @ 2'- 4'						
10392-009	NWTPH-Dx	DIESEL	29	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	66	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
GP-RR-5 @ 2'- 4'						
10392-009	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/24/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	108	%RECOVERY	50%-150%	
GP-RR-5 @ 14'-16'						
10392-010	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	56	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/24/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	127	%RECOVERY	50%-150%	
GP-RR-6 @ 2'- 4'						
10392-011	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	59	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
GP-RR-6 @ 2'- 4'						
10392-011	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/24/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPETHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	62	%RECOVERY	50%-150%	
GP-RR-6 @ 14'-16'						
10392-012	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	51	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/24/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	104	%RECOVERY	50%-150%	
GP-RR-7 @ 2'- 4'						
10392-013	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	91	%RECOVERY	50%-150%	

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SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
GP-RR-7 @ 2'- 4'						
10392-013	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/24/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	75	%RECOVERY	50%-150%	
GP-RR-7 @ 14'-16'						
10392-014	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	67	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/24/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	70	%RECOVERY	50%-150%	
GP-RR-8 @ 2'- 4'						
10392-015	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	145	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

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SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
GP-RR-8 @ 2'- 4'						
10392-015	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/24/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	108	%RECOVERY	50%-150%	
GP-RR-8 @ 14'-16'						
10392-016	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	56	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/24/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	77	%RECOVERY	50%-150%	
GP-RR-9 @ 2'- 4'						
10392-017	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	81	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

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SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
GP-RR-9 @ 2'- 4'						
10392-017	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/24/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	100	%RECOVERY	50%-150%	
GP-RR-9 @ 14'-16'						
10392-018	NWTPH-Dx	DIESEL	46	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	140	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/24/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	102	%RECOVERY	50%-150%	
GP-RR-10 @ 2'- 4'						
10392-019	NWTPH-Dx	DIESEL	400	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
GP-RR-10 @ 2'- 4'						
10392-019	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/24/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	105	%RECOVERY	50%-150%	
GP-RR-10 @ 14'-16'						
10392-020	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	74	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/24/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	98	%RECOVERY	50%-150%	
GP-RR-11 @ 2'- 4'						
10392-021	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	93	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
GP-RR-11 @ 2'- 4'						
10392-021	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/24/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	115	%RECOVERY	50%-150%	
GP-RR-11 @ 14'-16'						
10392-022	NWTPH-Dx	DIESEL	990	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.11	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.061	mg/Kg	0.05	03/24/2001
		ANTHRACENE	0.35	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	0.29	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	0.054	mg/Kg	0.05	
		PHENANTHRENE	1.2	mg/Kg	0.05	
		PYRENE	0.071	mg/Kg	0.05	
		SURROGATE	132	%RECOVERY	50%-150%	
GP-RR-12 @ 2'- 4'						
10392-023	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	119	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
GP-RR-12 @ 2'- 4'						
10392-023	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/24/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	77	%RECOVERY	50%-150%	
GP-RR-12 @ 14'-16'						
10392-024	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	105	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/25/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	86	%RECOVERY	50%-150%	
GP-RR-13 @ 2'- 4'						
10392-025	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	111	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
GP-RR-13 @ 2'- 4'						
10392-025	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/25/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	89	%RECOVERY	50%-150%	
GP-RR-13 @ 14'-16'						
10392-026	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/29/2001
		SURROGATE RECOVERY	99	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/25/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	72	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

ORIGINAL

CLIENT: GLENBROOK NICKEL - SMELTER
5093 RIDDLE BYPASS RD.
RIDDLE OR 97469

PHONE: (541) 874-3171
FAX: (541) 874-3380

DATE SUBMITTED: 03/09/2001

PROJECT NAME: GLENBROOK NICKEL, GEOPROBE

PROJECT NUMBER: JB 021.35

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
10393-001		03/06/2001	1427	Soil	GP-RR-1 @ 18'-20'
10393-002		03/06/2001	1619	Soil	GP-RR-2 @ 18'-20'
10393-003		03/06/2001	1759	Soil	GP-RR-3 @ 18'-20'
10393-004		03/07/2001	0913	Soil	GP-RR-4 @ 18'-20'
10393-005		03/07/2001	1022	Soil	GP-RR-5 @ 18'-20'
10393-006		03/07/2001	1211	Soil	GP-RR-6 @ 18'-20'
10393-007		03/07/2001	1331	Soil	GP-RR-7 @ 18'-20'
10393-008		03/07/2001	1437	Soil	GP-RR-8 @ 18'-20'
10393-009		03/07/2001	1553	Soil	GP-RR-9 @ 18'-20'
10393-010		03/07/2001	1725	Soil	GP-RR-10 @ 18'-20'
10393-011		03/08/2001	0940	Soil	GP-RR-11 @ 18'-20'
10393-012		03/08/2001	0943	Soil	GP-RR-12 @ 18'-20'
10393-013		03/08/2001	1127	Soil	GP-RR-13 @ 18'-20'
10393-014		03/08/2001	1307	Soil	GP-RR-15 @ 16'-18'
10393-015		03/08/2001	1359	Soil	GP-RR-16 @ 18'-20'

REPORT DATE: 04/12/2001 REPORT NUMBER: 10393

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
GP-RR-11 @ 18'-20'						
10393-011	NWTPH-Dx	DIESEL	46	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	04/10/2001
		SURROGATE RECOVERY	81	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	04/09/2001
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	

REVIEWED BY: _____
Martin Littie - Quality Manager

CERTIFICATE OF ANALYSIS ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
GP-RR-11 @ 18'-20'						
10393-011	PNAH 1	PHENANTHRENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	PYRENE	ND	mg/Kg	0.005	04/09/2001
		SURROGATE	106	%RECOVERY	50%-150%	
GP-RR-15 @ 16'-18'						
10393-014	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	04/10/2001
		SURROGATE RECOVERY	56	%RECOVERY	50%-150%	
	PNAR 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	04/09/2001
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	84	%RECOVERY	50%-150%	

AUGUST MACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION:
PAGE 1 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-1

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/6/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
Gravel blackish gray	1			NS	
1.1' Silty CLAY, reddish brown with small gravel, moist, firm	2		60		
	3			149	
	4				
	5		No Sample		
	6				
	7				
	8				
	9		100	NS	
	10				
	11			19	
	12				
Silty CLAY, brownish-gray, moist, soft	13		100	46	
	14				
	15			0	
Silty CLAY, reddish brown with small gravel, moist, firm	16				
	17		90	8	
	18				

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm
No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors
NS = Not Sampled

AUGUST MACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION: BG
PAGE 2 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-1

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/6/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
	19		90	2	
	20				
Boring Terminated @ 20.0'					

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm
No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors

AUGUST MACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION:
PAGE 1 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-2

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/6/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
Silty CLAY, reddish brown with chert (small rocks), moist, firm	1			NS	
	2		50		
	3			104	
	4				
	5		No Sample		
	6				
	7				
	8				
	9		100	NS	
	10				
Silty CLAY, reddish brown with chert, dry, hard	11			20	
	12				
	13		90	80	
	14				
	15			3	
Silty CLAY, reddish brown with chert, firm, moist	16				
	17		50	48	
	18				

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm
No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors
NS = Not Sampled

AUGUST MACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION: BG
PAGE 2 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-2

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/6/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
	19		50	1	
	20				
Boring Terminated @ 20.0'					

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm
No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors

AUGUST BLACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION:
PAGE 1 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-3

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/6/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
GRAVEL	1			NS	
	2		50		
Silty CLAY, reddish-brown with chert, moist, soft	3			62	
	4				
	5				
	6		No Sample		
	7				
	8				
	9			NS	
	10		100		
Silty CLAY, reddish-brown with chert, moist, firm	11			13	
	12				
12.0' Silty CLAY, reddish-brown with chert, moist, soft	13			9	
13.3' Silty CLAY, reddish-brown with chert, moist, firm	14		100		
	15			10	
	16				
16.00' Silty CLAY, reddish-brown with chert, moist, soft	17		100	10	
17.25' Silty CLAY, reddish-brown with chert, moist, firm	18				

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm
No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors
NS = Not Sampled

AUGUST BLACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION: BG
PAGE 2 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-3

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/6/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
	19		100	4	
	20				
Boring Terminated @ 20.0'					

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm
No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors

AUGUST ACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION:
PAGE 1 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-4

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/7/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
GRAVEL 0.5'					
Silty CLAY, brownish-gray with chert, moist, soft	1			NS	
	2		60		
	3			14	
	4				
	5				
	6		No Sample		
	7				
	8				
	9			NS	
8.7' Silty CLAY, reddish-brown with chert, moist, firm	10		100		
	11			6	
	12				
	13			6	
	14		100		
	15			6	
	16				
	17		100	5	
	18				

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm
No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors
NS = Not Sampled

AUGUST MACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION: BG
PAGE 2 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-4

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/7/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
	19		100	4	
	20				
Boring Terminated @ 20.0'					

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm
No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors

AUGUST MACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION:
PAGE 1 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-5

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/7/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
GRAVEL 0.33'					
Silty CLAY, reddish-brown with chert, moist, soft	1			NS	
	2		50		
	3			5	
	4				
	5				
	6		No Sample		
	7				
	8				
8.5' Silty CLAY, blackish-gray with chert, moist, soft	9			NS	
	10		80		
10.2' Silty CLAY, reddish-brown with chert, moist, soft	11			42	
	12				
	13			11	
13.3' Silty CLAY, reddish-brown with chert, moist, firm	14		95		
	15			3	
	16				
	17		100	0	
	18				

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm
No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors
NS = Not Sampled

AUGUST MACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION: BG
PAGE 2 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-5

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/7/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
	19		100	0	
	20				
Boring Terminated @ 20.0'					

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm
No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors

AUGUST MACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION:
PAGE 1 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-6

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/7/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
GRAVEL 0.5'					
Silty CLAY, reddish-brown with chert, moist, firm	1			NS	
	2		80		
	3			0	
	4				
	5				
	6		No Sample		
	7				
	8				
	9			NS	
	10		50		
	11			0	
	12				
	13			0	
	14		100		
	15			0	
	16				
	17		100	0	
	18				

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm
No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors
NS = Not Sampled

AUGUST MACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION: BG
PAGE 2 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-6

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/7/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
	19		100		
	20				
Boring Terminated @ 20.0'					

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm
No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors

AUGUST BLACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION:
PAGE 1 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-7

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/7/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
Silty CLAY, reddish-brown with chert, moist, firm	1			NS	
	2		50		
	3				
	4				
	5				
	6		No Sample		
	7				
	8				
8.0' Silty CLAY, reddish-brown with rocks, saturated, loose	9			NS	
	10		25		
	11				
	12				
	13				
	14		20		Not enough to analyze with PID
	15				
	16				
	17		25		Not enough to analyze with PID
	18				

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm

No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors
NS = Not Sampled

AUGUST MACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION: BG
PAGE 2 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-7

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/7/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
	19		25		
	20				
Boring Terminated @ 20.0'					

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm
No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors

AUGUST BLACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION:
PAGE 1 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-8

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/7/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
0.5' GRAVEL					
Silty CLAY, reddish-brown with chert, moist, firm	1			NS	
	2		75		
	3			6	
	4				
	5		Not Sampled		
	6				
	7				
	8				
	9		100	NS	
	10				
	11			0	
	12				
	13		100	0	
	14				
	15			2	
	16				
	17			0	
	18				

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm
No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors
NS = Not Sampled

AUGUST MACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION: BG
PAGE 2 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-8

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/7/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
	19			0	
	20				
Boring Terminated @ 20.0'					

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm
No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors

AUGUST BLACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION:
PAGE 1 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-9

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/7/01
ELEVATION: .
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
1.4' GRAVEL					
Silty CLAY, reddish-brown with chert, moist, firm	1			NS	
	2		75		
	3			6	
	4				
	5		Not Sampled		
	6				
	7				
	8				
	9		100	NS	
	10				
	11			7	
	12				
	13		80	7	
	14				
	15			9	
	16				
	17		100	0	
	18				

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm
No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors
NS = Not Sampled

AUGUST ACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION: BG
PAGE 2 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-9

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/7/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
	19		100	0	
	20				
Boring Terminated @ 20.0'					

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm
No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors

AUGUST MACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION:
PAGE 1 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-10

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/7/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
GRAVEL	1			NS	
1.5' Silty CLAY, bluish-green, moist, soft	2		60		
	3			32	
	4				
	5		Not Sampled		
	6				
	7				
	8				
8.0' Silty CLAY, brown, moist, firm	9			NS	
	10		100		
	11			0	
	12				
12.0' Silty CLAY, bluish-gray with chert, moist, firm	13			3	
	14		100		
	15			2	
	16				
	17		100	3	
	18				

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm

No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors
NS = Not Sampled

AUGUST MACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION: BG
PAGE 2 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-10

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/7/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
	19		100	3	
	20				
Boring Terminated @ 20.0'					

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm
No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors

AUGUST MACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION:
PAGE 1 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-11

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/8/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
GRAVEL	1			NS	
1.3' Silty CLAY, reddish-brown with chert, moist, firm	2		70		
	3			1	
	4				
	5		Not Sampled		
	6				
	7				
	8				
	9		100	NS	
	10				
9.8' Silty CLAY, greenish-gray with chert, moist, firm	11			3	
	12				
	13		100	0	
	14				
	15			55	
	16				
16.5' Silty CLAY, reddish-brown with chert, moist, firm	17		100	13	
	18				

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm
No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors
NS = Not Sampled

AUGUST BLACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION: BG
PAGE 2 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-11

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/8/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
	19		100	36	
	20				
Boring Terminated @ 20.0'					

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm
No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors

AUGUST MACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION:
PAGE 1 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-12

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/8/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
GRAVEL	1			NS	
1.4' Silty CLAY, reddish-brown with chert, moist, firm	2		60		
	3			2	
	4				
	5		Not Sampled		
	6				
	7				
	8				
	9		100	NS	
	10				
	11			1	
	12				
	13		100	2	
	14				
	15			0	
	16				
	17		100	0	
17.4' Silty CLAY, light brown, dry, hard	18				

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm
No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors
NS = Not Sampled

AUGUST MACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION: BG
PAGE 2 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-12

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/8/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
	19		100	0	
	20				
Boring Terminated @ 20.0'					

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm
No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors

AUGUST BLACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION:
PAGE 1 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-13

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/8/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
GRAVEL	1			NS	
1.4' Silty CLAY, reddish-brown with chert, moist, firm	2		75		
	3			0	
	4				
	5		Not Sampled		
	6				
	7				
	8				
	9		100	NS	
	10				
	11			1	
	12				
Silty CLAY, reddish-brown, dry, firm	13		100	0	
	14				
	15			0	
	16				
	17		100	0	
	18				

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm
No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors
NS = Not Sampled

AUGUST MACK ENVIRONMENTAL INC

RECORD OF SUBSURFACE INVESTIGATION

BORING IDENTIFICATION: BG
PAGE 2 OF

CLIENT: Cominco
PROJECT NAME: Subsurface Investigation
SITE LOCATION: Riddle
DRILLING LOCATION: GP-RR-13

PROJECT NUMBER: JB021.35
DATE DRILLED: 3/8/01
ELEVATION:
DRILLING METHOD: Geoprobe

GEOLOGIC DESCRIPTION	FT	No	REC%	TCV (ppm)	COMMENTS
	19		100	0	
	20				
Boring Terminated @ 20.0'					

* = Sample Submitted for Analysis
AMSL = Above Mean Sea Level
BLW = Blows Per 6 Inches
FT = Stratum Depth in Feet Below Grade
HSA = Hollow Stem Auger
ND = Not Detected at 2 ppm
No = Sample Number
ppm = Parts Per Million
REC = Percent of Total Sample Recovered
SS = Split-Spoon Sampler
TCV = Total Combustible Vapors

Appendix D

Confirmation Sampling Results
Sanitary Sand Filter Beds (AOC-R-4)

CERTIFICATE OF ANALYSIS

CLIENT: GLENBROOK NICKEL - SMELTER
5093 RIDDLE BYPASS RD.
RIDDLE OR 97469

PHONE: (541) 874-3171
FAX: (541) 874-3380

DATE SUBMITTED: 03/29/2001

PROJECT NAME: GLENBROOK-RIDDLE: AOC-R-4

PROJECT NUMBER: JA036.15

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
10522-001	CS-1	03/27/2001	0950	Soil	SOIL SAMPLE
10522-002	CS-1D	03/27/2001	0952	Soil	SOIL SAMPLE
10522-003	CS-2	03/27/2001	0940	Soil	SOIL SAMPLE
10522-004	CS-2D	03/27/2001	0942	Soil	SOIL SAMPLE
10522-005	CS-3	03/27/2001	1007	Soil	SOIL SAMPLE
10522-006	CS-4	03/27/2001	1005	Soil	SOIL SAMPLE
10522-007	CS-5	03/27/2001	1000	Soil	SOIL SAMPLE
10522-008	CS-5D	03/27/2001	1002	Soil	SOIL SAMPLE
10522-009	CS-6	03/27/2001	0955	Soil	SOIL SAMPLE
10522-010	CS-6D	03/27/2001	0957	Soil	SOIL SAMPLE
10522-011	CS-7	03/27/2001	1010	Soil	SOIL SAMPLE
10522-012	CS-8	03/27/2001	1012	Soil	SOIL SAMPLE
10522-013	CS-9	03/27/2001	0845	Soil	SOIL SAMPLE
10522-014	CS-9D	03/27/2001	0847	Soil	SOIL SAMPLE
10522-015	CS-10	03/27/2001	0855	Soil	SOIL SAMPLE
10522-016	CS-10D	03/27/2001	0857	Soil	SOIL SAMPLE
10522-017	CS-11	03/27/2001	0900	Soil	SOIL SAMPLE
10522-018	CS-11D	03/27/2001	0902	Soil	SOIL SAMPLE
10522-019	CS-12	03/27/2001	0910	Soil	SOIL SAMPLE
10522-020	CS-12D	03/27/2001	0912	Soil	SOIL SAMPLE
10522-021	CS-13	03/27/2001	0915	Soil	SOIL SAMPLE
10522-022	CS-14	03/27/2001	0920	Soil	SOIL SAMPLE
10522-023	CS-15	03/27/2001	0925	Soil	SOIL SAMPLE
10522-024	CS-16	03/27/2001	0930	Soil	SOIL SAMPLE

REPORT DATE: 04/02/2001 REPORT NUMBER: 10522

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-1				
10522-001	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	PPM	0.40	Greg W 04/02/2001
SOIL SAMPLE		SAMPLE ID: CS-1D				
10522 002	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	PPM	0.40	Greg W 04/02/2001
SOIL SAMPLE		SAMPLE ID: CS-2				
10522-003	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	PPM	0.40	Greg W 04/02/2001

REVIEWED BY: _____
Martin Little - Quality Manager

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-2D				
10522-004	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	PPM	0.12	Greg W 04/02/2001
SOIL SAMPLE		SAMPLE ID: CS-3				
10522-005	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	PPM	0.40	Greg W 04/02/2001
SOIL SAMPLE		SAMPLE ID: CS-4				
10522-006	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	PPM	0.40	Greg W 04/02/2001
SOIL SAMPLE		SAMPLE ID: CS-5				
10522-007	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	PPM	0.40	Greg W 04/02/2001
SOIL SAMPLE		SAMPLE ID: CS-5D				
10522-008	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	PPM	0.40	Greg W 04/02/2001
SOIL SAMPLE		SAMPLE ID: CS-6				
10522-009	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	PPM	0.40	Greg W 04/02/2001
SOIL SAMPLE		SAMPLE ID: CS-6D				
10522-010	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	PPM	0.40	Greg W 04/02/2001
SOIL SAMPLE		SAMPLE ID: CS-7				
10522-011	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	PPM	0.40	Greg W 04/02/2001
SOIL SAMPLE		SAMPLE ID: CS-8				
10522-012	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	PPM	0.40	Greg W 04/02/2001
SOIL SAMPLE		SAMPLE ID: CS-9				
10522-013	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	PPM	0.40	Greg W 04/02/2001
SOIL SAMPLE		SAMPLE ID: CS-9D				
10522-014	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	PPM	0.40	Greg W 04/02/2001
SOIL SAMPLE		SAMPLE ID: CS-10				
10522-015	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	PPM	0.40	Greg W 04/02/2001
SOIL SAMPLE		SAMPLE ID: CS-10D				
10522-016	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	PPM	0.40	Greg W 04/02/2001

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-11				
10522-017	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	PPM	0.40	Greg W 04/02/2001
SOIL SAMPLE		SAMPLE ID: CS-11D				
10522-018	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	4.1	PPM	0.40	Greg W 04/02/2001
SOIL SAMPLE		SAMPLE ID: CS-12				
10522-019	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	PPM	0.40	Greg W 04/02/2001
SOIL SAMPLE		SAMPLE ID: CS-12D				
10522-020	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	PPM	0.40	Greg W 04/02/2001
SOIL SAMPLE		SAMPLE ID: CS-13				
10522-021	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	PPM	0.40	Greg W 04/02/2001
SOIL SAMPLE		SAMPLE ID: CS-14				
10522-022	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	PPM	0.40	Greg W 04/02/2001
SOIL SAMPLE		SAMPLE ID: CS-15				
10522-023	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	PPM	0.40	Greg W 04/02/2001
SOIL SAMPLE		SAMPLE ID: CS-16				
10522-024	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	PPM	0.40	Greg W 04/02/2001

Appendix E

Confirmation Sampling Results
Granulation Ladle Tilt Station Hydraulic System (AOC-R-5)

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015	Date Reported: 09/07/00
PWS#:	Date Collected: 08/30/00
PWS Name:	Time Collected: 2:05 PM
Sampled At:	Sampled By: Talbot Tomes

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	Glenbrook Nickel
P.O. Box 85	AOC-R 5,6
5093 Riddle By-pass Road	Invoice#
Riddle, OR 97469	3892

Polynuclear Aromatic Hydrocabons — Matrix: solid

URC Sample #: 200830-24

Sample ID: AOC-5-4A

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Acenaphthene	EPA 8270	ND@0.1	mg/kg		09/05/00	BKO
Acenaphthylene	EPA 8270	ND@0.1	mg/kg		09/05/00	BKO
Anthracene	EPA 8270	ND@0.1	mg/kg		09/05/00	BKO
Benzo(a)anthracene	EPA 8270	ND@0.1	mg/kg		09/05/00	BKO
Benzo(a)pyrene	EPA 8270	ND@0.1	mg/kg		09/05/00	BKO
Benzo(b)fluoranthene	EPA 8270	ND@0.1	mg/kg		09/05/00	BKO
Benzo(ghi)perylene	EPA 8270	ND@0.1	mg/kg		09/05/00	BKO
Benzo(k)fluoranthene	EPA 8270	ND@0.1	mg/kg		09/05/00	BKO
Chrysene	EPA 8270	ND@0.1	mg/kg		09/05/00	BKO
Dibenzo(ah)anthracene	EPA 8270	ND@0.1	mg/kg		09/05/00	BKO
Fluoranthene	EPA 8270	ND@0.1	mg/kg		09/05/00	BKO
Fluorene	EPA 8270	ND@0.1	mg/kg		09/05/00	BKO
Indeno(1,2,3-cd)pyrene	EPA 8270	ND@0.1	mg/kg		09/05/00	BKO
Naphthalene	EPA 8270	ND@0.1	mg/kg		09/05/00	BKO
Phenanthrene	EPA 8270	ND@0.1	mg/kg		09/05/00	BKO
Pyrene	EPA 8270	ND@0.1	mg/kg		09/05/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200830-24

Appendix F

Confirmation Sampling Results
Lube Oil Storage Area (AOC-R-6)

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
Source Name:
Sampled At:

Date Reported: 09/07/00
Date Collected: 08/30/00
Time Collected: 13:25-13:30
Sampled By: Talbot Tomes

COMINCO Ltd., Glenbrook Operation
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

Glenbrook Nickel
AOC-R 5,6

Invoice# 3892

NWTPH-HCID

Matrix: Soil

URC Sample #:		200830-22	200830-23					
Sample ID:		AOC-6 A	AOC-6 B					
URC Sample#	Units	Results	Results			Method	Date Analyzed	Analyst
Hydrocarbon ID		Oils	ND			NWTPH-HCID	09/05/00	BKO
% Surrogate Recovery	%	120.6	82.1				09/05/00	BKO
Oils	mg/kg	1250				NWTPH-Dx	09/05/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected At Level Indicated

Approved By:

200830-22

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

FAXED 9/29/00

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
Source Name:
Sampled At:

Date Reported: 09/29/00
Date Collected: 09/19/00
Time Collected: 10:55 AM
Sampled By: David Katz

COMINCO Ltd., Glenbrook Operation
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

JA 036.15

Invoice# 4091

Polynuclear Aromatic Hydrocarbons — **Matrix:** Soil

	URC Sample #:	200919-49	200919-50					
	Sample ID:	HA-1 AOC R-6	HA-2 AOC R-6					
URC Sample#	Units	Results	Results			Method	Date Analyzed	Analyst
Hydrocarbon ID		ND	ND			NWTPH-HCID	09/26/00	BKO
% Surrogate Recovery	%	86.5	85.3				09/26/00	BKO
Confirmation	mg/kg	—	—			NWTPH-Dx	09/26/00	BKO
PAH's								
Acenaphthene	mg/kg	ND@1.0	ND@1.0			EPA 8270	09/26/00	BKO
Acenaphthylene	mg/kg	ND@1.0	ND@1.0			EPA 8270	09/26/00	BKO
Anthracene	mg/kg	ND@1.0	ND@1.0			EPA 8270	09/26/00	BKO
Benzo(a)anthracene	mg/kg	ND@1.0	ND@1.0			EPA 8270	09/26/00	BKO
Benzo(a)pyrene	mg/kg	ND@1.0	ND@1.0			EPA 8270	09/26/00	BKO
Benzo(b)fluoranthene	mg/kg	ND@1.0	ND@1.0			EPA 8270	09/26/00	BKO
Benzo(ghi)perylene	mg/kg	ND@1.0	ND@1.0			EPA 8270	09/26/00	BKO
Benzo(k)fluoranthene	mg/kg	ND@1.0	ND@1.0			EPA 8270	09/26/00	BKO
Chrysene	mg/kg	ND@1.0	ND@1.0			EPA 8270	09/26/00	BKO
Dibenzo(ah)anthracene	mg/kg	ND@1.0	ND@1.0			EPA 8270	09/26/00	BKO
Fluoranthene	mg/kg	ND@1.0	ND@1.0			EPA 8270	09/26/00	BKO
Fluorene	mg/kg	ND@1.0	ND@1.0			EPA 8270	09/26/00	BKO
Indeno(1,2,3-cd)pyrene	mg/kg	ND@1.0	ND@1.0			EPA 8270	09/26/00	BKO
Naphthalene	mg/kg	ND@1.0	ND@1.0			EPA 8270	09/26/00	BKO
Phenanthrene	mg/kg	ND@1.0	ND@1.0			EPA 8270	09/26/00	BKO
Pyrene	mg/kg	ND@1.0	ND@1.0			EPA 8270	09/26/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected At Level Indicated

Approved By:

200919-49-50

Appendix G

Confirmation Sampling Results
Calciner Lube Oil Areas (AOC-R-8)

CERTIFICATE OF ANALYSIS

CLIENT: GLENBROOK NICKEL - SMELTER
5093 RIDDLE BYPASS RD.
RIDDLE OR 97469

PHONE: (541) 874-3171
FAX: (541) 874-3380

DATE SUBMITTED: 09/21/2001

PROJECT NAME: GLENBROOK NICKEL: AOC-8 RIDDLE PROJECT NUMBER: JA036.15

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
11436-001		09/19/2001	1245	Soil	CS-1 South 4.0'
11436-002		09/19/2001	1250	Soil	CS-2 East 4.0'
11436-003		09/19/2001	1255	Soil	CS-3 North 4.0'
11436-004		09/19/2001	1300	Soil	CS-4 West 4.0'

REPORT DATE: 10/01/2001 REPORT NUMBER: 11436 PAGE: 1 OF 3

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-1 South 4.0'						
11436-001	NWTPH-Dx	DIESEL	37	mg/Kg	25	Dave M
	NWTPH-Dx	HEAVY OILS	149	mg/Kg	100	10/01/2001
		SURROGATE RECOVERY	77.1	%RECOVERY	50%-150%	
	PNAH]	ACENAPHTHENE	ND	mg/Kg	0.0081	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.0081	09/28/2001
		ANTHRACENE	ND	mg/Kg	0.0081	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.0081	
		BENZO(A)PYRENE	ND	mg/Kg	0.0081	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0081	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.0081	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0081	
		CHRYSENE	ND	mg/Kg	0.0081	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0081	
		FLUORANTHENE	ND	mg/Kg	0.0081	
		FLUORENE	ND	mg/Kg	0.0081	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0081	
		NAPHTHALENE	ND	mg/Kg	0.0081	
		PHENANTHRENE	ND	mg/Kg	0.0081	
		PYRENE	ND	mg/Kg	0.0081	
		SURROGATE	94	%RECOVERY	50%-150%	
CS-2 East 4.0'						
11436-002	NWTPH-Dx	DIESEL	38	mg/Kg	25	Dave M
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	09/26/2001
		SURROGATE RECOVERY	65.0	%RECOVERY	50%-150%	
	PNAH]	ACENAPHTHENE	ND	mg/Kg	0.00935	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00935	09/28/2001

REVIEWED BY: David Back - QS Manager

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-2 East 4.0'						
11436-002	PNAH 1	ANTHRACENE	ND	mg/Kg	0.00935	Robert M
	EPA 8270M (SIM)	BENZO(A)ANTHRACENE	ND	mg/Kg	0.00935	09/28/2001
		BENZO(A)PYRENE	ND	mg/Kg	0.00935	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00935	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00935	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00935	
		CHRYSENE	ND	mg/Kg	0.00935	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00935	
		FLUORANTHENE	ND	mg/Kg	0.00935	
		FLUORENE	ND	mg/Kg	0.00935	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00935	
		NAPHTHALENE	ND	mg/Kg	0.00935	
		PHENANTHRENE	ND	mg/Kg	0.00935	
		PYRENE	ND	mg/Kg	0.00935	
		SURROGATE	94	%RECOVERY	50%-150%	
CS-3 North 4.0'						
11436-003	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Dave M
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	09/26/2001
		SURROGATE RECOVERY	62.4	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.0099	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.0099	09/28/2001
		ANTHRACENE	ND	mg/Kg	0.0099	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.0099	
		BENZO(A)PYRENE	ND	mg/Kg	0.0099	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0099	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.0099	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0099	
		CHRYSENE	ND	mg/Kg	0.0099	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0099	
		FLUORANTHENE	ND	mg/Kg	0.0099	
		FLUORENE	ND	mg/Kg	0.0099	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0099	
		NAPHTHALENE	ND	mg/Kg	0.0099	
		PHENANTHRENE	ND	mg/Kg	0.0099	
		PYRENE	ND	mg/Kg	0.0099	
		SURROGATE	101	%RECOVERY	50%-150%	
CS-4 West 4.0'						
11436-004	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Dave M
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	09/26/2001
		SURROGATE RECOVERY	57.1	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.01445	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.01445	09/28/2001

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-4 West 4.0'						
11436-004	PNAH 1	ANTHRACENE	ND	mg/Kg	0.01445	Robert M
	EPA 8270M (SIM)	BENZO(A)ANTHRACENE	ND	mg/Kg	0.01445	09/28/2001
		BENZO(A)PYRENE	ND	mg/Kg	0.01445	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.01445	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.01445	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.01445	
		CHRYSENE	ND	mg/Kg	0.01445	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.01445	
		FLUORANTHENE	ND	mg/Kg	0.01445	
		FLUORENE	ND	mg/Kg	0.01445	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.01445	
		NAPHTHALENE	ND	mg/Kg	0.01445	
		PHENANTHRENE	ND	mg/Kg	0.01445	
		PYRENE	ND	mg/Kg	0.01445	
		SURROGATE	91	%RECOVERY	50%-150%	

Appendix H

Confirmation Sampling Results
Diesel Fueling Station and Fuel Line Area (AOC-R-10)

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

FAXED 9-19-00

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
Source Name:
Sampled At: CS

Date Reported: 09/18/00
Date Collected: 09/07/00
Time Collected: 10:45-10:55
Sampled By: David Katz

COMINCO Ltd., Glenbrook Operation
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

Cominco-Riddle
Glenbrook
JA036.15

Invoice# 3963

Polynuclear Aromatic Hydrocarbons

Matrix: Soil

URC Sample #:		200907-16	200907-17	200907-18	200907-19			
Sample ID:		CS-1	CS-2	CS-3	CS-4			
URC Sample#	Units	Results	Results	Results	Results	Method	Date Analyzed	Analyst
Hydrocarbon ID		ND	ND	Diesel	ND	WTPH-HCID	09/13/00	BEM
% Surrogate Recovery	%	112.5	94.4	108.3	118.3		09/13/00	BEM
Confirmation	mg/kg			103		NWTPH-Dx	09/13/00	BEM
PAH's								
Acenaphthene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Acenaphthylene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Anthracene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Benzo(a)anthracene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Benzo(a)pyrene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Benzo(b)fluoranthene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Benzo(ghi)perylene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Benzo(k)fluoranthene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Chrysene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Dibenzo(ah)anthracene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Fluoranthene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Fluorene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Indeno(1,2,3-cd)pyrene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Naphthalene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Phenanthrene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Pyrene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected At Level Indicated

Approved By: [signature]

200907-16-19

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

FAXED 9-19-00

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
Source Name:
Sampled At:

Date Reported: 09/18/00
Date Collected: 09/07/00
Time Collected: 11:00-11:15
Sampled By: David Katz

COMINCO Ltd., Glenbrook Operation
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

Cominco-Riddle
Glenbrook
JA036.15

Invoice#
3963

Polynuclear Aromatic Hydrocarbons

Matrix: Soil

URC Sample #:		200907-20	200907-21	200907-22	200907-23			
Sample ID:		CS-5	CS-6	CS-7	CS-8			
URC Sample#	Units	Results	Results	Results	Results	Method	Date Analyzed	Analyst
Hydrocarbon ID		ND	ND	ND	ND	WTPH-HCID	09/13/00	BEM
% Surrogate Recovery	%	77.5	70.3	50.7	71.2		09/13/00	BEM
PAH's								
Acenaphthene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Acenaphthylene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Anthracene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Benzo(a)anthracene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Benzo(a)pyrene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Benzo(b)fluoranthene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Benzo(ghi)perylene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Benzo(k)fluoranthene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Chrysene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Dibenzo(ah)anthracene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Fluoranthene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Fluorene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Indeno(1,2,3-cd)pyrene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Naphthalene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Phenanthrene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Pyrene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected At Level Indicated

Approved By:

200907-20-23

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

FAXED 9-19-00

REPORT

OREGON STATE CERTIFIED LAB #015	Date Reported: 09/18/00
PWS#:	Date Collected: 09/07/00
Source Name:	Time Collected: 11:20-11:35
Sampled At:	Sampled By: David Katz

COMINCO Ltd., Glenbrook Operation	Cominco - Riddle
P.O. Box 85	Glenbrook
5093 Riddle By-pass Road	JA036.15
Riddle, OR 97469	Invoice# 3963

Polynuclear Aromatic Hydrocarbons — Matrix: Soil

URC Sample #:		200907-24	200907-25	200907-26	200907-27			
Sample ID:		CS-9	CS-10	CS-11	CS-12			
URC Sample#	Units	Results	Results	Results	Results	Method	Date Analyzed	Analyst
Hydrocarbon ID		ND	ND	ND	Oils	WTPH-HCID	09/14/00	BEM
% Surrogate Recovery	%	101.3	90.7	73.7	79.9		09/14/00	BEM
Confirmation	mg/kg				66.4	NWTPH-Dx		
PAH's								
Acenaphthene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Acenaphthylene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Anthracene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Benzo(a)anthracene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Benzo(a)pyrene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Benzo(b)fluoranthene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Benzo(ghi)perylene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Benzo(k)fluoranthene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Chrysene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Dibenzo(ah)anthracene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Fluoranthene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Fluorene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Indeno(1,2,3-cd)pyrene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Naphthalene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Phenanthrene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Pyrene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected At Level Indicated

Approved By: [signature]

200907-24-27

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

FAXED 9/19/00

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
Source Name:
Sampled At:

Date Reported: 09/18/00
Date Collected: 09/07/00
Time Collected: 11:40-14:30
Sampled By: David Katz

COMINCO Ltd., Glenbrook Operation
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

Cominco-Riddle
Glenbrook
JA036.15

Invoice#
3963

Polynuclear Aromatic Hydrocarbons

Matrix: Soil

URC Sample #:		200907-28	200907-29	200907-30	200907-31			
Sample ID:		CS-13	CS14	CS-15	CS-16			
URC Sample#	Units	Results	Results	Results	Results	Method	Date Analyzed	Analyst
Hydrocarbon ID		Oils	Oils	ND	ND	WTPH-HCID	09/14/00	BEM
% Surrogate Recovery	%	102.1	106.4	82.8	82.8		09/14/00	BEM
Confirmation	mg/kg	543	603			NWTPH-Dx	09/15/00	BEM
PAH's								
Acenaphthene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
2-Methylnaphthylene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Anthracene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Benzo(a)anthracene	mg/kg	5.1	5.3	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Benzo(a)pyrene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Benzo(b)fluoranthene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Benzo(ghi)perylene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Benzo(k)fluoranthene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Chrysene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Dibenzo(ah)anthracene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Fluoranthene	mg/kg	ND@1.0	2.9	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Fluorene	mg/kg	1.2	1.4	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Indeno(1,2,3-cd)pyrene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Naphthalene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Phenanthrene	mg/kg	ND@1.0	2.6	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO
Pyrene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/14/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected At Level Indicated

Approved By:

200907-28-31

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

FAXED 9-29-00

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
Source Name:
Sampled At:

Date Reported: 09/29/00
Date Collected: 09/19/00
Time Collected: 9:45 AM
Sampled By: David Katz

COMINCO Ltd., Glenbrook Operation
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

JA 036.15

Invoice#
4091

Polynuclear Aromatic Hlydrocarbons

Matrix: Soil

URC Sample #:		200919-42	200919-43	200919-44	200919-45			
Sample ID:		CS-17	CS-18	CS-19	CS-20			
URC Sample#	Units	Results	Results	Results	Results	Method	Date Analyzed	Analyst
Hydrocarbon ID		ND	ND	Diesel/Oil	Diesel/Oil	WTPH-HCID	09/26/00	BKO
% Surrogate Recovery	%	95.4	97.6	148.2	131.7		09/26/00	BKO
Confirmation	mg/kg			1063	1155	NWTPH-Dx	09/26/00	BKO
PAH's								
Acenaphthene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/26/00	BKO
Acenaphthylene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/26/00	BKO
Anthracene	mg/kg	ND@1.0	ND@1.0	**4.5**	**4.8**	EPA 8270	09/26/00	BKO
Benzo(a)anthracene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/26/00	BKO
Benzo(a)pyrene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/26/00	BKO
Benzo(b)fluoranthene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/26/00	BKO
Benzo(ghi)perylene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/26/00	BKO
Benzo(k)fluoranthene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/26/00	BKO
Chrysene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/26/00	BKO
Dibenzo(ah)anthracene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/26/00	BKO
Fluoranthene	mg/kg	ND@1.0	ND@1.0	**2.7**	ND@1.0	EPA 8270	09/26/00	BKO
Fluorene	mg/kg	ND@1.0	ND@1.0	**1.1**	**1.0**	EPA 8270	09/26/00	BKO
Indeno(1,2,3-cd)pyrene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/26/00	BKO
Naphthalene	mg/kg	ND@1.0	ND@1.0	ND@1.0	ND@1.0	EPA 8270	09/26/00	BKO
Phenanthrene	mg/kg	ND@1.0	ND@1.0	**2.9**	**3.0**	EPA 8270	09/26/00	BKO
Pyrene	mg/kg	ND@1.0	ND@1.0	**1.9**	ND@1.0	EPA 8270	09/26/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected At Level Indicated

Approved By:

200919-42-45

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

FAXED 09-29-00

OREGON STATE CERTIFIED LAB #015	**Date Reported:** 09/29/00
PWS#:	**Date Collected:** 09/19/00
Source Name:	**Time Collected:** 10:15 AM
Sampled At:	**Sampled By:** David Katz

COMINCO Ltd., Glenbrook Operation **P.O. Box 85** **5093 Riddle By-pass Road** **Riddle, OR 97469**	**JA 036.15** **Invoice#** **4091**

Polynuclear Aromatic Hydrocarbons — **Matrix: Soil**

URC Sample #:	200919-46	200919-47	200919-48				
Sample ID:	CS-21	CS-22	CS-23				
URC Sample#	Units	Results	Results	Results		Method	Date Analyzed	Analyst
Hydrocarbon ID		ND	ND	Diesel/Oil		NWTPH-HCID	09/26/00	BKO
% Surrogate Recovery	%	96.2	131.7	148.2			09/26/00	BKO
Confirmation	mg/kg			516		NWTPH-Dx	09/26/00	BKO
PAH's								
Acenaphthene	mg/kg	ND@1.0	ND@1.0	ND@1.0		EPA 8270	09/26/00	BKO
1-Methylnaphthylene	mg/kg	ND@1.0	ND@1.0	**1.0**		EPA 8270	09/26/00	BKO
Anthracene	mg/kg	ND@1.0	ND@1.0	**4.4**		EPA 8270	09/26/00	BKO
Benzo(a)anthracene	mg/kg	ND@1.0	ND@1.0	ND@1.0		EPA 8270	09/26/00	BKO
Benzo(a)pyrene	mg/kg	ND@1.0	ND@1.0	ND@1.0		EPA 8270	09/26/00	BKO
Benzo(b)fluoranthene	mg/kg	ND@1.0	ND@1.0	ND@1.0		EPA 8270	09/26/00	BKO
Benzo(ghi)perylene	mg/kg	ND@1.0	ND@1.0	ND@1.0		EPA 8270	09/26/00	BKO
Benzo(k)fluoranthene	mg/kg	ND@1.0	ND@1.0	ND@1.0		EPA 8270	09/26/00	BKO
Chrysene	mg/kg	ND@1.0	ND@1.0	ND@1.0		EPA 8270	09/26/00	BKO
Dibenzo(ah)anthracene	mg/kg	ND@1.0	ND@1.0	ND@1.0		EPA 8270	09/26/00	BKO
Fluoranthene	mg/kg	ND@1.0	ND@1.0	**2.6**		EPA 8270	09/26/00	BKO
Fluorene	mg/kg	ND@1.0	ND@1.0	**1.1**		EPA 8270	09/26/00	BKO
Indeno(1,2,3-cd)pyrene	mg/kg	ND@1.0	ND@1.0	ND@1.0		EPA 8270	09/26/00	BKO
Naphthalene	mg/kg	ND@1.0	ND@1.0	ND@1.0		EPA 8270	09/26/00	BKO
Phenanthrene	mg/kg	ND@1.0	ND@1.0	**3.2**		EPA 8270	09/26/00	BKO
Pyrene	mg/kg	ND@1.0	ND@1.0	**1.8**		EPA 8270	09/26/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected At Level Indicated

Approved By:

200919-46-48

CERTIFICATE OF ANALYSIS

CLIENT: GLENBROOK NICKEL - COOS BAY
PO BOX 85
RIDDLE OR 97469

PHONE: (541) 874-3171
FAX: (541) 874-3380

DATE SUBMITTED: 09/22/2000

PROJECT NAME: COMINCO- GLENBROOK NICKEL PROJECT NUMBER: JA036.15

REPORT DATE: 10/06/2000 REPORT NUMBER: 01838

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
01838-001	CS-24	09/20/2000	1645	Soil	AOC-R-10 12' COMP
01838-002	CS-25	09/20/2000	1650	Soil	AOC-R-10 12' COMP
01838-003	CS-26	09/20/2000	1655	Soil	AOC-R-10 5' COMP
01838-004	CS-27	09/20/2000	1500	Soil	AOC-R-10 5' COMP
01838-005	CS-28	09/20/2000	1505	Soil	AOC-R-10 6.5' COMP
01838-006	CS-29	09/20/2000	1510	Soil	AOC-R-10 6.5' COMP
01838-007	CS-30	09/20/2000	1515	Soil	AOC-R-10 5' COMP
01838-008	CS-31	09/20/2000	1520	Soil	AOC-R-10 5' COMP

REVIEWED BY:

Martin Little - Quality Manager

CERTIFICATE OF ANALYSIS

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
01838-001	CS-24	09/20/2000	1645	Soil	AOC-R-10 12' COMP

REPORT DATE: 10/06/2000 **REPORT NUMBER: 01838**

ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST	ANALYSIS DATE
NWTPH-Dx	DIESEL	2,200	mg/Kg	125	Jacob F	09/26/2000
NWTPH-Dx	HEAVY OILS	ND	mg/Kg	500		
	SURROGATE RECOVERY	97%	%RECOVERY	50%-150%		
PNAH 1	ACENAPHTHENE	0.32	mg/Kg	0.005	Jacob F	09/26/2000
EPA 8270K (SIM)	ACENAPHTHYLENE	0.10	mg/Kg	0.005		
	ANTHRACENE	0.12	mg/Kg	0.005		
	BENZO(A)ANTHRACENE	0.015	mg/Kg	0.005		
	BENZO(A)PYRENE	ND	mg/Kg	0.02		
	BENZO(B)FLUORANTHENE	ND	mg/Kg	0.02		
	BENZO(GHI)PERYLENE	ND	mg/Kg	0.05		
	BENZO(K)FLUORANTHENE	ND	mg/Kg	0.02		
	CHRYSENE	0.034	mg/Kg	0.005		
	DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.03		
	FLUORANTHENE	0.038	mg/Kg	0.005		
	FLUORENE	0.51	mg/Kg	0.005		
	INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.04		
	NAPHTHALENE	0.80	mg/Kg	0.005		
	PHENANTHRENE	1.2	mg/Kg	0.005		
	PYRENE	0.064	mg/Kg	0.005		
	SURROGATE	123%	%RECOVERY	50%-150%		

CERTIFICATE OF ANALYSIS

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
01838-002	CS-25	09/20/2000	1650	Soil	AOC-R-10 12' COMP

ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST	ANALYSIS DATE
NWTPH-Dx	DIESEL	2,500	mg/Kg	125	Jacob F	09/26/2000
NWTPH-Dx	HEAVY OILS	ND	mg/Kg	500		
	SURROGATE RECOVERY	112%	%RECOVERY	50%-150%		
PNAH 1	ACENAPHTHENE	0.34	mg/Kg	0.005	Jacob F	09/26/2000
EPA 8270M (SIM)	ACENAPHTHYLENE	0.11	mg/Kg	0.005		
	ANTHRACENE	0.16	mg/Kg	0.005		
	BENZO(A)ANTHRACENE	ND	mg/Kg	0.005		
	BENZO(A)PYRENE	ND	mg/Kg	0.02		
	BENZO(B)FLUORANTHENE	ND	mg/Kg	0.02		
	BENZO(GHI)PERYLENE	ND	mg/Kg	0.05		
	BENZO(K)FLUORANTHENE	ND	mg/Kg	0.02		
	CHRYSENE	0.028	mg/Kg	0.005		
	DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.03		
	FLUORANTHENE	0.048	mg/Kg	0.005		
	FLUORENE	0.82	mg/Kg	0.005		
	INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.04		
	NAPHTHALENE	0.55	mg/Kg	0.005		
	PHENANTHRENE	1.4	mg/Kg	0.005		
	PYRENE	0.069	mg/Kg	0.005		
	SURROGATE	130%	%RECOVERY	50-150%		

CERTIFICATE OF ANALYSIS

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
01838-003	CS-26	09/20/2000	1655	Soil	AOC-R-10 5' COMP

REPORT DATE: 10/06/2000 **REPORT NUMBER: 01838**

ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST	ANALYSIS DATE
NWTPH-Dx	DIESEL	3,100	mg/Kg	250	Jacob F	09/26/2000
NWTPH-Dx	HEAVY OILS	ND	mg/Kg	1,000		
	SURROGATE RECOVERY	90%	%RECOVERY	50%-150%		
PNAH 1	ACENAPHTHENE	0.40	mg/Kg	0.005	Jacob F	09/26/2000
EPA 8270M (SIM)	ACENAPHTHYLENE	0.16	mg/Kg	0.005		
	ANTHRACENE	0.18	mg/Kg	0.005		
	BENZO(A)ANTHRACENE	0.009	mg/Kg	0.005		
	BENZO(A)PYRENE	ND	mg/Kg	0.02		
	BENZO(B)FLUORANTHENE	ND	mg/Kg	0.02		
	BENZO(GHI)PERYLENE	ND	mg/Kg	0.05		
	BENZO(K)FLUORANTHENE	ND	mg/Kg	0.02		
	CHRYSENE	0.024	mg/Kg	0.005		
	DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.03		
	FLUORANTHENE	0.046	mg/Kg	0.005		
	FLUORENE	0.69	mg/Kg	0.005		
	INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.04		
	NAPHTHALENE	0.61	mg/Kg	0.005		
	PHENANTHRENE	1.6	mg/Kg	0.005		
	PYRENE	0.073	mg/Kg	0.005		
	SURROGATE	135%	%RECOVERY	50-150%		

CERTIFICATE OF ANALYSIS

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
01838-004	CS-27	09/20/2000	1500	Soil	AOC-R-10 5' COMP

ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST	ANALYSIS DATE
BTEX 3	BENZENE	0.002	mg/Kg	0.001	Dave M	10/05/2000
EPA 8260	ETHYLBENZENE	0.084	mg/Kg	0.001		
	TOLUENE	0.17	mg/Kg	0.001		
	META- & PARA-XYLENE	0.10	mg/Kg	0.001		
	ORTHO-XYLENE	0.20	mg/Kg	0.001		
	SURROGATE RECOVERY	95%	%RECOVERY	80%-120%		
NWTPH-Dx	DIESEL	8,300	mg/Kg	250	Jacob F	09/26/2000
NWTPH-Dx	HEAVY OILS	ND	mg/Kg	1,000		
	SURROGATE RECOVERY	109%	%RECOVERY	50%-150%		
PNAH 1	ACENAPHTHENE	0.86	mg/Kg	0.005	Jacob F	09/26/2000
EPA 8270M (SIM)	ACENAPHTHYLENE	0.25	mg/Kg	0.005		
	ANTHRACENE	0.37	mg/Kg	0.005		
	BENZO(A)ANTHRACENE	0.026	mg/Kg	0.005		
	BENZO(A)PYRENE	ND	mg/Kg	0.02		
	BENZO(B)FLUORANTHENE	ND	mg/Kg	0.02		
	BENZO(GHI)PERYLENE	ND	mg/Kg	0.05		
	BENZO(K)FLUORANTHENE	ND	mg/Kg	0.02		
	CHRYSENE	0.081	mg/Kg	0.005		
	DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.03		
	FLUORANTHENE	0.092	mg/Kg	0.005		
	FLUORENE	2.2	mg/Kg	0.005		
	INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.04		
	NAPHTHALENE	3.8	mg/Kg	0.005		
	PHENANTHRENE	3.1	mg/Kg	0.005		
	PYRENE	0.23	mg/Kg	0.005		
	SURROGATE	111%	%RECOVERY	50-150%		

CERTIFICATE OF ANALYSIS

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
01838-005	CS-28	09/20/2000	1505	Soil	AOC-R-10 6.5' COMP

REPORT DATE: 10/06/2000 **REPORT NUMBER: 01838**

ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST	ANALYSIS DATE
NWTPH-Dx	DIESEL	6,700	mg/Kg	250	Jacob F	09/26/2000
NWTPH-Dx	HEAVY OILS	ND	mg/Kg	1,000		
	SURROGATE RECOVERY	106%	%RECOVERY	50%-150%		
PNAH 1	ACENAPHTHENE	0.68	mg/Kg	0.005	Jacob F	09/26/2000
EPA 8270M (SIM)	ACENAPHTHYLENE	0.29	mg/Kg	0.005		
	ANTHRACENE	0.24	mg/Kg	0.005		
	BENZO(A)ANTHRACENE	0.013	mg/Kg	0.005		
	BENZO(A)PYRENE	ND	mg/Kg	0.02		
	BENZO(B)FLUORANTHENE	ND	mg/Kg	0.02		
	BENZO(GHI)PERYLENE	ND	mg/Kg	0.05		
	BENZO(K)FLUORANTHENE	ND	mg/Kg	0.02		
	CHRYSENE	0.040	mg/Kg	0.005		
	DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.03		
	FLUORANTHENE	0.043	mg/Kg	0.005		
	FLUORENE	1.6	mg/Kg	0.005		
	INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.04		
	NAPHTHALENE	2.3	mg/Kg	0.005		
	PHENANTHRENE	2.5	mg/Kg	0.005		
	PYRENE	0.15	mg/Kg	0.005		
	SURROGATE	101%	%RECOVERY	50-150%		

CERTIFICATE OF ANALYSIS

LT SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
01838-006	CS-29	09/20/2000	1510	Soil	AOC-R-10 6.5' COMP

REPORT DATE: 10/06/2000 **REPORT NUMBER: 01838**

ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST	ANALYSIS DATE
NWTPH-Dx	DIESEL	7,200	mg/Kg	250	Jacob F	09/26/2000
NWTPH-Dx	HEAVY OILS	ND	mg/Kg	1,000		
	SURROGATE RECOVERY	107%	%RECOVERY	50%-150%		
PNAH 1	ACENAPHTRENE	0.73	mg/Kg	0.005	Jacob F	09/26/2000
EPA 8270M (SIM)	ACENAPHTHYLENE	0.33	mg/Kg	0.005		
	ANTHRACENE	0.23	mg/Kg	0.005		
	BENZO(A)ANTHRACENE	0.013	mg/Kg	0.005		
	BENZO(A)PYRENE	ND	mg/Kg	0.02		
	BENZO(B)FLUORANTHENE	ND	mg/Kg	0.02		
	BENZO(GHI)PERYLENE	ND	mg/Kg	0.05		
	BENZO(K)FLUORANTHENE	ND	mg/Kg	0.02		
	CHRYSENE	0.033	mg/Kg	0.005		
	DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.03		
	FLUORANTHENE	0.080	mg/Kg	0.005		
	FLUORENE	1.9	mg/Kg	0.005		
	INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.04		
	NAPHTHALENE	4.2	mg/Kg	0.005		
	PHENANTHRENE	2.6	mg/Kg	0.005		
	PYRENE	0.13	mg/Kg	0.005		
	SURROGATE	97%	%RECOVERY	50-150%		

CERTIFICATE OF ANALYSIS

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
01838-007	CS-30	09/20/2000	1515	Soil	AOC-R-10 5' COMP

REPORT DATE: 10/06/2000 **REPORT NUMBER: 01838**

ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST	ANALYSIS DATE
NWTPH-Dx	DIESEL	4,300	mg/Kg	250	Jacob F	09/26/2000
NWTPH-Dx	HEAVY OILS	ND	mg/Kg	1,000		
	SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%		
PNAH 1	ACENAPHTHENE	0.44	mg/Kg	0.005	Jacob F	09/26/2000
EPA 8270M (SIM)	ACENAPHTHYLENE	0.19	mg/Kg	0.005		
	ANTHRACENE	0.18	mg/Kg	0.005		
	BENZO(A)ANTHRACENE	ND	mg/Kg	0.005		
	BENZO(A)PYRENE	ND	mg/Kg	0.02		
	BENZO(B)FLUORANTHENE	ND	mg/Kg	0.02		
	BENZO(GHI)PERYLENE	ND	mg/Kg	0.05		
	BENZO(K)FLUORANTHENE	ND	mg/Kg	0.02		
	CHRYSENE	0.017	mg/Kg	0.005		
	DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.03		
	FLUORANTHENE	0.034	mg/Kg	0.005		
	FLUORENE	1.1	mg/Kg	0.005		
	INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.04		
	NAPHTHALENE	2.0	mg/Kg	0.005		
	PHENANTHRENE	1.7	mg/Kg	0.005		
	PYRENE	0.069	mg/Kg	0.005		
	SURROGATE	82%	%RECOVERY	50-150%		

CERTIFICATE OF ANALYSIS

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
01838-008	CS-31	09/20/2000	1520	Soil	AOC-R-10 5' COMP

ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST	ANALYSIS DATE
NWTPH-Dx	DIESEL	5,500	mg/Kg	250	Jacob F	09/26/2000
NWTPH-Dx	HEAVY OILS	ND	mg/Kg	1,000		
	SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%		
PNAH 1	ACENAPHTHENE	0.51	mg/Kg	0.005	Jacob F	09/26/2000
EPA 8270M (SIM)	ACENAPHTHYLENE	0.22	mg/Kg	0.005		
	ANTHRACENE	0.21	mg/Kg	0.005		
	BENZO(A)ANTHRACENE	0.008	mg/Kg	0.005		
	BENZO(A)PYRENE	ND	mg/Kg	0.02		
	BENZO(B)FLUORANTHENE	ND	mg/Kg	0.02		
	BENZO(GHI)PERYLENE	ND	mg/Kg	0.05		
	BENZO(K)FLUORANTHENE	ND	mg/Kg	0.02		
	CHRYSENE	0.026	mg/Kg	0.005		
	DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.03		
	FLUORANTHENE	0.029	mg/Kg	0.005		
	FLUORENE	1.4	mg/Kg	0.005		
	INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.04		
	NAPHTHALENE	2.4	mg/Kg	0.005		
	PHENANTHRENE	1.9	mg/Kg	0.005		
	PYRENE	0.090	mg/Kg	0.005		
	SURROGATE	118%	%RECOVERY	50-150%		

CERTIFICATE OF ANALYSIS

CLIENT: GLENBROOK NICKEL - COOS BAY
PO BOX 85
RIDDLE OR 97469

PHONE: (541) 874-3171
FAX: (541) 874-3380

DATE SUBMITTED: 09/28/2000

PROJECT NAME: TANK FARM AREA

PROJECT NUMBER: NONE PROVIDED

REPORT DATE: 10/04/2000

REPORT NUMBER: 01869

CI SAMPLE	CLIENT'S ID#	DATE	TIME	MATRIX	DESCRIPTION
01869-001	CS-24A	09/27/2000	1030	Soil	SOIL SAMPLE @ 6' R.R.
01869-002	CS-24B	09/27/2000	1045	Soil	SOIL SAMPLE @ 8' R.R.
01869-003	CS-25A	09/27/2000	1100	Soil	SOIL SAMPLE @ 6' T.F.
01869-004	CS-25B	09/27/2000	1115	Soil	SOIL SAMPLE @ 8' T.F.
01869-005	CS-26A	09/27/2000	1120	Soil	SOIL SAMPLE @ 8' FLOOR TRENCH
01869-006	CS-27A	09/27/2000	1130	Soil	SOIL SAMPLE @ 8' FLOOR TRENCH
01869-007	CS-28A	09/27/2000	1145	Soil	SOIL SAMPLE @ 6' R.R.
01869-008	CS-28B	09/27/2000	1200	Soil	SOIL SAMPLE @ 8' R.R.
01869-009	CS-29A	09/27/2000	1205	Soil	SOIL SAMPLE @ 12' FLOOR
01869-010	#3	09/27/2000	1215	Soil	STOCKPILE SOIL SAMPLE
01869-011	CS-30A	09/27/2000	1240	Soil	SOIL SAMPLE @ 8' R.R.
01869-012	CS-30B	09/27/2000	1245	Soil	SOIL SAMPLE @ 6' R.R.

REVIEWED BY: Dan T Bark for

Martin Little - Quality Manager

CERTIFICATE OF ANALYSIS

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
01869-001	CS-24A	09/27/2000	1030	Soil	SOIL SAMPLE @ 6' R.R.

ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST	ANALYSIS DATE
NWTPH-Dx	DIESEL	1,700	mg/Kg	25	Dick R	09/29/2000
NWTPH-Dx	HEAVY OILS	160	mg/Kg	100		
	SURROGATE RECOVERY	108%	%RECOVERY	50%-150%		
PNAH 1	ACENAPHTHENE	0.23	mg/Kg	0.005	Dave M	10/03/2000
EPA 8270M (SIM)	ACENAPHTHYLENE	0.16	mg/Kg	0.005		
	ANTHRACENE	0.090	mg/Kg	0.005		
	BENZO(A)ANTHRACENE	0.011	mg/Kg	0.005		
	BENZO(A)PYRENE	0.008	mg/Kg	0.005		
	BENZO(B)FLUORANTHENE	0.010	mg/Kg	0.005		
	BENZO(GHI)PERYLENE	0.008	mg/Kg	0.005		
	BENZO(K)FLUORANTHENE	0.005	mg/Kg	0.005		
	CHRYSENE	0.019	mg/Kg	0.005		
	DIBENZO(AH)ANTHRACENE	0.021	mg/Kg	0.005		
	FLUORANTHENE	0.009	mg/Kg	0.005		
	FLUORENE	0.30	mg/Kg	0.005		
	INDENO(1,2,3-CD)PYRENE	0.010	mg/Kg	0.005		
	NAPHTHALENE	0.40	mg/Kg	0.005		
	PHENANTHRENE	1.1	mg/Kg	0.005		
	PYRENE	0.029	mg/Kg	0.005		
	SURROGATE	88%	%RECOVERY	50%-150%		

CERTIFICATE OF ANALYSIS

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
01869-002	CS-24B	09/27/2000	1045	Soil	SOIL SAMPLE @ 8' R.R.

ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST	ANALYSIS DATE
NWTPH-Dx	DIESEL	4,900	mg/Kg	250	Jeremy B	10/03/2000
NWTPH-Dx	HEAVY OILS	ND	mg/Kg	1,000		
	SURROGATE RECOVERY	96%	%RECOVERY	50%-150%		
PNAH 1	ACENAPHTHENE	0.37	mg/Kg	0.005	Dave M	10/03/2000
EPA 8270M (SIM)	ACENAPHTHYLENE	0.16	mg/Kg	0.005		
	ANTHRACENE	0.22	mg/Kg	0.005		
	BENZO(A)ANTHRACENE	0.028	mg/Kg	0.005		
	BENZO(A)PYRENE	0.021	mg/Kg	0.005		
	BENZO(B)FLUORANTHENE	0.015	mg/Kg	0.005		
	BENZO(GHI)PERYLENE	0.009	mg/Kg	0.005		
	BENZO(K)FLUORANTHENE	0.022	mg/Kg	0.005		
	CHRYSENE	0.028	mg/Kg	0.005		
	DIBENZO(AH)ANTHRACENE	0.013	mg/Kg	0.005		
	FLUORANTHENE	0.063	mg/Kg	0.005		
	FLUORENE	0.32	mg/Kg	0.005		
	INDENO(1,2,3-CD)PYRENE	0.094	mg/Kg	0.005		
	NAPHTHALENE	0.24	mg/Kg	0.005		
	PHENANTHRENE	1.7	mg/Kg	0.005		
	PYRENE	0.11	mg/Kg	0.005		
	SURROGATE	68%	%RECOVERY	50%-150%		

CERTIFICATE OF ANALYSIS

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
01869-003	CS-25A	09/27/2000	1100	Soil	SOIL SAMPLE @ 6' T.F.

REPORT DATE: 10/04/2000 **REPORT NUMBER: 01869**

ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST	ANALYSIS DATE
NWTPH-Dx	DIESEL	1900	mg/Kg	25	Dick R	09/29/2000
NWTPH-Dx	HEAVY OILS	190	mg/Kg	100		
	SURROGATE RECOVERY	87	%RECOVERY	50%-150%		
PNAH 1	ACENAPHTHENE	0.29	mg/Kg	0.005	Dave M	10/03/2000
EPA 8270M (SIM)	ACENAPHTHYLENE	0.12	mg/Kg	0.005		
	ANTHRACENE	0.13	mg/Kg	0.005		
	BENZO(A)ANTHRACENE	0.016	mg/Kg	0.005		
	BENZO(A)PYRENE	0.009	mg/Kg	0.005		
	BENZO(B)FLUORANTHENE	0.007	mg/Kg	0.005		
	BENZO(GHI)PERYLENE	ND	mg/Kg	0.005		
	BENZO(K)FLUORANTHENE	0.009	mg/Kg	0.005		
	CHRYSENE	0.027	mg/Kg	0.005		
	DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005		
	FLUORANTHENE	0.034	mg/Kg	0.005		
	FLUORENE	0.71	mg/Kg	0.005		
	INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005		
	NAPHTHALENE	0.51	mg/Kg	0.005		
	PHENANTHRENE	1.2	mg/Kg	0.005		
	PYRENE	0.073	mg/Kg	0.005		
	SURROGATE	112%	%RECOVERY	50%-150%		

CERTIFICATE OF ANALYSIS

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
01869-004	CS-25B	09/27/2000	1115	Soil	SOIL SAMPLE @ 8' T.F.

REPORT DATE: 10/04/2000 **REPORT NUMBER: 01869**

ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST	ANALYSIS DATE
NWTPH-Dx	DIESEL	2700	mg/Kg	25	Dick R	09/29/2000
NWTPH-Dx	HEAVY OILS	320	mg/Kg	100		
	SURROGATE RECOVERY	83	%RECOVERY	50%-150%		
PNAH 1	ACENAPHTHENE	0.51	mg/Kg	0.005	Dave M	10/03/2000
EPA 8270M (SIM)	ACENAPHTHYLENE	0.18	mg/Kg	0.005		
	ANTHRACENE	0.19	mg/Kg	0.005		
	BENZO(A)ANTHRACENE	0.024	mg/Kg	0.005		
	BENZO(A)PYRENE	0.006	mg/Kg	0.005		
	BENZO(B)FLUORANTHENE	0.006	mg/Kg	0.005		
	BENZO(GHI)PERYLENE	ND	mg/Kg	0.005		
	BENZO(K)FLUORANTHENE	0.006	mg/Kg	0.005		
	CHRYSENE	0.022	mg/Kg	0.005		
	DIBENZO(AH)ANTHRACENE	0.006	mg/Kg	0.005		
	FLUORANTHENE	0.054	mg/Kg	0.005		
	FLUORENE	1.2	mg/Kg	0.005		
	INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005		
	NAPHTHALENE	2.8	mg/Kg	0.005		
	PHENANTHRENE	1.6	mg/Kg	0.005		
	PYRENE	0.10	mg/Kg	0.005		
	SURROGATE	82%	%RECOVERY	50%-150%		

CERTIFICATE OF ANALYSIS

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
01869-005	CS-26A	09/27/2000	1120	Soil	SOIL SAMPLE @ 8' FLOOR TRENCH

ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST	ANALYSIS DATE
NWTPH-Dx	DIESEL	4,300	mg/Kg	250	Jeremy B	10/03/2000
NWTPH-Dx	HEAVY OILS	ND	mg/Kg	1,000		
	SURROGATE RECOVERY	95%	%RECOVERY	50%-150%		
PNAH 1	ACENAPHTHENE	0.42	mg/Kg	0.005	Dave M	10/03/2000
EPA 8270M (SIM)	ACENAPHTHYLENE	0.22	mg/Kg	0.005		
	ANTHRACENE	0.21	mg/Kg	0.005		
	BENZO(A)ANTHRACENE	0.010	mg/Kg	0.005		
	BENZO(A)PYRENE	ND	mg/Kg	0.005		
	BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005		
	BENZO(GHI)PERYLENE	ND	mg/Kg	0.005		
	BENZO(K)FLUORANTHENE	0.005	mg/Kg	0.005		
	CHRYSENE	0.014	mg/Kg	0.005		
	DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005		
	FLUORANTHENE	0.059	mg/Kg	0.005		
	FLUORENE	1.2	mg/Kg	0.005		
	INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005		
	NAPHTHALENE	1.8	mg/Kg	0.005		
	PHENANTHRENE	1.7	mg/Kg	0.005		
	PYRENE	0.055	mg/Kg	0.005		
	SURROGATE	78%	%RECOVERY	50%-150%		

CERTIFICATE OF ANALYSIS

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
01869-006	CS-27A	09/27/2000	1130	Soil	SOIL SAMPLE @ 8' FLOOR TRENCH

ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST	ANALYSIS DATE
NWTPH-Dx	DIESEL	9,800	mg/Kg	250	Jeremy B	10/03/2000
NWTPH-Dx	HEAVY OILS	ND	mg/Kg	1,000		
	SURROGATE RECOVERY	90%	%RECOVERY	50%-150%		
PNAH 1	ACENAPHTHENE	0.70	mg/Kg	0.005	Dave M	10/03/2000
EPA 8270M (SIM)	ACENAPHTHYLENE	0.16	mg/Kg	0.005		
	ANTHRACENE	0.26	mg/Kg	0.005		
	BENZO(A)ANTHRACENE	0.010	mg/Kg	0.005		
	BENZO(A)PYRENE	ND	mg/Kg	0.005		
	BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005		
	BENZO(GHI)PERYLENE	ND	mg/Kg	0.005		
	BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005		
	CHRYSENE	0.021	mg/Kg	0.005		
	DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005		
	FLUORANTHENE	0.046	mg/Kg	0.005		
	FLUORENE	2.2	mg/Kg	0.005		
	INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005		
	NAPHTHALENE	7.7	mg/Kg	0.005		
	PHENANTHRENE	2.6	mg/Kg	0.005		
	PYRENE	0.11	mg/Kg	0.005		
	SURROGATE	107%	%RECOVERY	50%-150%		

CERTIFICATE OF ANALYSIS

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
01869-007	CS-28A	09/27/2000	1145	Soil	SOIL SAMPLE @ 6' R.R.

REPORT DATE: 10/04/2000 **REPORT NUMBER: 01869**

ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST	ANALYSIS DATE
NWTPH-Dx	DIESEL	7,600	mg/Kg	250	Jeremy B	10/03/2000
NWTPH-Dx	HEAVY OILS	ND	mg/Kg	1,000		
	SURROGATE RECOVERY	92%	%RECOVERY	50%-150%		
PNAH 1	ACENAPHTHENE	0.59	mg/Kg	0.005	Dave M	10/03/2000
EPA 8270M (SIM)	ACENAPHTHYLENE	0.26	mg/Kg	0.005		
	ANTHRACENE	0.23	mg/Kg	0.005		
	BENZO(A)ANTHRACENE	0.008	mg/Kg	0.005		
	BENZO(A)PYRENE	ND	mg/Kg	0.005		
	BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005		
	BENZO(GHI)PERYLENE	ND	mg/Kg	0.005		
	BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005		
	CHRYSENE	0.009	mg/Kg	0.005		
	DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005		
	FLUORANTHENE	0.076	mg/Kg	0.005		
	FLUORENE	1.9	mg/Kg	0.005		
	INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005		
	NAPHTHALENE	5.7	mg/Kg	0.005		
	PHENANTHRENE	2.1	mg/Kg	0.005		
	PYRENE	0.069	mg/Kg	0.005		
	SURROGATE	95%	%RECOVERY	50%-150%		

CERTIFICATE OF ANALYSIS

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
01869-008	CS-28B	09/27/2000	1200	Soil	SOIL SAMPLE @ 8' R.R.

REPORT DATE: 10/04/2000 **REPORT NUMBER: 01869**

ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST	ANALYSIS DATE
NWTPH-Dx	DIESEL	7,200	mg/Kg	250	Jeremy B	10/03/2000
NWTPH-Dx	HEAVY OILS	ND	mg/Kg	1,000		
	SURROGATE RECOVERY	91%	%RECOVERY	50%-150%		
PNAH 1	ACENAPHTHENE	0.58	mg/Kg	0.005	Dave M	10/03/2000
EPA 8270M (SIM)	ACENAPHTHYLENE	0.23	mg/Kg	0.005		
	ANTHRACENE	0.24	mg/Kg	0.005		
	BENZO(A)ANTHRACENE	0.009	mg/Kg	0.005		
	BENZO(A)PYRENE	ND	mg/Kg	0.005		
	BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005		
	BENZO(GHI)PERYLENE	ND	mg/Kg	0.005		
	BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005		
	CHRYSENE	0.009	mg/Kg	0.005		
	DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005		
	FLUORANTHENE	0.078	mg/Kg	0.005		
	FLUORENE	1.9	mg/Kg	0.005		
	INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005		
	NAPHTHALENE	5.3	mg/Kg	0.005		
	PHENANTHRENE	2.1	mg/Kg	0.005		
	PYRENE	0.069	mg/Kg	0.005		
	SURROGATE	84%	%RECOVERY	50%-150%		

CERTIFICATE OF ANALYSIS

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
01869-009	CS-29A	09/27/2000	1205	Soil	SOIL SAMPLE @ 12' FLOOR

ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST	ANALYSIS DATE
NWTPH-Dx	DIESEL	790	mg/Kg	25	Dick R	09/27/2000
NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100		
	SURROGATE RECOVERY	81%	%RECOVERY	50%-150%		
PNAH 1	ACENAPHTHENE	0.52	mg/Kg	0.005	Dave M	09/29/2000
EPA 8270M (SIM)	ACENAPHTHYLENE	0.080	mg/Kg	0.005		
	ANTHRACENE	0.19	mg/Kg	0.005		
	BENZO(A)ANTHRACENE	0.074	mg/Kg	0.005		
	BENZO(A)PYRENE	ND	mg/Kg	0.005		
	BENZO(B)FLUORANTHENE	0.064	mg/Kg	0.005		
	BENZO(GHI)PERYLENE	ND	mg/Kg	0.005		
	BENZO(K)FLUORANTHENE	0.006	mg/Kg	0.005		
	CHRYSENE	0.12	mg/Kg	0.005		
	DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005		
	FLUORANTHENE	0.40	mg/Kg	0.005		
	FLUORENE	0.73	mg/Kg	0.005		
	INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005		
	NAPHTHALENE	0.090	mg/Kg	0.005		
	PHENANTHRENE	0.90	mg/Kg	0.005		
	PYRENE	0.34	mg/Kg	0.005		
	SURROGATE	84%	%RECOVERY	50-150		

CERTIFICATE OF ANALYSIS

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
01869-010	#3	09/27/2000	1215	Soil	STOCKPILE SOIL SAMPLE

REPORT DATE: 10/04/2000 **REPORT NUMBER: 01869**

ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST	ANALYSIS DATE
BTEX 3	BENZENE	0.010	mg/Kg	0.001	Dave M	10/01/2000
EPA 8260	ETHYLBENZENE	0.021	mg/Kg	0.001		
	TOLUENE	0.17	mg/Kg	0.001		
	META- & PARA-XYLENE	0.060	mg/Kg	0.001		
	ORTHO-XYLENE	0.027	mg/Kg	0.001		
	SURROGATE RECOVERY	98%	%RECOVERY	80%-120%		
NWTPH-Dx	DIESEL	15,000	mg/Kg	25	Jeremy B	10/03/2000
NWTPH-Dx	HEAVY OILS	4,500	mg/Kg	100		
	SURROGATE RECOVERY	93%	%RECOVERY	50%-150%		
PNAH 1	ACENAPHTHENE	2.8	mg/Kg	0.005	Dave M	09/29/2000
EPA 8270M (SIM)	ACENAPHTHYLENE	0.43	mg/Kg	0.005		
	ANTHRACENE	1.1	mg/Kg	0.005		
	BENZO(A)ANTHRACENE	0.41	mg/Kg	0.005		
	BENZO(A)PYRENE	0.17	mg/Kg	0.005		
	BENZO(B)FLUORANTHENE	0.18	mg/Kg	0.005		
	BENZO(GHI)PERYLENE	0.12	mg/Kg	0.005		
	BENZO(K)FLUORANTHENE	0.18	mg/Kg	0.005		
	CHRYSENE	0.62	mg/Kg	0.005		
	DIBENZO(AH)ANTHRACENE	0.057	mg/Kg	0.005		
	FLUORANTHENE	2.2	mg/Kg	0.005		
	FLUORENE	3.0	mg/Kg	0.005		
	INDENO(1,2,3-CD)PYRENE	0.071	mg/Kg	0.005		
	NAPHTHALENE	0.49	mg/Kg	0.005		
	PHENANTHRENE	4.8	mg/Kg	0.005		
	PYRENE	2.1	mg/Kg	0.005		
	SURROGATE	94%	%RECOVERY	50%-150%		

CERTIFICATE OF ANALYSIS

II SAMPLE	CLIENT# ID#	DATE	TIME	MATRIX	DESCRIPTION
01869-011	CS-30A	09/27/2000	1240	Soil	SOIL SAMPLE @ 8' R.R.

REPORT DATE: 10/04/2000 **REPORT NUMBER: 01869**

ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST	ANALYSIS DATE
NWTPH-Dx	DIESEL	2600	mg/Kg	25	Dick R	09/29/2000
NWTPH-Dx	HEAVY OILS	290	mg/Kg	100		
	SURROGATE RECOVERY	122%	%RECOVERY	50%-150%		
PNAH 1	ACENAPHTHENE	0.37	mg/Kg	0.005	Dave M	09/29/2000
EPA 8270M (SIM)	ACENAPHTHYLENE	0.13	mg/Kg	0.005		
	ANTHRACENE	0.17	mg/Kg	0.005		
	BENZO(A)ANTHRACENE	0.009	mg/Kg	0.005		
	BENZO(A)PYRENE	ND	mg/Kg	0.005		
	BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005		
	BENZO(GHI)PERYLENE	ND	mg/Kg	0.005		
	BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005		
	CHRYSENE	0.012	mg/Kg	0.005		
	DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005		
	FLUORANTHENE	0.035	mg/Kg	0.005		
	FLUORENE	0.35	mg/Kg	0.005		
	INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005		
	NAPHTHALENE	0.76	mg/Kg	0.005		
	PHENANTHRENE	1.7	mg/Kg	0.005		
	PYRENE	0.051	mg/Kg	0.005		
	SURROGATE	76%	%RECOVERY	50%-150%		

CERTIFICATE OF ANALYSIS

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
01869-012	CS-30B	09/27/2000	1245	Soil	SOIL SAMPLE @ 6' R.R.

ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST	ANALYSIS DATE
NWTPH-Dx	DIESEL	2200	mg/Kg	25	Dick R	09/29/2000
NWTPH-Dx	HEAVY OILS	200	mg/Kg	100		
	SURROGATE RECOVERY	101%	%RECOVERY	50%-150%		
PNAH 1	ACENAPHTHENE	0.36	mg/Kg	0.005	Dave M	09/29/2000
EPA 8270M (SIM)	ACENAPHTHYLENE	0.15	mg/Kg	0.005		
	ANTHRACENE	0.14	mg/Kg	0.005		
	BENZO(A)ANTHRACENE	ND	mg/Kg	0.005		
	BENZO(A)PYRENE	ND	mg/Kg	0.005		
	BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005		
	BENZO(GHI)PERYLENE	ND	mg/Kg	0.005		
	BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005		
	CHRYSENE	0.009	mg/Kg	0.005		
	DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005		
	FLUORANTHENE	0.014	mg/Kg	0.005		
	FLUORENE	1.1	mg/Kg	0.005		
	INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005		
	NAPHTHALENE	1.1	mg/Kg	0.005		
	PHENANTHRENE	1.5	mg/Kg	0.005		
	PYRENE	0.056	mg/Kg	0.005		
	SURROGATE	89%	%RECOVERY	50%-150%		

CERTIFICATE OF ANALYSIS

CLIENT: GLENBROOK NICKEL - SMELTER
5093 RIDDLE BYPASS RD.
RIDDLE OR 97469

PHONE: (541) 874-3171
FAX: (541) 874-3380

DATE SUBMITTED: 10/12/20

PROJECT NAME: GLENBROOK RIDDLE

PROJECT NUMBER: JA036.15

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
01953-001	CS-32	10/10/2000	1515	Soil	SOIL SAMPLE @ 4.0-4.5'
01953-002	CS-33	10/10/2000	1520	Soil	SOIL SAMPLE @ 4.0-4.5'
01953-003	CS-34	10/10/2000	1525	Soil	SOIL SAMPLE @ 4.0-4.5'
01953-004	CS-35	10/10/2000	1530	Soil	SOIL SAMPLE @ 4.0-4.5'
01953-005	CS-36	10/10/2000	1535	Soil	SOIL SAMPLE @ 4.0-4.5'
01953-006	CS-37	10/10/2000	1540	Soil	SOIL SAMPLE @ 4.0-4.5'
01953-007	CS-38	10/10/2000	1545	Soil	SOIL SAMPLE @ 8.0-8.5'
01953-008	CS-39	10/10/2000	1550	Soil	SOIL SAMPLE @ 8.0-8.5'
01953-009	CS-40	10/10/2000	1555	Soil	SOIL SAMPLE @ 8.5-9.0'
01953-010	CS-41	10/10/2000	1600	Soil	SOIL SAMPLE @ 8.0-8.5'
01953-011	CS-42	10/10/2000	1605	Soil	SOIL SAMPLE @ 8.5-9.0'
01953-012	CS-43	10/10/2000	1610	Soil	SOIL SAMPLE @ 8.5-9.0'
01953-013	CS-44	10/10/2000	1615	Soil	SOIL SAMPLE @ 3.5-4.0'
01953-014	CS-45	10/10/2000	1620	Soil	SOIL SAMPLE @ 8.0-8.5'
01953-015	CS-46	10/10/2000	1625	Soil	SOIL SAMPLE @ 13.0-13.5'
1953-016	CS-47	10/10/2000	1630	Soil	SOIL SAMPLE @ 8.0-8.5'
01953-017	CS-48	10/10/2000	1635	Soil	SOIL SAMPLE @ 8.5-9.0'
01953-018	CS-49	10/10/2000	1640	Soil	SOIL SAMPLE @ 8.5-9.0'
01953-019	CS-50	10/10/2000	1645	Soil	SOIL SAMPLE @ 8.5-9.0'
01953-020	CS-51	10/10/2000	1650	Soil	SOIL SAMPLE @ 8.0-8.5'
01953-021	CS-52	10/10/2000	1655	Soil	SOIL SAMPLE @ 8.0-8.5'
01953-022	CS-53	10/10/2000	1700	Soil	SOIL SAMPLE @ 8.0-8.5'
01953-023	CS-54	10/10/2000	1705	Soil	SOIL SAMPLE @ 7.5-8.0'
01953-024	CS-55	10/10/2000	1710	Soil	SOIL SAMPLE @ 7.5-8.0'
01953-025	CS-56	10/10/2000	1715	Soil	SOIL SAMPLE @ 7.5-8.0'
01953-026	CS-57	10/10/2000	1720	Soil	SOIL SAMPLE @ 7.5-8.0'
01953-027	CS-58	10/10/2000	1725	Soil	SOIL SAMPLE @ 6.5-7.0'
01953-028	CS-59	10/10/2000	1730	Soil	SOIL SAMPLE @ 7.5-8.0'
01953-029	CS-44D	10/10/2000	1618	Soil	SOIL SAMPLE @ 8.5-9.0'

REPORT DATE: 10/16/2000 REPORT NUMBER: 01953 PAGE: 1 OF 16

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE @ 4.0-4.5'		SAMPLE ID: CS-32				
01953-001	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	75	mg/Kg	100	10/13/2000
		SURROGATE RECOVERY	106	%RECOVERY	50%-150%	

REVIEWED BY: _____
Martin Little - Quality Manager

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE @ 4.0-4.5'		SAMPLE ID: CS-32				
01953-001	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/13/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.013	mg/Kg	0.005	
		BENZO(A)PYRENE	0.009	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.010	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.006	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.009	mg/Kg	0.005	
		CHRYSENE	0.020	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.036	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.017	mg/Kg	0.005	
		PYRENE	0.041	mg/Kg	0.005	
		SURROGATE	105	%RECOVERY	50-150	
SOIL SAMPLE @ 4.0-4.5'		SAMPLE ID: CS-33				
01953-002	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/13/2000
		SURROGATE RECOVERY	106	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.018	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/13/2000
		ANTHRACENE	0.16	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.17	mg/Kg	0.005	
		BENZO(A)PYRENE	0.082	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.091	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.033	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.090	mg/Kg	0.005	
		CHRYSENE	0.25	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	0.016	mg/Kg	0.005	
		FLUORANTHENE	0.17	mg/Kg	0.005	
		FLUORENE	0.029	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	0.021	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.14	mg/Kg	0.005	
		PYRENE	0.14	mg/Kg	0.005	
		SURROGATE	113	%RECOVERY	50-150	
SOIL SAMPLE @ 4.0-4.5'		SAMPLE ID: CS-34				
01953-003	NWTPH-Dx	DIESEL	110	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	110	mg/Kg	100	10/13/2000
		SURROGATE RECOVERY	95	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE @ 4.0-4.5'		SAMPLE ID: CS-34				
01953-003	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.005	10/13/2000
		BENZO(A)ANTHRACENE	0.006	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.006	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.009	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.014	mg/Kg	0.005	
		PYRENE	0.007	mg/Kg	0.005	
		SURROGATE	137	%RECOVERY	50-150	
SOIL SAMPLE @ 4.0-4.5'		SAMPLE ID: CS-35				
01953-004	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/13/2000
		SURROGATE RECOVERY	120	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/13/2000
		ANTHRACENE	0.008	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.011	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	0.006	mg/Kg	0.005	
		PHENANTHRENE	0.009	mg/Kg	0.005	
		PYRENE	0.008	mg/Kg	0.005	
		SURROGATE	110	%RECOVERY	50-150	
SOIL SAMPLE @ 4.0-4.5'		SAMPLE ID: CS-36				
01953-005	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/13/2000
		SURROGATE RECOVERY	94	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE @ 4.0-4.5'		SAMPLE ID: CS-36				
01953-005	PNAH 1	ACENAPHTHENE	0.24	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.008	mg/Kg	0.005	10/13/2000
		ANTHRACENE	7.5	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.65	mg/Kg	0.005	
		BENZO(A)PYRENE	0.79	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.41	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.43	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.74	mg/Kg	0.005	
		CHRYSENE	1.9	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	0.20	mg/Kg	0.005	
		FLUORANTHENE	1.4	mg/Kg	0.005	
		FLUORENE	0.84	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	0.34	mg/Kg	0.005	
		NAPHTHALENE	0.022	mg/Kg	0.005	
		PHENANTHRENE	2.8	mg/Kg	0.005	
		PYRENE	1.1	mg/Kg	0.005	
		SURROGATE	82	%RECOVERY	50-150	
SOIL SAMPLE @ 4.0-4.5'		SAMPLE ID: CS-37				
01953-006	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/13/2000
		SURROGATE RECOVERY	96	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/13/2000
		ANTHRACENE	0.13	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.046	mg/Kg	0.005	
		BENZO(A)PYRENE	0.042	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.048	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.037	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.038	mg/Kg	0.005	
		CHRYSENE	0.057	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	0.013	mg/Kg	0.005	
		FLUORANTHENE	0.12	mg/Kg	0.005	
		FLUORENE	0.008	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	0.027	mg/Kg	0.005	
		NAPHTHALENE	0.022	mg/Kg	0.005	
		PHENANTHRENE	0.085	mg/Kg	0.005	
		PYRENE	0.11	mg/Kg	0.005	
		SURROGATE	116	%RECOVERY	50-150	
SOIL SAMPLE @ 8.0-8.5'		SAMPLE ID: CS-38				
01953-007	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/13/2000
		SURROGATE RECOVERY	89	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE @ 8.0-8.5'		SAMPLE ID: CS-38				
01953-007	PNAH 3	ACENAPHTHENE	0.007	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/13/2000
		ANTHRACENE	0.036	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.007	mg/Kg	0.005	
		BENZO(A)PYRENE	0.005	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.010	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.022	mg/Kg	0.005	
		FLUORENE	0.006	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.026	mg/Kg	0.005	
		PYRENE	0.023	mg/Kg	0.005	
		SURROGATE	115	%RECOVERY	50-150	
SOIL SAMPLE @ 8.0-8.5'		SAMPLE ID: CS-39				
01953-008	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/13/2000
		SURROGATE RECOVERY	94	%RECOVERY	50%-150%	
	PNAH 3	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/13/2000
		ANTHRACENE	0.010	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.009	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.009	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.021	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.019	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.031	mg/Kg	0.005	
		PYRENE	0.027	mg/Kg	0.005	
		SURROGATE	106	%RECOVERY	50-150	
SOIL SAMPLE @ 8.5-9.0'		SAMPLE ID: CS-40				
01953-009	NWTPH-Dx	DIESEL	180	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/13/2000
		SURROGATE RECOVERY	99	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE @ 8.5-9.0'		SAMPLE ID: CS-40				
01953-009	PNAH 1	ACENAPHTHENE	0.010	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.008	mg/Kg	0.005	10/13/2000
		ANTHRACENE	0.038	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.010	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.014	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.027	mg/Kg	0.005	
		FLUORENE	0.024	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.042	mg/Kg	0.005	
		PYRENE	0.033	mg/Kg	0.005	
		SURROGATE	103	%RECOVERY	50-150	
SOIL SAMPLE @ 8.0-8.5'		SAMPLE ID: CS-41				
01953-010	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/13/2000
		SURROGATE RECOVERY	101	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/13/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	121	%RECOVERY	50-150	
SOIL SAMPLE @ 8.5-9.0'		SAMPLE ID: CS-42				
01953-011	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/13/2000
		SURROGATE RECOVERY	100	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE @ 8.5-9.0'		SAMPLE ID: CS-42				
01953-011	PNAH 1	ACENAPHTHENE	0.014	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.015	mg/Kg	0.005	10/13/2000
		ANTHRACENE	0.042	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.006	mg/Kg	0.005	
		BENZO(A)PYRENE	0.012	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.010	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.013	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.017	mg/Kg	0.005	
		CHRYSENE	0.025	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	0.008	mg/Kg	0.005	
		FLUORANTHENE	0.017	mg/Kg	0.005	
		FLUORENE	0.012	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	0.009	mg/Kg	0.005	
		NAPHTHALENE	0.020	mg/Kg	0.005	
		PHENANTHRENE	0.036	mg/Kg	0.005	
		PYRENE	0.018	mg/Kg	0.005	
		SURROGATE	109	%RECOVERY	50-150	
SOIL SAMPLE @ 8.5-9.0'		SAMPLE ID: CS-43				
01953-012	NWTPH-Dx	DIESEL	1,600	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	160	mg/Kg	100	10/13/2000
		SURROGATE RECOVERY	92	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.14	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.026	mg/Kg	0.005	10/13/2000
		ANTHRACENE	0.067	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.006	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	0.15	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	0.13	mg/Kg	0.005	
		PHENANTHRENE	0.50	mg/Kg	0.005	
		PYRENE	0.014	mg/Kg	0.005	
		SURROGATE	99	%RECOVERY	50-150	
SOIL SAMPLE @ 3.5-4.0'		SAMPLE ID: CS-44				
01953-013	NWTPH-Dx	DIESEL	25	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	110	mg/Kg	100	10/13/2000
		SURROGATE RECOVERY	90	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE @ 3.5-4.0'		SAMPLE ID: CS-44				
01953-013	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/13/1900
		ANTHRACENE	0.017	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.011	mg/Kg	0.005	
		PYRENE	0.006	mg/Kg	0.005	
		SURROGATE	113	%RECOVERY	50-150	
SOIL SAMPLE @ 8.0-8.5'		SAMPLE ID: CS-45				
01953-014	NWTPH-Dx	DIESEL	71	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/13/2000
		SURROGATE RECOVERY	93	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/13/2000
		ANTHRACENE	0.028	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	0.005	mg/Kg	0.005	
		PHENANTHRENE	0.097	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	109	%RECOVERY	50-150	
SOIL SAMPLE @ 13.0-13.5'		SAMPLE ID: CS-46				
01953-015	NWTPH-Dx	DIESEL	3,600	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	430	mg/Kg	100	10/16/2000
		SURROGATE RECOVERY	100	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALIST
SOIL SAMPLE @ 13.0-13.5'		SAMPLE ID: CS-46				
01953-015	PNAH 1	ACENAPHTHENE	0.79	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.40	mg/Kg	0.005	10/13/2000
		ANTHRACENE	0.17	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.028	mg/Kg	0.005	
		BENZO(A)PYRENE	0.009	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.019	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.014	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.016	mg/Kg	0.005	
		CHRYSENE	0.028	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	0.009	mg/Kg	0.005	
		FLUORANTHENE	0.033	mg/Kg	0.005	
		FLUORENE	0.38	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	0.010	mg/Kg	0.005	
		NAPHTHALENE	0.63	mg/Kg	0.005	
		PHENANTHRENE	2.2	mg/Kg	0.005	
		PYRENE	0.071	mg/Kg	0.005	
		SURROGATE	104	%RECOVERY	50-150	
SOIL SAMPLE @ 8.0-8.5'		SAMPLE ID: CS-47				
01953-016	NWTPH-Dx	DIESEL	1,000	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	140	mg/Kg	100	10/16/2000
		SURROGATE RECOVERY	96	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.23	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.066	mg/Kg	0.005	10/13/2000
		ANTHRACENE	0.082	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.008	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.009	mg/Kg	0.005	
		FLUORENE	0.056	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	0.066	mg/Kg	0.005	
		PHENANTHRENE	0.28	mg/Kg	0.005	
		PYRENE	0.017	mg/Kg	0.005	
		SURROGATE	111	%RECOVERY	50-150	
SOIL SAMPLE @ 8.5-9.0'		SAMPLE ID: CS-48				
01953-017	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/16/2000
		SURROGATE RECOVERY	102	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE @ 8.5-9.0'		SAMPLE ID: CS-48				
01953-017	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/13/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	109	%RECOVERY	50-150	
SOIL SAMPLE @ 8.5-9.0'		SAMPLE ID: CS-49				
J1953-018	NWTPH-Dx	DIESEL	720	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	120	mg/Kg	100	10/16/2000
		SURROGATE RECOVERY	108	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.12	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.032	mg/Kg	0.005	10/13/2000
		ANTHRACENE	0.069	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.006	mg/Kg	0.005	
		FLUORENE	0.33	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	0.035	mg/Kg	0.005	
		PHENANTHRENE	0.64	mg/Kg	0.005	
		PYRENE	0.021	mg/Kg	0.005	
		SURROGATE	106	%RECOVERY	50-150	
SOIL SAMPLE @ 8.5-9.0'		SAMPLE ID: CS-50				
J1953-019	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/16/2000
		SURROGATE RECOVERY	104	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE @ 8.5-9.0'		SAMPLE ID: CS-50				
01953-019	PNAH 1	ACENAPHTHENE	0.017	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.013	mg/Kg	0.005	10/13/2000
		ANTHRACENE	0.029	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.014	mg/Kg	0.005	
		BENZO(A)PYRENE	0.008	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.013	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.011	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.015	mg/Kg	0.005	
		CHRYSENE	0.012	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	0.010	mg/Kg	0.005	
		FLUORANTHENE	0.014	mg/Kg	0.005	
		FLUORENE	0.014	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	0.005	mg/Kg	0.005	
		NAPHTHALENE	0.019	mg/Kg	0.005	
		PHENANTHRENE	0.035	mg/Kg	0.005	
		PYRENE	0.018	mg/Kg	0.005	
		SURROGATE	124	%RECOVERY	50-150	
SOIL SAMPLE @ 8.0-8.5'		SAMPLE ID: CS-51				
J1953-020	NWTPH-Dx	DIESEL	240	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/16/2000
		SURROGATE RECOVERY	101	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.046	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.012	mg/Kg	0.005	10/13/2000
		ANTHRACENE	0.015	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	0.039	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	0.005	mg/Kg	0.005	
		PHENANTHRENE	0.14	mg/Kg	0.005	
		PYRENE	0.005	mg/Kg	0.005	
		SURROGATE	110	%RECOVERY	50-150	
SOIL SAMPLE @ 8.0-8.5'		SAMPLE ID: CS-52				
J1953-021	NWTPH-Dx	DIESEL	40	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/16/2000
		SURROGATE RECOVERY	96	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE @ 8.0-8.5'		SAMPLE ID: CS-52				
01953-021	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/13/2000
		ANTHRACENE	0.031	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.034	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	124	%RECOVERY	50-150	
SOIL SAMPLE @ 8.0-8.5'		SAMPLE ID: CS-53				
1953-022	NWTPH-Dx	DIESEL	170	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/16/2000
		SURROGATE RECOVERY	101	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.018	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.008	mg/Kg	0.005	10/13/2000
		ANTHRACENE	0.036	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.006	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.018	mg/Kg	0.005	
		FLUORENE	0.066	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.14	mg/Kg	0.005	
		PYRENE	0.013	mg/Kg	0.005	
		SURROGATE	108	%RECOVERY	50-150	
SOIL SAMPLE @ 7.5-8.0'		SAMPLE ID: CS-54				
1953-023	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/16/2000
		SURROGATE RECOVERY	97	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE @ 7.5-8.0'		SAMPLE ID: CS-54				
01953-023	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/13/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	129	%RECOVERY	50-150	
SOIL SAMPLE @ 7.5-8.0'		SAMPLE ID: CS-55				
01953-024	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/16/2000
		SURROGATE RECOVERY	99	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/13/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	107	%RECOVERY	50-150	
SOIL SAMPLE @ 7.5-8.0'		SAMPLE ID: CS-56				
01953-025	NWTPH-Dx	DIESEL	240	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/16/2000
		SURROGATE RECOVERY	89	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE @ 7.5-8.0'		SAMPLE ID: CS-56				
01953-025	PNAH 1	ACENAPHTHENE	0.031	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/13/2000
		ANTHRACENE	0.030	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.013	mg/Kg	0.005	
		FLUORENE	0.12	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	0.009	mg/Kg	0.005	
		PHENANTHRENE	0.17	mg/Kg	0.005	
		PYRENE	0.008	mg/Kg	0.005	
		SURROGATE	110	%RECOVERY	50-150	
SOIL SAMPLE @ 7.5-8.0'		SAMPLE ID: CS-57				
01953-026	NWTPH-Dx	DIESEL	1,300	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	180	mg/Kg	100	10/16/2000
		SURROGATE RECOVERY	98	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.28	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.040	mg/Kg	0.005	10/14/2000
		ANTHRACENE	0.106	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.030	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.013	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.057	mg/Kg	0.005	
		FLUORENE	0.47	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	0.028	mg/Kg	0.005	
		PHENANTHRENE	0.90	mg/Kg	0.005	
		PYRENE	0.056	mg/Kg	0.005	
		SURROGATE	81	%RECOVERY	50-150	
SOIL SAMPLE @ 6.5-7.0'		SAMPLE ID: CS-58				
01953-027	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/16/2000
		SURROGATE RECOVERY	104	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE @ 6.5-7.0'		SAMPLE ID: CS-58				
01953-027	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/14/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	127	%RECOVERY	50-150	
SOIL SAMPLE @ 7.5-8.0'		SAMPLE ID: CS-59				
01953-028	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/16/2000
		SURROGATE RECOVERY	100	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/14/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	131	%RECOVERY	50-150	
SOIL SAMPLE @ 8.5-9.0'		SAMPLE ID: CS-44D				
01953-029	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/16/2000
		SURROGATE RECOVERY	100	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE @	8.5-9.0'	SAMPLE ID: CS-44D				
01953-029	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/14/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	115	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

CLIENT: GLENBROOK NICKEL - SMELTER
5093 RIDDLE BYPASS RD.
RIDDLE OR 97469

PHONE: (541) 874-3171
FAX: (541) 874-3380

DATE SUBMITTED: 10/27/2000

PROJECT NAME: GLENBROOK NICKEL

PROJECT NUMBER: JA036.15

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
02046-001		10/26/2000	1110	Soil	GS-1 2.0-2.5
02046-002		10/26/2000	1112	Soil	GS-2 2.0-2.5
02046-003		10/26/2000	1115	Soil	GS-3 2.0-2.5
02046-004		10/26/2000	1117	Soil	GS-4 2.0-2.5
02046-005		10/26/2000	1120	Soil	GS-5 2.0-2.5
02046-006		10/26/2000	1125	Soil	GS-6 1.5-2.0
02046-007		10/26/2000	1130	Soil	GS-7 1.5-2.0
02046-008		10/26/2000	1132	Soil	GS-8 1.5-2.0
02046-009		10/26/2000	1135	Soil	GS-9 1.5-2.0
02046-010		10/26/2000	1140	Soil	GS-10 1.5-2.0
02046-011		10/26/2000	1345	Soil	CS-60 2.0
02046-012		10/26/2000	1350	Soil	CS-60D 6.0
02046-013		10/26/2000	1355	Soil	CS-61 7.0
02046-014		10/26/2000	1400	Soil	CS-62 9.0
02046-015		10/26/2000	1405	Soil	CS-63 3.0
02046-016		10/26/2000	1410	Soil	CS-63D 9.0
02046-017		10/26/2000	1415	Soil	CS-64 3.0
02046-018		10/26/2000	1420	Soil	CS-64D 9.0
02046-019		10/26/2000	1425	Soil	CS-65 9.0
02046-020		10/26/2000	1430	Soil	CS-66 7.0
02046-021		10/26/2000	1435	Soil	CS-67 2.0
02046-022		10/26/2000	1440	Soil	CS-67D 7.0
02046-023		10/26/2000	1445	Soil	CS-68 2.0
02046-024		10/26/2000	1450	Soil	CS-68D 9.0
02046-025		10/26/2000	1455	Soil	CS-69 9.0
02046-026		10/26/2000	1500	Soil	CS-70 9.0
02046-027		10/26/2000	1505	Soil	CS-71 3.0
02046-028		10/26/2000	1510	Soil	CS-71D 9.0
02046-029		10/26/2000	1515	Soil	CS-72 3.0
02046-030		10/26/2000	1520	Soil	CS-72D 9.0
02046-031		10/26/2000	1525	Soil	CS-73 3.0
02046-032		10/26/2000	1530	Soil	CS-73D 9.0
02046-033		10/26/2000	1535	Soil	CS-74 9.0
02046-034		10/26/2000	1540	Soil	CS-75 3.0
02046-035		10/26/2000	1545	Soil	CS-75D 9.0
02046-036		10/26/2000	1550	Soil	CS-76 17.0
02046-037		10/26/2000	1555	Soil	CS-77 15.0
02046-038		10/26/2000	1600	Soil	CS-78 18.0
02046-039		10/26/2000	1605	Soil	CS-79 10.0
02046-040		10/26/2000	1610	Soil	CS-79D 18.0
02046-041		10/26/2000	1615	Soil	CS-80 18.0
02046-042		10/26/2000	1620	Soil	CS-81 25.0

COLUMBIA INSPECTION, INC. 7133 N. Lombard, Portland, OR 97203 Phone:(503) 286-9464 Fax:(503) 286-5355 E-mail:lab@ColumbiaInspection.com

CERTIFICATE OF ANALYSIS

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
02046-043		10/26/2000	1625	Soil	CS-82 18.0
02046-044		10/26/2000	1630	Soil	CS-82D 25.0
02046-045		10/26/2000	1635	Soil	CS-83 25.0
02046-046		10/26/2000	1640	Soil	CS-84 18.0
02046-047		10/26/2000	1645	Soil	CS-85 11.0
02046-048		10/26/2000	1650	Soil	CS-86 3.0
02046-049		10/26/2000	1655	Soil	CS-86D 9.0
02046-050		10/26/2000	1700	Soil	CS-87 11.0
02046-051		10/26/2000	1705	Soil	CS-88 9.0
02046-052		10/26/2000	1710	Soil	CS-89 2.0
02046-053		10/26/2000	1715	Soil	CS-89D 8.0
02046-054		10/26/2000	1720	Soil	CS-90 4.0
02046-055		10/26/2000	1315	Soil	GS-1-C
02046-056		10/26/2000	1025	Water	WS-1
02046-057		10/26/2000	1030	Soil	WS-1-Sed

REVIEWED BY: _____
Martin Little - Quality Manager

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-60 2.0						
02046-011	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/31/2000
		SURROGATE RECOVERY	128	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/30/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	91	%RECOVERY	50-150	
CS-60D 6.0						
02046-012	NWTPH-Dx	DIESEL	180	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/31/2000
		SURROGATE RECOVERY	119	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.012	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/07/2000
		ANTHRACENE	0.007	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.009	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.008	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.043	mg/Kg	0.005	
		FLUORENE	0.011	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	0.009	mg/Kg	0.005	
		PHENANTHRENE	0.025	mg/Kg	0.005	
		PYRENE	0.054	mg/Kg	0.005	
		SURROGATE	90	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-61 7.0						
02046-013	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/31/2000
		SURROGATE RECOVERY	118	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/30/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	0.005	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.022	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	114	%RECOVERY	50-150	
CS-62 9.0						
02046-014	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/31/2000
		SURROGATE RECOVERY	127	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/30/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.005	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	113	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-63 3.0						
02046-015	NWTPH-Dx	DIESEL	94	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	98	mg/Kg	100	10/31/2000
		SURROGATE RECOVERY	124	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/30/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.006	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	147	%RECOVERY	50-150	
CS-63D 9.0						
02046-016	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	117	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/31/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO[AH]ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	88	%RECOVERY		

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-64 3.0						
02046-017	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	91	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/31/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	85	%RECOVERY	50-150	
CS-64D 9.0						
02046-018	NWTPH-Dx	DIESEL	120	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	97	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/31/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	0.014	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.066	mg/Kg	0.005	
		PYRENE	0.005	mg/Kg	0.005	
		SURROGATE	99	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-65 9.0						
02046-019	NWTPH-Dx	DIESEL	35	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	91	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/31/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.026	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	110	%RECOVERY	50-150	
CS-66 7.0						
02046-020	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	54	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/31/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	92	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-67 2.0						
02046-021	NWTPH-Dx	DIESEL	570	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	390	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	135	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/07/2000
		ANTHRACENE	0.007	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.037	mg/Kg	0.005	
		BENZO(A)PYRENE	0.023	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.017	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.014	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.018	mg/Kg	0.005	
		CHRYSENE	0.058	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.18	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	0.009	mg/Kg	0.005	
		NAPHTHALENE	0.028	mg/Kg	0.005	
		PHENANTHRENE	0.030	mg/Kg	0.005	
		PYRENE	0.18	mg/Kg	0.005	
		SURROGATE	56	%RECOVERY	50-150	
CS-67D 7.0						
02046-022	NWTPH-Dx	DIESEL	64	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	112	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/31/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.008	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.009	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.022	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	0.005	mg/Kg	0.005	
		PHENANTHRENE	0.007	mg/Kg	0.005	
		PYRENE	0.032	mg/Kg	0.005	
		SURROGATE	98	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-6B 2.0						
02046-023	NWTPH-Dx	DIESEL	610	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	360	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	136	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.033	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.006	mg/Kg	0.005	11/07/2000
		ANTHRACENE	0.017	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.022	mg/Kg	0.005	
		BENZO(A)PYRENE	0.012	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.015	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.010	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.014	mg/Kg	0.005	
		CHRYSENE	0.026	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.078	mg/Kg	0.005	
		FLUORENE	0.073	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	0.005	mg/Kg	0.005	
		NAPHTHALENE	0.021	mg/Kg	0.005	
		PHENANTHRENE	0.19	mg/Kg	0.005	
		PYRENE	0.081	mg/Kg	0.005	
		SURROGATE	OBSCURED	%RECOVERY	50-150	
CS-6BD 9.0						
02046-024	NWTPH-Dx	DIESEL	450	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	110	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	101	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.027	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.006	mg/Kg	0.005	11/07/2000
		ANTHRACENE	0.014	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.009	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.005	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.010	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.040	mg/Kg	0.005	
		FLUORENE	0.038	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	0.007	mg/Kg	0.005	
		PHENANTHRENE	0.095	mg/Kg	0.005	
		PYRENE	0.043	mg/Kg	0.005	
		SURROGATE	65	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-69 9.0						
02046-025	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	98	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/31/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	86	%RECOVERY	50-150	
CS-70 9.0						
02046-026	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	88	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/31/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	0.008	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.038	mg/Kg	0.005	
		PYRENE	0.020	mg/Kg	0.005	
		SURROGATE	141	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-71 3.0						
02046-027	NWTPH-Dx	DIESEL	820	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	140	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	112	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.012	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.017	mg/Kg	0.005	11/07/2000
		ANTHRACENE	0.041	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.005	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.007	mg/Kg	0.005	
		FLUORENE	0.13	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.48	mg/Kg	0.005	
		PYRENE	0.028	mg/Kg	0.005	
		SURROGATE	146	%RECOVERY	50-150	
CS-71D 9.0						
02046-028	NWTPH-Dx	DIESEL	650	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	120	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	85	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.023	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.013	mg/Kg	0.005	11/07/2000
		ANTHRACENE	0.015	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	0.10	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.28	mg/Kg	0.005	
		PYRENE	0.016	mg/Kg	0.005	
		SURROGATE	99	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-72 3.0						
02046-029	NWTPH-Dx	DIESEL	130	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	97	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/31/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.019	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	86	%RECOVERY	50-150	
CS-72D 9.0						
02046-030	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	102	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/31/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	0.008	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.009	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	103	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-73 3.0						
02046-031	NWTPH-Dx	DIESEL	40	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	115	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/31/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.007	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	87	%RECOVERY	50-150	
CS-73D 9.0						
02046-032	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	131	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/01/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	86	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-74 9.0						
02046-033	NWTPH-Dx	DIESEL	110	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	131	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/01/2000
		ANTHRACENE	0.005	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.080	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	124	%RECOVERY	50-150	
CS-75 3.0						
02046-034	NWTPH-Dx	DIESEL	170	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	100	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/01/2000
		ANTHRACENE	0.006	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.006	mg/Kg	0.005	
		FLUORENE	0.006	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.020	mg/Kg	0.005	
		PYRENE	0.009	mg/Kg	0.005	
		SURROGATE	110	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-75D 9.0						
02046-035	NWTPH-Dx	DIESEL	50	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	88	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.006	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/01/2000
		ANTHRACENE	0.007	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	0.006	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.036	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	114	%RECOVERY	50-150	
CS-76 17.0						
02046-036	NWTPH-Dx	DIESEL	70	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	112	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/07/2000
		ANTHRACENE	0.008	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	0.007	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.066	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	104	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-77 15.0						
02046-037	NWTPH-Dx	DIESEL	25	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	91	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/01/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.009	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	138	%RECOVERY	50-150	
CS-78 18.0						
02046-038	NWTPH-Dx	DIESEL	430	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	102	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.017	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.021	mg/Kg	0.005	11/07/2000
		ANTHRACENE	0.025	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	0.037	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.17	mg/Kg	0.005	
		PYRENE	0.008	mg/Kg	0.005	
		SURROGATE	133	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-79 10.0						
02046-039	NWTPH-Dx	DIESEL	750	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	114	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.008	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.020	mg/Kg	0.005	11/07/2000
		ANTHRACENE	0.030	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	0.021	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.008	mg/Kg	0.005	
		PYRENE	0.012	mg/Kg	0.005	
		SURROGATE	313	%RECOVERY	50-150	
CS-79D 18.0						
02046-040	NWTPH-Dx	DIESEL	740	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	101	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.076	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.025	mg/Kg	0.005	11/07/2000
		ANTHRACENE	0.040	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.008	mg/Kg	0.005	
		FLUORENE	0.034	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	0.024	mg/Kg	0.005	
		PHENANTHRENE	0.14	mg/Kg	0.005	
		PYRENE	0.016	mg/Kg	0.005	
		SURROGATE	137	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-80 18.0						
02046-041	NWTPH-Dx	DIESEL	730	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	103	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.047	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.029	mg/Kg	0.005	11/07/2000
		ANTHRACENE	0.068	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.005	mg/Kg	0.005	
		FLUORENE	0.071	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	0.007	mg/Kg	0.005	
		PHENANTHRENE	0.40	mg/Kg	0.005	
		PYRENE	0.013	mg/Kg	0.005	
		SURROGATE	OBSCURED	%RECOVERY	50-150	
CS-81 25.0						
02046-042	NWTPH-Dx	DIESEL	680	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	106	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.071	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.022	mg/Kg	0.005	11/07/2000
		ANTHRACENE	0.035	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.007	mg/Kg	0.005	
		FLUORENE	0.053	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	0.046	mg/Kg	0.005	
		PHENANTHRENE	0.29	mg/Kg	0.005	
		PYRENE	0.010	mg/Kg	0.005	
		SURROGATE	142	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-82 18.0						
02046-043	NWTPH-Dx	DIESEL	85	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	101	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/01/2000
		ANTHRACENE	0.010	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.039	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	141	%RECOVERY	50-150	
CS-82D 25.0						
02046-044	NWTPH-Dx	DIESEL	1,200	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	120	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	112	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.053	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.041	mg/Kg	0.005	11/07/2000
		ANTHRACENE	0.057	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.06	mg/Kg	0.005	
		FLUORENE	0.034	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	0.035	mg/Kg	0.005	
		PHENANTHRENE	0.46	mg/Kg	0.005	
		PYRENE	0.019	mg/Kg	0.005	
		SURROGATE	121	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-83 25.0						
02046-045	NWTPH-Dx	DIESEL	5,400	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	430	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	105	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.067	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.19	mg/Kg	0.005	11/07/2000
		ANTHRACENE	0.12	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.015	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.017	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.044	mg/Kg	0.005	
		FLUORENE	0.13	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	0.31	mg/Kg	0.005	
		PHENANTHRENE	2.1	mg/Kg	0.005	
		PYRENE	0.074	mg/Kg	0.005	
		SURROGATE	130	%RECOVERY	50-150	
CS-84 18.0						
02046-046	NWTPH-Dx	DIESEL	660	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	99	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.019	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.020	mg/Kg	0.005	11/07/2000
		ANTHRACENE	0.021	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.005	mg/Kg	0.005	
		FLUORENE	0.020	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	0.024	mg/Kg	0.005	
		PHENANTHRENE	0.29	mg/Kg	0.005	
		PYRENE	0.008	mg/Kg	0.005	
		SURROGATE	123	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-85 11.0						
02046-047	NWTPH-Dx	DIESEL	380	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	104	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.008	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.012	mg/Kg	0.005	11/08/2000
		ANTHRACENE	0.008	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	0.007	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	0.007	mg/Kg	0.005	
		PHENANTHRENE	0.042	mg/Kg	0.005	
		PYRENE	0.010	mg/Kg	0.005	
		SURROGATE	150	%RECOVERY	50-150	
CS-86 3.0						
02046-048	NWTPH-Dx	DIESEL	420	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	160	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	101	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.011	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.010	mg/Kg	0.005	11/08/2000
		ANTHRACENE	0.040	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.19	mg/Kg	0.005	
		BENZO(A)PYRENE	0.14	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.20	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.10	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.084	mg/Kg	0.005	
		CHRYSENE	0.23	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	0.037	mg/Kg	0.005	
		FLUORANTHENE	0.39	mg/Kg	0.005	
		FLUORENE	0.011	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	0.079	mg/Kg	0.005	
		NAPHTHALENE	0.010	mg/Kg	0.005	
		PHENANTHRENE	0.068	mg/Kg	0.005	
		PYRENE	0.39	mg/Kg	0.005	
		SURROGATE	70	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-86D 9.0						
02046-049	NWTPH-Dx	DIESEL	390	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	130	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	104	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.014	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.013	mg/Kg	0.005	11/08/2000
		ANTHRACENE	0.037	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.085	mg/Kg	0.005	
		BENZO(A)PYRENE	0.059	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.064	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.042	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.063	mg/Kg	0.005	
		CHRYSENE	0.097	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	0.020	mg/Kg	0.005	
		FLUORANTHENE	0.23	mg/Kg	0.005	
		FLUORENE	0.014	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	0.031	mg/Kg	0.005	
		NAPHTHALENE	0.013	mg/Kg	0.005	
		PHENANTHRENE	0.090	mg/Kg	0.005	
		PYRENE	0.21	mg/Kg	0.005	
		SURROGATE	106	%RECOVERY	50-150	
CS-87 11.0						
02046-050	NWTPH-Dx	DIESEL	64	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	102	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/01/2000
		ANTHRACENE	0.005	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.020	mg/Kg	0.005	
		PYRENE	0.005	mg/Kg	0.005	
		SURROGATE	129	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-88 9.0						
02046-051	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	102	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/09/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.088	mg/Kg	0.005	
		BENZO(A)PYRENE	0.062	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.011	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.019	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.011	mg/Kg	0.005	
		CHRYSENE	0.18	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	0.009	mg/Kg	0.005	
		FLUORANTHENE	0.007	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	0.010	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	0.075	mg/Kg	0.005	
		SURROGATE	99	%RECOVERY	50-150	
CS-89 2.0						
02046-052	NWTPH-Dx	DIESEL	1,500	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	460	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	114	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.017	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.030	mg/Kg	0.005	11/08/2000
		ANTHRACENE	0.088	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.25	mg/Kg	0.005	
		BENZO(A)PYRENE	0.18	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.17	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.13	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.12	mg/Kg	0.005	
		CHRYSENE	0.36	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	0.045	mg/Kg	0.005	
		FLUORANTHENE	0.68	mg/Kg	0.005	
		FLUORENE	0.036	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	0.091	mg/Kg	0.005	
		NAPHTHALENE	0.011	mg/Kg	0.005	
		PHENANTHRENE	0.12	mg/Kg	0.005	
		PYRENE	0.68	mg/Kg	0.005	
		SURROGATE	76	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-89D 8.0						
02046-053	NWTPH-Dx	DIESEL	67	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	107	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/01/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.028	mg/Kg	0.005	
		BENZO(A)PYRENE	0.018	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.009	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.012	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.012	mg/Kg	0.005	
		CHRYSENE	0.040	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.040	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	0.006	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.011	mg/Kg	0.005	
		PYRENE	0.086	mg/Kg	0.005	
		SURROGATE	117	%RECOVERY	50-150	
CS-90 4.0						
02046-054	NWTPH-Dx	DIESEL	36	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/01/2000
		SURROGATE RECOVERY	108	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/09/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.012	mg/Kg	0.005	
		BENZO(A)PYRENE	0.009	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.012	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.012	mg/Kg	0.005	
		CHRYSENE	0.019	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.059	mg/Kg	0.005	
		FLUORENE	0.013	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.013	mg/Kg	0.005	
		PYRENE	0.064	mg/Kg	0.005	
		SURROGATE	115	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

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DATE SUBMITTED: 11/16/20

PROJECT NAME: AOCR-10

PROJECT NUMBER: JA036-15

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
02141-001	CS-91 @ 4.0'	11/14/2000	0845	Soil	SOIL SAMPLE
02141-002	CS-92 @ 13.0'	11/14/2000	0850	Soil	SOIL SAMPLE
02141-003	CS-93 @ 20.0'	11/14/2000	0935	Soil	SOIL SAMPLE
02141-004	CS-94 @ 20.0'	11/14/2000	0940	Soil	SOIL SAMPLE
02141-005	CS-95 @ 35.0'	11/14/2000	1400	Soil	SOIL SAMPLE
02141-006	CS-96 @ 6.0'	11/14/2000	1445	Soil	SOIL SAMPLE
02141-007	CS-97 @ 11.0'	11/14/2000	1505	Soil	SOIL SAMPLE
02141-008	CS-98 @ 6.0'	11/14/2000	1450	Soil	SOIL SAMPLE
02141-009	CS-99 @ 6.0'	11/14/2000	1520	Soil	SOIL SAMPLE
02141-010	CS-100 @ 11.0'	11/14/2000	1525	Soil	SOIL SAMPLE
02141-011	CS-101 @ 6.0'	11/14/2000	1528	Soil	SOIL SAMPLE
02141-012	CS-102 @ 6.0'	11/14/2000	1530	Soil	SOIL SAMPLE
02141-013	CS-103 @ 12.0'	11/14/2000	1532	Soil	SOIL SAMPLE
02141-014	CS-104 @ 6.0'	11/14/2000	1535	Soil	SOIL SAMPLE
02141-015	CS-105 @ 6.0'	11/14/2000	1538	Soil	SOIL SAMPLE
02141-016	CS-106 @ 12.0'	11/14/2000	1540	Soil	SOIL SAMPLE
02141-017	CS-107 @ 6.0'	11/14/2000	1545	Soil	SOIL SAMPLE
02141-018	CS-108 @ 8.0'	11/15/2000	0940	Soil	SOIL SAMPLE
02141-019	CS-109 @ 16.0'	11/15/2000	0943	Soil	SOIL SAMPLE
02141-020	CS-110 @ 4.0'	11/15/2000	0945	Soil	SOIL SAMPLE
02141-021	CS-111 @ 8.0'	11/15/2000	0948	Soil	SOIL SAMPLE
02141-022	CS-112 @ 13.0'	11/15/2000	0950	Soil	SOIL SAMPLE
02141-023	CS-113 @ 8.0'	11/15/2000	0952	Soil	SOIL SAMPLE
02141-024	CS-114 @ 4.0'	11/15/2000	0954	Soil	SOIL SAMPLE
02141-025	CS-115 @ 5.0'	11/15/2000	0956	Soil	SOIL SAMPLE
02141-026	CS-116 @ 4.0'	11/15/2000	0958	Soil	SOIL SAMPLE
02141-027	CS-117 @ 4.0'	11/15/2000	1000	Soil	SOIL SAMPLE
02141-028	CS-118 @ 3.0'	11/15/2000	1035	Soil	SOIL SAMPLE
02141-029	CS-119 @ 3.0'	11/15/2000	1040	Soil	SOIL SAMPLE
02141-030	CS-120 @ 3.0'	11/15/2000	1045	Soil	SOIL SAMPLE
02141-031	CS-121 @ 3.0'	11/15/2000	1050	Soil	SOIL SAMPLE
02141-032	CS-122 @ 3.0'	11/15/2000	1610	Soil	SOIL SAMPLE
02141-033	CS-123 @ 3.0'	11/15/2000	1605	Soil	SOIL SAMPLE
02141-034	CS-124 @ 3.0'	11/15/2000	1600	Soil	SOIL SAMPLE

REVIEWED BY: _____

Martin Little - Quality Manager

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CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-91 @ 4.0'				
02141-001	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	121	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/22/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	91	%RECOVERY	50-150	
SOIL SAMPLE		SAMPLE ID: CS-92 @ 13.0'				
02141-002	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	80	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/21/2000
		ANTHRACENE	0.027	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.015	mg/Kg	0.005	
		BENZO(A)PYRENE	0.005	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.006	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.006	mg/Kg	0.005	
		CHRYSENE	0.017	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.12	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.10	mg/Kg	0.005	
		PYRENE	0.088	mg/Kg	0.005	
		SURROGATE	90	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-93 @ 20.0'				
02141-003	NWTPH-Dx	DIESEL	320	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	145	%RECOVERY	50%-150%	
		ACENAPHTHENE	0.059	mg/Kg	0.005	Dave M
	PNAH 1	ACENAPHTHYLENE	0.014	mg/Kg	0.005	11/18/2000
	EPA 8270M (SIM)	ANTHRACENE	0.022	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.26	mg/Kg	0.005	
		PYRENE	0.012	mg/Kg	0.005	
		SURROGATE	81	%RECOVERY	50-150	
SOIL SAMPLE		SAMPLE ID: CS-94 @ 20.0'				
02141-004	NWTPH-Dx	DIESEL	31	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	103	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/18/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	100	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALIST
SOIL SAMPLE		SAMPLE ID: CS-95 @ 35.0'				
02141-005	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	85	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/18/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	90	%RECOVERY	50-150	
SOIL SAMPLE		SAMPLE ID: CS-96 @ 6.0'				
02141-006	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	52	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/21/2000
		ANTHRACENE	0.009	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.006	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.007	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.042	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.037	mg/Kg	0.005	
		PYRENE	0.029	mg/Kg	0.005	
		SURROGATE	64	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-97 @ 11.0'				
02141-007	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	141	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/18/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	92	%RECOVERY	50-150	
SOIL SAMPLE		SAMPLE ID: CS-98 @ 6.0'				
02141-008	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	70	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/18/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	83	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-99 @ 6.0'				
02141-009	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	113	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/18/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	91	%RECOVERY	50-150	
SOIL SAMPLE		SAMPLE ID: CS-100 @ 11.0'				
02141-010	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	84	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/18/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	100	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-101 @ 6.0'				
02141-011	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	75	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/18/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	100	%RECOVERY	50-150	
SOIL SAMPLE		SAMPLE ID: CS-102 @ 6.0'				
02141-012	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	89	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/18/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	94	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-103 @ 12.0'				
02141-013	NWTPH-Dx	DIESEL	69	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	91	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/18/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	102	%RECOVERY	50-150	
SOIL SAMPLE		SAMPLE ID: CS-104 @ 6.0'				
02141-014	NWTPH-Dx	DIESEL	55	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	59	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/21/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	0.005	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	0.006	mg/Kg	0.005	
		PHENANTHRENE	0.010	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	70	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-105 @ 6.0'				
02141-015	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	61	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/21/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	88	%RECOVERY	50-150	
SOIL SAMPLE		SAMPLE ID: CS-106 @ 12.0'				
02141-016	NWTPH-Dx	DIESEL	430	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	61	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.016	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/22/2000
		ANTHRACENE	0.033	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.025	mg/Kg	0.005	
		BENZO(A)PYRENE	0.10	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.031	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.012	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.029	mg/Kg	0.005	
		CHRYSENE	0.027	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	0.006	mg/Kg	0.005	
		FLUORANTHENE	0.048	mg/Kg	0.005	
		FLUORENE	0.007	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	0.013	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.35	mg/Kg	0.005	
		PYRENE	0.040	mg/Kg	0.005	
		SURROGATE	91	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-107 @ 6.0'				
02141-017	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	62	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/21/1900
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.005	mg/Kg	0.005	
		BENZO(A)PYRENE	0.006	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.006	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.010	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	0.007	mg/Kg	0.005	
		SURROGATE	102	%RECOVERY	50-150	
SOIL SAMPLE		SAMPLE ID: CS-108 @ 8.0'				
02141-018	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	58	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/21/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	104	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-109 @ 16.0'				
02141-019	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	65	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/21/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.013	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.006	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.009	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.005	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	0.010	mg/Kg	0.005	
		SURROGATE	126	%RECOVERY	50-150	
SOIL SAMPLE		SAMPLE ID: CS-110 @ 4.0'				
02141-020	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	64	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/21/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.014	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.005	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.011	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	0.011	mg/Kg	0.005	
		SURROGATE	132	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-111 @ 8.0'				
02141-021	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	73	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/21/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	142	%RECOVERY	50-150	
SOIL SAMPLE		SAMPLE ID: CS-112 @ 13.0'				
02141-022	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	79	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/21/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.006	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.006	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	0.006	mg/Kg	0.005	
		SURROGATE	119	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-113 @ 8.0'				
02141-023	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	62	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/21/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.007	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.006	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	0.006	mg/Kg	0.005	
		SURROGATE	122	%RECOVERY	50-150	
SOIL SAMPLE		SAMPLE ID: CS-114 @ 4.0'				
02141-024	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Dave M
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	129	%RECOVERY	50%-150%	
		ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/21/2000
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	104	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-115 @ 5.0'				
02141-025	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	60	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/22/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.005	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.005	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	108	%RECOVERY	50-150	
SOIL SAMPLE		SAMPLE ID: CS-116 @ 4.0'				
02141-026	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	60	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/21/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	89	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-117 @ 4.0'				
02141-027	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	57	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/22/2000
		ANTHRACENE	0.007	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.009	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.008	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.005	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.013	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	0.005	mg/Kg	0.005	
		PHENANTHRENE	0.008	mg/Kg	0.005	
		PYRENE	0.013	mg/Kg	0.005	
		SURROGATE	103	%RECOVERY	50-150	
SOIL SAMPLE		SAMPLE ID: CS-118 @ 3.0'				
02141-028	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	68	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/22/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.013	mg/Kg	0.005	
		BENZO(A)PYRENE	0.006	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.008	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.009	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	0.011	mg/Kg	0.005	
		SURROGATE	143%	%RECOVERY	50-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-119 @ 3.0'				
02141-029	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	60	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/22/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.013	mg/Kg	0.005	
		BENZO(A)PYRENE	0.005	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.005	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.008	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	0.010	mg/Kg	0.005	
		SURROGATE	105%	%RECOVERY	50-150%	
SOIL SAMPLE		SAMPLE ID: CS-120 @ 3.0'				
02141-030	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	54	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/22/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	103%	%RECOVERY	50-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-121 @ 3.0'				
02141-031	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	52	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/22/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.007	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.005	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	0.007	mg/Kg	0.005	
		SURROGATE	101%	%RECOVERY	50-150%	
SOIL SAMPLE		SAMPLE ID: CS-122 @ 3.0'				
02141-032	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	57	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/22/2000
		ANTHRACENE	0.006	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.006	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	101%	%RECOVERY	50-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-123 @ 3.0'				
02141-033	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	72	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/22/2000
		ANTHRACENE	0.006	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.007	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.007	mg/Kg	0.005	
		PYRENE	0.007	mg/Kg	0.005	
		SURROGATE	135%	%RECOVERY	50-150%	
SOIL SAMPLE		SAMPLE ID: CS-124 @ 3.0'				
02141-034	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/22/2000
		SURROGATE RECOVERY	66	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/22/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.005	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.006	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	0.006	mg/Kg	0.005	
		SURROGATE	116%	%RECOVERY	50-150%	

CERTIFICATE OF ANALYSIS

CLIENT: GLENBROOK NICKEL - COOS BAY
PO BOX 85
RIDDLE OR 97469

PHONE: (541) 874-3171
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DATE SUBMITTED: 11/30/20

PROJECT NAME: GLENBROOK NICKEL, RIDDLE,OR PROJECT NUMBER: JA036.15

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
02199-001		11/28/2000	1355	Soil	CS-126 @ 5.0'
02199-002		11/28/2000	1400	Soil	CS-126D @ 10.0'
02199-003		11/28/2000	1402	Soil	CS-127 @ 5.0'
02199-004		11/28/2000	1404	Soil	CS-127D @ 10.0'
02199-005		11/28/2000	1406	Soil	CS-128 @ 5.0'
02199-006		11/28/2000	1408	Soil	CS-128D @ 10.0'
02199-007		11/28/2000	1410	Soil	CS-129 @ 5.0'
02199-008		11/28/2000	1412	Soil	CS-129D @ 10.0'
02199-009		11/28/2000	1414	Soil	CS-130 @ 4.0'
02199-010		11/28/2000	1416	Soil	CS-130D @ 8.0'
02199-011		11/28/2000	1425	Soil	CS-131 @ 12.0'
02199-012		11/28/2000	1422	Soil	CS-132 @ 12.0'
02199-013		11/28/2000	1420	Soil	CS-133 @ 8.0'
02199-014		11/28/2000	1435	Soil	CS-134 @ 5.0'
02199-015		11/29/2000	0940	Soil	CS-125 @ 20.0'

REPORT DATE: 12/08/2000 REPORT NUMBER: 02199

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-126 @ 5.0'						
02199-001	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	12/07/2000
		SURROGATE RECOVERY	130	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	12/06/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	81%	%RECOVERY	50-150%	

REVIEWED BY:
Martin Little - Quality Manager

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-126D @ 10.0'						
02199-002	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	12/07/2000
		SURROGATE RECOVERY	91	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	12/06/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	68%	%RECOVERY	50-150%	
CS-127 @ 5.0'						
02199-003	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	12/07/2000
		SURROGATE RECOVERY	97	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	12/06/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	79%	%RECOVERY	50-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-127D @ 10.0'						
02199-004	NWTPH-Dx	DIESEL	2,000	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	1,300	mg/Kg	100	12/07/2000
		SURROGATE RECOVERY	105	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.076	mg/Kg	0.	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.	12/06/2000
		ANTHRACENE	0.068	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.032	mg/Kg	0.005	
		BENZO(A)PYRENE	0.010	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.015	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.005	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.017	mg/Kg	0.005	
		CHRYSENE	0.054	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.12	mg/Kg	0.005	
		FLUORENE	0.18	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	1.1	mg/Kg	0.005	
		PYRENE	0.13	mg/Kg	0.005	
		SURROGATE	75%	%RECOVERY	50-150%	
CS-128 @ 5.0'						
02199-005	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	12/07/2000
		SURROGATE RECOVERY	82	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.007	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	12/06/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	0.047	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.24	mg/Kg	0.005	
		PYRENE	0.009	mg/Kg	0.005	
		SURROGATE	74%	%RECOVERY	50-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-128D @ 10.0'						
02199-006	NWTPH-Dx	DIESEL	420	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	330	mg/Kg	100	12/07/2000
		SURROGATE RECOVERY	84	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.007	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	12/06/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	0.047	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.24	mg/Kg	0.005	
		PYRENE	0.009	mg/Kg	0.005	
		SURROGATE	68%	%RECOVERY	50-150%	
CS-129 @ 5.0'						
02199-007	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	12/07/2000
		SURROGATE RECOVERY	86	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	12/06/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	71%	%RECOVERY	50-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-129D @ 10.0'						
02199-008	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	12/07/2000
		SURROGATE RECOVERY	93	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	12/06/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	69%	%RECOVERY	50-150%	
CS-130 @ 4.0'						
02199-009	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	12/07/2000
		SURROGATE RECOVERY	97	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	12/06/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	81%	%RECOVERY	50-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-130D @ 6.0'						
02199-010	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	12/07/2000
		SURROGATE RECOVERY	96	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	12/06/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	79%	%RECOVERY	50-150%	
CS-131 @ 12.0'						
02199-011	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	12/07/2000
		SURROGATE RECOVERY	73	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	12/06/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	70%	%RECOVERY	50-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-132 @ 12.0'						
02199-012	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	12/07/2000
		SURROGATE RECOVERY	75	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	12/06/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	68%	%RECOVERY	50-150%	
CS-133 @ 8.0'						
02199-013	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	12/07/2000
		SURROGATE RECOVERY	101	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	12/06/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	83	%RECOVERY	50-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-134 @ 5.0'						
02199-014	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	12/07/2000
		SURROGATE RECOVERY	87	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	12/06/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	75%	%RECOVERY	50-150%	
CS-125 @ 20.0'						
02199-015	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	12/07/2000
		SURROGATE RECOVERY	93	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	12/06/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	87%	%RECOVERY	50-150%	

CI CERTIFICATE OF ANALYSIS

CLIENT: GLENBROOK NICKEL - SMELTER
5093 RIDDLE BYPASS RD.
RIDDLE OR 97469

PHONE: (541) 874-3171
FAX: (541) 874-3380

DATE SUBMITTED: 12/14/20

PROJECT NAME: GLENBROOK NICKEL, RIDDLE, OREGON PROJECT NUMBER: JA036.15

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
02271-001	CS-134D @ 10.0'	10/13/2000	0750	Soil	SOIL SAMPLE
02271-002	CS-135D @ 10.0'	10/13/2000	0805	Soil	SOIL SAMPLE

REPORT DATE: 12/20/2000 REPORT NUMBER: 02271

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-134D @ 10.0'				
02271-001	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Dave M
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	12/18/2000
		SURROGATE RECOVERY	88	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	12/16/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO[A]PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.008	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.006	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.005	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	89	%RECOVERY	50-150	
SOIL SAMPLE		SAMPLE ID: CS-135D @ 10.0'				
02271-002	NWTPH-Dx	DIESEL	66	mg/Kg	25	Dave M
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	12/18/2000
		SURROGATE RECOVERY	84	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	12/16/2000
		ANTHRACENE	0.007	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	

REVIEWED BY: _____
Merlin Little - Quality Manager

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-135D @ 10.0'				
02271-002	PNAH 1	BENZO(A)PYRENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	12/16/2000
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.050	mg/Kg	0.005	
		PYRENE	0.007	mg/Kg	0.005	
		SURROGATE	80	%RECOVERY	50-150	

CI CERTIFICATE OF ANALYSIS

CLIENT: GLENBROOK NICKEL - SMELTER
5093 RIDDLE BYPASS RD.
RIDDLE OR 97469

PHONE: (541) 874-3171
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DATE SUBMITTED: 01/12/20

PROJECT NAME: GLENBROOK NICKEL, RIDDLE, OREGON PROJECT NUMBER: 14036.15

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
10074-001	136-D	01/11/2001	0900	Soil	CS-136D @ 10.0'
10074-002	137-D	01/11/2001	0915	Soil	CS-137D @ 10.0'
10074-003	138	01/11/2001	0930	Soil	CS-138
10074-004	139	01/11/2001	0945	Soil	CS-139
10074-005	140	01/11/2001	0950	Soil	CS-140
10074-006	141	01/11/2001	1000	Soil	CS-141
10074-007	142	01/11/2001	1010	Soil	CS-142
10074-008	143	01/11/2001	1020	Soil	CS-143, 6' EAST WALL
10074-009	144	01/11/2001	1030	Soil	CS-144, 6' WEST WALL
10074-010	145	01/11/2001	1040	Soil	CS-145, 6' EAST WALL
10074-011	146	01/11/2001	1050	Soil	CS-146, 6' WEST WALL
10074-012	147	01/11/2001	1100	Soil	CS-147, 6' EAST WALL
10074-013	148	01/11/2001	1115	Soil	CS-148, 6' WEST WALL

REPORT DATE: 01/25/2001 REPORT NUMBER: 10074

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-136D @ 10.0'		SAMPLE ID: 136-D				
10074-001	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	01/19/2001
		SURROGATE RECOVERY	129	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	01/15/2001
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	73	%RECOVERY	50-150	

REVIEWED BY: _____
Martin Little - Quality Manager

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-137D @ 10.0'		SAMPLE ID: 137-D				
10074-002	NWTPH-Dx	DIESEL	53	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	01/19/2001
		SURROGATE RECOVERY	127	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	01/15/2001
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	86	%RECOVERY	50-150	
CS-138		SAMPLE ID: 138				
10074-003	NWTPH-Dx	DIESEL	340	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	300	mg/Kg	100	01/19/2001
		SURROGATE RECOVERY	125	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	01/15/2001
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	87	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-139		SAMPLE ID: 139				
10074-004	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	01/19/2001
		SURROGATE RECOVERY	103	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	01/15/2001
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	82	%RECOVERY	50-150	
CS-140		SAMPLE ID: 140				
10074-005	NWTPH-Dx	DIESEL	44	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	140	mg/Kg	100	01/19/2001
		SURROGATE RECOVERY	99	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	01/15/2001
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	79	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-141		SAMPLE ID: 141				
10074-006	NWTPH-Dx	DIESEL	140	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	160	mg/Kg	100	01/19/2001
		SURROGATE RECOVERY	95	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.011	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.011	mg/Kg	0.005	01/24/2001
		ANTHRACENE	0.11	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.025	mg/Kg	0.005	
		BENZO(A)PYRENE	0.033	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.013	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.023	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.020	mg/Kg	0.005	
		CHRYSENE	0.043	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.083	mg/Kg	0.005	
		FLUORENE	0.032	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	0.014	mg/Kg	0.005	
		NAPHTHALENE	0.020	mg/Kg	0.005	
		PHENANTHRENE	0.094	mg/Kg	0.005	
		PYRENE	0.12	mg/Kg	0.005	
		SURROGATE	81	%RECOVERY	50-150	
CS-142		SAMPLE ID: 142				
10074-007	NWTPH-Dx	DIESEL	320	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	740	mg/Kg	100	01/19/2001
		SURROGATE RECOVERY	149	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	01/15/2001
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.0086	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.0098	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.014	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.038	mg/Kg	0.005	
		FLUORENE	0.022	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.050	mg/Kg	0.005	
		PYRENE	0.030	mg/Kg	0.005	
		SURROGATE	100	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-143, 6' EAST WALL		SAMPLE ID: 143				
10074-008	NWTPH-Dx	DIESEL	15,000	mg/Kg	500	Jeremy B
	NWTPH-Dx	HEAVY OILS	38,500	mg/Kg	2,000	01/19/2001
		SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.14	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	01/24/2001
		ANTHRACENE	1.2	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.35	mg/Kg	0.005	
		BENZO(A)PYRENE	0.065	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	1.1	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	1.1	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	0.31	mg/Kg	0.005	
		FLUORANTHENE	0.22	mg/Kg	0.005	
		FLUORENE	0.22	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	1.0	mg/Kg	0.005	
		NAPHTHALENE	0.12	mg/Kg	0.005	
		PHENANTHRENE	0.12	mg/Kg	0.005	
		PYRENE	1.6	mg/Kg	0.005	
		SURROGATE	73	%RECOVERY	50-150	
CS-144, 6' WEST WALL		SAMPLE ID: 144				
10074-009	NWTPH-Dx	DIESEL	75	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	210	mg/Kg	100	01/19/2001
		SURROGATE RECOVERY	91	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	01/15/2001
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.0054	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.0074	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.014	mg/Kg	0.005	
		FLUORENE	0.0057	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.017	mg/Kg	0.005	
		PYRENE	0.012	mg/Kg	0.005	
		SURROGATE	80	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-145, 6' EAST WALL		SAMPLE ID: 145				
10074-010	NWTPH-Dx	DIESEL	54	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	220	mg/Kg	100	01/19/2001
		SURROGATE RECOVERY	123	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	01/15/2001
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.012	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	96	%RECOVERY	50-150	
CS-146, 6' WEST WALL		SAMPLE ID: 146				
10074-011	NWTPH-Dx	DIESEL	86	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	240	mg/Kg	100	01/19/2001
		SURROGATE RECOVERY	115	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.0063	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	01/24/2001
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.0074	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.0060	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	0.0061	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.027	mg/Kg	0.005	
		FLUORENE	0.014	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.029	mg/Kg	0.005	
		PYRENE	0.025	mg/Kg	0.005	
		SURROGATE	101	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-147, 6' EAST WALL		SAMPLE ID: 147				
10074-012	NWTPH-Dx	DIESEL	4,600	mg/Kg	500	Jeremy B
	NWTPH-Dx	HEAVY OILS	2,200	mg/Kg	2,000	01/19/2001
		SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.024	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.059	mg/Kg	0.005	01/15/2001
		ANTHRACENE	0.019	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.071	mg/Kg	0.005	
		BENZO(A)PYRENE	0.055	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.12	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.12	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.086	mg/Kg	0.005	
		CHRYSENE	0.12	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	0.045	mg/Kg	0.005	
		FLUORANTHENE	0.32	mg/Kg	0.005	
		FLUORENE	0.13	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	0.11	mg/Kg	0.005	
		NAPHTHALENE	0.046	mg/Kg	0.005	
		PHENANTHRENE	0.19	mg/Kg	0.005	
		PYRENE	0.38	mg/Kg	0.005	
		SURROGATE	77	%RECOVERY	50-150	
CS-148, 6' WEST WALL		SAMPLE ID: 148				
10074-013	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	130	01/19/2001
		SURROGATE RECOVERY	98	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.011	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	01/15/2001
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.012	mg/Kg	0.005	
		BENZO(A)PYRENE	0.009	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.010	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.019	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.015	mg/Kg	0.005	
		CHRYSENE	0.014	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	0.011	mg/Kg	0.005	
		FLUORANTHENE	0.036	mg/Kg	0.005	
		FLUORENE	0.016	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	0.012	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.020	mg/Kg	0.005	
		PYRENE	0.029	mg/Kg	0.005	
		SURROGATE	90	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

ORIGINAL

CLIENT: GLENBROOK NICKEL - SMELTER
5093 RIDDLE BYPASS RD.
RIDDLE OR 97469

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DATE SUBMITTED: 01/26/2001

PROJECT NAME: GLENBROOK NICKEL, COMINCO/RIDDLE

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
10164-001	CS-150	01/24/2001	1045	Soil	WATER PIPE CAP 5.0-6.0
10164-002	CS-152	01/24/2001	1115	Soil	2.5-3.0
10164-003	CS-153	01/24/2001	1117	Soil	7.5-8.0
10164-004	CS-154	01/24/2001	1120	Soil	3.0-3.5
10164-005	CS-155	01/24/2001	1122	Soil	8.5-9.0
10164-006	CS-156	01/24/2001	1125	Soil	3.0-3.5
10164-007	CS-157	01/24/2001	1127	Soil	8.5-9.0
10164-008	CS-158	01/24/2001	1130	Soil	3.0-3.5
10164-009	CS-159	01/24/2001	1133	Soil	8.5-9.0
10164-010	CS-160	01/24/2001	1135	Soil	9.0-9.5
10164-011	CS-161	01/24/2001	1138	Soil	8.5-9.0
10164-012	CS-162	01/24/2001	1140	Soil	3.0-3.5
10164-013	CS-163	01/24/2001	1142	Soil	9.0-9.5
10164-014	CS-164	01/24/2001	1144	Soil	8.5-9.0
10164-015	CS-165	01/24/2001	1146	Soil	3.0-3.5
10164-016	CS-166	01/24/2001	1148	Soil	9.0-9.5
10164-017	CS-167	01/24/2001	1150	Soil	8.5-9.0
10164-018	CS-168	01/24/2001	1152	Soil	3.0-3.5
10164-019	CS-169	01/24/2001	1154	Soil	3.0-3.5
10164-020	CS-170	01/24/2001	1158	Soil	8.5-9.0
10164-021	CS-171	01/24/2001	1200	Soil	9.0-9.5
10164-022	CS-172	01/24/2001	1202	Soil	8.5-9.0
10164-023	CS-173	01/24/2001	1204	Soil	3.0-3.5
10164-024	CS-176	01/24/2001	1400	Soil	4.5-5.0
10164-025	CS-177	01/24/2001	1402	Soil	4.5-5.0
10164-026	CS-178	01/24/2001	1404	Soil	4.5-5.0
10164-027	CS-179	01/24/2001	1406	Soil	4.5-5.0
10164-028	CS-180	01/24/2001	1410	Soil	4.5-5.0
10164-029	CS-181	01/24/2001	1415	Soil	4.5-5.0
10164-030	CS-182	01/24/2001	1420	Soil	4.5-5.0
10164-031	CS-151	01/24/2001	1100	Soil	COMPOSITE SOIL SAMPLE

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SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
WATER PIPE CAP 5.0-6.0		SAMPLE ID: CS-150				
10164-001	NWTPH-Dx	DIESEL	400	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	110	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	57	%RECOVERY	50%-150%	

REVIEWED BY: _____
Martin Little - Quality Manager

CERTIFICATE OF ANALYSIS ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
WATER PIPE CAP 5.0-6.0		SAMPLE ID: CS-150				
10164-001	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/09/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	0.059	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	0.035	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	97	%RECOVERY	50%-150%	
2.5-3.0		SAMPLE ID: CS-152				
10164-002	NWTPH-Dx	DIESEL	41	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	57	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/13/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	87	%RECOVERY	50%-150%	
7.5-8.0		SAMPLE ID: CS-153				
10164-003	NWTPH-Dx	DIESEL	220	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	120	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	70	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
7.5-8.0		SAMPLE ID: CS-153				
10164-003	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/13/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	92	%RECOVERY	50%-150%	
3.0-3.5		SAMPLE ID: CS-154				
10164-004	NWTPH-Dx	DIESEL	340	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	670	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	94	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.08	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/12/2001
		ANTHRACENE	0.06	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	0.07	mg/Kg	0.05	
		FLUORENE	0.26	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	0.54	mg/Kg	0.05	
		PYRENE	0.06	mg/Kg	0.05	
		SURROGATE	99	%RECOVERY	50%-150%	
8.5-9.0		SAMPLE ID: CS-155				
10164-005	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	69	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS *ORIGINAL*

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
8.5-9.0		SAMPLE ID: CS-155				
10164-005	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/07/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	91	%RECOVERY	50%-150%	
3.0-3.5		SAMPLE ID: CS-156				
10164-006	NWTPH-Dx	DIESEL	660	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	210	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.21	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/07/2001
		ANTHRACENE	0.19	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	0.07	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	0.37	mg/Kg	0.05	
		FLUORENE	0.35	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	1.2	mg/Kg	0.05	
		PYRENE	0.24	mg/Kg	0.05	
		SURROGATE	113	%RECOVERY	50%-150%	
8.5-9.0		SAMPLE ID: CS-157				
10164-007	NWTPH-Dx	DIESEL	87	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	84	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
8.5-9.0		SAMPLE ID: CS-157				
10164-007	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/07/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	0.05	mg/Kg	0.05	
		FLUORENE	0.05	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	0.13	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	115	%RECOVERY	50%-150%	
3.0-3.5		SAMPLE ID: CS-158				
10164-008	NWTPH-Dx	DIESEL	1,400	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	610	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	94	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.40	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/07/2001
		ANTHRACENE	0.30	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	0.12	mg/Kg	0.05	
		BENZO(A)PYRENE	0.06	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	0.05	mg/Kg	0.05	
		CHRYSENE	0.16	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	0.67	mg/Kg	0.05	
		FLUORENE	0.82	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	0.05	mg/Kg	0.05	
		PHENANTHRENE	3.0	mg/Kg	0.05	
		PYRENE	0.51	mg/Kg	0.05	
		SURROGATE	110	%RECOVERY	50%-150%	
8.5-9.0		SAMPLE ID: CS-159				
10164-009	NWTPH-Dx	DIESEL	54	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	50	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
8.5-9.0		SAMPLE ID: CS-159				
10164-009	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/07/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	0.08	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	0.13	mg/Kg	0.05	
		PYRENE	0.08	mg/Kg	0.05	
		SURROGATE	84	%RECOVERY	50%-150%	
9.0-9.5		SAMPLE ID: CS-160				
10164-010	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	71	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/07/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	90	%RECOVERY	50%-150%	
8.5-9.0		SAMPLE ID: CS-161				
10164-011	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	66	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
8.5-9.0		SAMPLE ID: CS-161				
10164-011	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/07/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	85	%RECOVERY	50%-150%	
3.0-3.5		SAMPLE ID: CS-162				
10164-012	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	86	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/07/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	86	%RECOVERY	50%-150%	
9.0-9.5		SAMPLE ID: CS-163				
10164-013	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	73	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
9.0-9.5		SAMPLE ID: CS-163				
10164-013	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/07/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	86	%RECOVERY	50%-150%	
8.5-9.0		SAMPLE ID: CS-164				
10164-014	NWTPH-Dx	DIESEL	68	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	110	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/08/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	54	%RECOVERY	50%-150%	
3.0-3.5		SAMPLE ID: CS-165				
10164-015	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/01/2001
		SURROGATE RECOVERY	54	%RECOVERY	50%-150%	

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SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
3.0-3.5		SAMPLE ID: CS-165				
10164-015	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/08/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	74	%RECOVERY	50%-150%	
9.0-9.5		SAMPLE ID: CS-166				
10164-016	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	57	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/08/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	79	%RECOVERY	50%-150%	
8.5-9.0		SAMPLE ID: CS-167				
10164-017	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	62	%RECOVERY	50%-150%	

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SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
8.5-9.0		SAMPLE ID: CS-167				
10164-017	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/08/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	77	%RECOVERY	50%-150%	
3.0-3.5		SAMPLE ID: CS-168				
10164-018	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	122	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/08/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	84	%RECOVERY	50%-150%	
3.0-3.5		SAMPLE ID: CS-169				
10164-019	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	76	%RECOVERY	50%-150%	

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SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
3.0-3.5		SAMPLE ID: CS-169				
10164-019	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/08/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	81	%RECOVERY	50%-150%	
8.5-9.0		SAMPLE ID: CS-170				
10164-020	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	66	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/08/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	88	%RECOVERY	50%-150%	
9.0-9.5		SAMPLE ID: CS-171				
10164-021	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	66	%RECOVERY	50%-150%	

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SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
9.0-9.5		SAMPLE ID: CS-171				
10164-021	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/08/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	90	%RECOVERY	50%-150%	
8.5-9.0		SAMPLE ID: CS-172				
10164-022	NWTPH-Dx	DIESEL	58	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	55	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/08/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	65	%RECOVERY	50%-150%	
3.0-3.5		SAMPLE ID: CS-173				
10164-023	NWTPH-Dx	DIESEL	210	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	200	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	54	%RECOVERY	50%-150%	

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SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALIST
3.0-3.5		SAMPLE ID: CS-173				
10164-023	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/08/2001
		ANTHRACENE	0.32	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	0.11	mg/Kg	0.05	
		FLUORENE	0.06	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	0.11	mg/Kg	0.05	
		SURROGATE	87	%RECOVERY	50%-150%	
4.5-5.0		SAMPLE ID: CS-176				
10164-024	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	82	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/08/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	84	%RECOVERY	50%-150%	
4.5-5.0		SAMPLE ID: CS-177				
10164-025	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	54	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
4.5-5.0		SAMPLE ID: CS-177				
10164-025	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/06/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	63	%RECOVERY	50%-150%	
4.5-5.0		SAMPLE ID: CS-178				
10164-026	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	76	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/08/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	63	%RECOVERY	50%-150%	
4.5-5.0		SAMPLE ID: CS-179				
10164-027	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	74	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
4.5-5.0		SAMPLE ID: CS-179				
10164-027	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/08/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	74	%RECOVERY	50%-150%	
4.5-5.0		SAMPLE ID: CS-180				
10164-028	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	84	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/08/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	76	%RECOVERY	50%-150%	
4.5-5.0		SAMPLE ID: CS-181				
10164-029	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/09/2001
		SURROGATE RECOVERY	69	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
4.5-5.0		SAMPLE ID: CS-181				
10164-029	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	02/08/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	81	%RECOVERY	50%-150%	
4.5-5.0		SAMPLE ID: CS-182				
10164-030	NWTPH-Dx	DIESEL	85	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	130	mg/Kg	100	02/08/2001
		SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%	
	PCB's	PCB-1016	ND	PPM	0.5	Robert M
	EPA 8082	PCB-1221	ND	PPM	0.5	02/08/2001
		PCB-1232	ND	PPM	0.5	
		PCB-1242	ND	PPM	0.5	
		PCB-1248	ND	PPM	0.5	
		PCB-1254	ND	PPM	0.5	
		PCB-1260	ND	PPM	0.5	
		SURROGATE 1	116	% RECOVERY	70%-130%	
		SURROGATE 2	127	% RECOVERY	70%-130%	

CI CERTIFICATE OF ANALYSIS

CLIENT: GLENBROOK NICKEL - SMELTER
5093 RIDDLE BYPASS RD.
RIDDLE OR 97469

PHONE: (541) 874-3171
FAX: (541) 874-3380

DATE SUBMITTED: 01/26/2001

PROJECT NAME: COMINCO/RIDDLE- DIESEL UST PIT

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
10163-001	CS-174	01/24/2001	1340	Soil	WEST SOIL SAMPLE @ 8.0-8.5'
10163-002	CS-175	01/24/2001	1345	Soil	EAST SOIL SAMPLE @ 10.5'-11.0'

REPORT DATE: 02/23/2001 REPORT NUMBER: 10163

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
WEST SOIL SAMPLE @ 8.0-8.5'		SAMPLE ID: CS-174				
10163-001	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	230	mg/Kg	100	02/05/2001
		SURROGATE RECOVERY	69	%RECOVERY		
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.02	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.02	02/23/2001
		ANTHRACENE	ND	mg/Kg	0.02	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.02	
		BENZO(A)PYRENE	ND	mg/Kg	0.02	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.02	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.02	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.02	
		CHRYSENE	ND	mg/Kg	0.02	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.02	
		FLUORANTHENE	ND	mg/Kg	0.02	
		FLUORENE	ND	mg/Kg	0.02	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.02	
		NAPHTHALENE	ND	mg/Kg	0.02	
		PHENANTHRENE	ND	mg/Kg	0.02	
		PYRENE	ND	mg/Kg	0.02	
		SURROGATE	86	%RECOVERY	80%-120%	
EAST SOIL SAMPLE @ 10.5'-11.0'		SAMPLE ID: CS-175				
10163-002	NWTPH-Dx	DIESEL	81	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	120	mg/Kg	100	02/05/2001
		SURROGATE RECOVERY	65	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.01	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.01	02/16/2001
		ANTHRACENE	ND	mg/Kg	0.01	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.01	

REVIEWED BY: _____
Martin Little - Quality Manager

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
EAST SOIL SAMPLE @ 10.5'-11.0'		SAMPLE ID: CS-175				
10163-002	PNAH 1	BENZO(A)PYRENE	ND	mg/Kg	0.04	Robert M
	EPA 8270M (SIM)	BENZO(B)FLUORANTHENE	ND	mg/Kg	0.04	02/16/2001
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.1	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.04	
		CHRYSENE	ND	mg/Kg	0.01	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.06	
		FLUORANTHENE	0.028	mg/Kg	0.01	
		FLUORENE	0.026	mg/Kg	0.01	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.08	
		NAPHTHALENE	ND	mg/Kg	0.01	
		PHENANTHRENE	0.033	mg/Kg	0.01	
		PYRENE	0.026	mg/Kg	0.01	
		SURROGATE	125	%RECOVERY	80%-120%	

CI CERTIFICATE OF ANALYSIS

CLIENT: GLENBROOK NICKEL - SMELTER
5093 RIDDLE BYPASS RD.
RIDDLE OR 97469

PHONE: (541) 874-3171
FAX: (541) 874-3380

DATE SUBMITTED: 02/09/2001

PROJECT NAME: GLENBROOK RIDDLE- AOC-10

PROJECT NUMBER: JA036.015

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
10253-001		02/07/2001	1000	Soil	CS-182 3.0' NW
10253-002		02/07/2001	0955	Soil	CS-182D 8.0' NW
10253-003		02/07/2001	1018	Soil	CS-186 5.0' NW
10253-004		02/07/2001	1015	Soil	CS-186D 9.0' NW
10253-005		02/07/2001	1005	Soil	CS-183 10.0' BOT
10253-006		02/07/2001	0935	Soil	CS-184 10.0' BOT
10253-007		02/07/2001	0945	Soil	CS-185 3.0' SW
10253-008		02/07/2001	1305	Soil	CS-185D 8.0' SW
10253-009		02/07/2001	1010	Soil	CS-187 12' BOT
10253-010		02/07/2001	1505	Soil	CS-188 17' BOT
10253-011		02/07/2001	1030	Soil	CS-189 5' SW
10253-012		02/07/2001	1025	Soil	CS-189D 9' SW

REPORT DATE: 02/23/2001 REPORT NUMBER: 10253

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-182 3.0' NW						
10253-001	NWTPH-Dx	DIESEL	96	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	290	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	78	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.012	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.012	02/22/2001
		ANTHRACENE	ND	mg/Kg	0.012	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.012	
		BENZO(A)PYRENE	ND	mg/Kg	0.047	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.047	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.12	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.047	
		CHRYSENE	ND	mg/Kg	0.012	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.071	
		FLUORANTHENE	ND	mg/Kg	0.012	
		FLUORENE	ND	mg/Kg	0.012	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.095	
		NAPHTHALENE	ND	mg/Kg	0.012	
		PHENANTHRENE	ND	mg/Kg	0.012	
		PYRENE	ND	mg/Kg	0.012	
		SURROGATE	126	%RECOVERY	50%-150%	

REVIEWED BY: Martin C. Little
Martin Little - Quality Manager

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-182D 8.0' NW						
10253-002	NWTPH-Dx	DIESEL	27	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	110	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	85	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.016	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.016	02/22/2001
		ANTHRACENE	ND	mg/Kg	0.016	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.016	
		BENZO(A)PYRENE	ND	mg/Kg	0.062	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.062	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.15	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.062	
		CHRYSENE	ND	mg/Kg	0.016	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.093	
		FLUORANTHENE	ND	mg/Kg	0.016	
		FLUORENE	ND	mg/Kg	0.016	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.12	
		NAPHTHALENE	ND	mg/Kg	0.016	
		PHENANTHRENE	ND	mg/Kg	0.016	
		PYRENE	ND	mg/Kg	0.016	
		SURROGATE	84	%RECOVERY	50%-150%	
CS-186 5.0' NW						
10253-003	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	76	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.015	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.015	02/22/2001
		ANTHRACENE	ND	mg/Kg	0.015	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.015	
		BENZO(A)PYRENE	ND	mg/Kg	0.059	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.059	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.15	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.059	
		CHRYSENE	ND	mg/Kg	0.015	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.088	
		FLUORANTHENE	ND	mg/Kg	0.015	
		FLUORENE	ND	mg/Kg	0.015	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.12	
		NAPHTHALENE	ND	mg/Kg	0.015	
		PHENANTHRENE	ND	mg/Kg	0.015	
		PYRENE	ND	mg/Kg	0.015	
		SURROGATE	108	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-186D 9.0' NW						
10253-004	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	57	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.026	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.026	02/22/2001
		ANTHRACENE	ND	mg/Kg	0.026	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.026	
		BENZO(A)PYRENE	ND	mg/Kg	0.10	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.10	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.26	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.10	
		CHRYSENE	ND	mg/Kg	0.026	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.16	
		FLUORANTHENE	ND	mg/Kg	0.026	
		FLUORENE	ND	mg/Kg	0.026	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.21	
		NAPHTHALENE	ND	mg/Kg	0.026	
		PHENANTHRENE	ND	mg/Kg	0.026	
		PYRENE	ND	mg/Kg	0.026	
		SURROGATE	79	%RECOVERY	50%-150%	
CS-183 10.0' BOT						
10253-005	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	54	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.013	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.013	02/22/2001
		ANTHRACENE	ND	mg/Kg	0.013	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.013	
		BENZO(A)PYRENE	ND	mg/Kg	0.051	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.051	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.13	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.051	
		CHRYSENE	ND	mg/Kg	0.013	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.076	
		FLUORANTHENE	0.016	mg/Kg	0.013	
		FLUORENE	ND	mg/Kg	0.013	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.10	
		NAPHTHALENE	ND	mg/Kg	0.013	
		PHENANTHRENE	0.025	mg/Kg	0.013	
		PYRENE	ND	mg/Kg	0.013	
		SURROGATE	76	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-184 10.0' BOT						
10253-006	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	51	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.012	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.012	02/22/2001
		ANTHRACENE	ND	mg/Kg	0.012	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.012	
		BENZO(A)PYRENE	ND	mg/Kg	0.050	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.050	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.12	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.050	
		CHRYSENE	ND	mg/Kg	0.012	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.075	
		FLUORANTHENE	ND	mg/Kg	0.012	
		FLUORENE	ND	mg/Kg	0.012	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.10	
		NAPHTHALENE	ND	mg/Kg	0.012	
		PHENANTHRENE	ND	mg/Kg	0.012	
		PYRENE	ND	mg/Kg	0.012	
		SURROGATE	80	%RECOVERY	50%-150%	
CS-185 3.0' SW						
10253-007	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	114	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.0097	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.0097	02/22/2001
		ANTHRACENE	ND	mg/Kg	0.0097	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.0097	
		BENZO(A)PYRENE	ND	mg/Kg	0.039	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.039	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.097	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.039	
		CHRYSENE	ND	mg/Kg	0.0097	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.058	
		FLUORANTHENE	ND	mg/Kg	0.0097	
		FLUORENE	ND	mg/Kg	0.0097	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.078	
		NAPHTHALENE	ND	mg/Kg	0.0097	
		PHENANTHRENE	ND	mg/Kg	0.0097	
		PYRENE	ND	mg/Kg	0.0097	
		SURROGATE	121	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-185D 8.0' SW						
10253-008	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	51	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.012	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.012	02/22/2001
		ANTHRACENE	ND	mg/Kg	0.012	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.012	
		BENZO(A)PYRENE	ND	mg/Kg	0.046	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.046	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.12	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.046	
		CHRYSENE	ND	mg/Kg	0.012	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.069	
		FLUORANTHENE	ND	mg/Kg	0.012	
		FLUORENE	ND	mg/Kg	0.012	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.092	
		NAPHTHALENE	ND	mg/Kg	0.012	
		PHENANTHRENE	ND	mg/Kg	0.012	
		PYRENE	ND	mg/Kg	0.012	
		SURROGATE	59	%RECOVERY	50%-150%	
CS-187 12' BOT						
10253-009	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	54	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.017	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.017	02/22/2001
		ANTHRACENE	ND	mg/Kg	0.017	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.017	
		BENZO(A)PYRENE	ND	mg/Kg	0.068	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.068	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.17	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.068	
		CHRYSENE	ND	mg/Kg	0.017	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.10	
		FLUORANTHENE	ND	mg/Kg	0.017	
		FLUORENE	ND	mg/Kg	0.017	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.14	
		NAPHTHALENE	ND	mg/Kg	0.017	
		PHENANTHRENE	ND	mg/Kg	0.017	
		PYRENE	ND	mg/Kg	0.017	
		SURROGATE	66	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-188 17' BOT						
10253-010	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	57	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.02	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.02	02/22/2001
		ANTHRACENE	ND	mg/Kg	0.02	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.02	
		BENZO(A)PYRENE	ND	mg/Kg	0.08	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.08	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.2	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.08	
		CHRYSENE	ND	mg/Kg	0.02	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.12	
		FLUORANTHENE	ND	mg/Kg	0.02	
		FLUORENE	ND	mg/Kg	0.02	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.16	
		NAPHTHALENE	ND	mg/Kg	0.02	
		PHENANTHRENE	ND	mg/Kg	0.02	
		PYRENE	ND	mg/Kg	0.02	
		SURROGATE	79	%RECOVERY	50%-150%	
CS-189 5' SW						
10253-011	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	55	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.014	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.014	02/22/2001
		ANTHRACENE	ND	mg/Kg	0.014	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.014	
		BENZO(A)PYRENE	ND	mg/Kg	0.056	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.056	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.14	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.056	
		CHRYSENE	ND	mg/Kg	0.014	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.084	
		FLUORANTHENE	ND	mg/Kg	0.014	
		FLUORENE	ND	mg/Kg	0.014	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.11	
		NAPHTHALENE	ND	mg/Kg	0.014	
		PHENANTHRENE	ND	mg/Kg	0.014	
		PYRENE	ND	mg/Kg	0.014	
		SURROGATE	69	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-189D 9' SW						
10253-012	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	54	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.014	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.014	02/22/2001
		ANTHRACENE	ND	mg/Kg	0.014	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.014	
		BENZO(A)PYRENE	ND	mg/Kg	0.058	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.058	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.14	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.058	
		CHRYSENE	ND	mg/Kg	0.014	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.087	
		FLUORANTHENE	ND	mg/Kg	0.014	
		FLUORENE	ND	mg/Kg	0.014	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.12	
		NAPHTHALENE	ND	mg/Kg	0.014	
		PHENANTHRENE	ND	mg/Kg	0.014	
		PYRENE	ND	mg/Kg	0.014	
		SURROGATE	79	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

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DATE SUBMITTED: 02/09/2001

PROJECT NAME: GLENBROOK RIDDLE AOC-10 CULVERT PROJECT NUMBER: JA036.15

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
10252-001		02/07/2001	1345	Soil	CS-138A 12' BOT
10252-002		02/07/2001	1350	Soil	CS-144A 6.0' WW
10252-003		02/07/2001	1355	Soil	CS-144A-D 9.0' WW
10252-004		02/07/2001	1400	Soil	CS-142A 12' BOT
10252-005		02/07/2001	1410	Soil	CS-147A 6.0' EW
10252-006		02/07/2001	1405	Soil	CS-147AD 9.0' EW
10252-007		02/07/2001	1415	Soil	CS-141A 12' BOT
10252-008		02/07/2001	1420	Soil	CS-140A 12' BOT
10252-009		02/07/2001	1425	Soil	CS-143A 6.0' EW
10252-010		02/07/2001	1430	Soil	CS-143A-D 9.0' EW
10252-011		02/07/2001	1435	Soil	CS-145A 6.0' EW
10252-012		02/07/2001	1440	Soil	CS-145A-D 9.0' EW
10252-013		02/07/2001	1445	Soil	CS-146A 6.0' WW
10252-014		02/07/2001	1450	Soil	CS-146AD 9.0' WW
10252-015		02/07/2001	1455	Soil	CS-190 6.0' SW
10252-016		02/07/2001	1458	Soil	CS-190D 9.0' SW

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-138A 12' BOT						
10252-001	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	71	%RECOVERY	50%-150%	
	PNAH 1	ACENAPETHENE	ND	mg/Kg	0.025	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.025	03/05/2001
		ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)PYRENE	ND	mg/Kg	0.025	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.025	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.025	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.025	
		CHRYSENE	ND	mg/Kg	0.025	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.025	
		FLUORANTHENE	ND	mg/Kg	0.025	
		FLUORENE	ND	mg/Kg	0.025	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.025	
		NAPHTHALENE	ND	mg/Kg	0.025	
		PHENANTHRENE	ND	mg/Kg	0.025	

REVIEWED BY: For:
Martin Little - Quality Manager

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-130A 12' BOT						
10252-001	PNAH 1	PYRENE	ND	mg/Kg	0.025	Robert M
	EPA 8270M (SIM)					02/22/2001
		SURROGATE	74	%RECOVERY	50%-150%	
CS-144A 6.0' WW						
10252-002	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	86	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.025	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.025	03/05/2001
		ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)PYRENE	ND	mg/Kg	0.025	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.025	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.025	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.025	
		CHRYSENE	ND	mg/Kg	0.025	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.025	
		FLUORANTHENE	ND	mg/Kg	0.025	
		FLUORENE	ND	mg/Kg	0.025	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.025	
		NAPHTHALENE	ND	mg/Kg	0.025	
		PHENANTHRENE	ND	mg/Kg	0.025	
		PYRENE	ND	mg/Kg	0.025	
		SURROGATE	84	%RECOVERY	50%-150%	
CS-144A-D 9.0' WW						
10252-003	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	69	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.025	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.025	03/05/2001
		ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)PYRENE	ND	mg/Kg	0.025	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.025	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.025	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.025	
		CHRYSENE	ND	mg/Kg	0.025	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.025	
		FLUORANTHENE	ND	mg/Kg	0.025	
		FLUORENE	ND	mg/Kg	0.025	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.025	
		NAPHTHALENE	ND	mg/Kg	0.025	
		PHENANTHRENE	ND	mg/Kg	0.025	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-144A-D 9.0' WW						
10252-003	PNAH 1 EPA 8270M (SIM)	PYRENE	ND	mg/Kg	0.025	Robert M 02/22/2001
		SURROGATE	78	%RECOVERY	50%-150%	
CS-142A 12' BOT						
10252-004	NWTPH-Dx	DIESEL	84	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	240	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	70	%RECOVERY	50%-150%	
	PNAH 1 EPA 8270M (SIM)	ACENAPHTHENE	ND	mg/Kg	0.025	Robert M 03/05/2001
		ACENAPHTHYLENE	ND	mg/Kg	0.025	
		ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)PYRENE	ND	mg/Kg	0.025	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.025	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.025	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.025	
		CHRYSENE	ND	mg/Kg	0.025	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.025	
		FLUORANTHENE	ND	mg/Kg	0.025	
		FLUORENE	ND	mg/Kg	0.025	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.025	
		NAPHTHALENE	ND	mg/Kg	0.025	
		PHENANTHRENE	ND	mg/Kg	0.025	
		PYRENE	ND	mg/Kg	0.025	
		SURROGATE	113	%RECOVERY	50%-150%	
CS-147A 6.0' EW						
10252-005	NWTPH-Dx	DIESEL	2,100	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	8,700	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	118	%RECOVERY	50%-150%	
	PNAH 1 EPA 8270M (SIM)	ACENAPHTHENE	0.031	mg/Kg	0.025	Robert M 03/05/2001
		ACENAPHTHYLENE	ND	mg/Kg	0.025	
		ANTHRACENE	0.093	mg/Kg	0.025	
		BENZO(A)ANTHRACENE	0.48	mg/Kg	0.025	
		BENZO(A)PYRENE	0.59	mg/Kg	0.025	
		BENZO(B)FLUORANTHENE	0.72	mg/Kg	0.025	
		BENZO(GHI)PERYLENE	0.41	mg/Kg	0.025	
		BENZO(K)FLUORANTHENE	0.57	mg/Kg	0.025	
		CHRYSENE	0.53	mg/Kg	0.025	
		DIBENZO(AH)ANTHRACENE	0.11	mg/Kg	0.025	
		FLUORANTHENE	0.58	mg/Kg	0.025	
		FLUORENE	0.10	mg/Kg	0.025	
		INDENO(1,2,3-CD)PYRENE	0.31	mg/Kg	0.025	
		NAPHTHALENE	ND	mg/Kg	0.025	
		PHENANTHRENE	0.12	mg/Kg	0.025	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-147A 6.0' EW						
10252-005	PNAH 1 EPA 8270M (SIM)	PYRENE	0.47	mg/Kg	0.025	Robert M 03/05/2001
		SURROGATE	117	%RECOVERY	50%-150%	
CS-147AD 9.0' EW						
10252-006	NWTPH-Dx	DIESEL	56	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	300	mg/Kg	100	02/14/2001
		SURROGATE RECOVERY	71	%RECOVERY	50%-150%	
	PNAH 1 EPA 8270M (SIM)	ACENAPHTHENE	ND	mg/Kg	0.025	Robert M 03/05/2001
		ACENAPHTHYLENE	ND	mg/Kg	0.025	
		ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)ANTHRACENE	0.047	mg/Kg	0.025	
		BENZO(A)PYRENE	ND	mg/Kg	0.025	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.025	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.025	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.025	
		CHRYSENE	ND	mg/Kg	0.025	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.025	
		FLUORANTHENE	ND	mg/Kg	0.025	
		FLUORENE	ND	mg/Kg	0.025	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.025	
		NAPHTHALENE	ND	mg/Kg	0.025	
		PHENANTHRENE	ND	mg/Kg	0.025	
		PYRENE	ND	mg/Kg	0.025	
		SURROGATE	126	%RECOVERY	50%-150%	
CS-141A 12' BOT						
10252-007	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	78	%RECOVERY	50%-150%	
	PNAH 1 EPA 8270M (SIM)	ACENAPHTHENE	ND	mg/Kg	0.025	Robert M 03/05/2001
		ACENAPHTHYLENE	ND	mg/Kg	0.025	
		ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)PYRENE	ND	mg/Kg	0.025	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.025	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.025	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.025	
		CHRYSENE	ND	mg/Kg	0.025	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.025	
		FLUORANTHENE	ND	mg/Kg	0.025	
		FLUORENE	ND	mg/Kg	0.025	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.025	
		NAPHTHALENE	ND	mg/Kg	0.025	
		PHENANTHRENE	ND	mg/Kg	0.025	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-141A 12' BOT						
10252-007	PNAH 1	PYRENE	ND	mg/Kg	0.025	Robert M
	EPA 8270M (SIM)					02/22/2001
		SURROGATE	99	%RECOVERY	50%-150%	
CS-140A 12' BOT						
10252-008	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	74	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.025	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.025	03/05/2001
		ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)PYRENE	ND	mg/Kg	0.025	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.025	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.025	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.025	
		CHRYSENE	ND	mg/Kg	0.025	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.025	
		FLUORANTHENE	ND	mg/Kg	0.025	
		FLUORENE	ND	mg/Kg	0.025	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.025	
		NAPHTHALENE	ND	mg/Kg	0.025	
		PHENANTHRENE	ND	mg/Kg	0.025	
		PYRENE	ND	mg/Kg	0.025	
		SURROGATE	110	%RECOVERY	50%-150%	
CS-143A 6.0' EW						
10252-009	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	120	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	64	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.025	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.025	03/05/2001
		ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)PYRENE	ND	mg/Kg	0.025	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.025	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.025	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.025	
		CHRYSENE	ND	mg/Kg	0.025	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.025	
		FLUORANTHENE	ND	mg/Kg	0.025	
		FLUORENE	ND	mg/Kg	0.025	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.025	
		NAPHTHALENE	ND	mg/Kg	0.025	
		PHENANTHRENE	ND	mg/Kg	0.025	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-143A 6.0' EW						
10252-009	PNAH 1 EPA 8270M (SIM)	PYRENE	ND	mg/Kg	0.025	Robert M 02/22/2001
		SURROGATE	77	%RECOVERY	50%-150%	
CS-143A-D 9.0' EW						
10252-010	NWTPH-Dx	DIESEL	27	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	170	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	77	%RECOVERY	50%-150%	
	PNAH 1 EPA 8270M (SIM)	ACENAPHTHENE	ND	mg/Kg	0.025	Robert M
		ACENAPHTHYLENE	ND	mg/Kg	0.025	03/05/2001
		ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)ANTHRACENE	0.075	mg/Kg	0.025	
		BENZO(A)PYRENE	ND	mg/Kg	0.025	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.025	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.025	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.025	
		CHRYSENE	ND	mg/Kg	0.025	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.025	
		FLUORANTHENE	ND	mg/Kg	0.025	
		FLUORENE	ND	mg/Kg	0.025	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.025	
		NAPHTHALENE	ND	mg/Kg	0.025	
		PHENANTHRENE	ND	mg/Kg	0.025	
		PYRENE	ND	mg/Kg	0.025	
		SURROGATE	109	%RECOVERY	50%-150%	
CS-145A 6.0' EW						
10252-011	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	67	%RECOVERY	50%-150%	
	PNAH 1 EPA 8270M (SIM)	ACENAPHTHENE	ND	mg/Kg	0.025	Robert M
		ACENAPHTHYLENE	ND	mg/Kg	0.025	03/05/2001
		ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)PYRENE	ND	mg/Kg	0.025	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.025	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.025	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.025	
		CHRYSENE	ND	mg/Kg	0.025	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.025	
		FLUORANTHENE	ND	mg/Kg	0.025	
		FLUORENE	ND	mg/Kg	0.025	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.025	
		NAPHTHALENE	ND	mg/Kg	0.025	
		PHENANTHRENE	ND	mg/Kg	0.025	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-145A 6.0' EW						
10252-011	PNAH 1	PYRENE	ND	mg/Kg	0.025	Robert M
	EPA 8270M (SIM)					02/22/2001
		SURROGATE	88	%RECOVERY	50%-150%	
CS-145A-D 9.0' EW						
10252-012	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	86	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.025	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.025	03/05/2001
		ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)PYRENE	ND	mg/Kg	0.025	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.025	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.025	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.025	
		CHRYSENE	ND	mg/Kg	0.025	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.025	
		FLUORANTHENE	ND	mg/Kg	0.025	
		FLUORENE	ND	mg/Kg	0.025	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.025	
		NAPHTHALENE	ND	mg/Kg	0.025	
		PHENANTHRENE	ND	mg/Kg	0.025	
		PYRENE	ND	mg/Kg	0.025	
		SURROGATE	65	%RECOVERY	50%-150%	
CS-146A 6.0' EW						
10252-013	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	72	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.025	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.025	03/05/2001
		ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)PYRENE	ND	mg/Kg	0.025	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.025	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.025	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.025	
		CHRYSENE	ND	mg/Kg	0.025	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.025	
		FLUORANTHENE	ND	mg/Kg	0.025	
		FLUORENE	ND	mg/Kg	0.025	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.025	
		NAPHTHALENE	ND	mg/Kg	0.025	
		PHENANTHRENE	ND	mg/Kg	0.025	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALIST
CS-146A 6.0' WW						
10252-013	PNAH 1 EPA 8270M (SIM)	PYRENE	ND	mg/Kg	0.025	Robert M 02/22/2001
		SURROGATE	78	%RECOVERY	50%-150%	
CS-146AD 9.0' WW						
10252-014	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	91	%RECOVERY	50%-150%	
	PNAH 1 EPA 8270M (SIM)	ACENAPHTHENE	ND	mg/Kg	0.025	Robert M
		ACENAPHTHYLENE	ND	mg/Kg	0.025	03/05/2001
		ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)PYRENE	ND	mg/Kg	0.025	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.025	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.025	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.025	
		CHRYSENE	ND	mg/Kg	0.025	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.025	
		FLUORANTHENE	0.039	mg/Kg	0.025	
		FLUORENE	ND	mg/Kg	0.025	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.025	
		NAPHTHALENE	ND	mg/Kg	0.025	
		PHENANTHRENE	ND	mg/Kg	0.025	
		PYRENE	ND	mg/Kg	0.025	
		SURROGATE	94	%RECOVERY	50%-150%	
CS-190 6.0' SW						
10252-015	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	85	%RECOVERY	50%-150%	
	PNAH 1 EPA 8270M (SIM)	ACENAPHTHENE	ND	mg/Kg	0.025	Robert M
		ACENAPHTHYLENE	ND	mg/Kg	0.025	03/05/2001
		ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.025	
		BENZO(A)PYRENE	ND	mg/Kg	0.025	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.025	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.025	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.025	
		CHRYSENE	ND	mg/Kg	0.025	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.025	
		FLUORANTHENE	ND	mg/Kg	0.025	
		FLUORENE	ND	mg/Kg	0.025	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.025	
		NAPHTHALENE	ND	mg/Kg	0.025	
		PHENANTHRENE	ND	mg/Kg	0.025	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-190 6.0' SW						
10252-015	PNAH 1 EPA 8270M (SIM)	PYRENE	ND	mg/Kg	0.025	Robert M 02/22/2001
		SURROGATE	106	%RECOVERY	50%-150%	
CS-190D 9.0' SW						
10252-016	NWTPH-Dx	DIESEL	3,500	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	11,000	mg/Kg	100	02/15/2001
		SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%	
	PNAH 1 EPA 8270M (SIM)	ACENAPHTHENE	ND	mg/Kg	0.025	Robert M
		ACENAPHTHYLENE	ND	mg/Kg	0.025	03/05/2001
		ANTHRACENE	0.046	mg/Kg	0.025	
		BENZO(A)ANTHRACENE	0.16	mg/Kg	0.025	
		BENZO(A)PYRENE	0.057	mg/Kg	0.025	
		BENZO(B)FLUORANTHENE	0.27	mg/Kg	0.025	
		BENZO(GHI)PERYLENE	0.091	mg/Kg	0.025	
		BENZO(K)FLUORANTHENE	0.031	mg/Kg	0.025	
		CHRYSENE	0.026	mg/Kg	0.025	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.025	
		FLUORANTHENE	0.028	mg/Kg	0.025	
		FLUORENE	0.062	mg/Kg	0.025	
		INDENO(1,2,3-CD)PYRENE	0.071	mg/Kg	0.025	
		NAPHTHALENE	ND	mg/Kg	0.025	
		PHENANTHRENE	ND	mg/Kg	0.025	
		PYRENE	0.21	mg/Kg	0.025	
		SURROGATE	131	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS
PARTIAL REPORT

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DATE SUBMITTED: 03/09/2001

PROJECT NAME: GLENBROOK, RIDDLE- HYDROCARBON AREA

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
10390-001		03/06/2001	1331	Soil	CS-143BD @ 9'
10390-002		03/06/2001	1325	Soil	CS-147B @ 6'
10390-003		03/06/2001	1331	Soil	CS-147BD @ 9'
10390-004		03/06/2001	1340	Soil	CS-142B @ 15'
10390-005		03/06/2001	1350	Soil	CS-191A @ 6'
10390-006		03/06/2001	1353	Soil	CS-191AD @ 9'
10390-007		03/06/2001	1424	Soil	CS-192 @ 6'
10390-008		03/06/2001	1425	Soil	CS-193 @ 9'
10390-009		03/06/2001	1427	Soil	CS-194 @ 3.5'
10390-010		03/06/2001	1428	Soil	CS-195 @ 7.0'
10390-011		03/06/2001	1430	Soil	CS-196 @ 6'
10390-012		03/06/2001	1432	Soil	CS-197 @ 9'
10390-013		03/06/2001	1433	Soil	CS-198 @ 6'
10390-014		03/06/2001	1435	Soil	CS-199 @ 9'
10390-015		03/06/2001	1448	Soil	CS-200 @ 9'
10390-016		03/06/2001	1450	Soil	CS-201 @ 7'
10390-017		03/06/2001	1512	Soil	CS-202 @ 6'
10390-018		03/06/2001	1515	Soil	CS-203 @ 9'
10390-019		03/06/2001	1516	Soil	CS-204 @ 6'
10390-020		03/06/2001	1517	Soil	CS-205 @ 9'
10390-021		03/06/2001	1518	Soil	CS-206 @ 9'
10390-022		03/07/2001		Soil	CS-207

SAMPLE	ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST
CS-143BD @ 9'		SAMPLE ID:				
10390-001	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B.
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	82	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	ACENAPETHYLENE	ND	mg/Kg	0.05	03/27/2001
		ANTHRACENE	ND	mg/Kg	0.05	

** Draft Report **
Data in this report may not be complete. This report has not undergone final quality assurance review

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CERTIFICATE OF ANALYSIS
PARTIAL REPORT

SAMPLE	ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST
CS-143BD @ 9'		SAMPLE ID:				
10390-001	PNAH 1	BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	BENZO(A)PYRENE	ND	mg/Kg	0.05	03/27/2001
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	76	%RECOVERY	50%-150%	
CS-147B @ 6'		SAMPLE ID:				
10390-002	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B.
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	85	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/27/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	76	%RECOVERY	50%-150%	
CS-147BD @ 9'		SAMPLE ID:				
10390-003	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B.
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	137	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/27/2001
		ANTHRACENE	ND	mg/Kg	0.05	

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SAMPLE	ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST
CS-147ED @ 9'		SAMPLE ID:				
10390-003	PNAH 1	BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	BENZO(A)PYRENE	ND	mg/Kg	0.05	03/27/2001
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	82	%RECOVERY	50%-150%	
142B @ 15'		SAMPLE ID:				
10390-004	NWTPH-Dx	DIESEL	99	mg/Kg	25	Jeremy B.
	NWTPH-Dx	HEAVY OILS	274	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	97	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/27/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	63	%RECOVERY	50%-150%	
79LA @ 6'		SAMPLE ID:				
10390-005	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B.
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/27/2001

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		SURROGATE RECOVERY	64	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/27/2001
		ANTHRACENE	ND	mg/Kg	0.05	

SAMPLE	ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST
CS-191A @ 6'		SAMPLE ID:				
10390-005	PNAH 1	BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	BENZO(A)PYRENE	ND	mg/Kg	0.05	03/27/2001
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	90	%RECOVERY	50%-150%	
CS-191AD @ 9'		SAMPLE ID:				
10390-006	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B.
	NWTPH-DX	HEAVY OILS	ND	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	87	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/27/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	100	%RECOVERY	50%-150%	

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CS-192 @ 6'		SAMPLE ID:				
10390-007	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B.
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	109	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/27/2001
		ANTHRACENE	ND	mg/Kg	0.05	

SAMPLE	ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST
CS-192 @ 6'		SAMPLE ID:				
10390-007	PNAH 1	BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	BENZO(A)PYRENE	ND	mg/Kg	0.05	03/27/2001
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	81	%RECOVERY	50%-150%	
CS-193 @ 9'		SAMPLE ID:				
10390-008	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B.
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	81	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/27/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.06	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	

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		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	84	%RECOVERY	50%-150%	
CS-194 @ 3.5'		SAMPLE ID:				
10390-009	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B.
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	99	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/27/2001
		ANTHRACENE	ND	mg/Kg	0.05	

SAMPLE	ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST
CS-194 @ 3.5'		SAMPLE ID:				
10390-009	PNAH 1	BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	BENZO(A)PYRENE	ND	mg/Kg	0.05	03/27/2001
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPETHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	75	%RECOVERY	50%-150%	
CS-195 @ 7.0'		SAMPLE ID:				
10390-010	NWTPH-Dx	DIESEL	114	mg/Kg	25	Jeremy B.
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	62	%RECOVERY	50%-150%	
	PNAH 1	ACENAPETHENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/27/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	

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		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	71	%RECOVERY	50%-150%	
CS-196 @ 6'		SAMPLE ID:				
10390-011	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B.
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	93	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/27/2001
		ANTHRACENE	ND	mg/Kg	0.05	

SAMPLE	ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST
CS-196 @ 6'		SAMPLE ID:				
10390-011	PNAH 1	BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	BENZO(A)PYRENE	ND	mg/Kg	0.05	03/27/2001
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	70	%RECOVERY	50%-150%	
CS-197 @ 9'		SAMPLE ID:				
10390-012	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B.
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	89	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/27/2001
		ANTHRACENE	ND	mg/Kg	0.05	

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		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	75	%RECOVERY	50%-150%	
CS-198 @ 6'		SAMPLE ID:				
10390-013	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B.
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	112	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/27/2001
		ANTHRACENE	ND	mg/Kg	0.05	

SAMPLE	ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST
CS-198 @ 6'		SAMPLE ID:				
10390-013	PNAH 1	BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	BENZO(A)PYRENE	ND	mg/Kg	0.05	03/27/2001
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	71	%RECOVERY	50%-150%	
CS-199 @ 9'		SAMPLE ID:				
10390-014	NWTPH-Dx	DIESEL	102	mg/Kg	25	Jeremy B.
	NWTPH-Dx	HEAVY OILS	346	mg/Kg	100	03/27/2001

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		SURROGATE RECOVERY	72	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/27/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	57	%RECOVERY	50%-150%	
CS-200 @ 9'		SAMPLE ID:				
10390-015	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B.
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	87	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/27/2001
		ANTHRACENE	ND	mg/Kg	0.05	

SAMPLE	ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST
CS-200 @ 9'		SAMPLE ID:				
10390-015	PNAH 1	BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	BENZO(A)PYRENE	ND	mg/Kg	0.05	03/27/2001
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	75	%RECOVERY	50%-150%	

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-201 @ 7'		SAMPLE ID:				
10390-016	NWTPH-Dx	DIESEL	38	mg/Kg	25	Jeremy B.
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	53	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/27/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	61	%RECOVERY	50%-150%	
202 @ 6'		SAMPLE ID:				
10390-017	NWTPH-Dx	DIESEL	1,600	mg/Kg	25	Jeremy B.
	NWTPH-Dx	HEAVY OILS	450	mg/Kg	100	03/22/2001
		SURROGATE RECOVERY	113	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.056	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.027	mg/Kg	0.05	03/27/2001
		ANTHRACENE	0.179	mg/Kg	0.05	

SAMPLE	ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST
CS-202 @ 6'		SAMPLE ID:				
10390-017	PNAH 1	BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	BENZO(A)PYRENE	ND	mg/Kg	0.05	03/27/2001
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	0.047	mg/Kg	0.05	
		FLUORENE	0.197	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	

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		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	0.346	mg/Kg	0.05	
		PYRENE	0.136	mg/Kg	0.05	
		SURROGATE	74	%RECOVERY	50%-150%	
CS-203 @ 9'		SAMPLE ID:				
10390-018	NWTPH-Dx	DIESEL	ND	mg/kg	25	
		HEAVY OILS	ND	mg/Kg	100	Jeremy B.
	NWTPH-Dx					03/22/2001
		SURROGATE RECOVERY	66	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/27/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	68	%RECOVERY	50%-150%	
CS-204 @ 6'		SAMPLE ID:				
10390-019	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B.
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/22/2001
		SURROGATE RECOVERY	74	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/27/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	

SAMPLE	ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST
CS-204 @ 6'		SAMPLE ID:				
0-019	PNAH 1	BENZO(A)PYRENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	03/27/2001
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	

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		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	64	%RECOVERY	50%-150%	
CS-205 @ 9'		SAMPLE ID:				
10390-020	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B.
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/22/2001
		SURROGATE RECOVERY	79	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/27/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	71	%RECOVERY	50%-150%	
CS-206 @ 9'		SAMPLE ID:				
10390-021	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B.
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/22/2001
		SURROGATE RECOVERY	72	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/27/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	

SAMPLE	ANALYSIS	PARAMETER	RESULT	UNIT	DETECTION LIMIT	ANALYST
CS-206 @ 9'		SAMPLE ID:				

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10390-021	PNAH 1	BENZO(A)PYRENE	ND	mg/Kg	0.05	Dick R.
	EPA 8270M (SIM)	BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	03/27/2001
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	0.069	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	60	%RECOVERY	50%-150%	

CS-207 SAMPLE ID:

CERTIFICATE OF ANALYSIS

ORIGINAL

CLIENT: GLENBROOK NICKEL - SMELTER
5093 RIDDLE BYPASS RD.
RIDDLE OR 97469

PHONE: (541) 874-3171
FAX: (541) 874-3380

DATE SUBMITTED: 03/09/2001

PROJECT NAME: GLENBROOK NICKEL - FESI TANK AREA PROJECT NUMBER: JA036.15

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
10391-001		03/06/2001	1605	Soil	CS-207 @ 5'
10391-002		03/06/2001	1608	Soil	CS-208 @ 10'
10391-003		03/06/2001	1610	Soil	CS-209 @ 15'
10391-004		03/06/2001	1612	Soil	CS-210 @ 15'
10391-005		03/06/2001	1621	Soil	CS-211 @ 7'
10391-006		03/06/2001	1625	Soil	CS-212 @ 15'
10391-007		03/06/2001	1637	Soil	CS-213 @ 11'
10391-008		03/06/2001	1640	Soil	CS-214 @ 15'
10391-009		03/06/2001	1641	Soil	CS-215 @ 7'
10391-010		03/06/2001	1644	Soil	CS-216 @ 15'
10391-011		03/07/2001	0945	Soil	CS-217 @ 12'
10391-012		03/07/2001	0950	Soil	CS-218 @ 12'
10391-013		03/07/2001	0952	Soil	CS-219 @ 12'

REPORT DATE: 04/02/2001 REPORT NUMBER: 10391

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-207 @ 5'						
10391-001	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	85	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/23/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	55	%RECOVERY	50%-150%	

REVIEWED BY: _____
Martin Little - Quality Manager

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ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-208 @ 10'						
10391-002	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	63	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/23/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	58	%RECOVERY	50%-150%	
CS-209 @ 15'						
10391-003	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	81	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M.
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/23/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	54	%RECOVERY	50%-150%	

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SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-210 @ 15'						
10391-004	NWTPH-Dx	DIESEL	280	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	68	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/23/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	56	%RECOVERY	50%-150%	
CS-211 @ 7'						
10391-005	NWTPH-Dx	DIESEL	287	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	56	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/23/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	84	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-212 @ 15'						
10391-006	NWTPH-Dx	DIESEL	296	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	57	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/23/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	109	%RECOVERY	50%-150%	
CS-213 @ 21'						
10391-007	NWTPH-Dx	DIESEL	195	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	72	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/24/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	129	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-214 @ 15'						
10391-008	NWTPH-Dx	DIESEL	52	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	52	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/24/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	121	%RECOVERY	50%-150%	
CS-215 @ 7'						
10391-009	NWTPH-Dx	DIESEL	8180	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	301	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.13	mg/Kg	0.05	03/27/2001
		ANTHRACENE	0.15	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	0.052	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	0.056	mg/Kg	0.05	
		PYRENE	0.33	mg/Kg	0.05	
		SURROGATE	73	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-216 @ 15'						
10391-010	NWTPH-Dx	DIESEL	7578	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	111	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.83	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.20	mg/Kg	0.05	03/24/2001
		ANTHRACENE	7.2	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	0.058	mg/Kg	0.05	
		FLUORENE	0.19	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	0.68	mg/Kg	0.05	
		PHENANTHRENE	8.0	mg/Kg	0.05	
		PYRENE	0.78	mg/Kg	0.05	
		SURROGATE	69	%RECOVERY	50%-150%	
CS-217 @ 12'						
10391-011	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	80	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/24/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	52	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-218 @ 12'						
10391-012	NWTPH-Dx	DIESEL	28	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	62	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	03/24/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	97	%RECOVERY	50%-150%	
CS-219 @ 12'						
10391-013	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/27/2001
		SURROGATE RECOVERY	108	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/24/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	106	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

ORIGINAL

CLIENT: GLENBROOK NICKEL - SMELTER
5093 RIDDLE BYPASS RD.
RIDDLE OR 97469

PHONE: (541) 874-3171
FAX: (541) 874-3380

DATE SUBMITTED: 03/29/2001

PROJECT NAME: GLENBROOK NICKEL, RIDDLE, OR PROJECT NUMBER: JA036.15

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
10524-001	CS-142C	03/28/2001	1335	Soil	SOIL SAMPLE
10524-002	CS-195B	03/28/2001	1255	Soil	SOIL SAMPLE
10524-003	CS-199B	03/28/2001	1300	Soil	SOIL SAMPLE
10524-004	CS-202B	03/28/2001	1310	Soil	SOIL SAMPLE

REPORT DATE: 04/04/2001 REPORT NUMBER: 10524

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-142C				
10524-001	NWTPH-Dx	DIESEL	820	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	1,300	mg/Kg	100	03/30/2001
		SURROGATE RECOVERY	130	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.028	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	04/03/2001
		ANTHRACENE	0.096	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.027	mg/Kg	0.005	
		BENZO(A)PYRENE	0.040	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.024	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.013	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.024	mg/Kg	0.005	
		CHRYSENE	0.017	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	0.013	mg/Kg	0.005	
		FLUORANTHENE	0.027	mg/Kg	0.005	
		FLUORENE	0.071	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	0.016	mg/Kg	0.005	
		NAPETHALENE	0.032	mg/Kg	0.005	
		PHENANTHRENE	0.11	mg/Kg	0.005	
		PYRENE	0.033	mg/Kg	0.005	
		SURROGATE	58	%RECOVERY	50%-150%	

REVIEWED BY: _____
Martin Little - Quality Manager

CERTIFICATE OF ANALYSIS

ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-195B				
10524-002	NWTPH-Dx	DIESEL	29	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/30/2001
		SURROGATE RECOVERY	104	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	04/03/2001
		ANTHRACENE	0.037	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.030	mg/Kg	0.005	
		BENZO(A)PYRENE	0.020	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.020	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.021	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.029	mg/Kg	0.005	
		CHRYSENE	0.023	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	0.026	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	0.019	mg/Kg	0.005	
		NAPHTHALENE	0.049	mg/Kg	0.005	
		PHENANTHRENE	0.024	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	81	%RECOVERY	50%-150%	
SOIL SAMPLE		SAMPLE ID: CS-199B				
10524-003	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/30/2001
		SURROGATE RECOVERY	102	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	04/03/2001
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	96	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-202B				
10524-004	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/30/2001
		SURROGATE RECOVERY	88	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	04/03/2001
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	77	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS ORIGINAL

CLIENT: GLENBROOK NICKEL - SMELTER
5093 RIDDLE BYPASS RD.
RIDDLE OR 97469

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DATE SUBMITTED: 03/29/2001

PROJECT NAME: GLENBROOK NICKEL, RIDDLE, OR PROJECT NUMBER: JA036.15

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
10525-001	CS-220	03/28/2001	1220	Soil	SOIL SAMPLE
10525-002	CS-210A	03/28/2001	1410	Soil	SOIL SAMPLE

REPORT DATE: 04/04/2001 REPORT NUMBER: 10525

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-220				
10525-001	NWTPH-Dx	DIESEL	300	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	310	mg/Kg	100	03/30/2001
		SURROGATE RECOVERY	112	%RECOVERY	50%-150%	
	PNAH 1	ACENAPRTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	04/03/2001
		ANTHRACENE	0.064	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	0.039	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.10	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	0.074	mg/Kg	0.005	
		SURROGATE	88	%RECOVERY	50%-150%	

REVIEWED BY: _____
Martin Little - Quality Manager

CERTIFICATE OF ANALYSIS

ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-210A				
10525-002	NWTPH-Dx	DIESEL	110	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/30/2001
		SURROGATE RECOVERY	75	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	04/03/2001
		ANTHRACENE	0.11	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.15	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	72	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

ORIGINAL

CLIENT: GLENBROOK NICKEL - SMELTER
5093 RIDDLE BYPASS RD.
RIDDLE OR 97469

PHONE: (541) 874-3171
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DATE SUBMITTED: 06/14/2001

PROJECT NAME: GLENBROOK RIDDLE-AOC-R-10 PROJECT NUMBER: JA036.15

REPORT DATE: 07/05/2001 REPORT NUMBER: 10955

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
10955-002	CS-NRR-2	06/12/2001	1345	Soil	Soil
10955-003	CS-NRR-3	06/12/2001	1349	Soil	Soil
10955-004	CS-NRR-4	06/12/2001	1352	Soil	Soil
10955-005	CS-NRR-5	06/12/2001	1354	Soil	Soil
10955-006	CS-NRR-6	06/12/2001	1355	Soil	Soil
10955-007	CS-NRR-7	06/12/2001	1357	Soil	Soil
10955-008	CS-NRR-8	06/12/2001	1400	Soil	Soil
10955-009	CS-NRR-9	06/12/2001	1402	Soil	Soil
10955-010	CS-NRR-10	06/12/2001	1404	Soil	Soil
10955-011	CS-NRR-11	06/12/2001	1405	Soil	Soil
10955-012	CS-NRR-12	06/12/2001	1407	Soil	Soil
10955-013	CS-NRR-13	06/12/2001	1410	Soil	Soil
10955-014	CS-NRR-14	06/12/2001	1414	Soil	Soil
10955-015	CS-NRR-15	06/12/2001	1416	Soil	Soil
955-016	CS-NRR-16	06/12/2001	1420	Soil	Soil
10955-017	CS-NRR-17	06/12/2001	1430	Soil	Soil
10955-018	CS-NRR-18	06/12/2001	1434	Soil	Soil
10955-019	CS-NRR-19	06/12/2001	1436	Soil	Soil
10955-020	CS-NRR-20	06/12/2001	1439	Soil	Soil
10955-021	CS-NRR-21	06/12/2001	1440	Soil	Soil
10955-022	CS-NRR-22	06/12/2001	1442	Soil	Soil
10955-023	CS-NRR-23	06/12/2001	1445	Soil	Soil
10955-024	CS-NRR-24	06/12/2001	1447	Soil	Soil
10955-025	CS-NRR-25	06/12/2001	1449	Soil	Soil
10955-026	CS-NRR-26	06/12/2001	1452	Soil	Soil
10955-027	CS-NRR-27	06/12/2001	1454	Soil	Soil
10955-028	CS-NRR-28	06/12/2001	1456	Soil	Soil
10955-029	CS-NRR-29	06/12/2001	1500	Soil	Soil
10955-030	CS-NRR-30	06/12/2001	1503	Soil	Soil
10955-031	CS-NRR-31	06/12/2001	1505	Soil	Soil
10955-032	CS-NRR-32	06/12/2001	1507	Soil	Soil
10955-033	CS-NRR-33	06/12/2001	1510	Soil	Soil
10955-034	CS-NRR-34	06/12/2001	1525	Soil	Soil
10955-035	CS-NRR-35	06/12/2001	1527	Soil	Soil
10955-036	CS-NRR-36	06/12/2001	1520	Soil	Soil
10955-037	CS-NRR-37	06/12/2001	1530	Soil	Soil
10955-038	CS-NRR-38	06/12/2001	1540	Soil	Soil
10955-039	CS-NRR-39	06/12/2001	1535	Soil	Soil
10955-040	CS-NRR-40	06/12/2001	1542	Soil	Soil
55-041	CS-NRR-41	06/12/2001	1543	Soil	Soil

REVIEWED BY: David Back

David Back - QA Manager

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-1				
10955-001	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	109	mg/Kg	100	06/21/2001
		SURROGATE RECOVERY	99	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.0000122	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.0000122	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.0000122	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.0000122	
		BENZO(A)PYRENE	ND	mg/Kg	0.0000488	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0000488	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.000122	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0000488	
		CHRYSENE	ND	mg/Kg	0.0000122	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0000732	
		FLUORANTHENE	ND	mg/Kg	0.0000122	
		FLUORENE	ND	mg/Kg	0.0000122	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0000976	
		NAPHTHALENE	ND	mg/Kg	0.0000122	
		PHENANTHRENE	ND	mg/Kg	0.0000122	
		PYRENE	ND	mg/Kg	0.0000122	
		SURROGATE	74	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-2				
10955-002	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/21/2001
		SURROGATE RECOVERY	72	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00001605	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00001605	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.00001605	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00001605	
		BENZO(A)PYRENE	ND	mg/Kg	0.0000642	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0000642	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.0001605	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0000642	
		CHRYSENE	ND	mg/Kg	0.00001605	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0000963	
		FLUORANTHENE	ND	mg/Kg	0.00001605	
		FLUORENE	ND	mg/Kg	0.00001605	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0001284	
		NAPHTHALENE	ND	mg/Kg	0.00001605	
		PHENANTHRENE	ND	mg/Kg	0.00001605	
		PYRENE	ND	mg/Kg	0.00001605	
		SURROGATE	60	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-3				
10955-003	NWTPH-Dx	DIESEL	44	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/21/2001
		SURROGATE RECOVERY	118	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00002305	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00002305	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.00002305	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00002305	
		BENZO(A)PYRENE	ND	mg/Kg	0.0000922	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0000922	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.0002305	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0000922	
		CHRYSENE	ND	mg/Kg	0.00002305	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0001383	
		FLUORANTHENE	ND	mg/Kg	0.00002305	
		FLUORENE	ND	mg/Kg	0.00002305	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0001844	
		NAPHTHALENE	ND	mg/Kg	0.00002305	
		PHENANTHRENE	ND	mg/Kg	0.00002305	
		PYRENE	ND	mg/Kg	0.00002305	
		SURROGATE	64	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-4				
10955-004	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/20/2001
		SURROGATE RECOVERY	60	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00005585	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00005585	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.00005585	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00005585	
		BENZO(A)PYRENE	ND	mg/Kg	0.0002234	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0002234	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.0005585	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0002234	
		CHRYSENE	ND	mg/Kg	0.00005585	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0003351	
		FLUORANTHENE	ND	mg/Kg	0.00005585	
		FLUORENE	ND	mg/Kg	0.00005585	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0004468	
		NAPHTHALENE	ND	mg/Kg	0.00005585	
		PHENANTHRENE	ND	mg/Kg	0.00005585	
		PYRENE	ND	mg/Kg	0.00005585	
		SURROGATE	73	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-5				
10955-005	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/20/2001
		SURROGATE RECOVERY	119	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00001965	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00001965	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.00001965	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00001965	
		BENZO(A)PYRENE	ND	mg/Kg	0.0000786	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0000786	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.0001965	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0000786	
		CHRYSENE	ND	mg/Kg	0.00001965	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0001179	
		FLUORANTHENE	ND	mg/Kg	0.00001965	
		FLUORENE	ND	mg/Kg	0.00001965	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0001572	
		NAPHTHALENE	ND	mg/Kg	0.00001965	
		PHENANTHRENE	ND	mg/Kg	0.00001965	
		PYRENE	ND	mg/Kg	0.00001965	
		SURROGATE	51	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-6				
10955-006	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/20/2001
		SURROGATE RECOVERY	72	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.000014	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.000014	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.000014	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.000014	
		BENZO(A)PYRENE	ND	mg/Kg	0.000056	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.000056	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00014	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.000056	
		CHRYSENE	ND	mg/Kg	0.000014	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.000084	
		FLUORANTHENE	ND	mg/Kg	0.000014	
		FLUORENE	ND	mg/Kg	0.000014	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.000112	
		NAPHTHALENE	ND	mg/Kg	0.000014	
		PHENANTHRENE	ND	mg/Kg	0.000014	
		PYRENE	ND	mg/Kg	0.000014	
		SURROGATE	61	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-7				
10955-007	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/20/2001
		SURROGATE RECOVERY	97	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.0000147	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.0000147	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.0000147	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.0000147	
		BENZO(A)PYRENE	ND	mg/Kg	0.0000588	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0000588	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.000147	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0000588	
		CHRYSENE	ND	mg/Kg	0.0000147	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0000882	
		FLUORANTHENE	ND	mg/Kg	0.0000147	
		FLUORENE	ND	mg/Kg	0.0000147	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0001176	
		NAPHTHALENE	ND	mg/Kg	0.0000147	
		PHENANTHRENE	ND	mg/Kg	0.0000147	
		PYRENE	ND	mg/Kg	0.0000147	
		SURROGATE	54	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-8				
10955-008	NWTPH-Dx	DIESEL	1100	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/20/2001
		SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00001175	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00001175	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.00001175	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00001175	
		BENZO(A)PYRENE	ND	mg/Kg	0.000047	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.000047	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.0001175	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.000047	
		CHRYSENE	ND	mg/Kg	0.00001175	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0000705	
		FLUORANTHENE	ND	mg/Kg	0.00001175	
		FLUORENE	ND	mg/Kg	0.00001175	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.000094	
		NAPHTHALENE	ND	mg/Kg	0.00001175	
		PHENANTHRENE	ND	mg/Kg	0.00001175	
		PYRENE	ND	mg/Kg	0.00001175	
		SURROGATE	64	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-9				
10955-009	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/20/2001
		SURROGATE RECOVERY	87	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.0000149	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.0000149	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.0000149	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.0000149	
		BENZO(A)PYRENE	ND	mg/Kg	0.0000596	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0000596	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.000149	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0000596	
		CHRYSENE	ND	mg/Kg	0.0000149	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0000894	
		FLUORANTHENE	ND	mg/Kg	0.0000149	
		FLUORENE	ND	mg/Kg	0.0000149	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0001192	
		NAPHTHALENE	ND	mg/Kg	0.0000149	
		PHENANTHRENE	ND	mg/Kg	0.0000149	
		PYRENE	ND	mg/Kg	0.0000149	
		SURROGATE	80	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-10				
10955-010	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/20/2001
		SURROGATE RECOVERY	123	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00000485	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00000485	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.00000485	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00000485	
		BENZO(A)PYRENE	ND	mg/Kg	0.00001942	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00001942	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00004855	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00001942	
		CHRYSENE	ND	mg/Kg	0.00000485	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00002913	
		FLUORANTHENE	ND	mg/Kg	0.00000485	
		FLUORENE	ND	mg/Kg	0.00000485	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00003884	
		NAPHTHALENE	ND	mg/Kg	0.00000485	
		PHENANTHRENE	ND	mg/Kg	0.00000485	
		PYRENE	ND	mg/Kg	0.00000485	
		SURROGATE	78	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-11				
10955-011	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	Abigail K
	NWTPH-Dx					06/20/2001
		SURROGATE RECOVERY	133	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00001585	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00001585	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.00001585	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00001585	
		BENZO(A)PYRENE	ND	mg/Kg	0.0000634	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0000634	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.0001585	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0000634	
		CHRYSENE	ND	mg/Kg	0.00001585	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0000951	
		FLUORANTHENE	ND	mg/Kg	0.00001585	
		FLUORENE	ND	mg/Kg	0.00001585	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0001268	
		NAPHTHALENE	ND	mg/Kg	0.00001585	
		PHENANTHRENE	ND	mg/Kg	0.00001585	
		PYRENE	ND	mg/Kg	0.00001585	
		SURROGATE	80	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-12				
10955-012	NWTPH-Dx	DIESEL	650	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/20/2001
		SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.029	mg/Kg	0.00002195	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00002195	06/26/2001
		ANTHRACENE	0.251	mg/Kg	0.00002195	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00002195	
		BENZO(A)PYRENE	ND	mg/Kg	0.0000878	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0000878	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.0002195	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0000878	
		CHRYSENE	0.026	mg/Kg	0.00002195	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0001317	
		FLUORANTHENE	ND	mg/Kg	0.00002195	
		FLUORENE	0.217	mg/Kg	0.00002195	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0001756	
		NAPHTHALENE	ND	mg/Kg	0.00002195	
		PHENANTHRENE	ND	mg/Kg	0.00002195	
		PYRENE	ND	mg/Kg	0.00002195	
		SURROGATE	76	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-13				
10955-013	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/20/2001
		SURROGATE RECOVERY	83	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00001585	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00001585	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.00001585	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00001585	
		BENZO(A)PYRENE	ND	mg/Kg	0.0000634	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0000634	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.0001585	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0000634	
		CHRYSENE	ND	mg/Kg	0.00001585	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0000951	
		FLUORANTHENE	ND	mg/Kg	0.00001585	
		FLUORENE	ND	mg/Kg	0.00001585	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0001268	
		NAPHTHALENE	ND	mg/Kg	0.00001585	
		PHENANTHRENE	ND	mg/Kg	0.00001585	
		PYRENE	ND	mg/Kg	0.00001585	
		SURROGATE	76	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-14				
10955-014	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/20/2001
		SURROGATE RECOVERY	55	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00002065	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00002065	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.00002065	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00002065	
		BENZO(A)PYRENE	ND	mg/Kg	0.0000826	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0000826	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.0002065	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0000826	
		CHRYSENE	ND	mg/Kg	0.00002065	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0001239	
		FLUORANTHENE	ND	mg/Kg	0.00002065	
		FLUORENE	ND	mg/Kg	0.00002065	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0001652	
		NAPHTHALENE	ND	mg/Kg	0.00002065	
		PHENANTHRENE	ND	mg/Kg	0.00002065	
		PYRENE	ND	mg/Kg	0.00002065	
		SURROGATE	71	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-15				
10955-015	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/20/2001
		SURROGATE RECOVERY	56	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.0000248	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.0000248	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.0000248	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.0000248	
		BENZO(A)PYRENE	ND	mg/Kg	0.0000992	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0000992	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.000248	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0000992	
		CHRYSENE	ND	mg/Kg	0.0000248	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0001488	
		FLUORANTHENE	ND	mg/Kg	0.0000248	
		FLUORENE	ND	mg/Kg	0.0000248	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0001984	
		NAPHTHALENE	ND	mg/Kg	0.0000248	
		PHENANTHRENE	ND	mg/Kg	0.0000248	
		PYRENE	ND	mg/Kg	0.0000248	
		SURROGATE	81	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-16				
10955-016	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	07/03/2001
		SURROGATE RECOVERY	82	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.000011	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.000011	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.000011	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.000011	
		BENZO(A)PYRENE	ND	mg/Kg	0.000044	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.000044	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00011	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.000044	
		CHRYSENE	ND	mg/Kg	0.000011	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.000066	
		FLUORANTHENE	ND	mg/Kg	0.000011	
		FLUORENE	ND	mg/Kg	0.000011	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.000088	
		NAPHTHALENE	ND	mg/Kg	0.000011	
		PHENANTHRENE	ND	mg/Kg	0.000011	
		PYRENE	ND	mg/Kg	0.000011	
		SURROGATE	72	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-17				
10955-017	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/20/2001
		SURROGATE RECOVERY	77	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.0000248	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.0000248	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.0000248	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.0000248	
		BENZO(A)PYRENE	ND	mg/Kg	0.0000992	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0000992	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.000248	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0000992	
		CHRYSENE	ND	mg/Kg	0.0000248	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0001488	
		FLUORANTHENE	ND	mg/Kg	0.0000248	
		FLUORENE	ND	mg/Kg	0.0000248	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0001984	
		NAPHTHALENE	ND	mg/Kg	0.0000248	
		PHENANTHRENE	ND	mg/Kg	0.0000248	
		PYRENE	ND	mg/Kg	0.0000248	
		SURROGATE	87	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-18				
10955-018	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/20/2001
		SURROGATE RECOVERY	104	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00003477	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00003477	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.00003477	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00003477	
		BENZO(A)PYRENE	ND	mg/Kg	0.0001391	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0001391	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00034775	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0001391	
		CHRYSENE	ND	mg/Kg	0.00003477	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00020865	
		FLUORANTHENE	ND	mg/Kg	0.00003477	
		FLUORENE	ND	mg/Kg	0.00003477	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0002782	
		NAPHTHALENE	ND	mg/Kg	0.00003477	
		PHENANTHRENE	ND	mg/Kg	0.00003477	
		PYRENE	ND	mg/Kg	0.00003477	
		SURROGATE	83	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-19				
10955-019	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/20/2001
		SURROGATE RECOVERY	113	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00001775	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00001775	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.00001775	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00001775	
		BENZO(A)PYRENE	ND	mg/Kg	0.000071	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.000071	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.0001775	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.000071	
		CHRYSENE	ND	mg/Kg	0.00001775	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0001065	
		FLUORANTHENE	ND	mg/Kg	0.00001775	
		FLUORENE	ND	mg/Kg	0.00001775	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.000142	
		NAPHTHALENE	ND	mg/Kg	0.00001775	
		PHENANTHRENE	ND	mg/Kg	0.00001775	
		PYRENE	ND	mg/Kg	0.00001775	
		SURROGATE	108	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-20				
10955-020	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/20/2001
		SURROGATE RECOVERY	57	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.0000194	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.0000194	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.0000194	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.0000194	
		BENZO(A)PYRENE	ND	mg/Kg	0.0000776	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0000776	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.000194	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0000776	
		CHRYSENE	ND	mg/Kg	0.0000194	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0001164	
		FLUORANTHENE	ND	mg/Kg	0.0000194	
		FLUORENE	ND	mg/Kg	0.0000194	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0001552	
		NAPHTHALENE	ND	mg/Kg	0.0000194	
		PHENANTHRENE	ND	mg/Kg	0.0000194	
		PYRENE	ND	mg/Kg	0.0000194	
		SURROGATE	79	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-21				
10955-021	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/20/2001
		SURROGATE RECOVERY	58	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.0000276	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.0000276	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.0000276	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.0000276	
		BENZO(A)PYRENE	ND	mg/Kg	0.0001104	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0001104	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.000276	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0001104	
		CHRYSENE	ND	mg/Kg	0.0000276	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0001656	
		FLUORANTHENE	ND	mg/Kg	0.0000276	
		FLUORENE	ND	mg/Kg	0.0000276	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0002208	
		NAPHTHALENE	ND	mg/Kg	0.0000276	
		PHENANTHRENE	ND	mg/Kg	0.0000276	
		PYRENE	ND	mg/Kg	0.0000276	
		SURROGATE	81	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-22				
10955-022	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/20/2001
		SURROGATE RECOVERY	65	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.0000184	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.0000184	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.0000184	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.0000184	
		BENZO(A)PYRENE	ND	mg/Kg	0.0000736	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0000736	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.000184	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0000736	
		CHRYSENE	ND	mg/Kg	0.0000184	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0001104	
		FLUORANTHENE	ND	mg/Kg	0.0000184	
		FLUORENE	ND	mg/Kg	0.0000184	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0001472	
		NAPHTHALENE	ND	mg/Kg	0.0000184	
		PHENANTHRENE	ND	mg/Kg	0.0000184	
		PYRENE	ND	mg/Kg	0.0000184	
		SURROGATE	79	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-23				
10955-023	NWTPH-Dx	DIESEL	106	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/20/2001
		SURROGATE RECOVERY	107	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.000012	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.000012	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.000012	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.000012	
		BENZO(A)PYRENE	ND	mg/Kg	0.000048	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.000048	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00012	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.000048	
		CHRYSENE	ND	mg/Kg	0.000012	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.000072	
		FLUORANTHENE	ND	mg/Kg	0.000012	
		FLUORENE	ND	mg/Kg	0.000012	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.000096	
		NAPHTHALENE	ND	mg/Kg	0.000012	
		PHENANTHRENE	ND	mg/Kg	0.000012	
		PYRENE	ND	mg/Kg	0.000012	
		SURROGATE	74	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-24				
10955-024	NWTPH-Dx	DIESEL	2200	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/20/2001
		SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.315	mg/Kg	0.0000205	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.691	mg/Kg	0.0000205	06/26/2001
		ANTHRACENE	1.366	mg/Kg	0.0000205	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.0000205	
		BENZO(A)PYRENE	ND	mg/Kg	0.000082	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.000082	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.000205	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.000082	
		CHRYSENE	ND	mg/Kg	0.0000205	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.000123	
		FLUORANTHENE	0.041	mg/Kg	0.0000205	
		FLUORENE	0.231	mg/Kg	0.0000205	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.000164	
		NAPHTHALENE	0.104	mg/Kg	0.0000205	
		PHENANTHRENE	1.771	mg/Kg	0.0000205	
		PYRENE	0.061	mg/Kg	0.0000205	
		SURROGATE	81	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-25				
10955-025	NWTPH-Dx	DIESEL	640	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/21/2001
		SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.029	mg/Kg	0.00002445	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.065	mg/Kg	0.00002445	06/26/2001
		ANTHRACENE	0.273	mg/Kg	0.00002445	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00002445	
		BENZO(A)PYRENE	ND	mg/Kg	0.0000978	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0000978	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.0002445	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0000978	
		CHRYSENE	ND	mg/Kg	0.00002445	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0001467	
		FLUORANTHENE	ND	mg/Kg	0.00002445	
		FLUORENE	0.226	mg/Kg	0.00002445	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0001956	
		NAPHTHALENE	ND	mg/Kg	0.00002445	
		PHENANTHRENE	0.092	mg/Kg	0.00002445	
		PYRENE	ND	mg/Kg	0.00002445	
		SURROGATE	78	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-26				
10955-026	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/26/2001
		SURROGATE RECOVERY	78	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.0000115	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.0000115	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.0000115	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.0000115	
		BENZO(A)PYRENE	ND	mg/Kg	0.000046	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.000046	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.000115	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.000046	
		CHRYSENE	ND	mg/Kg	0.0000115	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.000069	
		FLUORANTHENE	ND	mg/Kg	0.0000115	
		FLUORENE	ND	mg/Kg	0.0000115	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.000092	
		NAPHTHALENE	ND	mg/Kg	0.0000115	
		PHENANTHRENE	ND	mg/Kg	0.0000115	
		PYRENE	ND	mg/Kg	0.0000115	
		SURROGATE	76	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-27				
10955-027	NWTPH-Dx	DIESEL	40	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/26/2001
		SURROGATE RECOVERY	74	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.000023	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.000023	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.000023	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.000023	
		BENZO(A)PYRENE	ND	mg/Kg	0.000092	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.000092	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00023	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.000092	
		CHRYSENE	ND	mg/Kg	0.000023	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.000138	
		FLUORANTHENE	ND	mg/Kg	0.000023	
		FLUORENE	ND	mg/Kg	0.000023	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.000184	
		NAPHTHALENE	ND	mg/Kg	0.000023	
		PHENANTHRENE	ND	mg/Kg	0.000023	
		PYRENE	ND	mg/Kg	0.000023	
		SURROGATE	88	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-28				
10955-028	NWTPH-Dx	DIESEL	2800	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/26/2001
		SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.303	mg/Kg	0.00001645	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.537	mg/Kg	0.00001645	06/26/2001
		ANTHRACENE	0.817	mg/Kg	0.00001645	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00001645	
		BENZO(A)PYRENE	ND	mg/Kg	0.0000658	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0000658	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.0001645	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0000658	
		CHRYSENE	ND	mg/Kg	0.00001645	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0000987	
		FLUORANTHENE	ND	mg/Kg	0.00001645	
		FLUORENE	0.319	mg/Kg	0.00001645	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0001316	
		NAPHTHALENE	0.083	mg/Kg	0.00001645	
		PHENANTHRENE	1.554	mg/Kg	0.00001645	
		PYRENE	0.065	mg/Kg	0.00001645	
		SURROGATE	76	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-29				
10955-029	NWTPH-Dx	DIESEL	2200	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/26/2001
		SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.372	mg/Kg	0.0000282	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.232	mg/Kg	0.0000282	06/26/2001
		ANTHRACENE	1.024	mg/Kg	0.0000282	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.0000282	
		BENZO(A)PYRENE	ND	mg/Kg	0.0001128	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0001128	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.000282	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0001128	
		CHRYSENE	ND	mg/Kg	0.0000282	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0001692	
		FLUORANTHENE	ND	mg/Kg	0.0000282	
		FLUORENE	0.639	mg/Kg	0.0000282	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0002256	
		NAPHTHALENE	0.788	mg/Kg	0.0000282	
		PHENANTHRENE	1.326	mg/Kg	0.0000282	
		PYRENE	0.034	mg/Kg	0.0000282	
		SURROGATE	99	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-30				
10955-030	NWTPH-Dx	DIESEL	270	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/26/2001
		SURROGATE RECOVERY	94	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00001965	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00001965	06/26/2001
		ANTHRACENE	0.040	mg/Kg	0.00001965	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00001965	
		BENZO(A)PYRENE	ND	mg/Kg	0.0000786	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0000786	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.0001965	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0000786	
		CHRYSENE	ND	mg/Kg	0.00001965	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0001179	
		FLUORANTHENE	ND	mg/Kg	0.00001965	
		FLUORENE	ND	mg/Kg	0.00001965	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0001572	
		NAPHTHALENE	ND	mg/Kg	0.00001965	
		PHENANTHRENE	ND	mg/Kg	0.00001965	
		PYRENE	ND	mg/Kg	0.00001965	
		SURROGATE	85	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-31				
10955-031	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/26/2001
		SURROGATE RECOVERY	98	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.0000182	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.0000182	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.0000182	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.0000182	
		BENZO(A)PYRENE	ND	mg/Kg	0.0000728	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0000728	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.000182	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0000728	
		CHRYSENE	ND	mg/Kg	0.0000182	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0001092	
		FLUORANTHENE	ND	mg/Kg	0.0000182	
		FLUORENE	ND	mg/Kg	0.0000182	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0001456	
		NAPHTHALENE	ND	mg/Kg	0.0000182	
		PHENANTHRENE	ND	mg/Kg	0.0000182	
		PYRENE	ND	mg/Kg	0.0000182	
		SURROGATE	77	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-32				
10955-032	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/26/2001
		SURROGATE RECOVERY	74	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.0000169	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.0000169	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.0000169	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.0000169	
		BENZO(A)PYRENE	ND	mg/Kg	0.0000676	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0000676	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.000169	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0000676	
		CHRYSENE	ND	mg/Kg	0.0000169	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0001014	
		FLUORANTHENE	ND	mg/Kg	0.0000169	
		FLUORENE	ND	mg/Kg	0.0000169	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0001352	
		NAPHTHALENE	ND	mg/Kg	0.0000169	
		PHENANTHRENE	ND	mg/Kg	0.0000169	
		PYRENE	ND	mg/Kg	0.0000169	
		SURROGATE	80	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-33				
10955-033	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/26/2001
		SURROGATE RECOVERY	70	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00001695	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00001695	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.00001695	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00001695	
		BENZO(A)PYRENE	ND	mg/Kg	0.0000678	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0000678	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.0001695	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0000678	
		CHRYSENE	ND	mg/Kg	0.00001695	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0001017	
		FLUORANTHENE	ND	mg/Kg	0.00001695	
		FLUORENE	ND	mg/Kg	0.00001695	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0001356	
		NAPHTHALENE	ND	mg/Kg	0.00001695	
		PHENANTHRENE	ND	mg/Kg	0.00001695	
		PYRENE	ND	mg/Kg	0.00001695	
		SURROGATE	89	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-34				
10955-034	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/26/2001
		SURROGATE RECOVERY	93	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00003325	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00003325	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.00003325	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00003325	
		BENZO(A)PYRENE	ND	mg/Kg	0.000133	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.000133	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.0003325	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.000133	
		CHRYSENE	ND	mg/Kg	0.00003325	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0001995	
		FLUORANTHENE	ND	mg/Kg	0.00003325	
		FLUORENE	ND	mg/Kg	0.00003325	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.000266	
		NAPHTHALENE	ND	mg/Kg	0.00003325	
		PHENANTHRENE	ND	mg/Kg	0.00003325	
		PYRENE	ND	mg/Kg	0.00003325	
		SURROGATE	101	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-35				
10955-035	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	07/03/2001
		SURROGATE RECOVERY	80	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.0000324	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.0000324	07/03/2001
		ANTHRACENE	ND	mg/Kg	0.0000324	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.0000324	
		BENZO(A)PYRENE	ND	mg/Kg	0.0001296	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0001296	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.000324	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0001296	
		CHRYSENE	ND	mg/Kg	0.0000324	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0001944	
		FLUORANTHENE	ND	mg/Kg	0.0000324	
		FLUORENE	ND	mg/Kg	0.0000324	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0002592	
		NAPHTHALENE	ND	mg/Kg	0.0000324	
		PHENANTHRENE	ND	mg/Kg	0.0000324	
		PYRENE	ND	mg/Kg	0.0000324	
		SURROGATE	96	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-36				
10955-036	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	Abigail K
	NWTPH-Dx					06/26/2001
		SURROGATE RECOVERY	123	%RECOVERY	50%-150%	
	PNAH 1	ACENAPETHENE	ND	mg/Kg	0.0000186	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.0000186	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.0000186	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.0000186	
		BENZO(A)PYRENE	ND	mg/Kg	0.0000744	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0000744	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.000186	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0000744	
		CHRYSENE	ND	mg/Kg	0.0000186	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0001116	
		FLUORANTHENE	ND	mg/Kg	0.0000186	
		FLUORENE	ND	mg/Kg	0.0000186	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0001488	
		NAPHTHALENE	ND	mg/Kg	0.0000186	
		PHENANTHRENE	ND	mg/Kg	0.0000186	
		PYRENE	ND	mg/Kg	0.0000186	
		SURROGATE	71	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-37				
10955-037	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	07/05/2001
		SURROGATE RECOVERY	87	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00001745	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00001745	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.00001745	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00001745	
		BENZO(A)PYRENE	ND	mg/Kg	0.0000698	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0000698	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.0001745	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0000698	
		CHRYSENE	ND	mg/Kg	0.00001745	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0001047	
		FLUORANTHENE	ND	mg/Kg	0.00001745	
		FLUORENE	ND	mg/Kg	0.00001745	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0001396	
		NAPHTHALENE	ND	mg/Kg	0.00001745	
		PHENANTHRENE	ND	mg/Kg	0.00001745	
		PYRENE	ND	mg/Kg	0.00001745	
		SURROGATE	78	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-38				
10955-038	NWTPH-Dx	DIESEL	86	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	07/05/2001
		SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00002065	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00002065	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.00002065	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00002065	
		BENZO(A)PYRENE	ND	mg/Kg	0.0000826	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0000826	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.0002065	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0000826	
		CHRYSENE	ND	mg/Kg	0.00002065	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0001239	
		FLUORANTHENE	ND	mg/Kg	0.00002065	
		FLUORENE	ND	mg/Kg	0.00002065	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0001652	
		NAPHTHALENE	ND	mg/Kg	0.00002065	
		PHENANTHRENE	ND	mg/Kg	0.00002065	
		PYRENE	ND	mg/Kg	0.00002065	
		SURROGATE	99	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-39				
10955-039	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	150	mg/Kg	100	07/05/2001
		SURROGATE RECOVERY	98	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.0000306	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.0000306	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.0000306	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.0000306	
		BENZO(A)PYRENE	ND	mg/Kg	0.0001224	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0001224	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.000306	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0001224	
		CHRYSENE	ND	mg/Kg	0.0000306	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0001836	
		FLUORANTHENE	ND	mg/Kg	0.0000306	
		FLUORENE	ND	mg/Kg	0.0000306	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0002448	
		NAPHTHALENE	ND	mg/Kg	0.0000306	
		PHENANTHRENE	ND	mg/Kg	0.0000306	
		PYRENE	ND	mg/Kg	0.0000306	
		SURROGATE	92	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-40				
10955-040	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	07/05/2001
		SURROGATE RECOVERY	105	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00002075	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00002075	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.00002075	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00002075	
		BENZO(A)PYRENE	ND	mg/Kg	0.000083	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.000083	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.0002075	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.000083	
		CHRYSENE	ND	mg/Kg	0.00002075	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0001245	
		FLUORANTHENE	ND	mg/Kg	0.00002075	
		FLUORENE	0.033	mg/Kg	0.00002075	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.000166	
		NAPHTHALENE	ND	mg/Kg	0.00002075	
		PHENANTHRENE	ND	mg/Kg	0.00002075	
		PYRENE	ND	mg/Kg	0.00002075	
		SURROGATE	77	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-41				
10955-041	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	07/05/2001
		SURROGATE RECOVERY	131	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.0000178	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.0000178	06/26/2001
		ANTHRACENE	ND	mg/Kg	0.0000178	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.0000178	
		BENZO(A)PYRENE	ND	mg/Kg	0.0000712	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0000712	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.000178	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0000712	
		CHRYSENE	ND	mg/Kg	0.0000178	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0001068	
		FLUORANTHENE	ND	mg/Kg	0.0000178	
		FLUORENE	ND	mg/Kg	0.0000178	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0001424	
		NAPHTHALENE	ND	mg/Kg	0.0000178	
		PHENANTHRENE	ND	mg/Kg	0.0000178	
		PYRENE	ND	mg/Kg	0.0000178	
		SURROGATE	90	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

CLIENT: GLENBROOK NICKEL - SMELTER
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DATE SUBMITTED: 07/18/2001

PROJECT NAME: GLENBROOK- RIDDLE

PROJECT NUMBER: JA036.15

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
11107-001	CS-NRR-42	07/16/2001	0830	Soil	Soil
11107-002	CS-NRR-43	07/16/2001	0835	Soil	Soil
11107-003	CS-NRR-44	07/16/2001	0850	Soil	Soil
11107-004	CS-NRR-45	07/16/2001	0855	Soil	Soil
11107-005	CS-NRR-46	07/16/2001	1000	Soil	Soil
11107-006	CS-NRR-47	07/16/2001	1003	Soil	Soil
11107-007	CS-NRR-48	07/16/2001	1050	Soil	Soil
11107-008	CS-NRR-49	07/16/2001	1055	Soil	Soil

REPORT DATE: 07/30/2001 REPORT NUMBER: 11107

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-42				
11107-001	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	07/20/2001
		SURROGATE RECOVERY	55	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.03	Padma A
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.03	07/24/2001
		ANTHRACENE	0.09	mg/Kg	0.03	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.03	
		BENZO(A)PYRENE	ND	mg/Kg	0.03	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.03	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.03	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.03	
		CHRYSENE	ND	mg/Kg	0.03	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.03	
		FLUORANTHENE	ND	mg/Kg	0.03	
		FLUORENE	ND	mg/Kg	0.03	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.03	
		NAPHTHALENE	ND	mg/Kg	0.03	
		PHENANTHRENE	ND	mg/Kg	0.03	
		PYRENE	ND	mg/Kg	0.03	
		SURROGATE	92	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-43				
11107-002	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	07/20/2001

REVIEWED BY: David Back - QA Manager

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-43				
11107-002	NWTPH-Dx	SURROGATE RECOVERY	118	%RECOVERY	50%-150%	Abigail K
	NWTPH-Dx					07/20/2001
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.03	Padma A
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.03	07/24/2001
		ANTHRACENE	ND	mg/Kg	0.03	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.03	
		BENZO(A)PYRENE	ND	mg/Kg	0.03	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.03	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.03	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.03	
		CHRYSENE	ND	mg/Kg	0.03	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.03	
		FLUORANTHENE	ND	mg/Kg	0.03	
		FLUORENE	ND	mg/Kg	0.03	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.03	
		NAPHTHALENE	ND	mg/Kg	0.03	
		PHENANTHRENE	ND	mg/Kg	0.03	
		PYRENE	ND	mg/Kg	0.03	
		SURROGATE	108	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-44				
11107-003	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	07/23/2001
		SURROGATE RECOVERY	61	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.03	Padma A
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.03	07/24/2001
		ANTHRACENE	0.07	mg/Kg	0.03	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.03	
		BENZO(A)PYRENE	ND	mg/Kg	0.03	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.03	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.03	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.03	
		CHRYSENE	ND	mg/Kg	0.03	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.03	
		FLUORANTHENE	ND	mg/Kg	0.03	
		FLUORENE	ND	mg/Kg	0.03	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.03	
		NAPHTHALENE	ND	mg/Kg	0.03	
		PHENANTHRENE	ND	mg/Kg	0.03	
		PYRENE	ND	mg/Kg	0.03	
		SURROGATE	98	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-45				
11107-004	NWTPH-Dx	DIESEL	144	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	07/23/2001

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-45				
11107-004	NWTPH-Dx					Abigail K
	NWTPH-Dx	SURROGATE RECOVERY	57	%RECOVERY	50%-150%	07/23/2001
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.03	Padma A
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.03	07/24/2001
		ANTHRACENE	0.38	mg/Kg	0.03	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.03	
		BENZO(A)PYRENE	ND	mg/Kg	0.03	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.03	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.03	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.03	
		CHRYSENE	ND	mg/Kg	0.03	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.03	
		FLUORANTHENE	ND	mg/Kg	0.03	
		FLUORENE	ND	mg/Kg	0.03	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.03	
		NAPHTHALENE	ND	mg/Kg	0.03	
		PHENANTHRENE	0.17	mg/Kg	0.03	
		PYRENE	ND	mg/Kg	0.03	
		SURROGATE	78	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-46				
11107-005	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	07/30/2001
		SURROGATE RECOVERY	74	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.03	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.03	07/27/2001
		ANTHRACENE	ND	mg/Kg	0.03	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.03	
		BENZO(A)PYRENE	ND	mg/Kg	0.03	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.03	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.03	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.03	
		CHRYSENE	ND	mg/Kg	0.03	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.03	
		FLUORANTHENE	ND	mg/Kg	0.03	
		FLUORENE	ND	mg/Kg	0.03	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.03	
		NAPHTHALENE	ND	mg/Kg	0.03	
		PHENANTHRENE	ND	mg/Kg	0.03	
		PYRENE	ND	mg/Kg	0.03	
		SURROGATE	81.6	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-47				
11107-006	NWTPH-Dx	DIESEL	7800	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	07/23/2001

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-47				
11107-006	NWTPH-Dx					Abigail K
	NWTPH-Dx	SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%	07/23/2001
	PNAH 1	ACENAPHTHENE	1.55	mg/Kg	0.03	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.59	mg/Kg	0.03	07/27/2001
		ANTHRACENE	5.50	mg/Kg	0.03	
		BENZO(A)ANTHRACENE	0.14	mg/Kg	0.03	
		BENZO(A)PYRENE	0.10	mg/Kg	0.03	
		BENZO(B)FLUORANTHENE	0.05	mg/Kg	0.03	
		BENZO(GHI)PERYLENE	0.05	mg/Kg	0.03	
		BENZO(K)FLUORANTHENE	0.05	mg/Kg	0.03	
		CHRYSENE	0.15	mg/Kg	0.03	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.03	
		FLUORANTHENE	0.14	mg/Kg	0.03	
		FLUORENE	3.04	mg/Kg	0.03	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.03	
		NAPHTHALENE	1.44	mg/Kg	0.03	
		PHENANTHRENE	3.99	mg/Kg	0.03	
		PYRENE	0.41	mg/Kg	0.03	
		SURROGATE	87.2	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-48				
11107-007	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	07/23/2001
		SURROGATE RECOVERY	115	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.03	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.03	07/27/2001
		ANTHRACENE	ND	mg/Kg	0.03	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.03	
		BENZO(A)PYRENE	ND	mg/Kg	0.03	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.03	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.03	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.03	
		CHRYSENE	ND	mg/Kg	0.03	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.03	
		FLUORANTHENE	ND	mg/Kg	0.03	
		FLUORENE	ND	mg/Kg	0.03	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.03	
		NAPHTHALENE	ND	mg/Kg	0.03	
		PHENANTHRENE	0.04	mg/Kg	0.03	
		PYRENE	ND	mg/Kg	0.03	
		SURROGATE	96.7	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-NRR-49				
11107-008	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	07/23/2001

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-NRR-49				
11107-008	NWTPH-Dx					Abigail K
	NWTPH-Dx	SURROGATE RECOVERY	93	%RECOVERY	50%-150%	07/23/2001
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.03	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.03	07/27/2001
		ANTHRACENE	ND	mg/Kg	0.03	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.03	
		BENZO(A)PYRENE	ND	mg/Kg	0.03	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.03	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.03	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.03	
		CHRYSENE	ND	mg/Kg	0.03	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.03	
		FLUORANTHENE	ND	mg/Kg	0.03	
		FLUORENE	ND	mg/Kg	0.03	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.03	
		NAPHTHALENE	ND	mg/Kg	0.03	
		PHENANTHRENE	ND	mg/Kg	0.03	
		PYRENE	ND	mg/Kg	0.03	
		SURROGATE	117	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

ORIGINAL

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DATE SUBMITTED: 08/23/2001
PROJECT NAME: AOC-10 DAY BINS:NORTH SIDE RR TRACKPROJECT NUMBER: JA036.15

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
11284-001		08/21/2001	0930	Soil	CSNRR-50 26'
11284-002		08/21/2001	0955	Soil	CSNRR-51 10'
11284-003		08/21/2001	1000	Soil	CSNRR-52 10'
11284-004		08/21/2001	1330	Soil	CSNRR-53 23'
11284-005		08/21/2001	1400	Soil	CSNRR-54 10'
11284-006		08/21/2001	1405	Soil	CSNRR-55 20'
11284-007		08/21/2001	1435	Soil	CSNRR-56 15'
11284-008		08/21/2001	1440	Soil	CSNRR-57 8.0'
11284-009		08/21/2001	1445	Soil	CSNRR-58 12'
11284-010		08/21/2001	1450	Soil	CSNRR-59 10'
11284-011		08/21/2001	1455	Soil	CSNRR-60 5.0'
11284-012		08/21/2001	1515	Soil	CSNRR-61 10'
11284-013		08/21/2001	1615	Soil	CSNRR-62 16.0'
11284-014		08/21/2001	1635	Soil	CSNRR-63 14.0'
11284-015		08/21/2001	1645	Soil	CSNRR-64 8.0'
11284-016		08/21/2001	1705	Soil	CSNRR-65 8.0'

REPORT DATE: 09/07/2001 REPORT NUMBER: 11284

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CSNRR-50 26'						
11284-001	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	08/24/2001
		SURROGATE RECOVERY	81	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00001	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00001	08/30/2001
		ANTHRACENE	ND	mg/Kg	0.00001	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00001	
		BENZO(A)PYRENE	ND	mg/Kg	0.00004	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00004	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00013	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00004	
		CHRYSENE	ND	mg/Kg	0.00001	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00007	
		FLUORANTHENE	ND	mg/Kg	0.00001	
		FLUORENE	ND	mg/Kg	0.00001	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00009	
		NAPHTHALENE	ND	mg/Kg	0.00001	
		PHENANTHRENE	ND	mg/Kg	0.00001	
		PYRENE	ND	mg/Kg	0.00001	
		SURROGATE	83	%RECOVERY	50%-150%	

REVIEWED BY: David Back - QS Manager

CERTIFICATE OF ANALYSIS ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CSNRR-51 10'						
11284-002	NWTPH-Dx	DIESEL	77	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	08/24/2001
		SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%	
	PNAH 3	ACENAPHTHENE	ND	mg/Kg	0.00001	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00001	08/30/2001
		ANTHRACENE	ND	mg/Kg	0.00001	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00001	
		BENZO(A)PYRENE	ND	mg/Kg	0.00005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00013	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00005	
		CHRYSENE	ND	mg/Kg	0.00001	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00007	
		FLUORANTHENE	ND	mg/Kg	0.00001	
		FLUORENE	0.020	mg/Kg	0.00001	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00013	
		NAPHTHALENE	ND	mg/Kg	0.00001	
		PHENANTHRENE	0.035	mg/Kg	0.00001	
		PYRENE	ND	mg/Kg	0.00001	
		SURROGATE	99	%RECOVERY	50%-150%	
CSNRR-52 10'						
11284-003	NWTPH-Dx	DIESEL	350	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	08/24/2001
		SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%	
	PNAH 3	ACENAPHTHENE	ND	mg/Kg	0.00002	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00002	08/30/2001
		ANTHRACENE	ND	mg/Kg	0.00002	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00002	
		BENZO(A)PYRENE	ND	mg/Kg	0.00006	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00006	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00019	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00006	
		CHRYSENE	ND	mg/Kg	0.00002	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00009	
		FLUORANTHENE	ND	mg/Kg	0.00002	
		FLUORENE	0.0144	mg/Kg	0.00002	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00013	
		NAPHTHALENE	ND	mg/Kg	0.00002	
		PHENANTHRENE	0.0559	mg/Kg	0.00002	
		PYRENE	0.0156	mg/Kg	0.00002	
		SURROGATE	75	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CSNRR-53 23'						
11284-004	NWTPH-Dx	DIESEL	52	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	08/24/2001
		SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00002	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00002	08/30/2001
		ANTHRACENE	ND	mg/Kg	0.00002	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00002	
		BENZO(A)PYRENE	ND	mg/Kg	0.00006	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00006	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00019	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00006	
		CHRYSENE	ND	mg/Kg	0.00002	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00012	
		FLUORANTHENE	ND	mg/Kg	0.00002	
		FLUORENE	ND	mg/Kg	0.00002	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00012	
		NAPHTHALENE	ND	mg/Kg	0.00002	
		PHENANTHRENE	ND	mg/Kg	0.00002	
		PYRENE	ND	mg/Kg	0.00002	
		SURROGATE	73	%RECOVERY	50%-150%	
CSNRR-54 10'						
11284-005	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	08/24/2001
		SURROGATE RECOVERY	73	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00002	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00002	08/30/2001
		ANTHRACENE	ND	mg/Kg	0.00002	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00002	
		BENZO(A)PYRENE	ND	mg/Kg	0.00007	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00007	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00017	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00007	
		CHRYSENE	ND	mg/Kg	0.00002	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00010	
		FLUORANTHENE	ND	mg/Kg	0.00002	
		FLUORENE	ND	mg/Kg	0.00002	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00013	
		NAPHTHALENE	ND	mg/Kg	0.00002	
		PHENANTHRENE	ND	mg/Kg	0.00002	
		PYRENE	ND	mg/Kg	0.00002	
		SURROGATE	61	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CSNRR-55 20'						
11284-006	NWTPH-Dx	DIESEL	220	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	08/24/2001
		SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00002	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00002	08/30/2001
		ANTHRACENE	ND	mg/Kg	0.00002	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00002	
		BENZO(A)PYRENE	ND	mg/Kg	0.00008	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00008	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00019	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00008	
		CHRYSENE	ND	mg/Kg	0.00002	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00012	
		FLUORANTHENE	ND	mg/Kg	0.00002	
		FLUORENE	ND	mg/Kg	0.00002	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00016	
		NAPHTHALENE	ND	mg/Kg	0.00002	
		PHENANTHRENE	ND	mg/Kg	0.00002	
		PYRENE	ND	mg/Kg	0.00002	
		SURROGATE	59	%RECOVERY	50%-150%	
CSNRR-56 15'						
11284-007	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	08/24/2001
		SURROGATE RECOVERY	91	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00003	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00003	08/30/2001
		ANTHRACENE	ND	mg/Kg	0.00003	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00003	
		BENZO(A)PYRENE	ND	mg/Kg	0.00014	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00014	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00034	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00014	
		CHRYSENE	ND	mg/Kg	0.00003	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00020	
		FLUORANTHENE	ND	mg/Kg	0.00003	
		FLUORENE	ND	mg/Kg	0.00003	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00027	
		NAPHTHALENE	ND	mg/Kg	0.00003	
		PHENANTHRENE	ND	mg/Kg	0.00003	
		PYRENE	ND	mg/Kg	0.00003	
		SURROGATE	70	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CSNRR-57 8.0'						
11284-008	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	08/24/2001
		SURROGATE RECOVERY	110	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00003	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00003	08/30/2001
		ANTHRACENE	ND	mg/Kg	0.00003	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00003	
		BENZO(A)PYRENE	ND	mg/Kg	0.00014	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00014	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00034	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00014	
		CHRYSENE	ND	mg/Kg	0.00003	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00020	
		FLUORANTHENE	ND	mg/Kg	0.00003	
		FLUORENE	ND	mg/Kg	0.00003	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00027	
		NAPHTHALENE	ND	mg/Kg	0.00003	
		PHENANTHRENE	ND	mg/Kg	0.00003	
		PYRENE	ND	mg/Kg	0.00003	
		SURROGATE	70	%RECOVERY	50%-150%	
CSNRR-58 12'						
11284-009	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	08/24/2001
		SURROGATE RECOVERY	89	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00002	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00002	08/30/2001
		ANTHRACENE	ND	mg/Kg	0.00002	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00002	
		BENZO(A)PYRENE	ND	mg/Kg	0.00007	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00007	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00019	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00007	
		CHRYSENE	ND	mg/Kg	0.00002	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00011	
		FLUORANTHENE	ND	mg/Kg	0.00002	
		FLUORENE	ND	mg/Kg	0.00002	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00015	
		NAPHTHALENE	ND	mg/Kg	0.00002	
		PHENANTHRENE	ND	mg/Kg	0.00002	
		PYRENE	ND	mg/Kg	0.00002	
		SURROGATE	64	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CSNRR-59 10'						
11284-010	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	08/24/2001
		SURROGATE RECOVERY	90	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00004	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00004	08/30/2001
		ANTHRACENE	ND	mg/Kg	0.00004	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00004	
		BENZO(A)PYRENE	ND	mg/Kg	0.00014	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00014	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00035	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00014	
		CHRYSENE	ND	mg/Kg	0.00004	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00021	
		FLUORANTHENE	ND	mg/Kg	0.00004	
		FLUORENE	ND	mg/Kg	0.00004	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00028	
		NAPHTHALENE	ND	mg/Kg	0.00004	
		PHENANTHRENE	ND	mg/Kg	0.00004	
		PYRENE	ND	mg/Kg	0.00004	
		SURROGATE	64	%RECOVERY	50%-150%	
CSNRR-60 5.0'						
11284-011	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	08/27/2001
		SURROGATE RECOVERY	70	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00001	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00001	09/04/2001
		ANTHRACENE	ND	mg/Kg	0.00001	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00001	
		BENZO(A)PYRENE	ND	mg/Kg	0.00004	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00004	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00010	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00004	
		CHRYSENE	ND	mg/Kg	0.00001	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00007	
		FLUORANTHENE	ND	mg/Kg	0.00001	
		FLUORENE	ND	mg/Kg	0.00001	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00009	
		NAPHTHALENE	ND	mg/Kg	0.00001	
		PHENANTHRENE	ND	mg/Kg	0.00001	
		PYRENE	ND	mg/Kg	0.00001	
		SURROGATE	62	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CSNRR-61 10'						
11284-012	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	08/27/2001
		SURROGATE RECOVERY	103	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00002	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00002	09/04/2001
		ANTHRACENE	ND	mg/Kg	0.00002	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00002	
		BENZO(A)PYRENE	ND	mg/Kg	0.00007	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00007	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00018	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00007	
		CHRYSENE	ND	mg/Kg	0.00002	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00011	
		FLUORANTHENE	ND	mg/Kg	0.00002	
		FLUORENE	ND	mg/Kg	0.00002	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00014	
		NAPHTHALENE	ND	mg/Kg	0.00002	
		PHENANTHRENE	ND	mg/Kg	0.00002	
		PYRENE	ND	mg/Kg	0.00002	
		SURROGATE	84	%RECOVERY	50%-150%	
CSNRR-62 16.0'						
11284-013	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	08/27/2001
		SURROGATE RECOVERY	117	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00002	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00002	09/04/2001
		ANTHRACENE	ND	mg/Kg	0.00002	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00002	
		BENZO(A)PYRENE	ND	mg/Kg	0.00009	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00009	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00023	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00009	
		CHRYSENE	ND	mg/Kg	0.00002	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00014	
		FLUORANTHENE	ND	mg/Kg	0.00002	
		FLUORENE	ND	mg/Kg	0.00002	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00018	
		NAPHTHALENE	ND	mg/Kg	0.00002	
		PHENANTHRENE	ND	mg/Kg	0.00002	
		PYRENE	ND	mg/Kg	0.00002	
		SURROGATE	76	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CSNRR-65 8.0'						
11284-016	NWTPH-Dx	DIESEL	135	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	08/27/2001
		SURROGATE RECOVERY	108	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00003	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00003	09/04/2001
		ANTHRACENE	ND	mg/Kg	0.00003	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00003	
		BENZO(A)PYRENE	ND	mg/Kg	0.00013	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00013	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00032	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00013	
		CHRYSENE	ND	mg/Kg	0.00003	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00019	
		FLUORANTHENE	ND	mg/Kg	0.00003	
		FLUORENE	ND	mg/Kg	0.00003	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00026	
		NAPHTHALENE	ND	mg/Kg	0.00003	
		PHENANTHRENE	ND	mg/Kg	0.00003	
		PYRENE	ND	mg/Kg	0.00003	
		SURROGATE	58	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

ORIGINAL

CLIENT: GLENBROOK NICKEL - SMELTER
5093 RIDDLE BYPASS RD.
RIDDLE OR 97469

PHONE: (541) 874-3171
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DATE SUBMITTED: 09/21/2001

PROJECT NAME: GLENBROOK NICKEL: AOC-10 NRR RIDDLEPROJECT NUMBER: JA036.15

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
11434-001		09/19/2001	1425	Soil	CSNRR-66 6.0'
11434-002		09/19/2001	1440	Soil	CSNRR-67 10.0'
11434-003		09/19/2001	1420	Soil	CSNRR-68 6.0'
11434-004		09/19/2001	1445	Soil	CSNRR-69 10.0'
11434-005		09/19/2001	1435	Soil	CSNRR-70 12.0'
11434-006		09/19/2001	1545	Soil	CSNRR-71 6.0'
11434-007		09/19/2001	1540	Soil	CSNRR-72 11.0'
11434-008		09/19/2001	1550	Soil	CSNRR-73 6.0'
11434-009		09/19/2001	1645	Soil	CSNRR-74 13.0'
11434-010		09/21/2001	0830	Soil	CSNRR-75 6.0'
11434-011		09/21/2001	0825	Soil	CSNRR-76 6.0'
11434-012		09/21/2001	1020	Soil	CSNRR-77 6.0'
11434-013		09/21/2001	1025	Soil	CSNRR-78 6.0'
11434-014		09/21/2001	1030	Soil	CSNRR-79 7.0'
11434-015		09/21/2001	1035	Soil	CSNRR-80 6.0'

REPORT DATE: 10/03/2001 REPORT NUMBER: 11434

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CSNRR-66 6.0'						
11434-001	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Dave M
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	09/28/2001
		SURROGATE RECOVERY	77	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.0176	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.0176	09/27/2001
		ANTHRACENE	ND	mg/Kg	0.0176	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.0176	
		BENZO(A)PYRENE	ND	mg/Kg	0.0176	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0176	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.0176	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0176	
		CHRYSENE	ND	mg/Kg	0.0176	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0176	
		FLUORANTHENE	ND	mg/Kg	0.0176	
		FLUORENE	ND	mg/Kg	0.0176	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0176	
		NAPHTHALENE	ND	mg/Kg	0.0176	
		PHENANTHRENE	0.019	mg/Kg	0.0176	
		PYRENE	ND	mg/Kg	0.0176	
		SURROGATE	106	%RECOVERY	50%-150%	

REVIEWED BY: David Back

David Back - QS Manager

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CSNRR-67 10.0'						
11434-002	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Dave M
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	09/26/2001
		SURROGATE RECOVERY	82	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.01445	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.01445	09/27/2001
		ANTHRACENE	ND	mg/Kg	0.01445	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.01445	
		BENZO(A)PYRENE	ND	mg/Kg	0.01445	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.01445	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.01445	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.01445	
		CHRYSENE	ND	mg/Kg	0.01445	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.01445	
		FLUORANTHENE	ND	mg/Kg	0.01445	
		FLUORENE	ND	mg/Kg	0.01445	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.01445	
		NAPHTHALENE	ND	mg/Kg	0.01445	
		PHENANTHRENE	ND	mg/Kg	0.01445	
		PYRENE	ND	mg/Kg	0.01445	
		SURROGATE	105	%RECOVERY	50%-150%	
CSNRR-68 6.0'						
11434-003	NWTPH-Dx	DIESEL	58.9	mg/Kg	25	Dave M
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	09/28/2001
		SURROGATE RECOVERY	55	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.0042	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.0042	09/27/2001
		ANTHRACENE	ND	mg/Kg	0.0042	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.0042	
		BENZO(A)PYRENE	ND	mg/Kg	0.0042	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0042	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.0042	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0042	
		CHRYSENE	ND	mg/Kg	0.0042	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0042	
		FLUORANTHENE	ND	mg/Kg	0.0042	
		FLUORENE	0.007	mg/Kg	0.0042	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0042	
		NAPHTHALENE	ND	mg/Kg	0.0042	
		PHENANTHRENE	0.013	mg/Kg	0.0042	
		PYRENE	ND	mg/Kg	0.0042	
		SURROGATE	68	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CSNRR-63 14.0'						
11284-014	NWTPH-Dx	DIESEL	1200	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	08/28/2001
		SURROGATE RECOVERY	66	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.076	mg/Kg	0.00002	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.032	mg/Kg	0.00002	09/04/2001
		ANTHRACENE	0.252	mg/Kg	0.00002	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00002	
		BENZO(A)PYRENE	ND	mg/Kg	0.00007	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00007	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00017	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00007	
		CHRYSENE	ND	mg/Kg	0.00002	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00010	
		FLUORANTHENE	0.015	mg/Kg	0.00002	
		FLUORENE	0.059	mg/Kg	0.00002	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00014	
		NAPHTHALENE	0.139	mg/Kg	0.00002	
		PHENANTHRENE	1.420	mg/Kg	0.00002	
		PYRENE	0.046	mg/Kg	0.00002	
		SURROGATE	84	%RECOVERY	50%-150%	
CSNRR-64 8.0'						
11284-015	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	08/28/2001
		SURROGATE RECOVERY	83	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00005	09/05/2001
		ANTHRACENE	ND	mg/Kg	0.00005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00005	
		BENZO(A)PYRENE	ND	mg/Kg	0.00020	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00020	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00050	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00020	
		CHRYSENE	ND	mg/Kg	0.00005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00030	
		FLUORANTHENE	ND	mg/Kg	0.00005	
		FLUORENE	ND	mg/Kg	0.00005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00040	
		NAPHTHALENE	ND	mg/Kg	0.00005	
		PHENANTHRENE	ND	mg/Kg	0.00005	
		PYRENE	ND	mg/Kg	0.00005	
		SURROGATE	74	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CSNRR-69 10.0'						
11434-004	NWTPH-Dx	DIESEL	185	mg/Kg	25	Dave M
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	09/25/2001
		SURROGATE RECOVERY	55	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00595	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.010	mg/Kg	0.00595	09/27/2001
		ANTHRACENE	ND	mg/Kg	0.00595	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00595	
		BENZO(A)PYRENE	ND	mg/Kg	0.00595	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00595	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00595	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00595	
		CHRYSENE	ND	mg/Kg	0.00595	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00595	
		FLUORANTHENE	ND	mg/Kg	0.00595	
		FLUORENE	0.017	mg/Kg	0.00595	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00595	
		NAPHTHALENE	0.013	mg/Kg	0.00595	
		PHENANTHRENE	0.014	mg/Kg	0.00595	
		PYRENE	0.007	mg/Kg	0.00595	
		SURROGATE	74	%RECOVERY	50%-150%	
CSNRR-70 12.0'						
11434-005	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Dave M
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	09/25/2001
		SURROGATE RECOVERY	51	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00505	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00505	09/27/2001
		ANTHRACENE	ND	mg/Kg	0.00505	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00505	
		BENZO(A)PYRENE	ND	mg/Kg	0.00505	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00505	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00505	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00505	
		CHRYSENE	ND	mg/Kg	0.00505	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00505	
		FLUORANTHENE	ND	mg/Kg	0.00505	
		FLUORENE	ND	mg/Kg	0.00505	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00505	
		NAPHTHALENE	0.011	mg/Kg	0.00505	
		PHENANTHRENE	ND	mg/Kg	0.00505	
		PYRENE	ND	mg/Kg	0.00505	
		SURROGATE	74	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CSNRR-71 6.0'						
11434-006	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Dave M
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	09/25/2001
		SURROGATE RECOVERY	65	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00595	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00595	09/27/2001
		ANTHRACENE	ND	mg/Kg	0.00595	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00595	
		BENZO(A)PYRENE	ND	mg/Kg	0.00595	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00595	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00595	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00595	
		CHRYSENE	ND	mg/Kg	0.00595	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00595	
		FLUORANTHENE	ND	mg/Kg	0.00595	
		FLUORENE	ND	mg/Kg	0.00595	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00595	
		NAPHTHALENE	ND	mg/Kg	0.00595	
		PHENANTHRENE	ND	mg/Kg	0.00595	
		PYRENE	ND	mg/Kg	0.00595	
		SURROGATE	82	%RECOVERY	50%-150%	
CSNRR-72 11.0'						
11434-007	NWTPH-Dx	DIESEL	31	mg/Kg	25	Dave M
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	09/25/2001
		SURROGATE RECOVERY	63	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00685	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00685	09/27/2001
		ANTHRACENE	ND	mg/Kg	0.00685	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00685	
		BENZO(A)PYRENE	ND	mg/Kg	0.00685	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00685	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00685	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00685	
		CHRYSENE	ND	mg/Kg	0.00685	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00685	
		FLUORANTHENE	ND	mg/Kg	0.00685	
		FLUORENE	ND	mg/Kg	0.00685	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00685	
		NAPHTHALENE	ND	mg/Kg	0.00685	
		PHENANTHRENE	0.008	mg/Kg	0.00685	
		PYRENE	ND	mg/Kg	0.00685	
		SURROGATE	87	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CSNRR-73 6.0'						
11434-008	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Dave M
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	09/25/2001
		SURROGATE RECOVERY	56	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00555	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00555	09/27/2001
		ANTHRACENE	ND	mg/Kg	0.00555	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00555	
		BENZO(A)PYRENE	ND	mg/Kg	0.00555	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00555	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00555	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00555	
		CHRYSENE	ND	mg/Kg	0.00555	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00555	
		FLUORANTHENE	ND	mg/Kg	0.00555	
		FLUORENE	ND	mg/Kg	0.00555	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00555	
		NAPHTHALENE	ND	mg/Kg	0.00555	
		PHENANTHRENE	ND	mg/Kg	0.00555	
		PYRENE	ND	mg/Kg	0.00555	
		SURROGATE	72	%RECOVERY	50%-150%	
CSNRR-74 13.0'						
11434-009	NWTPH-Dx	DIESEL	171	mg/Kg	25	Dave M
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	09/26/2001
		SURROGATE RECOVERY	OBS	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	09/27/2001
		ANTHRACENE	0.026	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	0.015	mg/Kg	0.005	
		PHENANTHRENE	0.219	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	72	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CSNRR-75 6.0'						
11434-010	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Dave M
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	09/25/2001
		SURROGATE RECOVERY	106	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00605	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00605	09/27/2001
		ANTHRACENE	ND	mg/Kg	0.00605	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00605	
		BENZO(A)PYRENE	ND	mg/Kg	0.00605	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00605	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00605	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00605	
		CHRYSENE	ND	mg/Kg	0.00605	
		DIBENZO(AH)ANTHRACENE	0.007	mg/Kg	0.00605	
		FLUORANTHENE	ND	mg/Kg	0.00605	
		FLUORENE	ND	mg/Kg	0.00605	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00605	
		NAPHTHALENE	ND	mg/Kg	0.00605	
		PHENANTHRENE	ND	mg/Kg	0.00605	
		PYRENE	ND	mg/Kg	0.00605	
		SURROGATE	51	%RECOVERY	50%-150%	
CSNRR-76 6.0'						
11434-011	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Dave M
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	09/26/2001
		SURROGATE RECOVERY	120	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.01105	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.01105	09/27/2001
		ANTHRACENE	ND	mg/Kg	0.01105	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.01105	
		BENZO(A)PYRENE	ND	mg/Kg	0.01105	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.01105	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.01105	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.01105	
		CHRYSENE	ND	mg/Kg	0.01105	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.01105	
		FLUORANTHENE	ND	mg/Kg	0.01105	
		FLUORENE	ND	mg/Kg	0.01105	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.01105	
		NAPHTHALENE	ND	mg/Kg	0.01105	
		PHENANTHRENE	ND	mg/Kg	0.01105	
		PYRENE	ND	mg/Kg	0.01105	
		SURROGATE	56	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CSNRR-77 6.0'						
11434-012	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Dave M
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	09/26/2001
		SURROGATE RECOVERY	61	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.0107	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.0107	09/27/2001
		ANTHRACENE	ND	mg/Kg	0.0107	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.0107	
		BENZO(A)PYRENE	ND	mg/Kg	0.0107	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0107	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.0107	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0107	
		CHRYSENE	ND	mg/Kg	0.0107	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0107	
		FLUORANTHENE	ND	mg/Kg	0.0107	
		FLUORENE	ND	mg/Kg	0.0107	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0107	
		NAPHTHALENE	ND	mg/Kg	0.0107	
		PHENANTHRENE	ND	mg/Kg	0.0107	
		PYRENE	ND	mg/Kg	0.0107	
		SURROGATE	85	%RECOVERY	50%-150%	
CSNRR-78 6.0'						
11434-013	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Dave M
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	09/26/2001
		SURROGATE RECOVERY	51	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00775	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00775	09/27/2001
		ANTHRACENE	ND	mg/Kg	0.00775	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00775	
		BENZO(A)PYRENE	ND	mg/Kg	0.00775	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00775	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00775	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00775	
		CHRYSENE	ND	mg/Kg	0.00775	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00775	
		FLUORANTHENE	ND	mg/Kg	0.00775	
		FLUORENE	ND	mg/Kg	0.00775	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00775	
		NAPHTHALENE	ND	mg/Kg	0.00775	
		PHENANTHRENE	ND	mg/Kg	0.00775	
		PYRENE	ND	mg/Kg	0.00775	
		SURROGATE	80	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CSNRR-79 7.0'						
11434-014	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Dave M
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	09/26/2001
		SURROGATE RECOVERY	68	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.00675	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.00104625	09/27/2001
		ANTHRACENE	ND	mg/Kg	0.00104625	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.00104625	
		BENZO(A)PYRENE	ND	mg/Kg	0.00104625	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.00104625	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.00104625	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.00104625	
		CHRYSENE	ND	mg/Kg	0.00104625	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.00104625	
		FLUORANTHENE	ND	mg/Kg	0.00104625	
		FLUORENE	ND	mg/Kg	0.00104625	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.00104625	
		NAPHTHALENE	ND	mg/Kg	0.00104625	
		PHENANTHRENE	ND	mg/Kg	0.00104625	
		PYRENE	ND	mg/Kg	0.00104625	
		SURROGATE	90	%RECOVERY	50%-150%	
CSNRR-80 6.0'						
11434-015	NWTPH-Dx	DIESEL	25.3	mg/Kg	25	Dave M
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	09/26/2001
		SURROGATE RECOVERY	71	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.0055	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.0055	09/27/2001
		ANTHRACENE	ND	mg/Kg	0.0055	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.0055	
		BENZO(A)PYRENE	ND	mg/Kg	0.0055	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.0055	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.0055	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.0055	
		CHRYSENE	ND	mg/Kg	0.0055	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.0055	
		FLUORANTHENE	ND	mg/Kg	0.0055	
		FLUORENE	ND	mg/Kg	0.0055	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.0055	
		NAPHTHALENE	0.009	mg/Kg	0.0055	
		PHENANTHRENE	ND	mg/Kg	0.0055	
		PYRENE	ND	mg/Kg	0.0055	
		SURROGATE	87	%RECOVERY	50%-150%	

Appendix I

Confirmation Sampling Results
Pilot Plant Fuel Oil AST (AOC-R-12)

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015

Date Reported: 09/07/00
Date Collected: 08/29/00
Time Collected: 2:05 PM
Sampled At: AOC
Sampled By: TC Tomes/AME

COMINCO Ltd., Glenbrook Operation
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

Invoice# 3876

PAH's — Method: EPA 8310 — Matrix: Soil

URC Sample #:		200829-23	200829-24	200829-25	200829-26			
Sample ID:		AOC-12 A	AOC-12 B	AOC-12 C	AOC-12 D			
Analyte	Units	Results	Results	Results	Results		Date Analyzed	Analyst
Acenaphthene	mg/kg	ND@0.1	ND@0.1	ND@0.1	ND@0.1		9/5/00	BKO
Acenaphthylene	mg/kg	ND@0.1	ND@0.1	ND@0.1	ND@0.1		09/05/00	BKO
Anthracene	mg/kg	ND@0.1	ND@0.1	ND@0.1	ND@0.1		09/05/00	BKO
Benzo(a)anthracene	mg/kg	ND@0.1	ND@0.1	ND@0.1	ND@0.1		09/05/00	BKO
Benzo(a)pyrene	mg/kg	ND@0.1	ND@0.1	ND@0.1	ND@0.1		09/05/00	BKO
.zo(b)fluoranthene	mg/kg	ND@0.1	ND@0.1	ND@0.1	ND@0.1		09/05/00	BKO
Benzo(ghi)perylene	mg/kg	ND@0.1	ND@0.1	ND@0.1	ND@0.1		09/05/00	BKO
Benzo(k)fluoranthene	mg/kg	ND@0.1	ND@0.1	ND@0.1	ND@0.1		09/05/00	BKO
Chrysene	mg/kg	ND@0.1	ND@0.1	ND@0.1	ND@0.1		09/05/00	BKO
Dibenzo(ah)anthracene	mg/kg	ND@0.1	ND@0.1	ND@0.1	ND@0.1		09/05/00	BKO
Fluoranthene	mg/kg	ND@0.1	ND@0.1	ND@0.1	ND@0.1		09/05/00	BKO
Fluorene	mg/kg	ND@0.1	ND@0.1	ND@0.1	ND@0.1		09/05/00	BKO
Indeno(1,2,3-cd)pyrene	mg/kg	ND@0.1	ND@0.1	ND@0.1	ND@0.1		09/05/00	BKO
Naphthalene	mg/kg	ND@0.1	ND@0.1	ND@0.1	ND@0.1		09/05/00	BKO
Phenanthrene	mg/kg	ND@0.1	ND@0.1	ND@0.1	ND@0.1		09/05/00	BKO
Pyrene	mg/kg	ND@0.1	ND@0.1	ND@0.1	ND@0.1		09/05/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected At Level Indicated

Approved By:

200829-23-26

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 09/07/00
Date Collected: 08/29/00
Time Collected: 2:05 PM
Sampled By: TC Tomes/AME

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation	JA036.15
P.O. Box 85	
5093 Riddle By-pass Road	Invoice#
Riddle, OR 97469	3876

NWTPH-HCID — Matrix: Soil

URC Sample #: 200829-23
Sample ID: AOC-12 A

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND			09/01/00	BKO
% Surrogate Recovery		109.5	%		09/01/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200829-23hcid

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 09/07/00
Date Collected: 08/28/00
Time Collected: 2:10 PM
Sampled By: TC Tomes/AME

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation P.O. Box 85 5093 Riddle By-pass Road Riddle, OR 97469	JA036.15 Invoice# 3876

NWTPH-HCID — Matrix: Soil

URC Sample #: 200829-24
Sample ID: AOC-12 B

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	ND			09/01/00	BKO
% Surrogate Recovery		102.2	%		09/01/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200829-24hcid

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 09/07/00
Date Collected: 08/29/00
Time Collected: 2:15 PM
Sampled By: TC Tomes/AME

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation P.O. Box 85 5093 Riddle By-pass Road Riddle, OR 97469	JA036.15 Invoice# 3876

NWTPH-HCID — Matrix: Soil

URC Sample #: 200829-25
Sample ID: AOC-12 C

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Heavy Oils			09/01/00	BKO
% Surrogate Recovery		101.2	%		09/01/00	BKO
Heavy Oils	NWTPH-Dx	30.1	mg/kg		09/01/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200829-25hcid

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 09/07/00
Date Collected: 08/29/00
Time Collected: 2:25 PM
Sampled By: TC Tomes/AME

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation P.O. Box 85 5093 Riddle By-pass Road Riddle, OR 97469	JA036.15 Invoice# 3876

NWTPH-HCID — Matrix: Soil

URC Sample #: 200829-26
Sample ID: AOC-12 D

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Heavy Oils			09/01/00	BKO
% Surrogate Recovery		80.5	%		09/01/00	BKO
Heavy Oils	NWTPH-Dx	26.5	mg/kg		09/01/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200829-26ahcid

Appendix J

Confirmation Sampling Results
Vehicle Maintenance and Washdown Area (AOC-R-13)

CERTIFICATE OF ANALYSIS

CLIENT: GLENBROOK NICKEL - SMELTER
5093 RIDDLE BYPASS RD.
RIDDLE OR 97469

PHONE: (541) 874-3171
FAX: (541) 874-3380

DATE SUBMITTED: 01/26/20

PROJECT NAME: COMINCO/RIDDLE - AOC-R-13

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
10165-001	CS-1	01/25/2001	1615	Soil	4.5-5.0
10165-002	CS-2	01/25/2001	1618	Soil	4.5-5.0
10165-003	CS-3	01/25/2001	1620	Soil	4.5-5.0
10165-004	CS-4	01/25/2001	1622	Soil	4.5-5.0
10165-005	CS-5	01/25/2001	1624	Soil	4.5-5.0
10165-006	CS-6	01/25/2001	1626	Soil	4.5-5.0
10165-007	CS-7	01/25/2001	1628	Soil	3.5-4.0
10165-008	CS-8	01/25/2001	1630	Soil	3.5-4.0
10165-009	CS-9	01/25/2001	1632	Soil	3.5-4.0
10165-010	CS-10	01/25/2001	1634	Soil	3.5-4.0
10165-011	CS-11	01/25/2001	1636	Soil	3.5-4.0
10165-012	CS-12	01/25/2001	1638	Soil	3.5-4.0
10165-013	CS-13	01/25/2001	1640	Soil	3.5-4.0
10165-014	CS-14	01/25/2001	1642	Soil	3.5-4.0
10165-015	ASSP	01/25/2001	1645	Soil	STOCKPILE COMPOSITE SOIL SAMPLE

REPORT DATE: 02/09/2001 REPORT NUMBER: 10165

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
4.5-5.0		SAMPLE ID: CS-1				
10165-001	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	27	mg/Kg	0.3	Greg W 01/31/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/07/2001
		SURROGATE RECOVERY	77	%RECOVERY	50%-150%	
4.5-5.0		SAMPLE ID: CS-2				
10165-002	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	31	mg/Kg	0.30	Greg W 01/31/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/07/2001
		SURROGATE RECOVERY	80	%RECOVERY	50%-150%	
4.5-5.0		SAMPLE ID: CS-3				
10165-003	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	50	mg/Kg	0.30	Greg W 01/31/2001

REVIEWED BY: Martin Little - Quality Manager

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
4.5-5.0		SAMPLE ID: CS-3				
10165-003	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/07/2001
		SURROGATE RECOVERY	82	%RECOVERY	50%-150%	
4.5-5.0		SAMPLE ID: CS-4				
10165-004	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	38	mg/Kg	0.30	Greg W 01/31/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/07/2001
		SURROGATE RECOVERY	66	%RECOVERY	50%-150%	
4.5-5.0		SAMPLE ID: CS-5				
10165-005	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	46	mg/Kg	0.30	Greg W 01/31/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/07/2001
		SURROGATE RECOVERY	62	%RECOVERY	50%-150%	
4.5-5.0		SAMPLE ID: CS-6				
10165-006	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	37	mg/Kg	0.30	Greg W 01/31/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/07/2001
		SURROGATE RECOVERY	70	%RECOVERY	50%-150%	
3.5-4.0		SAMPLE ID: CS-7				
10165-007	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	33	mg/Kg	0.30	Greg W 01/31/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	270	mg/Kg	100	02/07/2001
		SURROGATE RECOVERY	80	%RECOVERY	50%-150%	
3.5-4.0		SAMPLE ID: CS-8				
10165-008	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	34	mg/Kg	0.27	Greg W 02/01/2001
	NWTPH-Dx	DIESEL	170	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	1,200	mg/Kg	100	02/07/2001
		SURROGATE RECOVERY	86	%RECOVERY		

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
3.5-4.0		SAMPLE ID: CS-9				
10165-009	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	31	mg/Kg	0.3	Greg W 02/01/2001
10165-009	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	170	mg/Kg	100	02/07/2001
		SURROGATE RECOVERY	79	%RECOVERY		
3.5-4.0		SAMPLE ID: CS-10				
10165-010	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	30	mg/Kg	0.3	Greg W 02/01/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	02/07/2001
		SURROGATE RECOVERY	79	%RECOVERY	50%-150%	
3.5-4.0		SAMPLE ID: CS-11				
10165-011	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	32	mg/Kg	0.30	Greg W 01/31/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	100	mg/Kg	100	02/07/2001
		SURROGATE RECOVERY	79	%RECOVERY	50%-150%	
3.5-4.0		SAMPLE ID: CS-12				
10165-012	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	32	mg/Kg	0.30	Greg W 01/31/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	170	mg/Kg	100	02/07/2001
		SURROGATE RECOVERY	66	%RECOVERY	50%-150%	
3.5-4.0		SAMPLE ID: CS-13				
10165-013	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	53	mg/Kg	0.3	Greg W 02/01/2001
	NWTPH-Dx	DIESEL	73	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	2,300	mg/Kg	100	02/07/2001
		SURROGATE RECOVERY	66	%RECOVERY	50%-150%	
3.5-4.0		SAMPLE ID: CS-14				
10165-014	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	33	mg/Kg	0.30	Greg W 01/31/2001

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
3.5-4.0		SAMPLE ID: CS-14				
10165-014	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	360	mg/Kg	100	02/07/2001
		SURROGATE RECOVERY	85	%RECOVERY	50%-150%	
STOCKPILE COMPOSITE SOIL SAMPLE		SAMPLE ID: ASSP				
10165-015	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	39	mg/Kg	0.30	Greg W 01/31/2001
	BARIUM - ICP EPA 200.7/6010B	TOTAL BARIUM	130	mg/Kg	0.03	Greg W 01/31/2001
	BTEX 3 EPA 8260	BENZENE	ND	mg/Kg	0.001	Dave M 01/30/2001
		ETHYLBENZENE	0.002	mg/Kg	0.001	
		TOLUENE	0.015	mg/Kg	0.001	
		META- & PARA-XYLENE	0.007	mg/Kg	0.001	
		ORTHO-XYLENE	0.004	mg/Kg	0.001	
		SURROGATE 1 RECOVERY	99	%RECOVERY	80%-120%	
	CADMIUM - ICP EPA 200.7/6010B	TOTAL CADMIUM	ND	mg/Kg	0.03	Greg W 01/31/2001
	CHROMIUM - ICP EPA 200.7/6010B	TOTAL CHROMIUM	81	mg/Kg	0.03	Greg W 01/31/2001
	LEAD - ICP EPA 200.7/6010B	TOTAL LEAD	10	mg/Kg	0.03	Greg W 01/31/2001
	MERCURY - CVAA (SLD) EPA 245.1/7471	MERCURY	ND	mg/Kg	0.01	Greg W 02/01/2001
	SELENIUM - ICP EPA 200.7/6010B	TOTAL SELENIUM	ND	mg/Kg	1.4	Greg W 01/31/2001
	SILVER - ICP EPA 200.7/6010B	TOTAL SILVER	ND	mg/Kg	0.03	Greg W 01/31/2001
	TCLP - 8 METALS EPA 1311	EPA 6010/200.7 TCLP ARSENIC	0.01	mg/L	0.01	Greg W 02/08/2001
		EPA 6010/200.7 TCLP BARIUM	2.1	mg/L	0.001	
		EPA 6010/200.7 TCLP CADMIUM	ND	mg/L	0.001	
		EPA 6010/200.7 TCLP CHROMIUM	0.013	mg/L	0.001	
		EPA 6010/200.7 TCLP LEAD	0.029	mg/L	0.001	
		EPA 7470/245.1 TCLP MERCURY	ND	mg/L	0.0003	
		EPA 6010/200.7 TCLP SELENIUM	ND	mg/L	0.04	
		EPA 6010/200.7 TCLP SILVER	ND	mg/L	0.001	

CERTIFICATE OF ANALYSIS

CLIENT: GLENBROOK NICKEL - SMELTER
5093 RIDDLE BYPASS RD.
RIDDLE OR 97469

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DATE SUBMITTED: 03/09/2001

PROJECT NAME: GLENBROOK NICKEL, RIDDLE, OREGON PROJECT NUMBER: JA036.15

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
10389-001		03/07/2001	1016	Soil	CS-15 @ 4'
10389-002		03/07/2001	1018	Soil	CS-16 @ 8'
10389-003		03/07/2001	1020	Soil	CS-17 @ 4'
10389-004		03/07/2001	1022	Soil	CS-18 @ 8'
10389-005		03/07/2001	1023	Soil	CS-19 @ 4'
10389-006		03/07/2001	1024	Soil	CS-20 @ 8'
10389-007		03/07/2001	1029	Soil	CS-21 @ 4'
10389-008		03/07/2001	1031	Soil	CS-22 @ 8'
10389-009		03/07/2001	1035	Soil	CS-23 @ 4'
10389-010		03/07/2001	1037	Soil	CS-24 @ 8'
10389-011		03/07/2001	1042	Soil	CS-25 @ 4'
10389-012		03/07/2001	1044	Soil	CS-26 @ 8'
10389-013		03/07/2001	1055	Soil	CS-27 @ 8'
10389-014		03/07/2001	1057	Soil	CS-28 @ 8'
10389-015		03/07/2001	1059	Soil	CS-29 @ 8'
10389-016		03/07/2001	1100	Soil	CS-30 @ 8'
10389-017		03/07/2001	1251	Soil	CS-31 @ 3.5'
10389-018		03/07/2001	1253	Soil	CS-32 @ 7.0'
10389-019		03/07/2001	1254	Soil	CS-33 @ 3.5'
10389-020		03/07/2001	1255	Soil	CS-34 @ 7.0'
10389-021		03/07/2001	1256	Soil	CS-35
10389-022		03/07/2001	1259	Soil	CS-36
10389-023		03/07/2001	1301	Soil	CS-37
10389-024		03/07/2001	1315	Soil	CS-38
10389-025		03/07/2001	1317	Soil	CS-39
10389-026		03/07/2001	1319	Soil	CS-40

REPORT DATE: 03/29/2001 REPORT NUMBER: 10389

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-15 @ 4'						
10389-001	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W 03/11/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/14/2001
		SURROGATE RECOVERY	64	%RECOVERY	50%-150%	

REVIEWED BY:

CERTIFICATE OF ANALYSIS

Martin Little - Quality Manager

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-15 @ 4'						
10389-001	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/15/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	72	%RECOVERY	50%-150%	
CS-16 @ 8'						
10389-002	ARSENIC - ICP	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W
	EPA 200.7/6010B					03/11/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/14/2001
		SURROGATE RECOVERY	78	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/15/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	77	%RECOVERY	50%-150%	
CS-17 @ 4'						
10389-003	ARSENIC - ICP	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W
	EPA 200.7/6010B					03/11/2001

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-17 @ 4'						
10389-003	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/14/2001
		SURROGATE RECOVERY	63	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/15/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	89	%RECOVERY	50%-150%	
CS-18 @ 8'						
10389-004	ARSENIC - ICP	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W
	EPA 200.7/6010B					03/11/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/14/2001
		SURROGATE RECOVERY	90	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/15/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	78	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-19 @ 4'						
10389-005	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W 03/11/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/14/2001
		SURROGATE RECOVERY	102	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/15/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	89	%RECOVERY	50%-150%	
CS-20 @ 8'						
10389-006	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W 03/11/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/14/2001
		SURROGATE RECOVERY	81	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/15/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-20 @ 8'						
10389-006	PNAH 1 EPA 8270M (SIM)	PYRENE	ND	mg/Kg	0.05	Robert M 03/15/2001
		SURROGATE	05	%RECOVERY	50%-150%	
CS-21 @ 4'						
10389-007	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W 03/11/2001
	NWTPH-Dx	DIESEL	85	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	641	mg/Kg	100	03/26/2001
		SURROGATE RECOVERY	124	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	0.41	mg/Kg	0.05	03/15/2001
		BENZO(A)ANTHRACENE	0.099	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	0.15	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	0.067	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	0.19	mg/Kg	0.05	
		FLUORENE	0.21	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	0.078	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	0.45	mg/Kg	0.05	
		PYRENE	0.16	mg/Kg	0.05	
		SURROGATE	73	%RECOVERY	50%-150%	
CS-22 @ 8'						
10389-008	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W 03/11/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	108	mg/Kg	100	03/26/2001
		SURROGATE RECOVERY	88	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/15/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	

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SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
		FLUORANTHENE	ND	mg/Kg	0.05	
CS-22 @ 8'						
10389-008	PNAH 1	FLUORENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	03/15/2001
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	88	%RECOVERY	50%-150%	
CS-23 @ 4'						
10389-009	ARSENIC - ICP	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W
	EPA 200.7/6010B					03/11/2001
	NWTPH-Dx	DIESEL	34	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	168	mg/Kg	100	03/26/2001
		SURROGATE RECOVERY	82	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/15/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	86	%RECOVERY	50%-150%	
CS-24 @ 0'						
10389-010	ARSENIC - ICP	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W
	EPA 200.7/6010B					03/11/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	111	mg/Kg	100	03/26/2001
		SURROGATE RECOVERY	87	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/15/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	

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		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-24 @ 8'						
10389-010	PNAH 1	BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	CHRYSENE	ND	mg/Kg	0.05	03/15/2001
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	108	%RECOVERY	50%-150%	
CS-25 @ 4'						
10389-011	ARSENIC - ICP	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W
	EPA 200.7/6010B					03/11/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/14/2001
		SURROGATE RECOVERY	98	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/15/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	85	%RECOVERY	50%-150%	
CS-26 @ 8'						
10389-012	ARSENIC - ICP	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W
	EPA 200.7/6010B					03/11/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/14/2001
		SURROGATE RECOVERY	84	%RECOVERY	50%-150%	

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SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-26 @ 8'						
10389-012	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/15/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	88	%RECOVERY	50%-150%	
CS-27 @ 8'						
10389-013	ARSENIC - ICP	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W
	EPA 200.7/6010B					03/11/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/14/2001
		SURROGATE RECOVERY	74	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/15/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	75	%RECOVERY	50%-150%	
CS-28 @ 8'						
10389-014	ARSENIC - ICP	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W
	EPA 200.7/6010B					03/11/2001

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ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-28 @ 8'						
10389-014	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/14/2001
		SURROGATE RECOVERY	69	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/15/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	72	%RECOVERY	50%-150%	
CS-29 @ 8'						
10389-015	ARSENIC - ICP	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W
	EPA 200.7/6010B					03/11/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/14/2001
		SURROGATE RECOVERY	94	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/15/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	86	%RECOVERY	50%-150%	

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SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-30 @ 8'						
10389-016	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W 03/11/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/14/2001
		SURROGATE RECOVERY	64	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/22/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.2	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.2	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.5	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.2	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.3	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.4	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	113	%RECOVERY	50%-150%	
CS-31 @ 3.5'						
10389-017	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	PPM	0.50	Greg W 03/11/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/14/2001
		SURROGATE RECOVERY	79	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/22/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.2	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.2	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.5	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.2	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.3	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.4	
		NAPHTHALENE	ND	mg/Kg	0.05	

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SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-31 @ 3.5'						
10389-017	PNAH 1	PHENANTHRENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	PYRENE	ND	mg/Kg	0.05	03/15/2001
		SURROGATE	99	%RECOVERY	50%-150%	
CS-32 @ 7.0'						
10389-018	ARSENIC - ICP	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W
	EPA 200.7/6010B					03/11/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/14/2001
		SURROGATE RECOVERY	58	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/15/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	73	%RECOVERY	50%-150%	
CS-33 @ 3.5'						
10389-019	ARSENIC - ICP	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W
	EPA 200.7/6010B					03/11/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/14/2001
		SURROGATE RECOVERY	116	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/15/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	

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SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-33 @ 3.5'						
10389-019	PNAH 1	DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	FLUORANTHENE	ND	mg/Kg	0.05	03/15/2001
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	81	%RECOVERY	50%-150%	
CS-34 @ 7.0'						
10389-020	ARSENIC - ICP	TOTAL ARSENIC	ND	PPM	0.50	Greg W
	EPA 200.7/6010B					03/11/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/14/2001
		SURROGATE RECOVERY	56	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/16/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	67	%RECOVERY	50%-150%	
CS-35						
10389-021	ARSENIC - ICP	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W
	EPA 200.7/6010B					03/11/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/14/2001
		SURROGATE RECOVERY	113	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/16/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-35						
10389-021	PNAH 1	BENZO(A)PYRENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	03/16/2001
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	73	%RECOVERY	50%-150%	
CS-36						
10389-022	ARSENIC - ICP	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W
	EPA 200.7/6010B					03/11/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/14/2001
		SURROGATE RECOVERY	139	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/22/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.2	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.2	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.5	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.2	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.3	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.4	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	103	%RECOVERY	50%-150%	
CS-37						
10389-023	ARSENIC - ICP	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W
	EPA 200.7/6010B					03/11/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/14/2001

CERTIFICATE OF ANALYSIS

		SURROGATE RECOVERY	103	%RECOVERY	50%-150%	

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-37						
10389-023	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/22/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.2	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.2	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.5	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.2	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.3	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.4	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	99	%RECOVERY	50%-150%	
CS-38						
10389-024	ARSENIC - ICP	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W
	EPA 200.7/6010B					03/11/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/14/2001
		SURROGATE RECOVERY	124	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/23/1901
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.2	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.2	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.5	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.2	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.3	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.4	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	91.56	%RECOVERY	50%-150%	
CS-39						
10389-025	ARSENIC - ICP	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W
	EPA 200.7/6010B					03/11/2001

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
CS-39						
10389-025	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/14/2001
		SURROGATE RECOVERY	106	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/22/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.2	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.2	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.5	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.2	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.3	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.4	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	65	%RECOVERY	50%-150%	
CS-40						
10389-026	ARSENIC - ICP	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W
	EPA 200.7/6010B					03/11/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/14/2001
		SURROGATE RECOVERY	123	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHYLENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ANTHRACENE	ND	mg/Kg	0.05	03/22/2001
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.2	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.2	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.5	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.2	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.3	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.4	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	75	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

CLIENT: GLENBROOK NICKEL - SMELTER
5093 RIDDLE BYPASS RD.
RIDDLE OR 97469

PHONE: (541) 874-3171
FAX: (541) 874-3380

DATE SUBMITTED: 03/29/2001

PROJECT NAME: GLENBROOK NICKEL, RIDDLE, OR PROJECT NUMBER: JA036.15

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
10523-002	CS-21	03/27/2001	1050	Soil	SOIL SAMPLE

REPORT DATE: 04/04/2001 REPORT NUMBER: 10523

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: CS-21 A CW				
10523-001	ARSENIC - ICP EPA 200.7/6010B	TOTAL ARSENIC	ND	mg/Kg	0.50	Greg W 04/02/2001
	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	03/30/2001
		SURROGATE RECOVERY	102	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	04/03/2001
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	88	%RECOVERY	50%-150%	

REVIEWED BY: _____
Martin Little - Quality Manager

Appendix K

Confirmation Sampling Results
BPA Substation (AOC-R-20)

CERTIFICATE OF ANALYSIS

CLIENT: GLENBROOK NICKEL - SMELTER
5093 RIDDLE BYPASS RD.
RIDDLE OR 97469

PHONE: (541) 874-3171
FAX: (541) 874-3380

DATE SUBMITTED: 06/14/2001
PROJECT NAME: GLENBROOK RIDDLE- AOC-R-20
PROJECT NUMBER: JA036.15

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
10954-001	CS-BPA-P1-EW	06/13/2001	1136	Soil	Soil
10954-002	CS-BPA-P1-BTM	06/13/2001	1140	Soil	Soil
10954-003	CS-BPA-P2-NW	06/13/2001	1150	Soil	Soil
10954-004	CS-BPA-P2-EW	06/13/2001	1153	Soil	Soil
10954-005	CS-BPA-P2-WW	06/13/2001	1147	Soil	Soil
10954-006	CS-BPA-P2-BTM	06/13/2001	1155	Soil	Soil
10954-007	CS-BPA-P3-WW	06/13/2001	1200	Soil	Soil
10954-008	CS-BPA-P3-EW	06/13/2001	1205	Soil	Soil
10954-009	CS-BPA-P3-SW	06/13/2001	1203	Soil	Soil
10954-010	CS-BPA-P3-BTM	06/13/2001	1207	Soil	Soil
10954-011	CS-BPA-P4-NW	06/13/2001	1215	Soil	Soil
10954-012	CS-BPA-P4-WW	06/13/2001	1220	Soil	Soil
10954-013	CS-BPA-P4-EW	06/13/2001	1217	Soil	Soil
10954-014	CS-BPA-P4-BTM	06/13/2001	1223	Soil	Soil
10954-015	CS-BPA-P5-NW	06/13/2001	1228	Soil	Soil
10954-016	CS-BPA-P5-EW	06/13/2001	1230	Soil	Soil
10954-017	CS-BPA-P5-WW	06/13/2001	1225	Soil	Soil
10954-018	CS-BPA-P5-BTM	06/13/2001	1233	Soil	Soil

REPORT DATE: 06/26/2001 REPORT NUMBER: 10954

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-BPA-P1-EW				
10954-001	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/15/2001
		SURROGATE RECOVERY	54	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	06/22/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	0.05	mg/Kg	0.05	
		CHRYSENE	0.08	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	

REVIEWED BY: Richard O Reid
Dick Reid - Laboratory Director

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-BPA-P1-EW				
10954-001	PNAH 1	NAPHTHALENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	PHENANTHRENE	ND	mg/Kg	0.05	06/22/2001
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	89	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-BPA-P1-BTM				
10954-002	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/15/2001
		SURROGATE RECOVERY	56	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	06/22/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	70	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-BPA-P2-NW				
10954-003	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/15/2001
		SURROGATE RECOVERY	64	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	06/22/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-BPA-P2-NW				
10954-003	PNAH 1	NAPHTHALENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	PHENANTHRENE	ND	mg/Kg	0.05	06/22/2001
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	77	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-BPA-P2-EW				
10954-004	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	130	mg/Kg	100	06/15/2001
		SURROGATE RECOVERY	54	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	06/22/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	0.067	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	0.068	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	74	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-BPA-P2-WW				
10954-005	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/15/2001
		SURROGATE RECOVERY	61	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	06/22/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	0.06	mg/Kg	0.05	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-BPA-P2-WW				
10954-005	PNAH 1	NAPHTHALENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	PHENANTHRENE	ND	mg/Kg	0.05	06/22/2001
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	65	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-BPA-P2-BTM				
10954-006	NWTPH-Dx	DIESEL	48	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/15/2001
		SURROGATE RECOVERY	65	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	06/22/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	85	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-BPA-P3-WW				
10954-007	NWTPH-Dx	DIESEL	3020	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	650	mg/Kg	100	06/15/2001
		SURROGATE RECOVERY	78	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	06/22/2001
		ANTHRACENE	0.33	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	0.23	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	

CERTIFICATE OF ANALYSIS ORIGINAL

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-BPA-P3-WW				
10954-007	PNAH 1	NAPHTHALENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	PHENANTHRENE	0.09	mg/Kg	0.05	06/22/2001
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	71	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-BPA-P3-EW				
10954-008	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/15/2001
		SURROGATE RECOVERY	66	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	06/22/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	82	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-BPA-P3-SW				
10954-009	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/15/2001
		SURROGATE RECOVERY	86	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	06/22/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-BPA-P3-SW				
10954-009	PNAH 1	NAPHTHALENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	PHENANTHRENE	ND	mg/Kg	0.05	06/22/2001
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	60	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-BPA-P3-BTM				
10954-010	NWTPH-Dx	DIESEL	34	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/15/2001
		SURROGATE RECOVERY	94	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	06/22/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	52	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-BPA-P4-NW				
10954-011	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/15/2001
		SURROGATE RECOVERY	67	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	06/22/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-BPA-P4-NW				
10954-011	PNAH 1	NAPHTHALENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	PHENANTHRENE	ND	mg/Kg	0.05	06/22/2001
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	78	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-BPA-P4-WW				
10954-012	NWTPH-Dx	DIESEL	800	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/15/2001
		SURROGATE RECOVERY	OBSCURED	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	06/22/2001
		ANTHRACENE	0.061	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	0.164	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	67	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-BPA-P4-EW				
10954-013	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/15/2001
		SURROGATE RECOVERY	52	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	06/22/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-BPA-P4-EW				
10954-013	PNAH 1	NAPHTHALENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	PHENANTHRENE	ND	mg/Kg	0.05	06/22/2001
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	71	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-BPA-P4-BTM				
10954-014	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/15/2001
		SURROGATE RECOVERY	59	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	06/22/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	76	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-BPA-P5-NW				
10954-015	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/15/2001
		SURROGATE RECOVERY	66	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	06/22/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-BPA-P5-NW				
10954-015	PNAH 1	NAPHTHALENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	PHENANTHRENE	ND	mg/Kg	0.05	06/22/2001
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	80	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-BPA-P5-EW				
10954-016	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/15/2001
		SURROGATE RECOVERY	61	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	06/22/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	79	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-BPA-P5-WW				
10954-017	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/15/2001
		SURROGATE RECOVERY	103	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	06/22/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-BPA-P5-WW				
10954-017	PNAH 1	NAPHTHALENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	PHENANTHRENE	ND	mg/Kg	0.05	06/22/2001
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	56	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-BPA-P5-BTM				
10954-018	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	06/15/2001
		SURROGATE RECOVERY	62	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.05	Robert M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.05	06/22/2001
		ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.05	
		BENZO(A)PYRENE	ND	mg/Kg	0.05	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.05	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.05	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.05	
		CHRYSENE	ND	mg/Kg	0.05	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.05	
		FLUORANTHENE	ND	mg/Kg	0.05	
		FLUORENE	ND	mg/Kg	0.05	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.05	
		NAPHTHALENE	ND	mg/Kg	0.05	
		PHENANTHRENE	ND	mg/Kg	0.05	
		PYRENE	ND	mg/Kg	0.05	
		SURROGATE	75	%RECOVERY	50%-150%	

CERTIFICATE OF ANALYSIS

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DATE SUBMITTED: 07/18/2001

PROJECT NAME: GLENBROOK- RIDDLE: AOC-R-20 PROJECT NUMBER: JA036.15

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
11108-001	CS-BPA-P2-EW-A	07/17/2001	0815	Soil	Soil
11108-002	CS-BPA-P3-WW-A	07/17/2001	0820	Soil	Soil
11108-003	CS-BPA-P4-WW-A	07/17/2001	0833	Soil	Soil

REPORT DATE: 07/30/2001 REPORT NUMBER: 11108

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: CS-BPA-P2-EW-A				
11108-001	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	07/19/2001
		SURROGATE RECOVERY	64	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.06	mg/Kg	0.02	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	0.02	mg/Kg	0.02	07/27/2001
		ANTHRACENE	0.41	mg/Kg	0.02	
		BENZO(A)ANTHRACENE	0.15	mg/Kg	0.02	
		BENZO(A)PYRENE	0.26	mg/Kg	0.02	
		BENZO(B)FLUORANTHENE	0.18	mg/Kg	0.02	
		BENZO(GHI)PERYLENE	0.31	mg/Kg	0.02	
		BENZO(K)FLUORANTHENE	0.10	mg/Kg	0.02	
		CHRYSENE	0.15	mg/Kg	0.02	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.02	
		FLUORANTHENE	0.35	mg/Kg	0.02	
		FLUORENE	0.11	mg/Kg	0.02	
		INDENO(1,2,3-CD)PYRENE	0.09	mg/Kg	0.02	
		NAPHTHALENE	ND	mg/Kg	0.02	
		PHENANTHRENE	0.42	mg/Kg	0.02	
		PYRENE	0.34	mg/Kg	0.02	
		SURROGATE	89.5	%RECOVERY	50%-150%	
Soil		SAMPLE ID: CS-BPA-P3-WW-A				
11108-002	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	07/19/2001
		SURROGATE RECOVERY	66	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.02	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.02	07/27/2001
		ANTHRACENE	ND	mg/Kg	0.02	

REVIEWED BY: David Back
David Back - QA Manager

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
Soil		SAMPLE ID: C3-BPA-P3-WW-A				
11108-002	PNAH 1	BENZO(A)ANTHRACENE	ND	mg/Kg	0.02	Dave M
	EPA 8270M (SIM)	BENZO(A)PYRENE	ND	mg/Kg	0.02	07/27/2001
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.02	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.02	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.02	
		CHRYSENE	ND	mg/Kg	0.02	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.02	
		FLUORANTHENE	ND	mg/Kg	0.02	
		FLUORENE	ND	mg/Kg	0.02	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.02	
		NAPHTHALENE	ND	mg/Kg	0.02	
		PHENANTHRENE	ND	mg/Kg	0.02	
		PYRENE	ND	mg/Kg	0.02	
		SURROGATE	130	%RECOVERY	50%-150%	
Soil		SAMPLE ID: C3-BPA-P4-WW-A				
11108-003	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Abigail K
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	07/19/2001
		SURROGATE RECOVERY	64	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.02	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.02	07/27/2001
		ANTHRACENE	ND	mg/Kg	0.02	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.02	
		BENZO(A)PYRENE	ND	mg/Kg	0.02	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.02	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.02	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.02	
		CHRYSENE	ND	mg/Kg	0.02	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.02	
		FLUORANTHENE	ND	mg/Kg	0.02	
		FLUORENE	ND	mg/Kg	0.02	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.02	
		NAPHTHALENE	ND	mg/Kg	0.02	
		PHENANTHRENE	ND	mg/Kg	0.02	
		PYRENE	ND	mg/Kg	0.02	
		SURROGATE	117	%RECOVERY	50%-150%	

Appendix L

Confirmation Sampling Results
Shotting Water Tank (AOC-R-23)

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
Source Name:
Sampled At:

Date Reported: 09/07/00
Date Collected: 08/29/00
Time Collected: 13:05-13:25
Sampled By: TC Tomes/AME

COMINCO Ltd., Glenbrook Operation
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

JA036.15

Invoice#
3876

NWTPH-HCID

Matrix: Soil

URC Sample #:		200829-19	200829-20	200829-21	200829-22			
Sample ID:		AOC-23 A	AOC-23 B	AOC-23 C	AOC-23 D			
URC Sample#	Units	Results	Results	Results	Results	Method	Date Analyzed	Analyst
Hydrocarbon ID		Oils	Oils	Oils	ND	WTPH-HCID	09/01/00	BKO
% Surrogate Recovery	%	106.5	113.2	141.7	115.4		09/01/00	BKO
Oils	mg/kg	55.0	26.4	233		NWTPH-Dx	09/01/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected At Level Indicated

Approved By:

200829-19-22

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
Source Name:
Sampled At:

Date Reported: 09/29/00
Date Collected: 09/19/00
Time Collected: 8:00-8:15
Sampled By: David Katz

COMINCO Ltd., Glenbrook Operation
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

JA 036.15

Invoice# 4091

Polynuclear Aromatic Hydrocarbons

Matrix: Soil

URC Sample #: 200919-38
Sample ID: HA-1 Shudding

URC Sample#	Units	Results	Method	Date Analyzed	Analyst
Hydrocarbon ID		ND	NWTPH-HCID	09/25/00	BKO
% Surrogate Recovery	%	132.1		09/25/00	BKO
Confirmation	mg/kg		NWTPH-Dx	09/25/00	BKO
PAH's					
Acenaphthene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
enaphthylene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
nthracene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Benzo(a)anthracene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Benzo(a)pyrene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Benzo(b)fluoranthene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Benzo(ghi)perylene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Benzo(k)fluoranthene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Chrysene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Dibenzo(ah)anthracene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Fluoranthene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Fluorene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Indeno(1,2,3-cd)pyrene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Naphthalene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Phenanthrene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Pyrene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected At Level Indicated

Approved By:

200919-38

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
Source Name:
Sampled At:

Date Reported: 09/29/00
Date Collected: 09/19/00
Time Collected: 8:00-8:15
Sampled By: David Katz

COMINCO Ltd., Glenbrook Operation
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

JA 036.15

Invoice# 4091

Polynuclear Aromatic Hydrocarbons — Matrix: Soil

URC Sample #: 200919-39
Sample ID: DA-2 Shudding

URC Sample#	Units	Results	Method	Date Analyzed	Analyst
Hydrocarbon ID		ND	NWTPH-HCID	09/25/00	BKO
% Surrogate Recovery	%	95.2		09/25/00	BKO
Confirmation	mg/kg		NWTPH-Dx	09/25/00	BKO
PAH's					
Acenaphthene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
enaphthylene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Anthracene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Benzo(a)anthracene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Benzo(a)pyrene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Benzo(b)fluoranthene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Benzo(ghi)perylene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Benzo(k)fluoranthene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Chrysene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Dibenzo(ah)anthracene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Fluoranthene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Fluorene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Indeno(1,2,3-cd)pyrene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Naphthalene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Phenanthrene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Pyrene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected At Level Indicated

Approved By:

200919-39

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
Source Name:
Sampled At:

Date Reported: 09/29/00
Date Collected: 09/19/00
Time Collected: 8:00-8:15
Sampled By: David Katz

COMINCO Ltd., Glenbrook Operation
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

JA 036.15

Invoice# 4091

Polynuclear Aromatic Hydrocarbons — Matrix: Soil

URC Sample #:	200919-40
Sample ID:	HA-3 Shudding

URC Sample#	Units	Results	Method	Date Analyzed	Analyst
Hydrocarbon ID		Oils	NWTPH-HCID	09/25/00	BKO
% Surrogate Recovery	%	148.4		09/25/00	BKO
Confirmation	mg/kg	32.3	NWTPH-Dx	09/25/00	BKO
PAH's					
Acenaphthene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
enaphthylene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Anthracene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Benzo(a)anthracene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Benzo(a)pyrene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Benzo(b)fluoranthene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Benzo(ghi)perylene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Benzo(k)fluoranthene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Chrysene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Dibenzo(ah)anthracene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Fluoranthene.	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Fluorene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Indeno(1,2,3-cd)pyrene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Naphthalene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Phenanthrene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO
Pyrene	mg/kg	ND@1.0	EPA 8270	09/26/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected At Level Indicated

Approved By:

200919-40

Appendix M

Confirmation Sampling Results
Lower Ore Body

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 09/07/00
Date Collected: 08/29/00
Time Collected: 10:10 AM
Sampled By: TC Tomes/AME

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation P.O. Box 85 5093 Riddle By-pass Road Riddle, OR 97469	JA036.15 Invoice# 3876

NWTPH-HCID — Matrix: Soil

URC Sample #: 200829-27
Sample ID: COMP A

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Oils			09/05/00	BKO
% Surrogate Recovery		113.6	%		09/05/00	BKO
Oils	NWTPH-Dx	312	mg/kg		09/05/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200829-27

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 09/07/00
Date Collected: 08/29/00
Time Collected: 10:15 AM
Sampled By: TC Tomes/AME

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation P.O. Box 85 5093 Riddle By-pass Road Riddle, OR 97469	JA036.15 Invoice# 3876

NWTPH-HCID — Matrix: Soil

URC Sample #: 200829-28
Sample ID: COMP B

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Diesel & Oils			09/05/00	BKO
% Surrogate Recovery		113.3	%		09/05/00	BKO
Diesel & Oil	NWTPH-Dx	616	mg/kg		09/05/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200829-28

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 09/07/00
Date Collected: 08/29/00
Time Collected: 10:25 AM
Sampled By: TC Tomes/AME

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation P.O. Box 85 5093 Riddle By-pass Road Riddle, OR 97469	JA036.15 Invoice# 3876

NWTPH-HCID — Matrix: Soil

URC Sample #: 200829-29
Sample ID: COMP C

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Heavy Oils			09/05/00	BKO
% Surrogate Recovery		72.9	%		09/05/00	BKO
Heavy Oils	NWTPH-Dx	20.2	mg/kg		09/05/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200829-29

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

OREGON STATE CERTIFIED LAB #015
PWS#:
PWS Name:
Sampled At:

Date Reported: 09/07/00
Date Collected: 08/29/00
Time Collected: 10:30 AM
Sampled By: TC Tomes/AME

Mailing Address for Report	Sample Information
COMINCO Ltd., Glenbrook Operation P.O. Box 85 5093 Riddle By-pass Road Riddle, OR 97469	JA036.15 Invoice# 3876

NWTPH-HCID — Matrix: Soil

URC Sample #: 200829-30
Sample ID: COMP D

Analyte	Method	Results	Units	MCL	Date Analyzed	Analyst
Hydrocarbon ID	NWTPH-HCID	Oils			09/05/00	BKO
% Surrogate Recovery		67.5	%		09/05/00	BKO
Oils	NWTPH-Dx	43.5	mg/kg		09/05/00	BKO

MCL = Maximum Contaminant Level
ND = None Detected

Approved By:

200829-30

UMPQUA Research Company
P.O. Box 609 - 626 Division Street
Myrtle Creek, OR 97457
(541) 863-5201 Fax: (541) 863-6199

REPORT

FAXED 9/20/00

OREGON STATE CERTIFIED LAB #015
PWS#:
Source Name:
Sampled At:

Date Reported: 09/20/00
Date Collected: 09/13/00
Time Collected: 13:10-14:00
Sampled By: Darrell

COMINCO Ltd., Glenbrook Operation
P.O. Box 85
5093 Riddle By-pass Road
Riddle, OR 97469

Oregon Nickel Lower Ore Body

Invoice#
4024

NWTPH-HCID

Matrix: Soil

URC Sample #:		200913-32	200913-33	200913-34	200913-35			
Sample ID:		Lower Ore Body	B-2 LOB	A-1 LOB	A-2 LOB			
URC Sample#	Units	Results	Results	Results	Results	Method	Date Analyzed	Analyst
Hydrocarbon ID		ND	ND	ND	ND	WTPH-HCID	09/20/00	BEM
% Surrogate Recovery	%	82.7	92.4	83.1	86.6			

MCL = Maximum Contaminant Level
ND = None Detected At Level Indicated

Approved By:

200913-32-35

Appendix N

Confirmation Sampling Results
Baghouse AST Area

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
GS-1 2.0-2.5						
02046-001	NWTPH-Dx	DIESEL	33	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/31/2000
		SURROGATE RECOVERY	116	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/30/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	97	%RECOVERY	50-150	
GS-2 2.0-2.5						
02046-002	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/31/2000
		SURROGATE RECOVERY	121	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005 -	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/28/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.009	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	104	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
GS-3 2.0-2.5						
02046-003	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/31/2000
		SURROGATE RECOVERY	121	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	0.007	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/28/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	0.013	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	0.012	mg/Kg	0.005	
		PHENANTHRENE	0.023	mg/Kg	0.005	
		PYRENE	0.006	mg/Kg	0.005	
		SURROGATE	98	%RECOVERY	50-150	
GS-4 2.0-2.5						
02046-004	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/31/2000
		SURROGATE RECOVERY	141	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/28/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	104	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
GS-5 2.0-2.5						
02046-005	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/31/2000
		SURROGATE RECOVERY	122	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/28/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	93	%RECOVERY	50-150	
GS-6 1.5-2.0						
02046-006	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/31/2000
		SURROGATE RECOVERY	124	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/28/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	96	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
GS-7 1.5-2.0						
02046-007	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/31/2000
		SURROGATE RECOVERY	116	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/30/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	110	%RECOVERY	50-150	
GS-8 1.5-2.0						
02046-008	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/31/2000
		SURROGATE RECOVERY	127	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/30/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	112	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
GS-9 1.5-2.0						
02046-009	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/31/2000
		SURROGATE RECOVERY	111	%RECOVERY	50%-150%	
	PNAH 1	ACENAPETHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/07/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	0.006	mg/Kg	0.005	
		BENZO(A)PYRENE	0.008	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	0.007	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	0.006	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.007	mg/Kg	0.005	
		CHRYSENE	0.007	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.008	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	0.005	mg/Kg	0.005	
		PYRENE	0.008	mg/Kg	0.005	
		SURROGATE	119	%RECOVERY	50-150	
GS-10 1.5-2.0						
02046-010	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	10/31/2000
		SURROGATE RECOVERY	135	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	10/30/2000
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	0.006	mg/Kg	0.005	
		CHRYSENE	0.007	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	0.008	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	ND	mg/Kg	0.005	
		PHENANTHRENE	ND	mg/Kg	0.005	
		PYRENE	0.005	mg/Kg	0.005	
		SURROGATE	109	%RECOVERY	50-150	

CERTIFICATE OF ANALYSIS

CLIENT: GLENBROOK NICKEL - ~~COOS BAY~~ Riddle OR
PO BOX 85
RIDDLE OR 97469

PHONE: (541) 874-3171
FAX: (541) 874-3380

DATE SUBMITTED: 11/16/20

PROJECT NAME: BAGHOUSE MAINTANENCE AREA PROJECT NUMBER: JA036.15

CI SAMPLE	CLIENTS ID#	DATE	TIME	MATRIX	DESCRIPTION
02139-001	GS-11 @ 4.0'	11/15/2000	1125	Soil	SOIL SAMPLE

REPORT DATE: 11/21/2000 REPORT NUMBER: 02139 PAGE: 1 OF 1

SAMPLE	ANALYSIS	PARAMETER	RESULTS	UNITS	DETECTION LIMIT	ANALYST
SOIL SAMPLE		SAMPLE ID: GS-11 @ 4.0'				
02139-001	NWTPH-Dx	DIESEL	ND	mg/Kg	25	Jeremy B
	NWTPH-Dx	HEAVY OILS	ND	mg/Kg	100	11/21/2000
		SURROGATE RECOVERY	68	%RECOVERY	50%-150%	
	PNAH 1	ACENAPHTHENE	ND	mg/Kg	0.005	Dave M
	EPA 8270M (SIM)	ACENAPHTHYLENE	ND	mg/Kg	0.005	11/17/1900
		ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)ANTHRACENE	ND	mg/Kg	0.005	
		BENZO(A)PYRENE	ND	mg/Kg	0.005	
		BENZO(B)FLUORANTHENE	ND	mg/Kg	0.005	
		BENZO(GHI)PERYLENE	ND	mg/Kg	0.005	
		BENZO(K)FLUORANTHENE	ND	mg/Kg	0.005	
		CHRYSENE	ND	mg/Kg	0.005	
		DIBENZO(AH)ANTHRACENE	ND	mg/Kg	0.005	
		FLUORANTHENE	ND	mg/Kg	0.005	
		FLUORENE	ND	mg/Kg	0.005	
		INDENO(1,2,3-CD)PYRENE	ND	mg/Kg	0.005	
		NAPHTHALENE	0.012	mg/Kg	0.005	
		PHENANTHRENE	0.010	mg/Kg	0.005	
		PYRENE	ND	mg/Kg	0.005	
		SURROGATE	80	%RECOVERY	50-150	

REVIEWED BY: _____
Martin Little - Quality Manager

Appendix O

BPA Substation NFA

Oregon
John A. Kitzhaber, M.D., Governor

Department of Environmental Quality
Western Region Eugene Office
1102 Lincoln Street, Suite 210
Eugene, OR 97401
(541) 686-7838
FAX (541) 686-7551
TTY (541) 687-5603

October 3, 2001

Mr. Greg Schoen
Glenbrook Nickel Company
C/o John Schultz, Esq.
Aler Wynne LLP
222 SW Columbia, Suite 1800
Portland, OR 97201

Subject: No Further Action Required - PCB Removal
Former Electric Substation, Glenbrook Nickel Riddle Facility
Riddle, Oregon

Dear Mr. Schoen:

The Oregon Department of Environmental Quality (DEQ) has reviewed information provided by the Glenbrook Nickel Company (Glenbrook) regarding the investigation and cleanup of PCB containing soil at a former electrical substation at the Glenbrook Riddle Facility ("the site"). This information included a *Report of PCB Removal Action* dated April 25, 2001 prepared by August Mack Environmental, Inc. (August Mack). The report described a removal action conducted at the site to address soil containing polychlorinated biphenyls (PCBs). Soil containing PCBs at concentrations exceeding 1 milligram per kilogram (mg/kg), the current Oregon acceptable level for residential site use, were removed and disposed of off-site at the Chemical Waste Management landfill facility in Arlington, Oregon.

The DEQ transmitted a letter dated May 14, 2001 to you listing our comments and identifying data gaps in the *Report of PCB Removal Action.* August Mack provided a response to our comments and data to fill identified gaps in a letter dated June 7, 2001. The June 7 letter adequately responded to our comments and filled identified data gaps.

In August 2001, the DEQ prepared a Staff Report on the PCB removal and recommended that no further action be required. A notice of this recommendation was published in the Secretary of State's Bulletin and posted in the Riddle library. A 30-day comment period was held from September 1, to October 1, 2001 to allow an opportunity for interested members of the public to comment on the proposed recommendation. No comments were received.

Therefore, the DEQ has determined that the PCB removal at the former substation is complete and no further action to address PCBs in soil at the substation is required under ORS 465.200, *et.seq*. DEQ reserves the right to alter this determination if new information becomes available justifying further investigation.

If you have any questions, please call Amanda Spencer at 541-686-7838 ext. 271.

Sincerely,

Michael McCann, P.E.
Acting Manager, Western Region Cleanup Program

Cc: Amanda Spencer, WR-DEQ
Doug Linebach, August Mack
John Schultz, Ater Wynne

Site Summary Report

Prepared by Oregon DEQ

December 2002

Site Summary Report
Glenbrook Nickel Facility
Riddle, Oregon

ECSI No. 2898

Prepared By

Oregon Department of Environmental Quality
Western Region Cleanup Program

December 2002
(revised March 13, 2003 for public comment reopening. see section V)

Site Summary Report
Glenbrook Nickel Facility
Riddle, Oregon
ECSI No. 2898

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Attachments - Figures 1, 1B, 1C, 2, 2A

Site Summary Report
Glenbrook Nickel Facility
Riddle, Oregon
ECSI No. 2898

I. Purpose

This document presents a summary of the environmental investigations and cleanup that occurred from April 2000 through October 2002 at the Glenbrook Nickel Company (Glenbrook) facility located at 5093 Riddle By-Pass Road, Riddle, Oregon (See attached Figures 1, 1B and 1C). The purpose of this Site Summary Report (SSR) is to document the Oregon Department of Environmental Quality's (DEQ's) recommendation for no further action (NFA) at the site.

The following processes are not considered in this NFA recommendation:

Former electrical substation. Glenbrook originally entered the Voluntary Cleanup Program (VCP) on December, 1st, 2000 in order to obtain a no further action determination from DEQ for the removal of PCB-containing soil at the two capacitor banks in the northwest corner of the former substation. On October 3, 2001 DEQ issued a no further action determination for this area of the former substation. The SSR and project files prepared for this removal action already provide the details on this no further action recommendation.

Areas of concern (AOCs) outside of the Glenbrook facility boundaries. AOC 15, 16, 17, 18, 19, and the Lower Ore Body (Reference Figures 2 and 2A) are not within the site boundaries, and are therefore not being considered for the no further action recommendation.

Storm water discharge from ore piles. The storm and process water discharge at the Glenbrook facility has historically been regulated under DEQ's Water Quality Program. When the Glenbrook facility was operating, storm and process water discharged to creeks down-gradient of the facility was permitted under the DEQ NPDES water quality program and routinely sampled in accordance with the facility's permit. Historical sampling results indicate that sampled parameters were consistently within the NPDES discharge limits. When the southwestern portion of the facility was

sold in January 2000 to Arden Development, Inc., the remaining portion of the Glenbrook facility was separated from the NPDES permit (permit transferred to the new owner, Arden). Storm water runoff at the Glenbrook facility now discharges to an unnamed tributary (no fish habitat) approximately 900-1000 feet east of the smelter operating area, which ultimately reaches Cow Creek. Cow Creek is located about one-mile to the south (See attached figures 1 and 1B). Currently there are ore piles (New Caledonia and fine grained remnants) on the Glenbrook facility. The piles contain nickel that would not present a human health risk, or an ecological risk if storm water runoff does not carry nickel containing sediment into a drainage system that could reach Cow Creek (or any other creek with aquatic habitat). DEQ and Glenbrook determined in August 2002 that a mechanism to monitor storm water run-off from these piles and verify no impact from nickel should be in place. Glenbrook (through its affiliated company, Teck Cominco Inc.) applied for a 1200-Z Storm Water General Permit Application in October 2002. The 1200-Z storm water permit was issued on November 14, 2002. Since 1200-Z permits do not monitor for nickel, the Storm Water Pollution Control Plan will be enhanced for this pupose. This plan will be submitted to DEQ Water Quality by February 2003. Monitoring and reporting under the new permit will be conducted by Glenbrook or the potential purchaser.

II. Introduction

The facility was operated by Hanna Nickel Smelting Company as a nickel mine and smelter for approximately 40 years, beginning in the late 1940s. Glenbrook purchased the facility in 1989 from Nickel Mountain Resources, a salvage company. Glenbrook operated the smelter intermittently from 1991 to 1998. The smelting operations at the facility consisted of a large smelter building, various office buildings, laboratory, maintenance and storage facilities, and associated structures including dryers, storage silos, and an electrical substation. Hanna mining operations took place at the top of Nickel Mountain, at elevations of approximately 3,000 feet (National Geodetic Vertical Datum of 1929 (NGVD)), on land leased from private landowners. Glenbrook's limited mining operation took place below the top of the mountain at a location known as the "lower ore body" at an elevation of approximately 2,000 feet NGVD on leased land from private land owners. The Glenbrook facility is now owned by Teck Cominco Metals, but this document will continue to refer to the facility as Glenbrook. In January 2000, a portion of the Glenbrook facility was sold and purchased by Arden Development, Inc. The remaining portion of the Glenbrook facility, which is the subject of this SSR, is outlined in black on Figures 1 and 1B attached.

III. Site History and Background

The Glenbrook facility is surrounded by undeveloped or agricultural land; the city of Riddle is located approximately one mile to the east. Riddle By-Pass Road is located approximately one

mile south of the primary smelter operations area. The facility lies on the southeastern flank of Nickel Mountain and has some steep slopes. Groundwater is estimated to be at a depth greater than 28 feet below grade based on a groundwater well at the facility. The well is located approximately 3400 feet southeast of the smelter operation area at an elevation approximately 130 feet lower. The closest surface water body is an unnamed tributary to Cow Creek located approximately 900-1000 feet east of the smelter operating area. Cow Creek is located about one mile to the south. The Glenbrook features are illustrated in Figures 1, 1B, and 2A attached.

The property was undeveloped prior to its use as a nickel smelter. The smelter operations were constructed in 1950. Nickel smelting operations ceased in March of 1998, and current activities at the facility primarily consist of demolition and/or sale of equipment and facilities. Glenbrook conducted the environmental investigations and cleanup for sale of the property.

The primary smelter operation area covers approximately 40 acres of the 528 facility acres and is located in the northeastern portion of the facility. The smelter operation area is on a generally flat portion of the facility. The smelting operations were approximately two miles south-southeast of the upper mine at approximately 1,200 feet (NGVD). A tramway was once used to transport ore from the upper mine down to the smelter. Power for the smelter was provided by a former on-site Bonneville Power Administration (BPA) substation, located just south of the smelter building. Four above-ground fuel-oil storage tanks and a vehicle fueling station were located west of the smelter building. A rail spur ran along the northern edge of the smelter building and storage tanks. Dryers, the ferro-silicon bag house, and several storage silos were located to the north, across the rail spur. Office and laboratory buildings were located east of the smelter building. The primary smelter operation area is illustrated in Figure 2.

IV. Investigation and Remediation Summary

Environmental investigations and cleanup occurred from April 2000 through October 2002. The environmental investigation data was presented in the following three reports: August Mack, 2000, *Report of Confirmation Sampling, Riddle and Coos Bay Facilities*, August; Linebach FunkHouser, Inc., 2002, *Report of Remedial Actions Eleven Areas of Concern Glenbrook Nickel Facility, Riddle Oregon*, June 18; and Linebach FunkHouser, Inc., 2002, *Updates to the Report of Remedial Actions Eleven Areas of Concern Glenbrook Nickel Facility, Riddle Oregon*, October 23. Over the course of these investigations and cleanup, 29 potential areas of concern (AOCs) were identified. The initial preliminary assessment identified 23 of these AOCs. The remaining 6 were identified during the investigation at the 23 initial AOCs. The 23 AOCs were primarily located in the smelter operation area at the Glenbrook facility. The primary smelter operation area is illustrated in Figure 2. Table 1 below summarizes the initial 23 potential AOCs:

Table 1: Initial 23 Potential Areas of Concern

Number	AOC	Description	Chemicals of Concern
1	Sand Blast Area	Sand blast cleaning of equipment and parts	Lead
2	Lab Drain Line Discharge Point	Discharge point of drain line from sinks and drains in the laboratory	VOCs PAHs Metals
3	Former Sand Blast Area	Former area used for sand blasting (same as #1 above)	Lead
4	Sanitary Sand Filter Beds	Sand filter beds that received sanitary waste from the site's septic tanks	VOCs PAHs Metals
5	Granulation Ladle Tilt Station Hydraulic System	Hydraulic fluid used in the operation of the Granulation Ladle	PAHs
6	Lube Oil Storage Shed	Drum storage of lube oils and greases in shed and one outside AST for used oil storage	TPH PCB VOCs PAHs Metals
7	Ferrro Silicon Bag House	Air emission control equipment	Lead
8	Calciner Lube Oil	Lube oils used in the operation of the calciners	PAHs
9	#3 Dryer	Lube oils used in the operation of the dryer	PAHs
10	Diesel Fueling Station and Line Area	Fueling station and product distribution lines under the roadway	TPH PAHs
11	AST Area	Diesel fuel and bunker-C ASTs	TPH PAHs
12	Pilot Plant Fuel Oil Tank	Fuel oil AST	TPH PAHs
13	Vehicle Maintenance and Washdown Area	Concrete pad, sump, and drains used for Washing and Equipment Maintenance	VOCs PAHs Metals
14	Generator Shed	Small shed housing generators/motors behind skull plant	TPH PAHs

15	USTs at Mine Site*	3,000 gallon gasoline and 10,000 gallon used oil USTs at mine site (top of mountain)	TPH PAHs BTEX PCB
16	Near Creek above Smelter Building*	Creek running down mountain.	Metals
17	Below Two Middle Ponds*	Part of the NPDES for the facility.	Metals
18	Below Lower Pond*	Part of the NPDES for the facility.	Metals
19	Below AST Area*	Area down-gradient from Diesel fuel and Bunker-C ASTs.	TPH PAHs Metals
20	BPA Substation	Equipment Pads	TPH PCB 1,1,1-TCA
21	Below New Caledonia Ore Pile	Area downgradient from New Caledonia Ore Pile	Metals
22	New Caledonia Ore Pile	Stockpile of New Caledonia Ore northwest of smelter building.	Metals
23	Shotting Water Tank	Location of former water storage tank, added as AOC	TPH PAHs VOCs

Notes:

AST - Aboveground Storage Tank
BTEX – Benzene, Toluene, Ethylbenzene, Xylene
NPDES – National Pollutant Discharge Elimination System
PAH - Polynuclear Aromatic Hydrocarbon
PCB - Polychlorinated Biphenyls
TPH - Total Petroleum Hydrocarbons
UST - Underground Storage Tank
VOC –Volatile Organic Compound

*AOC not within the Glenbrook facility property boundaries.

Sampling at the the initial 23 potential AOCs was conducted at the facility on April 26-28, 2000. Sampling activities included soil sampling from geoprobe borings and test pits.

Based on the sampling and analysis, 9 of the 23 AOC were identified as warranting further action due to TPH (diesel and oil-related constituents), PAHs and/or metals in the soil. No

VOCs were detected warranting further investigation. All 9 were within the property boundaries.

- Sanitary Sand Filter Beds (AOC-4)
- Granulation Ladle Tilt Station Hydraulic System (AOC-5)
- Lube Oil Storage Area (AOC-6)
- Calciner Lube Oil Area (AOC-8)
- Diesel Fueling Station and Fuel Line Area (AOC-10)
- Pilot Plant Fuel Oil AST (AOC-12)
- Vehicle Maintenance and Washdown Area (AOC-13)
- BPA Substation Equipment Pads (AOC-20)
- Shotting Water Tank (AOC-23)

The Glenbrook selected cleanup goals and levels were as follows:

Constituent	Cleanup Level/Goals
Polynuclear Aromatic Hydrocarbons	OAR 340-122-045 Appendix 1 Industrial
Determined Background Concentrations for Arsenic	24.87 ppm OAR 340-122-045(5)
Diesel - Glenbrook Soil Matrix Calculation	100/1,000 mg/kg**
Oil - Glenbrook Soil Matrix Calculation	100/1,000 mg/kg**
Lead	OAR 340-122-045 Appendix 1 Residential

**100 mg/kg is Glenbrook's self-imposed level 1 cleanup goal. 1000 mg/kg is the level 3 cleanup goal.The actual soil matrix cleanup goal that applies to the Glenbrook facility is 1000 mg/kg. 1000 mg/kg was used when excavation was not feasible.

Two additional AOC were identified during the sampling events for the above mentioned 23 AOC. They were addressed with the 9 aforementioned AOCs, and are identified in Table 2 below:

Table 2: Two Additional AOC

Number	AOC	Description	Chemicals of Concern
--	Lower Ore Body*	A Former Diesel AST	TPH PAHs
--	Baghouse AST Area	A former Fuel AST	TPH PAHs

Notes:

AST - Aboveground Storage Tank
PAH - Polynuclear Aromatic Hydrocarbon

TPH - Total Petroleum Hydrocarbons

*AOC not within the Glenbrook facility property boundaries.

Based on the constituents identified at the 11 AOC and the limited extent of those constituents detected during the confirmation sampling, the remedial actions consisted of soil excavation and off-site disposal. The soil excavation and disposal activities primarily occurred between August 2000 and September 2001. A total of approximately 39,040 cubic yards of impacted soil was removed from the 11 AOCs and disposed of at Valley Landfills in Corvallis, Oregon. Soil contaminants consisted of either petroleum-related compounds or arsenic. Soil excavation depths ranged from 1 foot to approximately 25 feet. No water was encountered in the excavations. Following removal of impacted soil, approximately 434 confirmation soil samples were collected for laboratory analysis. Analytical methods included; PAH by EPA Method 8270M, TPH-DRO by Method NWTPH-Dx, and arsenic by EPA Method 6010B. Following the receipt of the analytical results and confirmation that the applicable cleanup goals were achieved, the excavations were backfilled with crushed quartz road aggregate from an off-site quarry and covered with overburden soil from the facility.

A description of the soil excavation, disposal, and cleanup confirmation sampling for each of the eleven AOC follows:

Sanitary Sand Filter Beds (AOC-4)
The April 2000 sampling results indicated elevated levels of arsenic in the soil in the two Sanitary Sand Filter Beds. This area was sampled because the sand filter beds had the potential to receive chemicals inadvertently discharged to the sanitary system. The sand filter material and approximately two feet of adjacent soil on the walls and bottom was excavated from each bed. A total of 24 samples collected from the walls and bottom of the beds confirmed removal of the arsenic-impacted material that exceeded the site-specific naturally occurring background level of 24.87 ppm for arsenic.

Granulation Ladle Tilt Station Hydraulic System (AOC-5)
The April 2000 sampling results indicated elevated levels of PAH constituents at one of the four Granulation Ladle Tilt Station Hydraulic System units (unit #4). Hydraulic fluid used in the unit had been released to the underlying soil. An area of visually impacted soil, approximately 12 feet x 12 feet and 2 feet deep, was excavated at the base of unit #4. Sampling from the bottom of the excavation confirmed removal of the PAH-impacted soil that exceeded DEQ numeric soil cleanup levels for PAHs. Results for PAHs were all <0.10 mg/kg. One mg/kg is the lowest industrial level for PAHs.

Lube Oil Storage Area (AOC-6)
The April 2000 sampling results indicated elevated levels of TPH constituents (oil) in soil around the used-oil AST on the east side of the Lube Oil Storage Area. These elevated levels were probably due to minor spills and overfilling. An area of visually impacted soil, approximately 12 feet x 16 feet and 1.5 feet deep, was excavated. Two confirmation soil samples (AOC-6A and AOC-6B) were collected on August 30, 2000. Both samples were analyzed for TPH constituents. Results for one sample (AOC-6A) indicated TPH concentrations of 1,250 ppm. The other sample (AOC-6B) was non-detect for TPH. Additional soil was excavated and two additional samples (HA-1 AOC-R-6 and HA-2 AOC-R-6) were collected on September 19, 2000 and analyzed for TPH and PAH. Results for the second round of sampling confirmed removal of the impacted soil that exceeded DEQ numeric soil cleanup levels for PAH. Results for PAH were all <0.10 mg/kg. One mg/kg is the lowest industrial level for PAHs. TPH was non-detect.

Calciner Lube Oil Area (AOC-8)
The April 2000 sampling results indicated elevated levels of PAH and TPH constituents around one of the four Calciner Lube Oil Areas (pillars). These elevated levels were probably due to minor leakage and spills. An area of visually impacted soil, covering a radius of approximately 6 feet around the pillar and extending to a depth of approximately 4 feet was excavated. Results from the sampling confirmed removal of the impacted soil that exceeded Glenbrook soil matrix cleanup levels of TPH and the DEQ numeric soil cleanup levels for PAHs. Except for one sample, results for TPH were all less than Glenbrook's self-imposed soil matrix cleanup goal of 100 mg/kg. The one sample that exceeded was at 149 mg/kg for heavy oil. Due to the excavation limitations in this area, the 1000 mg/kg soil matrix goal was applied. Results for PAHs were all <0.10 mg/kg. One mg/kg is the lowest industrial level for PAHs.

Diesel Fueling Station and Fuel Line Area (AOC-10)
The April 2000 sampling results indicated elevated levels of TPH (heavy oil) and PAH constituents in the soil around the Diesel Fueling Station and along the Fuel Line Area. Leaks, spills, and overfilling of diesel fuel from the tanks, transfer station, and underground transfer lines had occurred through the operating years of the facility. Excavation began in the diesel fueling station area and continued north to the railroad tracks. The excavation activities extended along the south and north sides of the railroad tracks west and south to the Arden Development, Inc. property line, and east to the smelter building. The excavation extended to depths of 25 feet in some areas. No groundwater was encountered. Sixteen rounds of excavation and sampling occurred between September 2000 and September 2001, and a total of 334 soil samples were collected from the bottom and side walls of the excavation. The final round of samples in September 2001 confirmed removal of the impacted soil that exceeded Glenbrook's soil matrix cleanup levels for TPH and the DEQ numeric soil cleanup levels for PAHs. Results for heavy oil were all less than the self-imposed limit of 100 mg/kg. Except for two of the 15 samples, the 100 mg/kg soil matrix cleanup level was met for diesel. Two samples were at 171 mg/kg and 185

mg/kg. The 1000 mg/kg soil matrix goal, which is the actual soil matrix cleanup level, was applied to these 2 samples. Results for PAHs were all <1 mg/kg. One mg/kg is the lowest industrial level for PAHs.

Geoprobe Assessment Beneath Rail Line

Impacted soil was removed along the north and south sides of the railroad tracks from the western property boundary to the smelter building. Soil beneath the tracks was also impacted by the diesel constituents, but could not be removed due to the risk of compromising the integrity of the rail line.

To identify the vertical extent of impacted soil beneath the tracks and to confirm levels of diesel in the soil, geoprobe borings were advanced along the rail line and soil samples were collected. The
vertical extent soil sampling activities were conducted during March of 2001 and included the following:

- Thirteen soil borings were advanced along the rail line using geoprobe equipment. The borings were located between the railroad ties and extended to a depth of 20 feet.

- Soil samples were collected from each boring at the two to four foot interval to identify the general concentrations of diesel in the soil. *Based on sampling and excavation that had occurred along the tracks, it was anticipated that the most significantly impacted soil would likely be in the upper few feet beneath the tracks.*

- Each two-foot interval below ten feet was screened in the field for organic vapors. Based on the field screening results, samples were collected from soil that was anticipated to be below the vertical extent of the diesel-impacted soil.

- The samples were analyzed for TPH and PAH.

- No ground water was impacted.

Results of the geoprobe assessment confirmed that petroleum-impacted soil beneath the tracks met the Glenbrook soil matrix cleanup levels for TPH and DEQ numeric cleanlup levels for PAH constituents. Heavy oil and diesel samples were less than 100 mg/kg. Results for PAHs were all <1 mg/kg. One mg/kg is the lowest industrial level for PAHs.

Pilot Plant Fuel Oil AST (AOC-12)
The April 2000 sampling results indicated elevated levels of TPH and PAH constituents in soil beneath the former Pilot Plant Fuel Oil AST. Contamination was due to previous leaks and spills. Soil from an area approximately 33 feet x 24 feet and 3 feet deep beneath the AST was excavated. Samples collected from the excavation confirmed removal of the impacted soil that exceeded Glenbrook soil matrix cleanup levels for TPH (heavy oil) and the DEQ numeric soil cleanup levels for PAHs. Results for heavy oil were less than 100 mg/kg. No diesel was detected. Results for PAHs were all <0.1 mg/kg. One mg/kg is the lowest industrial level for PAHs.

Vehicle Maintenance and Washdown Area (AOC-13)
The April 2000 sampling results indicated elevated levels of arsenic in the soil around the Vehicle Maintenance and Washdown Area. Later, during excavation and confirmation sampling for the arsenic impacted soil, elevated levels of PAH and TPH constituents were also identified. The area was used for washing and maintenance of facility equipment, resulting in the release of oils, grease and detergents to the sump, drains, and surrounding soil. A concrete basin and surrounding soil, an area approximately 28 feet x 47 feet and 4 feet deep, was excavated. Four rounds of excavation and sampling were conducted and a total of 40 soil samples were collected for TPH, PAH, and arsenic. The final round of excavation and sampling confirmed removal of the impacted soil that exceeded the site-specific naturally occurring background levels of 24.87 ppm for arsenic, Glenbrook soil matrix cleanup levels for TPH and DEQ numeric soil cleanup levels for PAH constituents. Results for arsenic were all <.5 mg/kg. Results for diesel were <25 mg/kg. Results for heavy oil were predominantly <100 mg/kg. 4 of the 27 samples for heavy oil were greater than 100 mg/kg but considerable less than 1000 mg/kg. Results for PAHs were all considerably lower than 1.0 mg/kg. One mg/kg is the lowest industrial level for PAHs.

BPA Substation (AOC-20)***
Due to minor leakage from electrical equipment, elevated levels of TPH constituents were detected around some of the equipment pads in the former BPA Substation based on results of the June 2000 sampling. Two rounds of excavation and sampling were conducted and a total of 21 samples were collected, confirming removal of the impacted soil that exceeded the Glenbrook cleanup levels for TPH and DEQ numeric soil cleanup levels for PAH constituents. Results for TPH were <100 mg/kg. Results for PAHs were all considerably lower than 1.0 mg/kg. One mg/kg is the lowest industrial level for PAHs.

***Note: As indicated in Section I, PCBs were addressed in October 2001.

Shotting Water Tank (AOC-23)
Elevated levels of TPH (heavy oil) and PAH constituents were identified in soil beneath the Shotting Water Tank during the initial sampling activities in April 2000. A release of diesel fuel, possibly from a truck transferring water to or from the tank, resulted in the impacted soil. Soil

beneath the former AST, an area approximately 26 feet x 26 feet and 3 feet deep was excavated. Two rounds of excavation and sampling were conducted and a total of seven samples were collected, confirming removal of the impacted soil that exceeded the Glenbrook soil matrix cleanup levels for TPH and DEQ numeric soil cleanup levels for PAH constituents. The first round of excavation samples were tested for TPH. Two samples of heavy oil were <100 mg/kg. One sample was 233 mg/kg for heavy oil. No diesel was detected. The second round of excavation samples were tested for TPH and PAH. Results for heavy oil were 32.3 mg/kg. Results for PAHs were all <1 mg/kg. One mg/kg is the lowest industrial level for PAHs.

Lower Ore Body (Not within property boundaries)****

A former fueling area (one diesel AST) at the Lower Ore Body (located approximately one mile north of the smelter facility at an approximate elevation of 2000 feet NGVD) was identified as an additional potential area of concern based on visual observations made during remedial activities at the previously identified AOCs. The approximate location of the Lower Ore Body is illustrated in Figure 2A. Minor leaks or spills through the years of operation likely resulted in the impacted soil around the former fueling area. Two rounds of excavation and sampling were conducted and a total of eight samples were collected, confirming removal of the impacted soil that exceeded the Glenbrook soil matrix cleanup levels for TPH and DEQ numeric cleanup levels for PAH constituents.

****Note: As indicated in Section I, this SSR does not address the Lower Ore Body.

Baghouse AST Area

Due to evidence of minor spills or overfilling, a former AST area located approximately 100 feet west of the baghouse structure (AOC-7) was identified as an additional potential area of concern during remedial activities at the previously identified AOCs. The approximate location of the bag house AST is illustrated in Figure 2A. An area approximately 27 feet x 60 feet was excavated to a depth of approximately two feet. A total of eleven samples were collected and analyzed for TPH and PAH constituents. Results confirmed removal of all impacted soils that exceeded the Glenbrook soil matrix cleanup levels for TPH and the DEQ numeric soil cleanup levels for PAH constituents. Results for heavy oil and diesel were both less 100 mg/kg. Results for PAH were all <1 mg/kg. One mg/kg is the lowest industrial level for PAHs.

Supplemental Investigation

In addition to the 11 AOCs above, four additional AOCs were identified by a potential purchaser of the property. The AOCs included primary and secondary iron turnings off-loading areas, a sawdust (hog fuel) pile, and a transformer vault in the smelter building. The 4 AOCs are within the Glenbrook facility property boundaries and are illustrated in Figure 2A. An additional 20 cubic yards of soil was excavated from the primary and secondary turnings areas. The assessments at these four areas follows:

Primary Iron Turnings Off-loading Area
The primary iron turnings off-loading area encompassed an area approximately 75 feet by 250 feet. Soil in the impacted area was excavated to a depth of approximately two feet over the approximately 18,750 square-foot area for off-site disposal. Confirmation samples were collected and analyzed for lead, confirming lead levels below the DEQ residential maximum allowable soil concentration of 200 mg/kg (OAR 340-122-045, Appendix 1).

Secondary Iron Turnings Off-loading Area
The secondary off-loading area consists of two smaller sections of approximately 70 feet by 115 feet and 75 feet by 65 feet, located south and southwest of the primary area, respectively. Soil in the impacted area was excavated to a depth of approximately one foot over the approximately 8,375 square-foot area for off-site disposal. Confirmation samples were collected and analyzed for lead, confirming lead levels below the DEQ residential maximum allowable soil concentration of 200 mg/kg (OAR 340-122-045, Appendix 1).

Sawdust Pile
A sawdust pile (used for hog fuel) was sampled for petroleum constituents at the request of the potential purchaser. Two grab samples (SDPE-1 and SDPE-2) were collected from the pile on August 29, 2002 and analyzed for TPH and PAH. The samples were also subjected to a Silica Gel Test (SGT) to distinguish between petroleum hydrocarbons and organic hydrocarbons. High levels of organic hydrocarbons would be expected from the decaying wood (organic material). The TPH levels after the SGT were non-detect for diesel in both samples, and 330 mg/kg and 220 mg/kg for heavy oils, respectively. No PAH constituents were detected.

Transformer Vault
Residual oil in the bottom of a transformer vault located in the smelter building was sampled at the request of the potential purchaser. A sample of the oil was collected on August 2, 2002 and analyzed for PCB by EPA Method 8082. PCBs were not detected in the sample.

Groundwater and Surface Water Evaluation

Actual groundwater depth at the facility is approximately 28 feet, based on the static water level at the one permanent groundwater well at the facility. Because all impacted soil was removed, no water was encountered during removal, confirmation sampling indicated that levels were below applicable cleanup levels, and the soil overlying the uppermost groundwater-producing zone is relatively impermeable, groundwater is not anticipated or

suspected to have been impacted by the former presence of the TPH, PAHs and/or metals. Additionally, two water samples were collected from the guard shack well in August 2002. The location of the well is illustrated in Figure 2A attached. One sample was analyzed for metals, VOCs, PAHs, and chlorinated herbicides, the second was analyzed for VOCs and PAHs. No constituents were detected above Oregon DEQ Residential Risk-Based Concentrations, Appendix A. Similarly, the nearest surface water body is more than 900-1000 feet away and is unlikely to have been impacted by the AOCs addressed in the investigation and cleanup activities at the Site.

V. Public Notice and Comments

The notification for DEQ's recommendation and comment period was published in the Secretary of State's Bulletin on December 1, 2002 and in the Grants Pass Daily Courier on December 2, 2002. The Grant's Pass Daily Courier was assumed to be a common local paper for Riddle, Oregon and the surrounding area. The comment period was held from December 1, 2002 through December 30, 2002. No comments were received. DEQ issued a no further action letter on January 10, 2003. On January 30, 2003 it came to DEQ's attention that The Roseburg News Review and The Douglas County Mail were newspapers that were more representative for the Riddle, Oregon area. As a result, DEQ reopened the public comment period on March 1, 2003 and held a public meeting at the Riddle Community Center on March 11, 2003. The second public comment period ended March 31, 2003. Approximately 24 people attended the public meeting at the Riddle Community Center. All comments received at the public meeting were for the no further action. In addition, no comments were received by mail or phone.

VI. Conclusions and Recommendations

Environmental investigations and sampling were conducted from April 2000 through October 2002 to identify potentially contaminated areas at the Glenbrook facility. Remedial activities consisting of soil excavation and off-site disposal were implemented at the 13 AOC (Lower Ore Body not included) identified as needing further action. A total of approximately 39,060 cubic yards of impacted soil were removed, and greater than 434 confirmation soil samples were collected from the excavated areas to confirm removal of the impacted soil. All final confirmation soil sample results met applicable cleanup levels (Glenbrook soil matrix levels for TPH, DEQ Numeric Soil Cleanup Levels for PAH or lead, and/or site-specific naturally occurring background levels for arsenic). Groundwater samples collected from the guard shack well did not identify constituents above DEQ risk-based cleanup levels. Because of the limited vertical extent of the contaminants in soil and the depth to groundwater, groundwater is unlikely to have been impacted by the former presence of the TPH, PAH and metals. The nearest surface water body is more than 900-1000 feet away and is unlikely to have been impacted by the former presence of the TPH, PAH, and metals.

Based on this information, the extensive soil excavation and off-site disposal has adequately mitigated any potential threat to human health or the environment posed by the TPH, PAH and/or metals.

At this time, the VCP considers the investigation and cleanup at the Glenbrook facility to be complete and recommends that, unless new or previously undisclosed information becomes available which warrants further investigation, DEQ require no further action at Glenbrook facility under ORS 465.200, *et. seq.* DEQ's Environmental Cleanup and Site Information (ECSI) database will be updated to reflect this decision.

VII. References

August Mack, 2000, *PCB Remedial Work Plan Former BPA Substation Glenbrook Nickel Facility, Riddle Oregon*, December 7.

August Mack, 2000, *Report of Confirmation Sampling, Riddle and Coos Bay Facilities*, August.

August Mack, 2001, *Report of PCB Removal Actions Former BPA Substation Glenbrook Nickel Facility, Riddle Oregon*, April 25.

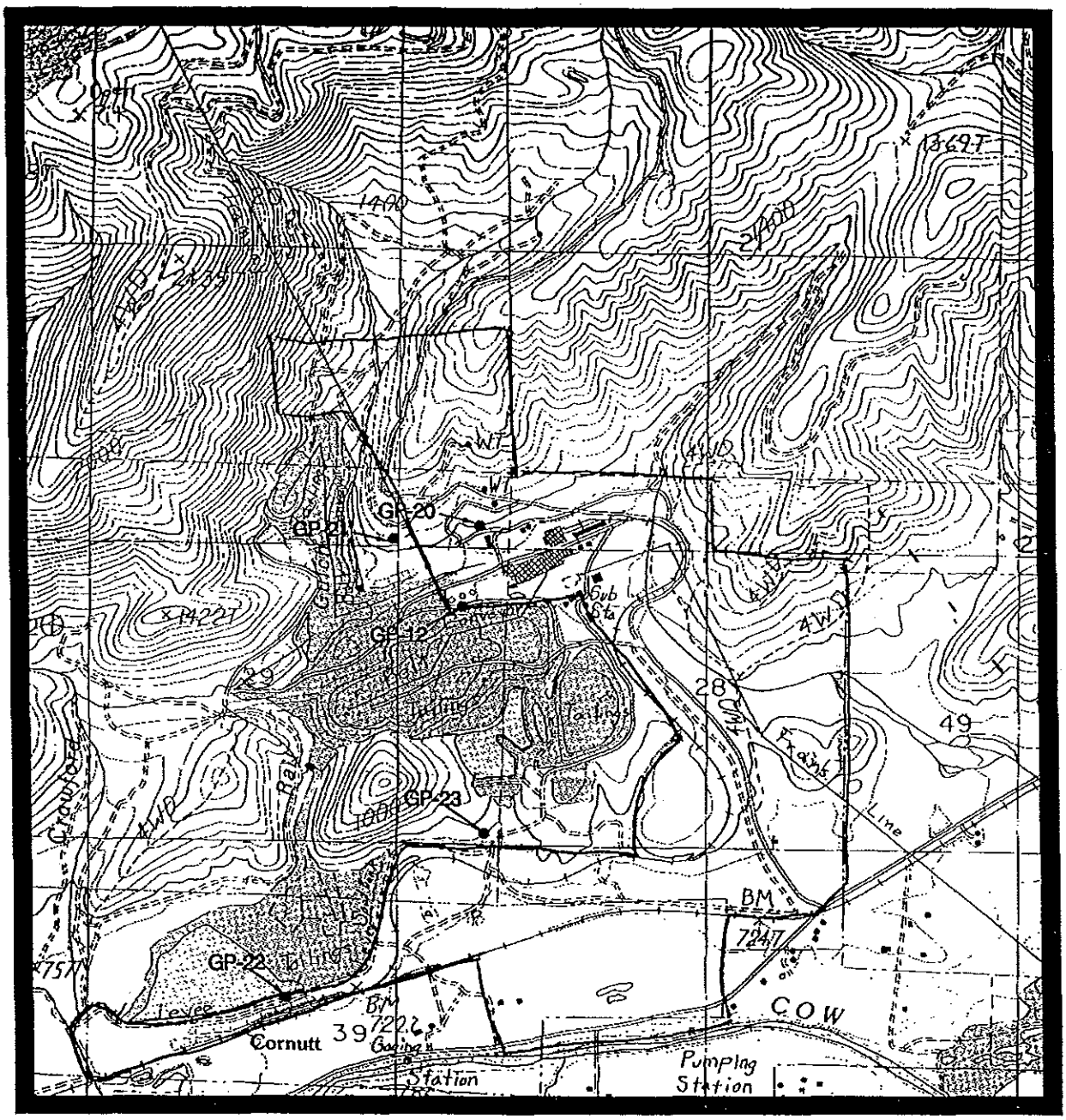
DEQ, 2001, No *Further Action Required – PCB Removal Former Electric Substation, Glenbrook Nickel Riddle Facility, Riddle Oregon*, October 3.

DEQ, 2001, Site *Summary Report Former Electrical Substation at the Glenbrook Nickel Riddle Facility*, August 15.

Linebach FunkHouser, Inc., 2002, *Report of Remedial Actions Eleven Areas of Concern Glenbrook Nickel Facility, Riddle Oregon*, June 18.

Linebach FunkHouser, Inc., 2002, Updates to the *Report of Remedial Actions Eleven Areas of Concern Glenbrook Nickel Facility, Riddle Oregon*, October 23.

SOURCE: U.S. GEOLOGICAL SURVEY; 7.5 MIN[illegible] SERIES (TOPOGRAPHIC)
NICKEL MOUNTAIN QUADRANGLE, OR[illegible] DATED 1986



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APPROXIMATE SCALE IN MILES

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APPROXIMATE SCALE IN FEET

GLENBROOK NICKEL - OREGON
RIDDLE FACILITY

Linebach ▪ Funkhouser, Inc.
environmental compliance & consulting

LOCATIONS OF GEOPROBE POINTS
GP-12, GP-20, GP-21, GP-22 AND GP-23

PROJECT NO:	SCALE:	FILENAME: 01202-1A	FIGURE:
012-02	-	PLOT DATE: 9/11/02	1

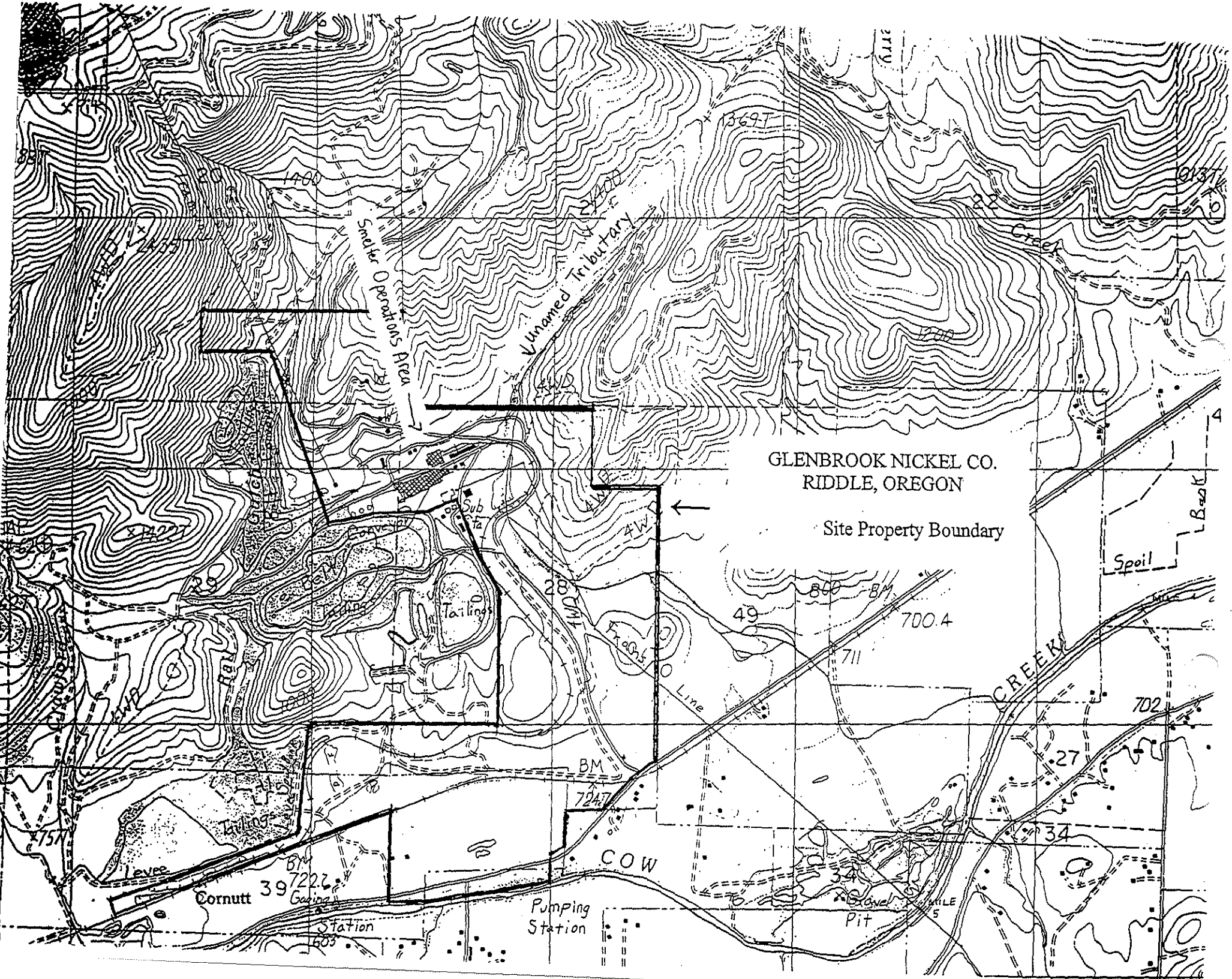

GLENBROOK NICKEL CO.
RIDDLE, OREGON
Site Property Boundary
Smelter Operations Area
Unnamed Tributary
Creek
Tailings
Conveyor
Sub Sta
Frame Line
Spoil
Bank
CREEK
COW
Levee
Cornutt
Gaging Station
Pumping Station
Gravel Pit
BM
700.4
711
702
724.7
722.7
1400
1200
1369T
4WD
4W
28
29
27
34
39
49

Figure 1C - Legal Description of Teck Cominco Property

Those three parcels of land being hereinafter described as Ministerial Land Partition Parcel 3, Boundary Line Adjustment Parcel and Parcel 1 of Land Partition Plat 1998-0048:

MINISTERIAL LAND PARTITION PARCEL 3

A parcel of land located in Sections 20, 28, 29 and 32 of T.30S., R.6W., W.M., being a portion of Parcel No. 1 of LAND PARTITION PLAT 2000-0092 A & B as recorded in Instrument No. 2000-25849 of the Records of Douglas County, Oregon and being Parcel 3 of that Ministerial Land Partition approved by the Douglas County Planning Department under File No. 01-M1045, and being more particularly described as follows:

Beginning at a 5/8" iron rod at the Northwest Corner of Parcel No. 2 of Partition Plat 2000-0092 A & B as recorded in Instrument No. 2000-25849 of the Records of Douglas County, Oregon from which the ¼ Corner common to Section 20 and Section 29 of T.30S., R.6W., W.M. bears S.1°02'10"W., 614.51 feet; thence the following courses along the North, East and South Boundaries of said Parcel No. 2:

S.89°47'55"E., 1111.64 feet to a 5/8" iron rod,
S.23°30'12"E., 1751.88 feet to a 5/8" iron rod,
N.72°25'29"E., 761.35 feet to a 5/8" iron rod,
S.23°00'35"E., 704.75 feet to a 5/8" iron rod,
N.84°29'02"E., 519.14 feet to a 5/8" iron rod,
N.69°11'44"E., 239.35 feet to a 5/8" iron rod,
S.24°19'50"E., 170.64 feet to a 5/8" iron rod,
N.66°49'56"E., 89.78 feet to a 5/8" iron rod,
S.22°58'16"E., 536.95 feet to a 5/8" iron rod,
S.33°16'55"E., 649.65 feet to a 5/8" iron rod,
S.13°35'42"W., 599.08 feet to a 5/8" iron rod,
S.00°00'00"E., 978.96 feet to a 5/8" iron rod,
N.89°16'00"W., 1486.43 feet to a 5/8" iron rod,
N.89°17'14"W., 913.42 feet to a 5/8" iron rod,
S.10°36'09"W., 1660.60 feet to a 5/8" iron rod,
S.69°35'59"W., 1621.08 feet to a 5/8" iron rod,
S.83°58'25"W., 1331.57 feet to a 5/8" iron rod,
S.00°00'00"E., 486.20 feet to a 5/8" iron rod on the South Line of the William H. Riddle D.L.C. No. 39, T.30S., R.6W., W.M.; thence S.89°15'18"E. along said South Line of D.L.C. No. 39, 21.30 feet to a point on the Northerly Right of Way Line of the Central Oregon and Pacific Railroad; thence approximately 7900 feet Northeasterly along said Northerly Right of Way Line to the Northerly Right of Way Line of County Road No. 39; thence approximately 400 feet Northeasterly along the Northerly Right of Way Line of County Road No. 39 to a point on the West Line of the William H. Merryman D.L.C. No. 49, T.30S., R.6W., W.M.; thence N.0°00'49"W. along the West Line of said D.L.C. No. 49, 3217.23 feet to the Northeast Corner of Government Lot 3 of said Section 28; thence N.89°14'41"W., 1119.00 feet to the Southeast Corner of said Government Lot 3; thence N.0°13'56"W. along the West Line of Government Lot 2 of said Section 28, 1301.03 feet to a point; thence N.45°04'14"W., 50.28 feet to a point on the North Line of said Section 28; thence N.89°54'33"W., 2625.70 feet to the Northwest Corner of said

Section 28; thence N.1° 22'12"E., 1325.42 feet to the South 1/16 Corner common to Sections 28 and 29; thence N.89°50'09"W., 2658.63 feet to the Center South 1/16 Corner of said Section 20; thence S.1°02'10"W., 709.05 feet to the point of beginning.

BOUNDARY LINE ADJUSTMENT PARCEL

A parcel of land located in Section 28 and Section 29, T.30S., R.6W., W.M., being that portion of Parcel No. 1 of LAND PARTITION PLAT 2000-0092 A & B as recorded in Instrument No. 2000-25849 of the Records of Douglas County, Oregon which was surveyed by Kristian O. DeGroot under that BOUNDARY LINE ADJUSTMENT recorded as M 138-24 with the Douglas County Surveyor's Office and being more particularly described as follows:

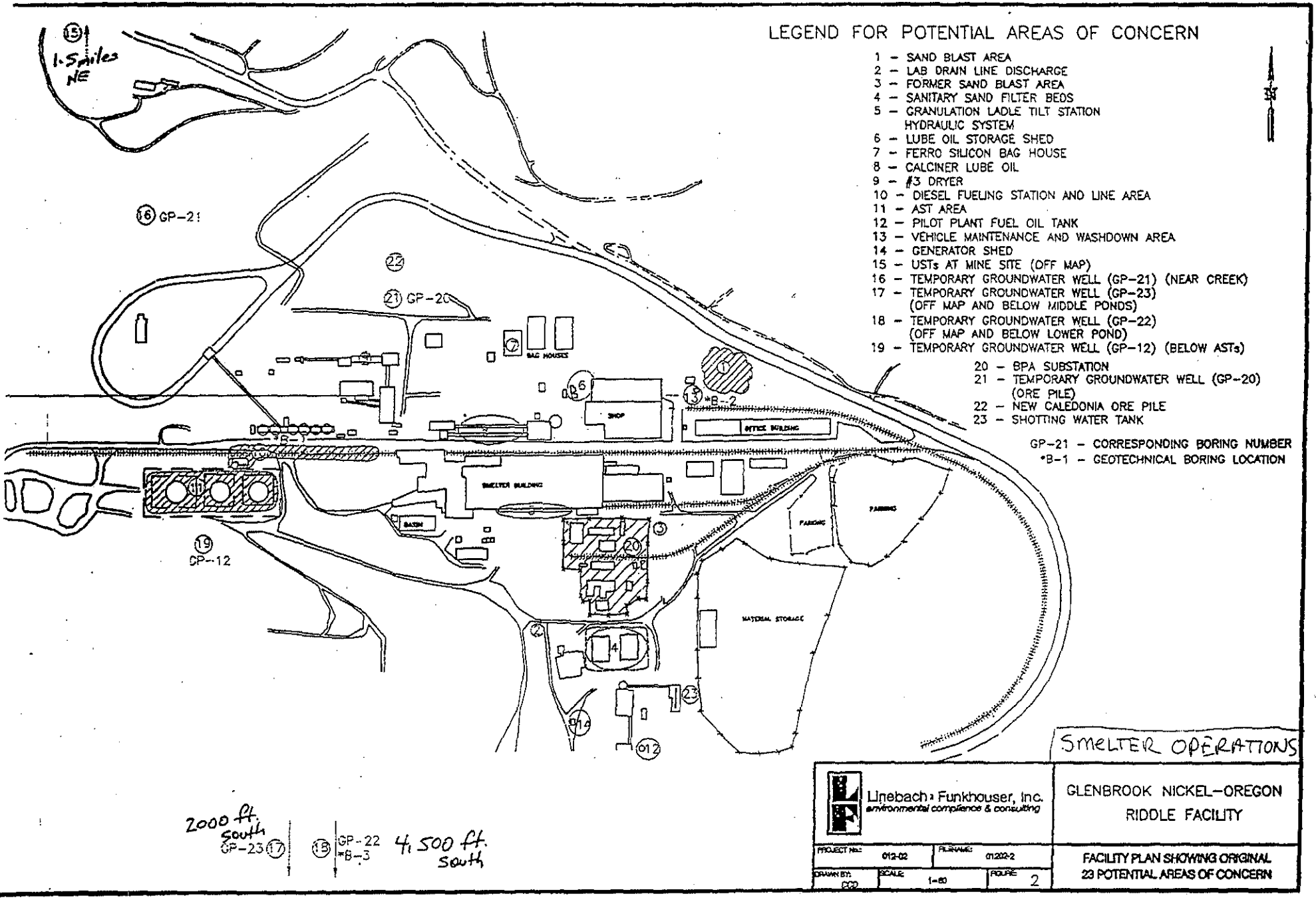
Beginning at a 5/8" iron rod on the West Line of said Parcel No. 1 from which a brass capped iron pipe at the Section Corner common to Sections 20, 21, 28 and 29 of T.30S., R.6W., W.M. bears N.40°04'03"E., 1289.05 feet; thence the following courses along the West Line of said Parcel No. 1:

S.23°30'12"E., 562.59 feet to a 5/8" iron rod,
S.84°51'34"E., 177.09 feet to a 5/8" iron rod,
N.71°58'01"E., 252.64 feet to a 5/8" iron rod,
N.84°29'02"E., 362.00 feet to a 5/8" iron rod;

thence N.23°00'35"W. leaving said West Line, 704.75 feet to a 5/8" iron rod; thence S.72°25'29"W., 761.35 feet to the point of beginning.

PARCEL 1 of LAND PARTITION PLAT 1998-0048

Parcel 1 of Land Partition Plat 1998-0048 as recorded in Instrument No. 98-12686 of the Records of Douglas County, Oregon.



LEGEND FOR POTENTIAL AREAS OF CONCERN

1 – SAND BLAST AREA
2 – LAB DRAIN LINE DISCHARGE
3 – FORMER SAND BLAST AREA
4 – SANITARY SAND FILTER BEDS
5 – GRANULATION LADLE TILT STATION HYDRAULIC SYSTEM
6 – LUBE OIL STORAGE SHED
7 – FERRO SILICON BAG HOUSE
8 – CALCINER LUBE OIL
9 – #3 DRYER
10 – DIESEL FUELING STATION AND LINE AREA
11 – AST AREA
12 – PILOT PLANT FUEL OIL TANK
13 – VEHICLE MAINTENANCE AND WASHDOWN AREA
14 – GENERATOR SHED
15 – USTs AT MINE SITE (OFF MAP)
16 – TEMPORARY GROUNDWATER WELL (GP-21) (NEAR CREEK)
17 – TEMPORARY GROUNDWATER WELL (GP-23) (OFF MAP AND BELOW MIDDLE PONDS)
18 – TEMPORARY GROUNDWATER WELL (GP-22) (OFF MAP AND BELOW LOWER POND)
19 – TEMPORARY GROUNDWATER WELL (GP-12) (BELOW ASTs)
20 – BPA SUBSTATION
21 – TEMPORARY GROUNDWATER WELL (GP-20) (ORE PILE)
22 – NEW CALEDONIA ORE PILE
23 – SHOTTING WATER TANK

GP-21 – CORRESPONDING BORING NUMBER
*B-1 – GEOTECHNICAL BORING LOCATION

SMELTER OPERATIONS

Linebach Funkhouser, Inc.
environmental compliance & consulting

GLENBROOK NICKEL–OREGON
RIDDLE FACILITY

PROJECT No.: 012-02	FILENAME: 012202-2	FACILITY PLAN SHOWING ORIGINAL 23 POTENTIAL AREAS OF CONCERN
DRAWN BY: CCP	SCALE: 1=80	FIGURE: 2

Linebach Funkhouser 5072595400 11/29/96 01:54pm P.005

SOURCE: U.S. GEOLOGICAL SURVEY; 7.5 MINUTE SERIES (TOPOGRAPHIC)
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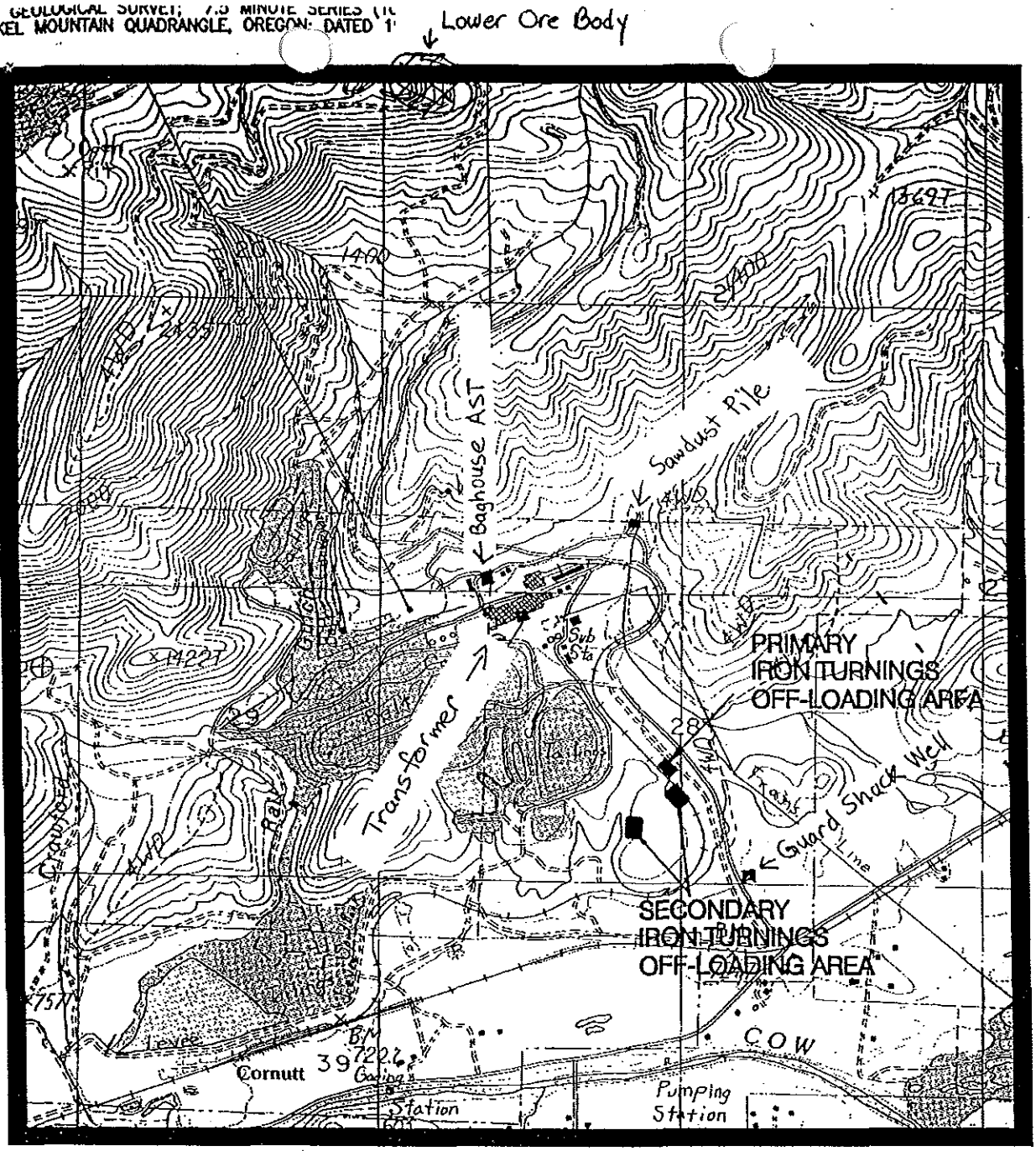

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APPROXIMATE SCALE IN FEET

GLENBROOK NICKEL - OREGON RIDDLE FACILITY	Linebach ▪ Funkhouser, Inc. *environmental compliance & consulting*	PRIMARY AND SECONDARY IRON TURNINGS OFF-LOADING AREAS
PROJECT NO: 012-02 / SCALE: -	FILENAME: 01202-2A PLOT DATE: 9/11/02	FIGURE: 2A

Site Inspection

Prepared by USEPA

April 2018

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

OFFICE OF
ENVIRONMENTAL CLEANUP

Brian Rebuck
Green Diamond Sand Products
500 East 6th Avenue
Riddle, Oregon 97469

Re: Former Glenbrook Nickel Smelter Site Inspection Report

Dear Mr. Rebuck:

The U.S. Environmental Protection Agency (EPA), through its contractor, Ecology & Environment, Inc. has completed a Site Inspection for the former Glenbrook Nickel Smelter site near Riddle, Oregon. A copy of the Site Inspection report is enclosed. An electronic version of the report contained on a CD is also enclosed.

Based on this review, EPA does not anticipate further investigation under the Federal Superfund Program. EPA's no further action designation does not relieve your facility from complying with the appropriate Oregon state regulations.

EPA appreciates Green Diamond Sand Products' cooperation in obtaining pertinent site records and providing support during the August, 2017 field work.

RECEIVED
APR 25 2018
WESTERN REGION EUGENE
DEPT. OF ENVIRONMENTAL QUALITY

If you have any questions, please do not hesitate to contact me at 503-326-3269, or e-mail me at marcy.ken@epa.gov.

Sincerely,

Ken Marcy
Site Assessment Manager

Enclosure

cc: Mallory Ott
ODEQ, Western Regional Office

Heather Bartlett
Cow Creek Band of Umpqua Tribe of Indians

00

RECEIVED
OREGON OPERATIONS OFFICE
APR 19 2018
EPA-REGION 10

SITE INSPECTION
Glenbrook Nickel Smelter Site
Riddle, Oregon

Contract Number: EP-S7-13-07
Technical Direction Document Number: 17-03-0006

April 2018

Prepared for:

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
1200 Sixth Avenue
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SITE INSPECTION
Glenbrook Nickel Smelter Site
Riddle, Oregon

Contract Number: EP-S7-13-07
Technical Direction Document Number: 17-03-0006

April 2018

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List of Abbreviations and Acronyms

Term	Definition
%R	Percent recovery
°F	Fahrenheit
µg/L	Micrograms per Liter
amsl	Above Mean Sea Level
AOC	Area of Concern
AST	Aboveground Storage Tank
August Mack	August Mack Environmental, Inc.
bgs	Below Ground Surface
BPA	Bonneville Power Administration
BS	Blank Spike
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	Cubic Feet per Second
CLP	Contract Laboratory Program
CRQL	Contract Required Quantitation Limit
DQO	Data Quality Objective
E & E	Ecology and Environment, Inc.
EPA	United States Environmental Protection Agency
ESA	Environmental Site Assessment
Green Diamond	Green Diamond Sand Products
GNS	Glenbrook Nickel Smelter
GPS	Global Positioning System
IDW	Investigation-Derived Waste
kg	kilograms
LWES	Land And Water Environmental Services, Inc.
MEL	Manchester Environmental Laboratory
mg/kg	Milligram per Kilogram
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Unit
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
OWRD	Oregon Water Resources Division
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PPE	Probable Point of Entry
QA	Quality Assurance
QC	Quality Control
RBC	Risk-Based Concentration

List of Abbreviations and Acronyms (cont.)

Term	Definition
REC	Recognized Environmental Condition
RPD	Relative Percent Difference
SF	Square Feet
SI	Site Inspection
SPLP	Synthetic Precipitation Leaching Procedure
SQAP	Sampling and Quality Assurance Plan
SQL	Sample Quantitation Limit
START	Superfund Technical Assessment and Response Team
STLC	Soluble Threshold Limit Concentration
SVOC	Semivolatile Organic Compound
TAL	Target Analyte List
TCLP	Toxicity Characteristic Leaching Procedure
TDL	Target Distance Limit
TM	Task Monitor
TPH	Total Petroleum Hydrocarbon
TPH-Dx	Diesel Range Total Petroleum Hydrocarbons
VOC	Volatile Organic Compound

1 Introduction

Ecology and Environment, Inc., (E & E) was tasked by the United States Environmental Protection Agency (EPA) to provide technical support for completion of a Site Inspection (SI) at the Glenbrook Nickel Smelter (GNS) site located in Riddle, Oregon (Figure 1-1). E & E completed SI activities under Technical Direction Document Number 17-03-0006, issued under EPA, Region 10, Superfund Technical Assessment and Response Team (START)-IV, Contract No. EP-S7-13-07.

The specific goals for the GNS SI, identified by the EPA, are to:

- Determine the potential threat to public health or the environment posed by the site;
- Determine the potential for a release of hazardous constituents into the environment; and
- Determine the potential for placement of the site on the National Priorities List.

EPA conducted this SI in coordination with site owners and operators (Green Diamond Sand), the Oregon Department of Environmental Quality and the Cow Creek Band of Umpqua Tribe of Indians. All parties provided critical input to the Sampling and Analysis Plan for the SI, and Cow Creek Band staff helped assess potential impacts to tribal cultural resources during shallow groundwater push probe sampling. In addition to EPA's evaluation of the information in this SI, data will also be useful to Oregon DEQ for comparing to state surface water and drinking water standards, and for the tribe in its ongoing efforts to monitor the quality and health of Cow Creek.

Completion of the SI included reviewing existing site information, determining regional characteristics, collecting receptor information within the range of site influence, executing a sampling plan, and producing this report. The report is organized as follows:

- Section 1, Introduction – Authority for performance of this work, goals for the project, and summary of the report contents;
- Section 2, Site Background – Site description, site operations and waste characteristics, and a summary of investigation locations;
- Section 3, Field Activities and Analytical Protocol – Summary of the field effort;
- Section 4, Quality Assurance/Quality Control (QA/QC) – Summary of the laboratory data;

- Section 5, Analytical Results Reporting and Background Samples – Discussion of results reporting criteria and background sample locations and analytical results;
- Section 6, Potential Sources – Discussion of site sources, sample locations, and analytical results;
- Section 7, Migration/Exposure Pathways and Targets – Discussion of the migration/exposure pathways, sample locations, and analytical results;
- Section 8, Summary and Conclusions – Summary of the investigation and recommendation for the site based on the information gathered during the investigation; and
- Section 9, References – Alphabetical listing of the references cited throughout the text.

2 Site Background

This section describes the background of the site, including location, description, ownership history, operations and source characteristics, previous investigations, and a summary of the site investigation locations.

2.1 Site Location

Site Name:	Glenbrook Nickel Smelter
SEMS ID Number	Not available
Site Address:	5093 Riddle By-Pass Road Riddle, Oregon 97469
Latitude:	42.9393° North
Longitude:	-123.4244° West
Legal Description:	Township 30 South, Range 6 West, Section 28
County:	Douglas
Congressional District:	4
Site Owner/Operator(s):	Green Diamond Sand Products 6th and E Street Riddle, Oregon 97469 541-874-3111
Site Contact(s):	Art Schweizer Green Diamond Sand Products 6th and E Street Riddle, Oregon 97469 541-874-3111

2.2 Site Description

The GNS site is located approximately 3.25 miles southwest of Riddle, Oregon, in Douglas County. The site is surrounded by rural, agricultural, and/or undeveloped land and lies on the southeastern flank of Nickel Mountain at approximately 900 feet above mean sea level (amsl) (Figure 1-1). In general, terrain at the site slopes southeast toward Cow Creek.

The site originally operated as a nickel mine and smelter; the smelter and many of the associated buildings have been removed from the site. As a result of former site operations, portions of the site have been extensively filled and/or covered by large piles of slag/mining byproduct (see Figure 2-1). These byproducts include slag piles and skull piles (i.e., more finely crushed slag). At these piles' widest point, they stretch approximately 0.75 mile across. Two upper retention/settling ponds are located at the base of the slag/mining byproduct piles in the southern portion of the site. One of these ponds is situated at a somewhat higher elevation and is slightly smaller in size than the other. Surface water from the smaller

retention/settling pond flows into the slightly larger upper retention/settling pond, before ultimately draining into a large lower retention/settling pond that is covered in grass and, sparsely, with trees. Several sedimentation cells are located in the northeast corner of the lower retention/settling pond. Rail Gulch bisects the site, flowing north to south into the lower retention/settling pond. A portion of Rail Gulch is culverted and buried beneath the slag/mining byproduct. Crawford Branch flows north to south across the western end of the site. Surface water from the ponds drains into Crawford Branch, which flows into Cow Creek. (LWES 2000; Linebach Funkhouser 2002a).

Several nearby drainages/tributaries of Cow Creek originate near the top of Nickel Mountain. These include the Crawford Branch and Rail Gulch, as well as Doe Creek, Jerry Creek, and an unnamed drainage. Surface water in Cow Creek flows from the southwest to the northeast, ultimately draining into the South Umpqua River.

2.3 Site Ownership History

The GNS site was originally developed in the late 1940s by Nickel Mountain Resources. In 1989, Teck Cominco Metals, operating as the Glenbrook Nickel Company, purchased the site from Nickel Mountain Resources. The Glenbrook Nickel Company only operated at the mine for only a short time, up to 1998. In 1999, 600 acres of the site were sold to Green Diamond Sand Products (Green Diamond; owned by Arden Development Inc.), followed by an additional 600 acres (including the location of the former smelter and slag piles) in 2003. (Linebach Funkhouser 2002a; ARI 2004)

2.4 Historic and Current Site Operations

The site was operated by Hanna Nickel Smelting Company, the only manufacturer of ferro-nickel (an iron and nickel alloy) in the United States, as a nickel mine and smelter for approximately 40 years, beginning in the late 1940s. Early mining at the site took place at the top of Nickel Mountain, at elevations of approximately 3,000 feet amsl on land leased from private landowners. As mentioned above, the Glenbrook Nickel Company purchased the facility in 1989. It is not clear when the Glenbrook Nickel Company ended mining operations at the site; however they operated the smelter intermittently up to 1998. Glenbrook Nickel Company's limited mining operation took place below the top of Nickel Mountain at an elevation of approximately 2,000 feet amsl, known as the "lower ore body." Additional ore was also imported from New Caledonia, an island in the South Pacific. Mining and nickel smelting operations ceased in March of 1998, and the smelter building was removed in 2002. (Linebach Funkhouser 2002a)

Figure 2-2 presents historic site features. The primary smelting operations were located approximately 2 miles south-southeast of the mine at approximately 900 feet amsl and covered approximately 40 acres of the 528-acre facility (ODEQ

2002). An aerial tramway was used to transport ore from the mine down to the smelter facility. The smelter facility consisted of a large smelter building, various office buildings, a laboratory, maintenance and storage facilities, and associated structures, including dryers and storage silos. Power was provided by an on-site Bonneville Power Administration (BPA) electrical substation, located just south of the smelter building. Four aboveground fuel oil storage tanks and a vehicle fueling station were located west of the smelter building. A rail spur ran along the northern edge of the smelter building and storage tanks. Dryers, a ferrosilicon bag house, and several storage silos were located to the north, across the rail spur. Office and laboratory buildings were located east of the smelter building. (Linebach Funkhouser 2002a)

The first step in the smelting process was drying and calcining ore at 1,400 degrees Fahrenheit (°F) to remove moisture. The ore then passed through one of four electric arc furnaces to heat it to approximately 3,100°F. Ferro-silicate was added to the molten ore to reduce it to ferro-nickel. Molten ferro-nickel passed through one of two refining furnaces, where it was poured into a water bath to cool in irregular modules. Approximately 1.2 million tons of ore were processed per year, producing up to 18 million pounds of product (LWES 2000). Green- to gray-colored slag was created as a byproduct of the smelting process. The exact amount of slag produced was not recorded in available site-related documents, though estimates put it at 12 to 15 million tons (The Oregonian 2012; ARI 2004).

Current site operations include washing and sorting the slag byproduct for sale. More than 40 related products are produced for a variety of purposes, including road surfacing, sports field drainage material, roofing material, material for foundry moldings, and abrasives for sandblasting operations (ARI 2004).

Based on available data, analytical results of slag material samples analyzed by toxicity characteristic leaching procedure (TCLP), synthetic precipitation leaching procedure (SPLP), and soluble threshold limit concentration (STLC) do not exceed federal hazardous waste criteria, and thus do not pose an unacceptable leaching threat.

2.5 Previous Investigations

2.5.1 Report of Confirmation Sampling, Riddle and Coos Bay Facilities, Oregon

In August 10, 2000, August Mack Environmental, Inc. (August Mack) completed environmental investigation activities at the GNS site, as well as a facility located in Coos Bay, Oregon (where port operations were maintained), in preparation for the sale of both properties. The investigation as it relates to the GNS site is discussed below.

The overall goal of the investigation was to: 1) ensure that the site does not pose an unacceptable risk to human health and the environment, and 2) limit potential long-term environmental liabilities associated with the site. A total of 23 areas of

concern (AOCs) were identified (Figure 2-3). Initial sampling occurred April 26 through April 28, 2000, with follow-up sampling on June 6 and 7, 2000 at AOC-R-20. Sampling activities included collecting soil and groundwater samples from geoprobe borings and test pits. Based on the sampling and analysis, nine of the 23 AOCs were identified as warranting further investigation due to the presence of total petroleum hydrocarbons (TPHs) (oil and diesel), polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and/or metals in the soil. Volatile organic compounds (VOCs) were determined to not warrant further investigation for all remaining AOCs. (August Mack 2000)

The following nine AOCs were identified as warranting further investigation:

- Sanitary Sand Filter Beds (AOC-R-4)
- Granulation Ladle Tilt Station Hydraulic System (AOC-R-5)
- Lube Oil Storage Area (AOC-R-6)
- Calciner Lube Oil Area (AOC-R-8)
- Diesel Fueling Station and Fuel Line Area (AOC-R-10)
- Pilot Plant Fuel Oil Aboveground Storage Tanks (ASTs) (AOC-R-12)
- Vehicle Maintenance and Wash-down Area (AOC-R-13)
- BPA Substation Equipment Pads (AOC-R-20)
- Shotting Water Tank (AOC-R-23) (August Mack 2000)

A summary of the AOCs and significant detections is presented in Table 2-1; their locations are presented on Figure 2-3.

2.5.2 Phase I and Phase II Environmental Site Assessment of a Portion of the Property Located at 5093 Riddle By-Pass Road, Riddle, Oregon

On August 30, 2000, Land And Water Environmental Services, Inc. (LWES) completed a Phase I and Phase II Environmental Site Assessment (ESA) at the GNS site. The Phase I ESA was performed to identify potential recognized environmental conditions (RECs). These RECs were identified in addition to the AOCs listed above; however, in some cases, the RECs identified during the Phase I ESA overlap with the AOCs. The Phase II ESA was performed to evaluate the potential RECs identified during the Phase I ESA, in an attempt to either confirm them as RECs or eliminate them from further work. In total, the Phase I ESA identified 16 potential RECs, which are listed below. LWES 2000

Phase I Findings:
RECs 1 and 2 were identified during document review (EPA multimedia assessment):

1. Disposal of laboratory wastes (approximately 222 kilograms [kg]/month) into the site's waste water treatment system consisting of surface impoundments and dirt lined ditches; and
2. Used oil from two drums that was dumped or drained onto the ground in the bone yard located south of the skull plant (the area where slag is crushed into finer material). (LWES 2000)

RECs 3 through 6 were identified during review of the draft *Report of Confirmation Sampling, Riddle and Coos Bay Facilities, Oregon* (summarized above) and a site visit.

3. Three ASTs having capacities of 500 gallons, 12,000 gallons, and 250,000 gallons; a boiler house; a pipeline; an equipment fueling area; and a reported release;
4. Potential contaminants in two sand filters used for sewage disposal (resulting in high arsenic concentrations) near the northeast corner of the site;
5. Potential contaminants related to an AST located off site near the northeast site corner; and
6. Oil-stained soil outside of the generator shed located south of the skull plant. (LWES 2000)

RECs 7 through 15 were identified during a site visit.

7. Disposal of petroleum-contaminated scrap metal, automotive parts, and crushed drums in the Rail Gulch drainage west of the slag pile;
8. The potential presence of petroleum products or hazardous wastes in metal turnings, black plastic, and crushed drums located north of the slag pile;
9. Leachate from the slag pile (potential source of contamination to shallow groundwater);
10. Leachate from the skull fine pile (potential source of contamination to shallow groundwater);
11. Process water and sediment from the washing operation south of the slag pile (potential source of contamination to shallow groundwater);
12. Shallow groundwater downgradient of the slag and skull fine piles;
13. Observed petroleum on surface water in shallow depression south of the skull plant;

14. The potential presence of petroleum products or hazardous wastes in scrap metal, automotive parts, and the lid from a 55-gallon drum in the bone yard west of the skull fine pile; and
15. Leachate from the sedimentation cells. (LWES 2000)

REC 16 was identified during the interview process.

16. The potential discharge of surface water from the site's lower retention/settling pond in excess of the site's National Pollutant Discharge Elimination System (NPDES) Wastewater Discharge Permit (LWES 2000).

Phase II ESA Findings:
The Phase II ESA included sample data from the *Report of Confirmation Sampling, Riddle and Coos Bay Facilities, Oregon* (summarized in Section 2.5.1) provided by the Glenbrook Nickel Company to LWES, as well as additional analytical data from samples collected as part of the Phase II ESA. During the Phase II ESA, several RECs (2, 5, 6, 7, and 14) were eliminated based on further document review, interviews, and an additional site visit. Only the RECs that required additional investigation in the way of sampling are discussed below. Phase II ESA sample locations are presented on Figure 2-4.

- **REC 1**: One sediment (S-9) and one surface water sample (W-2) were collected from the ditch that would have received laboratory waste. The sediment sample was analyzed for metals by TCLP. No metals exceeded the Oregon Department of Environmental Quality (ODEQ) leachate concentrations.
- **REC 8**: Three samples were collected from this REC: one of slag beneath the crushed drums (S-1), one of slag beneath a pile of scrap metal (S-2), and one of metal shavings (S-3). All samples were analyzed for TPH; the metal shavings sample was also analyzed for metals by TCLP. TPH as oil was detected in the metal shavings sample above ODEQ Risk-Based Concentrations (RBCs). No other results from the three samples collected at this REC exceeded ODEQ RBCs. The scrap metal was removed from the site.
- **REC 9:** A slag sample (S-6) was collected from the south side of the slag pile and analyzed for chromium, manganese, and nickel by TCLP. These results were lower than ODEQ leachate concentration limits.
- **REC 10:** One sample (S-5) was collected from the north side of the skull fine pile and analyzed for chromium, manganese, and nickel by TCLP. All three analytes were below the ODEQ leachate concentration limits.
- **REC 11:** One sediment (S-7) and one water (W-3) sample were collected from the easternmost upper retention/settling pond and analyzed for 11 metals by TCLP. Only manganese and nickel were detected, though at concentrations below the ODEQ leachate concentration limits. The water

sample was analyzed for three dissolved metals: chromium, manganese, and nickel. Both chromium and manganese concentrations were also below ODEQ leachate concentration limits listed above; nickel was not detected.

- **REC 12:** Two shallow groundwater samples were collected: one downgradient of the skull fines pile (GP-1) and the other downgradient of the slag pile (GP-2). Only barium was detected in the sample collected below the skull fines pile, while barium and nickel were detected in the sample collected below the slag pile. In both samples, detected analytes were below ODEQ RBCs.
- **REC 13:** One water (W-1) and one sediment (S-4) sample were collected from the depression south of the skull plant and analyzed for TPH. TPH as diesel and oil were detected in the water sample, though not in the sediment sample. Based on these results, the water was drained from the depression. The Phase II ESA does not indicate the location of the drainage.
- **REC 15:** One sample (S-8) was collected from the northeast sedimentation cell and analyzed for chromium, manganese, and nickel by TCLP. All analytes were below ODEQ leachate concentrations. (LWES 2000)

Through a review of data provided to LWES, data collected as part of the Phase II ESA, and additional document review, all but three of the RECs (3, 4, and 16) identified in the Phase I ESA were determined to not require further assessment work. REC 3 was not eliminated due to historic use of petroleum products and a reported release, REC 4 was not eliminated due to the presence of arsenic at concentrations greater than ODEQ RBCs, and REC 16 was not eliminated due to the potential for discharges from the lower retention/settling pond of water exceeding the site's NPDES Wastewater Discharge Permit. (LWES 2000)

2.5.3 Report of PCB Removal Actions, Former BPA Substation, Glenbrook Nickel Facility, Riddle, Oregon

In April of 2001, August Mack completed removal activities at the GNS site, removing PCB-contaminated soil at the former BPA electrical substation (identified as AOC-R-20) (Figure 2-3). The substation had been used for approximately 50 years (1950 to 2000) to provide electric power to the GNS site. The removal action was conducted before BPA transferred the approximately 1.6-acre substation property to the Glenbrook Nickel Company. A total of 20 soil and six wipe samples were collected in April 2000, and an additional 40 soil samples in June 2000. Sample results indicated that PCB contamination was limited to a small area in the northwest corner of the substation, in the area of two capacitor banks. The impacted area measured 72 feet by 53 feet, with an average depth of 3 feet. (August Mack 2001)

The substation was dismantled prior to the removal action, and a primary remedial goal for the site of 1 milligram per kilogram (mg/kg) was established. Soil excavation activities began at the site on January 23, 2001, and initial confirmation samples were collected on January 25, 2001. Laboratory results for the initial confirmation samples indicated that elevated levels of PCBs were still present at levels exceeding the cleanup goal. Additional excavation and sampling was conducted on February 6 and 7, 2001, to reach the cleanup goal of 1 mg/kg. (August Mack 2001)

Approximately 620 yards of PCB-contaminated soil were excavated from the site and disposed of at the hazardous waste landfill in Arlington, Oregon. The excavation was backfilled with clean fill from the mining operations. (August Mack 2001)

2.5.4 No Further Action Required - PCB Removal - Former Electric Substation, Glenbrook Nickel Riddle Facility, Riddle, Oregon

Based on the April 2001 August Mack report detailing the removal of PCB-contaminated soil from an on-site substation (see Section 2.5.3), ODEQ determined on October 3, 2001, that the PCB removal was complete and no further action to address PCBs in soil was required (Linebach Funkhouser 2002a).

2.5.5 Removal of Remedial Actions, Eleven Areas of Concern, Glenbrook Nickel Facility, Riddle, Oregon

In June 2002, Linebach Funkhouser Inc. completed additional removal activities at the GNS site to address the nine AOCs requiring additional investigation based on sampling conducted in April and June 2000 by August Mack and presented in the *Report of Confirmation Sampling, Riddle and Coos Bay Facilities, Oregon* (see Section 2.5.1).

Soil excavation and disposal activities were performed between August 2000 and September 2001. The amount of soil initially excavated at each AOC was based on field observations and field screening. Two or more rounds of excavation and confirmation sampling were performed at several of the AOCs. A cleanup goal/background of 24.87 mg/kg was set for arsenic and 100 mg/kg for TPH. In areas where excavation was limited due to structures, the ODEQ RBC for TPH of 1,000 mg/kg was used. For PAHs, ODEQ RBCs were used (Linebach Funkhouser 2002a). Each of the nine AOCs are presented on Figure 2-3, and discussed below.

- **Sanitary Sand Filter Beds (AOC-R-4):** Elevated levels of arsenic were identified in this AOC. The sand filter material and approximately 2 feet of adjacent soil on the walls and bottom of each bed was excavated. A total of 24 samples were collected from the bed walls and bottoms to confirm removal of the arsenic-impacted material. Results indicated that all arsenic-impacted material that exceeded the site-specific naturally

occurring background level of 24.87 mg/kg had been removed from this AOC.

- **Granulation Ladle Tilt Station Hydraulic System (AOC-R-5):** Elevated levels of PAHs were identified at one of the four granulation ladle tilt station hydraulic system units (i.e., Unit #4). An area of visually impacted soil, approximately 12 feet by 12 feet and 2 feet deep, was excavated at the base of Unit #4. One confirmation sample was collected from the bottom of the excavation that confirmed the successful removal of the PAH-impacted soil.
- **Lube Oil Storage Area (AOC-R-6):** Elevated levels of TPH constituents (i.e., oil) were identified in soil around the used-oil AST on the east side of the lube oil storage area, likely due to minor spills and overfilling. An area of visually impacted soil, approximately 12 feet by 16 feet and 1.5 feet deep, was excavated, and two samples were collected from the bottom of the excavation to confirm removal of the TPH-impacted soil. Results indicated the need for additional excavation, and following this work, two additional confirmation samples were collected for TPH and PAH analyses. Sample results indicated that no TPH- or PAH-contaminated soil remained after the second round of excavation.
- **Calciner Lube Oil Area (AOC-R-8):** Elevated levels of PAHs were identified in soil around one of the four calciner lube oil areas (pillars), likely due to minor leakage and spills. An area of visually impacted soil covering a radius of approximately 6 feet around the pillar and extending to a depth of approximately 4 feet was excavated, with four samples collected to confirm removal of the PAH-impacted soil. Except for one sample, TPH results were all less than the Glenbrook Nickel Company's self-assigned soil cleanup goal of 100 mg/kg. The 1,000 mg/kg goal was applied due to excavation limitations in this area.
- **Diesel Fueling Station and Fuel Line Area (AOC-R-10):** Elevated levels of TPH constituents were identified in soil around the diesel fueling station and along the fuel line area, likely from leaks, spills, and overfilling of diesel fuel from the tanks, the transfer station, and underground transfer lines that had occurred throughout the operational years of the facility. Excavation began in the diesel fueling station area and continued north to the railroad tracks, reaching 25 feet below ground surface (bgs) in some areas. Free product was encountered in some areas during excavation. Sixteen rounds of excavation and sampling occurred between September 2000 and September 2001, with 334 soil samples being collected. TPH-impacted soil discovered beneath a rail line was left in place to avoid the risk of compromising the integrity of the rail line. Sample results indicated that by the end of the last round of excavation and sampling in September 2001, no TPH contamination remained at concentrations greater that cleanup goals.

- **Pilot Plant Fuel Oil AST (AOC-R-12):** Elevated levels of TPH and PAHs were identified in soil beneath the pilot plant fuel oil AST after its removal. An area approximately 33 feet by 24 feet and 3 feet deep was excavated and four samples were collected. Sample results indicated that no PAH-contaminated soil remained, and that TPH contamination was not present at concentrations greater than cleanup goals.
- **Vehicle Maintenance and Wash-down Area (AOC-R-13):** Elevated levels of arsenic were identified in soil around the vehicle maintenance and wash-down area. Elevated levels of PAH and TPHs were also identified during excavation and confirmation sampling for the arsenic impacted soil. An area approximately 28 feet by 47 feet and 4 feet deep was excavated, with four rounds of excavation and sampling being conducted. In total, 40 samples were collected, confirming the removal of contaminated soil from this AOC.
- **BPA Substation Equipment Pads (AOC-R-20):** Elevated levels of TPH constituents were detected around some of the equipment pads in the former BPA substation. Two rounds of excavation and sampling were conducted, and a total of 21 samples were collected to confirm removal of the impacted soil. The area and depth of excavation is not known.
- **Shotting Water Tank (AOC-R-23):** Elevated levels of TPH constituents were identified in soil beneath the shotting water tank. An area 26 feet by 26 feet and 3 feet deep was excavated in two rounds, with subsequent sampling. A total of seven samples were collected, which indicated that no contamination remained at concentrations greater than cleanup levels. (Linebach Funkhouser 2002a)

Two additional AOCs (lower ore body fueling area and Baghouse AST) were identified as additional AOCs based on visual observations made during remedial activities at previously identified AOCs.

- **Lower Ore Body Fueling Area:** One diesel AST was located in a fueling area at the lower ore body. Two rounds of excavation and sampling were conducted, with a total of eight confirmation samples collected. Sample results indicated that no contamination remained at this AOC at concentrations greater than cleanup goals.
- **Baghouse AST Area:** Due to evidence of minor spills or overfilling, a former AST area located approximately 100 feet west of the baghouse structure (AOC-R-7) was identified as an additional AOC. An area approximately 27 feet by 60 feet was excavated to a depth of approximately 2 feet, with 11 confirmation samples being collected. Results indicated that no contamination was present at concentrations greater than cleanup goals. (Linebach Funkhouser 2002a)

Approximately 39,660 cubic yards of impacted soil was removed from the GNS site and disposed of at a landfill in Corvallis, Oregon. Soil excavation activities

and confirmation sampling indicted that cleanup goals were achieved at all 11 AOCs. (Linebach Funkhouser 2002a)

2.5.6 Response to Comments Letter from Glenbrook Nickel Company to ODEQ

On July 16, 2002, ODEQ provided the Glenbrook Nickel Company with comments on the June 2002 *Removal of Remedial Actions, Eleven Areas of Concern, Glenbrook Nickel Facility, Riddle, Oregon* report (summarized above in Section 2.5.5) identifying several issues that needed to be addressed further, as well as information regarding additional areas of concern raised by a potential purchaser of the property. This letter was available; however, a response letter from the Glenbrook Nickel Company dated October 23, 2002, was available. In this letter, the Glenbrook Nickel Company addressed ODEQ's comments, as well as provided additional sample collection information and analytical results (Linebach Funkhouser 2002b). The letter provides the following information regarding new sampling at AOCs, as well as the identification and sampling of newly identified AOCs:

New Sampling at AOCs:

The Glenbrook Nickel Company's letter indicates that to further supplement the lead analytical results from previous samples collected from the Sand Blast Area (AOC-R-1), three additional grab samples were collected on August 15, 2002, for analysis of 18 metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc). Analytical results were compared to ODEQ RBCs and EPA Region 9 Preliminary Remediation Goals residential and industrial standards. Detected analytes were all less than ODEQ RBCs and EPA Preliminary Remediation Goals (both residential and industrial).

In addition, two water samples were collected from the guard shack well on August 29, 2002. One sample was analyzed for metals, VOCs, PAHs, and chlorinated herbicides; the second (believed to be a duplicate) was analyzed for VOCs and PAHs. Aluminum, barium, molybdenum, zinc, benzo(k)fluoranthene, and phenanthrene were detected in one sample, while benzo(a)anthracene and fluoranthene were detected in the other. All detected analytes were below ODEQ RBCs.

Finally, a water sample was collected from Rail Gulch upgradient of the former smelter facility on August 15, 2002, and analyzed for 18 metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc). Aluminum and nickel were detected, though at concentrations below ODEQ RBCs. No other analytes were detected. (Linebach Funkhouser 2002b)

Sampling at Newly Identified AOCs: The Glenbrook Nickel Company's letter also indicates that the following new AOCs were identified and were addressed as described below:

- **Primary Iron Turnings Off-loading Area:** This AOC encompassed an area measuring approximately 75 feet by 250 feet (Figure 2-4). Two surface soil samples collected in the off-loading area indicated lead at concentrations of 911 mg/kg and 202 mg/kg. Approximately 1 foot of soil was removed from impacted area. Confirmation samples were later collected at eight locations in the excavation bottom on August 29, 2002, which indicated lead above 100 mg/kg in two samples. An additional 1 foot of soil was removed from the excavation, and additional confirmation samples were collected on September 4, 2002, that indicated lead concentrations below ODEQ residential RBCs.
- **Secondary Iron Turnings Off-loading Area**: This AOC consists of two areas measuring approximately 70 feet by 115 feet and 75 feet by 65 feet, located south and southwest of the Primary Iron Turnings Off-loading Area, respectively (Figure 2-4). Nine surface grab samples collected from these areas indicated lead levels ranging from less than 10 mg/kg to 8,900 mg/kg. Soil in the impacted areas was excavated to a depth of approximately 1 foot. Confirmation samples were collected at 15 locations in the excavation bottom on October 14, 2002. Sample results indicated that lead concentrations were below ODEQ residential RBCs.
- **Sawdust Pile:** Two grab samples were collected from a sawdust pile (location unknown) used for hog fuel and were analyzed for TPH and PAH. The samples were also subjected to a silica gel test to distinguish between petroleum hydrocarbons and organic hydrocarbons. Sample results indicated the presence of TPH as oil below ODEQ RBCs. No PAHs were detected.
- **Transformer Vault:** Residual oil in the bottom of a transformer vault located in the smelter building was sampled on August 2, 2002. One sample was collected and analyzed for PCBs; PCBs were not detected in the sample. (Linebach Funkhouser 2002b)

2.5.7 ODEQ Site Summary Report, Glenbrook Nickel Facility, Riddle, Oregon

On December 2002, ODEQ completed a Site Summary Report summarizing the environmental investigations and cleanup that occurred from April 2000 through October 2002 at the GNS site. Through a review of all available documentation, ODEQ concluded that the investigation and cleanup within the GNS site boundary is complete and recommended that unless new or previously undisclosed information becomes available, ODEQ would require no further action. This determination was based on the remedial activities discussed above, all final confirmation soil sample results meeting applicable cleanup levels, the limited vertical extent of the contaminants in soil, and the depth to groundwater,

as well as the nearest surface waterbody being more than 900 to 1,000 feet from former contaminant areas. However, ODEQ indicated that several areas outside of the GNS site boundary were not included in the no further action determination. These areas included AOCs 15, 16, 17, 18, 19; the lower ore body fueling area; and storm water discharges from ore piles. (ODEQ 2002)

2.5.8 No Further Action Determination - Glenbrook Nickel Facility, 5093 Riddle By-Pass Road, Riddle, Oregon ECSI #2898 Voluntary Cleanup Program

On January 8, 2003, ODEQ issued a no further action determination for the GNS site for areas within the site's boundary. However, as mentioned above, ODEQ indicated that the no further action determination did not apply to the AOCs outside of the GNS site boundaries, including AOCs 15, 16, 17, 18, and 19; the lower ore body fueling area; and discharges of storm water runoff from the ore piles. (ODEQ 2003)

2.6 Potential Sources and Source Characteristics

As discussed in Section 2.5, many of the potential source areas at the site have been extensively investigated and many removal/remedial actions have occurred. As a result of these removal/remedial actions, contaminants associated with potential sources areas at the site (i.e., primarily semivolatile organic compounds [SVOCs]/PAHs and TPHs) have been remediated to concentrations at or below ODEQ cleanup standards. For this reason, potential sources investigated as part of this SI were limited to the two upper and one lower retention/settling ponds.

These ponds are located below the slag/mining byproduct stockpiles (Figure 2-1). The two upper retention/settling ponds encompass an approximate area of 143,530 square feet (SF) and 244,364 SF, with the larger of the two ponds being situated at a slightly lower elevation than the smaller pond. The lower retention/settling pond encompass an approximate area of 2,834,032 SF. The depths of these ponds are not known.

Surface water from the two upper retention/settling ponds drains into a large lower retention/settling pond (Figure 2-1). As stated in Section 2.2, the lower of the two upper ponds is currently used to store and recirculate water used by Green Diamond in on-site operations. One sediment (S-7) and one surface water (W-3) sample were collected from the eastern edge of the upper of these two ponds during the Phase II ESA sampling event discussed in Section 2.5.2. Results from these samples indicate that manganese and nickel were present in the sediment, and dissolved chromium and manganese were present in surface water. Concentrations of all analytes detected in the above samples were below ODEQ leachate concentration limits.

Potential contaminants associated with these ponds include diesel range TPH, PCBs, SVOCs/PAHs, and Target Analyte List (TAL) metals.

2.7 START Site Visit

A site visit to the GNS site was conducted on May 12, 2017. Photographs of site features were taken during this time (Appendix A). Site visit attendees included:

- Art Schweizer, Green Diamond, Owner;
- Brian Rebuck Jr., Green Diamond, President;
- Brandon Legg, Green Diamond, General Manager of Operations;
- Steve Legg, Green Diamond, Environmental Health and Safety Supervisor;
- Ken Marcy, EPA, Task Monitor (TM);
- Mallory Ott, ODEQ; and
- Derek Pulvino, E & E, START Team Member.

Prior to the site visit, all participants met at the Green Diamond Corporate Office in Riddle, Oregon. Participants discussed the nature and purpose of the START's visit to the site; background details on both the site's current operations and how that relates to previous smelting work performed at the site; and the property owner/operator and EPA/ODEQ's knowledge of environmental characterization and cleanup work that has occurred at the site. Based on this information, it appeared that additional work had been performed at the site outside of EPA's and/or ODEQ's knowledge and that corresponding reports had not been provided to these agencies (e.g., the Phase I and Phase II ESA [see Section 2.5.2]).

In addition, property owner/operator personnel also indicated that, per governmental and vendor certification requirements, an extensive body of analytical data has been generated in regard to the environmental, physical, and chemical characteristics of the remaining slag/mining byproduct at the site. The site also operates under a NPDES permit overseen by ODEQ staff.

Given the large area encompassed by the site, site visit attendees used trucks to tour much of the site. While many of the structures and portions of operational infrastructure remain on the site, such structures in areas of the site that had been previously remediated are largely gone. Buildings/structures no longer present include the smelter building itself; the bag house and various sorting equipment; aboveground fuel storage tanks and related fueling stations; and the electrical substation previously operated by the BPA.

Railroad spurs remain on the central portion of the former smelter area. These spurs connect the former smelter building area by way of siding track to the local railroad right-of-way. The spurs and sidings are actively used to transport materials.

The largest operational area of the site is associated with the smelter used to reclaim slag and mining byproduct for sorting and sale. This product essentially

forms a contiguous stockpile of material that at its widest point extends nearly 0.75 mile from end to end, reaching an estimated height of several hundred feet on its western end. Prior to Green Diamond beginning operations, the entire stockpile had reportedly reached this same height. According to Green Diamond's representatives, the oldest portions of the stockpile are on its eastern flank. While the smelter was in operation, the mining byproduct was conveyed to this area, and as the stockpile reached the height of the conveyor system, the conveyor was extended further westward. By the 1990s, the conveyor system reached the western margins of this stockpile, where the newest material was deposited. As viewed from east to west, different eras of material are discernable, with material becoming darker, apparently in relation to the smelting process used and the slag grain size. Since the end of the smelting operations, these stockpiles have only been used as a source material for Green Diamond's operation, with no additional material added to the stockpile.

A fence-enclosed storage area is situated to the east of the stockpile. During the site visit, the area was noted to be asphalt paved. Items stored in this area included what appeared to be empty drums, damaged vehicles, and other equipment remnants that were apparently related to the historic smelting operations. No significant staining or discoloration was noted in this area. Where present, the asphalt appeared to be in good condition. A ball mill and the original small/pilot smelter were both present within several hundred feet west of the storage area. The ball mill was in operation at the time of the site visit and is used to extract small amounts of nickel that may remain in mining byproduct on site.

Two retention/settling ponds are present below the byproduct stockpiles; one pond is slightly lower in elevation than the other. The lower of the two is used to store and recirculate water used by Green Diamond in on-site operations. The lower side of the lower holding pond is formed by an earthen dam. Although hydrographic maps show a stream drainage channel in the area below the settling/retention pond, no such drainage was observed at the time of the site visit.

A lower retention/settling pond is located in the southwest corner of the site. As depicted on Figure 2-1, this pond also includes a levy along its lower margins. A gravel/dirt road accessing this portion of the site is constructed atop the levy. A sluice gate is located at a man-made drainage channel in the southwest corner of this area. According to site representatives, this sluice gate is the only surface water drainage channel from this portion of the site. Although there was standing water in the ponded area behind the levy at the time of the site visit, the water level was too low to allow for surface water outflow. For the majority of the year, storm water does not leave the site through this channel. The sluice gate is sampled under the site's NPDES permit during those months when storm water flow is present.

Finally, while hydrographic maps of the area also depict several surface water drainages leading from the site to Cow Creek, no such drainage features were observed.

2.8 Summary of SI Investigation Locations

Sampling under the GNS SI was conducted at possible sources of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)–regulated substances and at areas (i.e., targets) that may have been contaminated through the migration of hazardous substances from site sources. The features identified under inspection under the SI were determined based on a site visit, and a review of previous investigations and background information. These features are discussed below.:

2.8.1 Sources

As outlined above in Section 2.5, several removal/remedial actions have occurred at potential source areas, resulting in potential contaminants associated with these areas (i.e., primarily SVOC/PAHs and TPHs) having been remediated to concentrations at or below ODEQ cleanup standards. For this reason, they were not included as part of this SI. Potential sources investigated as part of this SI were limited to the two upper and one lower retention/settling ponds.

2.8.2 Targets

Targets in proximity to the site that may be impacted by past operations include:

- **Cow Creek:** Previous investigations did not sufficiently assessed the site's potential impacts to Cow Creek. In addition to serving as the drinking source for the City of Riddle and Lawson Acres subdivision, Cow Creek provides critical habitat for the federally listed threatened Oregon Coast Coho salmon (*Oncorhynchus kisutch*) (NOAA 2017a; USFWS 2017a).
- **Shallow Groundwater:** Previous investigations did not sufficiently assessed the potential for contamination in shallow groundwater to the surface waters of Cow Creek. Additionally, several private domestic water wells are located immediately downgradient of the GNS site. However, these wells typically draw water from a deeper, regional aquifer, which is believed to be confined.
- **Nearby Drainages/Tributaries:** Several nearby drainages/tributaries convey surface water runoff from the upper mine area to Cow Creek. An assessment of these drainages has not been conducted to determine if surface water runoff from the upper mine area has impacted Cow Creek.

3 Field Activities and Analytical Protocol

A sampling and quality assurance plan (SQAP) for the GNS SI was developed by the START prior to field sampling (E & E 2017). The SQAP describes the sampling strategy, sampling methodology, and analytical program used to investigate potential hazardous substance sources and potential targets. With few exceptions, the SI field activities were conducted in accordance with the approved SQAP. Deviations from the SQAP are described, when applicable, in this section and in the sampling location discussions in Section 6 (source areas) and Section 7 (target areas). All deviations to this SQAP were discussed with the EPA TM during the field sampling event, and were recorded in the field logbook(s) and on a Sample Plan Alteration Form (Appendix B).

The SI field sampling event was conducted from November 27, 2017 through December 1, 2017. A total of 87 samples, including seven background samples, one QA (rinsate) sample, and one investigation derived waste (IDW) sample were collected for the SI. Sample types and methods of collection are described below. A list of all samples collected for laboratory analysis under this SI is contained in Table 3-1. Photographic documentation of SI field activities is included as Appendix A.

Alphanumeric identification numbers applied by the START to each sample location (e.g., BH01GW-D) are used in the report as the sample location identifiers. Table 3-2 summarizes the sample coding system used for formulating sample numbers. For example, the sample number BH01GW-D indicates the following:

- **BH** for the source code (in this case, for a borehole);
- **01** for the sequential number of samples from a given source by matrix (in this case, the first groundwater sample collected from a borehole);
- **GW** for the sample matrix (in this case, groundwater); and
- **-D** to indicate a sample a sample was submitted for dissolved metals analysis.

This section describes sampling methodology, analytical protocol, global positions system (GPS), and IDW.

3.1 Sampling Methodology

Grass, leaves, other vegetative material, rocks, and other debris unsuitable for analysis were removed from samples before being placed into sample containers. Samples were stored in coolers, on ice, continuously maintained under the

custody of START personnel. Sampling methods used for each sample type are described below.

3.1.1 Surface Water Sampling

Surface water samples were collected by either hand-dipping the sample container into the surface waterbody being sampled or by using a peristaltic pump. A peristaltic pump and 0.45 micron filter were utilized for each sample aliquot collected for dissolved metals analysis. Sample collection began at the most downstream location, and progressed from downstream to upstream locations to limit the possibility for cross-contamination from suspended sediment. Further, all surface water sampling on Cow Creek was completed prior to sampling the nearby drainages/tributaries. Samples were preserved as per method requirements following sample collection. Additionally, prior to sampling at most locations, water quality measurements (pH, temperature, conductivity, dissolved oxygen, and turbidity) were recorded. Where surface water samples were co-located with sediment samples, surface water samples were collected prior collecting sediment samples to prevent introduction of re-suspended sediment into the sample.

3.1.2 Surface Sediment Sampling

In areas where the ground surface was covered by debris unsuitable for analysis (e.g., leaves, rocks, vegetation), samples were collected from up to the first 6 inches of material beneath these layers. Sample collection began at the most downstream location, and progressed to upstream locations to limit the possibility for cross-contamination. Further, all sediment sampling on Cow Creek was completed prior to sampling the nearby drainages/tributaries. All samples were collected using dedicated stainless steel spoons. Collected material was placed into a dedicated stainless steel bowl, thoroughly homogenized, and placed into a certified clean pre-labeled container. Where sediment samples were co-located with surface water samples, sediment samples were collected following the collection of surface water samples.

3.1.3 Shallow Groundwater Sampling

Shallow groundwater samples were collected from temporary wellpoints installed using a Geoprobe™ direct push drill rig. Each wellpoint consisted of a 4-foot 0.010-inch slot stainless steel well screen. A peristaltic pump and dedicated Teflon-lined tubing was utilized to purge and sample each temporary wellpoint. Sampling tubing was set approximately 1 foot below the water table, with the pumping rate set between 0.1 and 0.5 liters per minute during purging. In general, at each wellpoint, groundwater was purged until the targeted water quality parameters listed in the bulleted text below had stabilized. However, at some locations, water quality parameters (primarily turbidity) would not stabilize, even after two hours of purging (see Appendix B). With EPA TM approval, samples were collected prior to stabilization in these cases.

- ± 0.1 standard unit for pH;
- ± 3% for temperature and specific conductance;

- ± 10% for dissolved oxygen; and
- ± 10% for turbidity or is less than 10 nephelometric turbidity units.

Samples were pumped directly into pre-labeled sample containers using low-flow sampling techniques (i.e., pumping rate of 0.1 and 0.5 liters per minute) and preserved as per method requirements upon sample collection completion. Each sample aliquot collected for dissolved TAL metals analysis was filtered with a 0.45 micron filter.

3.1.4 Drinking Water Well Sampling

A single sample was collected from an unused drinking water supply located at the guard shack. The sample was collected from the closest faucet to the wellhead, though the faucet was located downstream of the systems holding tank (a faucet prior to the system's holding tank was not available). It was anticipated that prior to sampling, the faucet would be allowed to discharge at a steady rate for at least 15 minutes to ensure fresh formation water was sampled. However, the well pumped dry and would not continuously produce water; approximately 1 liter of water was produced prior to the well pumping dry each time. Because of this, water quality parameters (pH, temperature, turbidity, oxidation reduction potential, conductivity) were not recorded. Sample containers were filled directly from the faucet into pre-labeled sample containers and preserved as per method requirements upon sample collection completion.

3.2 Analytical Protocol

Analytical protocols applied to the SI samples included off-site fixed laboratory analysis of samples for varying combinations of TAL metals, PCBs, SVOCs, and total petroleum hydrocarbons as diesel (TPH-Dx). Additionally, surface water and shallow groundwater samples were analyzed for dissolved TAL metals. Analyses applied to the samples are presented in Table 3-1.

The following samples were submitted to the EPA's Manchester Environmental Laboratory (MEL), or an EPA Contract Laboratory Program (CLP) laboratory for analysis.

3.2.1 EPA Region 10 MEL Sample Analysis

The following samples (including QA/QC samples) were submitted to the Region 10 EPA MEL for the following analysis:

- **Diesel Range TPH:** 19 sediment and 25 water samples were analyzed by NWTPH-Dx.

3.2.2 EPA CLP Sample Analysis

The following samples (including QA/QC samples) were submitted to Bonner Analytical Testing Company, located in Hattiesburg, Mississippi, for the following analyses:

- **TAL Metals (including mercury):** 26 sediment and 31 water samples were analyzed by EPA CLP SOW ISM02.4;
- **Dissolved TAL Metals (including mercury):** 30 water samples were analyzed by EPA CLP SOW ISM02.4;

The following samples (including QA/QC samples) were submitted to ChemTech Consulting Group, located in Mountainside, New Jersey, for the following analyses:

- **PCBs:** 25 water samples were analyzed by EPA CLP SOW SOM02.4;
- **SVOCs:** 25 water samples were analyzed by EPA CLP SOW SOM02.4; and
- **SVOCs/PCBs:** 19 sediment samples were analyzed by EPA CLP SOW SOM02.4.

3.3 Global Positioning System

GPS coordinates of SI sample locations were collected utilizing a Trimble ProXR™. Recorded GPS coordinates by sample point are listed in Appendix C.

3.4 Investigation-Derived Waste

IDW generated during the GNS SI sampling event included disposable sampling supplies, disposable personal protection equipment, and decontamination water. All disposable IDW was bagged in opaque plastic bags. Materials that could be recycled (plastic, cardboard, steel, and paper) were segregated from trash for recycling. Both the disposable IDW and recyclable materials were returned to the EPA Region 10 warehouse located in Seattle, Washington, and collected by Waste Management.

Decontamination water was contained in one 55-gallon drum. One sample (ID01WT) was collected and analyzed for PCBs, SVOCs, TAL metals, and TPH-Dx for waste characterization purposes. Sample results were submitted to Waste Management for profiling (see Appendix D), who determined that the decontamination water is non-hazardous. The drum is pending removal from the site by Waste Management, who will transport it to their landfill in Arlington, Oregon, for disposal as non-hazardous waste.

4 Quality Assurance/ Quality Control

QA/QC data are necessary to determine precision and accuracy and to demonstrate the absence of interferences and/or contamination of sampling equipment, glassware, and reagents. Specific QC requirements for laboratory analyses are incorporated in the *USEPA Contract Laboratory Program Statement of Work for Inorganic Superfund Methods Multi-Media Multi-Concentration ISM02.4* (EPA 2016a) and the *USEPA Contract Laboratory Program Statement of Work for Organic Superfund Methods Multi-Media Multi-Concentration SOM02.4* (EPA 2016b). These QC requirements or equivalent requirements found in the analytical methods were followed for analytical work on the project. This section describes the QA/QC measures taken for the project and provides an evaluation of the usability of data presented in this report.

Data from the CLP laboratories were reviewed and validated by EPA chemists, and underwent a cursory review from a START chemist. Data qualifiers and labels were applied as necessary according to the following guidance:

- EPA (2017a) *National Functional Guidelines for Inorganic Superfund Methods Data Review.*
- EPA (2017b) *National Functional Guidelines for Organic Superfund Methods Data Review.*
- EPA (2009) *Guidance for Labeling Externally Validated Laboratory Data for Superfund Use.*

In the absence of other QC guidance, method- and/or SOP-specific QC limits were also utilized to apply qualifiers to the data. Chain-of-custody forms are provided in Appendix E. Data validation memoranda and laboratory data sheets of analytical results for all samples are provided in Appendix E.

4.1 Satisfaction of Data Quality Objectives

The following EPA (EPA 2000) guidance document was used to establish data quality objectives (DQOs) for this project:

- *Guidance for the Data Quality Objectives Process* (EPA QA/G-4), EPA/600/R-96/055.

The EPA TM determined that definitive data without error and bias determination would be used for the sampling and analyses conducted during the field activities. The data quality achieved during the field work produced sufficient data that met the DQOs stated in the SQAP (E & E 2017). A detailed discussion of accomplished project objectives is presented in the following sections.

4.2 QA/QC Samples

Trip blank QA samples were not required as no samples were collected for VOC analysis. Rinsate blank QA samples were collected for each 20 samples collected using non-dedicated sampling equipment. QC samples included matrix spike/matrix spike duplicate (MS/MSD) and/or blank spike (BS) samples at a rate of one MS/MSD and/or BS per 20 samples per matrix.

4.3 Project-Specific Data Quality Objectives

The laboratory data were reviewed to ensure that DQOs for the project were met. The following describes the laboratories' and/or field team's abilities to meet project DQOs for precision, accuracy, and completeness and the field team's ability to meet project DQOs for representativeness and comparability. The laboratories and the field team were able to meet DQOs for the project.

4.3.1 Precision

Precision measures the reproducibility of the sampling and analytical methodology. Laboratory and field precision is defined as the relative percent difference (RPD) between duplicate sample analyses. The laboratory duplicate samples or MS/MSD samples measure the precision of the analytical method. The RPD values were reviewed for all commercial laboratory samples. No sample results were qualified based on precision outliers; therefore, the project DQO for precision was met.

4.3.2 Accuracy

Accuracy indicates the conformity of the measurements to fact. Laboratory accuracy is defined as the surrogate spike percent recovery (%R) or the MS/MSD/BS %Rs for all laboratory analyses. The surrogate %R values were reviewed for all appropriate sample analyses. A total of 54 sample results (approximately 1.2% of the data) were qualified as estimated quantities (J) based on surrogate outliers.

The %R values were reviewed for all MS/MSD/BS analyses. A total of 79 sample results (approximately 1.8% of the data) were qualified as estimated quantities (J) based on MS/MSD/BS outliers; therefore, the project DQO for accuracy of 90% was met.

4.3.3 Completeness

Data completeness is defined as the percentage of usable data (usable data divided by the total possible data). All laboratory data were reviewed for data validation and usability. No sample results were rejected (R); therefore, the project DQO for completeness of 90% was met.

4.3.4 Representativeness

Data representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point or environmental condition. The number and selection of samples were determined in the field to account accurately for site variations and sample matrices. The DQO for representativeness was met.

4.3.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another. Data produced for this site followed applicable field sampling techniques and specific analytical methodology. The DQO for comparability was met.

4.4 Laboratory QA/QC Parameters

The laboratory data also were reviewed for holding times/temperatures/sample containers, laboratory blank samples, serial dilution analyses, and rinsate blanks. These QA/QC parameters are summarized below.

4.4.1 Holding Times/Temperatures/Sample Containers

All holding times, sample temperatures, and containers were acceptable.

4.4.2 Laboratory Blanks

All laboratory blanks met the frequency criteria. The following potential contaminants of concern were detected in the laboratory blanks:

- Inorganics: antimony, barium, beryllium, cadmium, calcium, chromium, cobalt, manganese, mercury, nickel, potassium, sodium, vanadium, and zinc.

See the data validation memoranda for results qualified based on blank contamination.

4.4.3 Serial Dilution Analyses

Serial dilution analyses met the frequency criteria. A total of nine sample results (approximately 0.2% of the data) were qualified based on serial dilution outliers.

4.4.4 Rinsate Blanks

Rinsate blank analyses were performed at a frequency of one per 20 samples collected using non-dedicated sampling equipment (groundwater samples). Calcium (21.8 JQ micrograms per liter [µg/L], dissolved and 17.9 JQ µg/L, undissolved) were detected in the rinsate blanks. No qualifications were applied to associated sample results as these results were all greater than five times the rinsate blank results.

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5 Analytical Results Reporting and Background Samples

This section describes the reporting and methods applied to analytical results presented in Section 6 (sources) and Section 7 (targets) of this report, and discusses background locations and sample results. Table 3-1 lists all samples collected for laboratory analysis.

5.1 Analytical Results Evaluation Criteria

Analytical results presented in the summary tables of Sections 6 and 7 show all analytes detected above laboratory detection limits in bold type. Analytical results indicating significant/elevated concentrations of contaminants in source samples (Section 6) and target samples (Section 7) with respect to background concentrations are shown underlined and in bold type. For the purposes of this investigation, significant/elevated concentrations include those concentrations that are:

- Equal to or greater than the sample's adjusted Contract Required Quantitation Limit (CRQL) or the adjusted Sample Quantitation Limit (SQL) when a non-CLP laboratory was used; and
- Equal to or greater than the background sample's adjusted CRQL or adjusted SQL when the background concentration was below detection limits; or
- At least three times greater than the background concentration when the background concentration equals or exceeds the detection limits.

The analytical summary tables present all detected compounds, but only those detected analytes at potential sources and targets meeting the significant/elevated concentration criteria are discussed in the report text. However, all detected concentrations are discussed for the background samples. When samples were diluted for re-analysis at a laboratory, the dilution results were considered for evaluation and are provided in the tables.

5.1.1 Sample Results Reporting

The analytes aluminum, calcium, iron, magnesium, potassium, and sodium are common earth crust elements. Based on EPA, Region 10, policy, these common earth crust elements will not be discussed in this report.

5.2 Background Samples

Background samples were collected for each of the naturally occurring media from which SI samples were collected, and include surface water, groundwater, and sediment. Background sample locations are presented on Figure 6-1 and

Figure 7-4. Results for the appropriate background samples are shown in the first column of the analytical results summary tables in Sections 6 and 7 for comparison against source or target sample results.

5.2.1 Background Surface Water Samples

5.2.1.1 Sample Location

Background surface water sample locations are presented on Figure 7-4. Two background surface water samples (BK01SW and BK01SW-D) were collected from Cow Creek upstream of its confluence with Doe Creek and were used for comparison of surface water samples collected from Cow Creek, as well as the samples collected from the lower reaches of Doe Creek, Crawford Branch, Rail Gulch, the unnamed drainage, and Jerry Creek. Two additional background surface water samples (BK02SW and BK01SW-D) were collected from Little Doe Creek, and used for comparison of surface water samples collected from the upper reaches of Doe Creek, Crawford Branch, and Rail Gulch. These background samples were also used for comparison of the surface water samples collected from the upper and lower settling/retention ponds, with the most conservative (i.e., highest) detected concentration per analyte being used for comparison.

5.2.1.2 Sample Results

Analytical results indicate the following:

- **BK01SW:** Sample results indicate that other than common earth crust metals, manganese was the only analyte detected above CRQLs in the background surface water sample collected from Cow Creek.
- **BK01SW-D:** Sample results indicate that no dissolved metals were detected above CRQLs in the background surface water sample collected from Cow Creek.
- **BK02SW:** Sample results indicate that other than common earth crust metals, no analytes were detected above CRQLs in the background surface water sample collected from Little Doe Creek.
- **BK02SW-D:** Sample results indicate that no dissolved metals were detected above CRQLs in the background surface water sample collected from Little Doe Creek.

5.2.2 Background Sediment Samples

5.2.2.1 Sample Location

Background sediment sample locations are presented on Figure 7-4. One background sediment sample (BK01SD) was collected from Cow Creek upstream of its confluence with Doe Creek and was used for comparison of sediment samples collected from Cow Creek, as well as the samples collected from the lower reaches of Doe Creek, Crawford Branch, Rail Gulch, the unnamed drainage, and Jerry Creek. One additional background sediment sample (BK02SD) was collected from Little Doe Creek and was used for comparison of

sediment samples collected from the upper reaches of Doe Creek, Crawford Branch, Rail Gulch, and the unnamed drainage. Background samples BK01SD and BK02SD were also used for comparison of the sediment samples collected from the upper and lower settling/retention ponds, with the most conservative (i.e., highest) detected concentration being used for comparison.

5.2.2.2 Sample Results

Analytical results indicate the following:

- **BK01SD:** Ten TAL metals (arsenic, barium, chromium, cobalt, copper, lead, manganese, nickel, vanadium, and zinc) and one SVOC (dimethylphthalate) were detected above their respective CRQLs in the background sediment sample collected from Cow Creek.
- **BK02SD:** Ten TAL metals (arsenic, barium, chromium, cobalt, copper, lead, manganese, nickel, vanadium, and zinc) were detected above their respective CRQLs in the background sediment sample collected from Little Doe Creek.

5.2.3 Background Groundwater Samples

5.2.3.1 Sample Location

Background sample locations are presented on Figure 6-1. A total of two background groundwater samples (BK01GW and BK01GW-D) were collected from one temporary wellpoint installed in the western portion of the site from a location thought to be upgradient and unaffected by historic site activities. Groundwater at this location was encountered at approximately 7.2 feet bgs and the temporary well screen was placed from 6 to 10 feet bgs. The temporary wellpoint at this location was purged for approximately 30 minutes prior to stopping due to low light conditions. The next day, an additional 30 minutes of purging was conducted to reach the water quality parameters outlined in Section 3.1.1.

5.2.3.2 Sample Results

Analytical results indicate the following:

- **BK01GW:** Sample results indicate that no analytes, other than common earth crust elements, were detected in the background groundwater sample.
- **BK01GW-D:** Sample results indicate that no dissolved metals, other than common earth crust elements, were detected above CRQLs in the background groundwater sample.

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6 Potential Sources

This section describes potential sources, sample locations, and analytical results of SI samples obtained from potential sources that were detected at concentrations that were significant relative to background concentrations.

6.1 Upper Retention/Settling Ponds

As discussed in Section 2.6, the two upper retention/settling ponds encompass an approximate area of 143,530 SF and 244,364 SF, with the larger of the two ponds being situated at a slightly lower elevation than the smaller pond. The depths of these ponds are not known. Currently, the lower of these two ponds are used to store and recirculate water used by Green Diamond in on-site operations.

6.1.1 Sample Locations

Surface water and sediment samples were collected from three locations (UP01, UP02, and UP03) at or near the two upper retention/settling ponds (Figure 6-1). Sample collection activities were conducted from lower, downgradient locations first then progressed to upgradient locations to avoid the risk of cross-contamination of sample points. At stations UP02 and UP03, co-located surface water and sediment samples were collected. As explained below, it was not possible to collect a co-located surface water/sediment sample set at UP01. Specific observations made during sample collection activities are noted below.

- **UP01:** Attempts made to collect a co-located surface water/sediment sample set from the outfall draining the larger upper retention/settling pond were not successful. The outfall could not be approached without wading into the pond water, which caused the fine silt/clay at this location to become suspended in the water column. Because of this, surface water samples UP01SW and UP01SW-D were collected approximately 75 downgradient of the outfall. Surface water quality measurements obtained prior to sample collection indicated a pH of 8.63 and a turbidity of 2.1 nephelometric turbidity unit (NTUs). Sediment sample UP01SD was collected at the outfall from 0 to 3 inches bgs and consisted of white to tan silt layered on top of gray silt with a trace amount of gravel.
- **UP02:** Samples UP02SW, UP02SW-D, and UP02SD were collected from a forested area on the northwest edge of the larger upper retention/settling pond. Surface water quality measurements obtained prior to collecting samples UP02SW and UP02SW-D indicated a pH of 9.06 and a turbidity of 47.6 NTUs. Sediment sample UP02SD was collected from 0 to 3 inches bgs and consisted of dark brown silt with a high organic content.
- **UP03:** Samples UP03SW, UP03SW-D, and UP03SD were collected from the south portion of the smaller upper retention/settling pond where it drains into the larger upper retention/settling pond. Surface water quality

measurements obtained prior to collecting sample UP03SW and UP03SW-D indicated a pH of 9.04 and a turbidity of 172 NTUs. Sediment sample UP03SD was collected from 0 to 3 inches bgs and consisted of mixture of tan silt and coarse, angular slag/mining byproduct, similar to the surrounding piles.

6.1.2 Sample Results

Surface water sample results are presented in Table 6-1 and sediment sample results are presented in Table 6-2.

Chromium was detected at significant concentrations in all three surface water samples (UP01SW, UP02SW, and UP03SW) analyzed for total metals. Chromium was also detected at significant concentrations in all three surface water samples (UP01SW-D, UP02SW-D, and UP03SW-D) analyzed for dissolved metals. The highest concentrations of both total and dissolved chromium were detected in the surface water samples collected at station UP02 in the large upper retention/settling pond. No other analytes were detected at significant concentrations in the surface water samples collected from the upper retention/settling ponds.

One TAL metal (cadmium) was detected in sediment sample UP01SD at significant concentrations. Chromium, lead, mercury, and nickel were detected at significant concentrations in sediment sample UP02SD, while antimony, cadmium, chromium, and nickel were detected at significant concentrations in sediment sample UP03SD. Additionally, both diesel range and motor oil range TPHs were detected in sediment sample UP02SD. No other analytes were detected at significant concentrations in the sediment samples collected from the upper retention/settling ponds.

6.2 Lower Retention/Settling Pond

As discussed in Section 2.6, the lower retention/settling ponds encompass an approximate area of 2,834,032 SF. The depths of this pond is not known. Several sedimentation cells are present in the eastern portion of this pond. Surface water from the upper retention/settling ponds ultimately drains into the large lower retention/settling pond.

6.2.1 Sample Locations

Samples were collected from four locations (LP01, LP02, LP03, and LP04) within, and one location (LP05) outside of the lower retention/settling pond. Sample collection began at the western end of the lower retention/settling pond and progressed to the east. Sample locations are presented on Figure 6-1 and are discussed in the order they were collected below:

- **LP05:** One sediment sample (LD05SD) was collected from approximately 35 feet downgradient of the site's NPDES discharge point. This sample was collected from approximately 0 to 6 inches bgs from the middle of the

channel that leads from the lower retention/settling pond to Crawford Branch. Based on conversations with site representatives and observations made during the SI field event, construction to replace a washed out culvert on Crawford Branch had just been completed approximately 200 feet downgradient of the NPDES discharge point. Sample LP05SD was collected upgradient of the disturbed area created by the culvert replacement and consisted of brown well-graded sand with silt; no surface water was present at this location at the time of sampling.

- **LP01:** One sediment sample (LD01SD) was collected from the western portion of the lower retention/settling pond. This sample was collected from approximately 0 to 3 inches bgs from the center of a defined channel leading from the pond to the NPDES discharge point and consisted of brown inorganic loamy sand; no surface water was present at this location at the time of sampling.
- **LP02:** Two surface water samples (LP02SW and LP02SW-D) and one co-located sediment sample (LP02SD) were collected from the southern portion of the lower retention/settling pond. Surface water quality measurements recorded prior to collecting sample LP02SW and LP02SW-D indicated a pH of 8.42 and a turbidity of 15.5 NTUs. Sample LP02SD was collected from approximately 0 to 3 inches bgs and consisted of brown inorganic silt.
- **LP03:** Two surface water samples (LP03SW and LP03SW-D) and one co-located sediment sample (LP03SD) were collected near the middle of the sedimentation cells located in the eastern portion of the lower retention/settling pond. Surface water collected from this location originated from the upper retention/settling ponds. Sediment sample LP03SD was collected from approximately 0 to 3 inches bgs and consisted of light brown/tan inorganic silt.
- **LP04:** Two surface water samples (LP04SW and LP04SW-D) and one co-located sediment sample (LP04SD) were collected near the northern edge of the sedimentation cells located in the eastern portion of the lower retention/settling pond. Surface water collected from this location originated from the upper retention/settling ponds. Sediment sample LP04SD was collected from approximately 0 to 3 inches bgs and consisted of dense light brown/tan inorganic silt.

6.2.2 Sample Results

Sediment sample results are presented in Table 6-1 and surface water sample results are presented in Table 6-2.

Chromium was detected at significant concentrations in all three surface water samples (LP01SW, LP02SW, and LP03SW) analyzed for total metals. Chromium was also detected at significant concentrations in all three surface water samples (LP01SW-D, L02SW-D, and LP03SW-D) analyzed for dissolved

metals. No other analytes were detected at significant concentrations in the surface water samples collected from the lower retention/settling ponds.

Two TAL metals (cadmium and nickel) were detected at significant concentrations in all four sediment samples (LP01SD, LP02SD, LP03SD, and LP04SD) collected from within the lower retention/settling pond, as well as sediment sample LP05SD, collected downgradient of the NPDES discharge point. Chromium and selenium were detected at significant concentrations in each of the sediment samples collected within the lower retention/settling pond. Antimony was detected at significant concentrations in samples LP02SD, LP03SD, and LP04SD, and cobalt was detected at significant concentrations in samples LP02SD and LP04SD. Lastly, mercury and zinc were detected at significant concentrations only in sample LP04SD. No other analytes were detected at significant concentrations in the sediment samples collected from the lower retention/settling pond.

7 Migration/Exposure Pathways and Targets

The following subsections describe migration pathways and potential targets within the site's range of influence (Figures 7-1 and 7-2). As demonstrated above, several investigations have focused on the former smelter area of the GNS site. However, these previous investigations have not sufficiently assessed the site's retention/settling ponds and their potential impacts to Cow Creek. Therefore, this SI focuses primarily on the surface water migration pathway. An assessment of nearby drainages/tributaries to Cow Creek and shallow groundwater downgradient of the site was also conducted to determine the potential for contaminants to migrate from the former mine area located above the GNS and for shallow groundwater to impact the surface waters of Cow Creek.

7.1 Groundwater Migration Pathway

The target distance limit (TDL) for the groundwater migration pathway is a 4-mile radius that extends from the sources at the site. As mentioned above, this SI focuses on the surface water migration pathway and, as such, only domestic drinking water wells located downgradient of the site between Cow Creek and the site were identified. Figure 7-1 depicts the groundwater 4-TDL.

7.1.1 Geologic Setting

The GNS site is located within the Klamath Mountains physiographic province, which consists of complex terrain of metamorphosed marine and volcanic sediments, overlain by successions of younger sediments with volcanic and plutonic activity as well. A large, irregular body of peridotite and serpentine extends northeast and southwest from Nickel Mountain. The nickel deposits are related to the peridotite, an ultrabasic rock consisting chiefly of olivine and enstatite. The peridotite and serpentine body is intrusive into Jurassic sandstone and late Jurassic greenstone and related rocks, and is late Jurassic in age. The structure of these older rocks has a predominant northeasterly trend, and the rocks are unconformably overlain by the Knoxville formation and younger sedimentary rocks (Pecora 1942; Ore-Bin 1953).

Previous investigations at the facility identified a relatively homogenous thickness of reddish-brown silty clay to depths of 20 feet bgs. Soil permeability tests conducted on soil samples collected from approximately 3 to 5 feet bgs indicated that soil consisted of clay with a permeability range of 10^{-6} to 10^{-7} centimeters per second (Linebach Funkhouser 2002a).

7.1.2 Aquifer System

Temporary groundwater monitoring wells installed at the facility sporadically encountered groundwater representative of perched conditions (above the regional

aquifer) ranging from 3 feet to 6 feet bgs. The direction of flow of shallow groundwater in the area of the site has been interpreted to be south, toward Cow Creek (LWES 2000; Linebach Funkhouser 2002a).

Well logs for the on-site well located at the guard shack indicate that it was completed within the regional aquifer. Well logs show that water was first encountered during drilling of this well at 75 feet bgs. The static water level in this well has been measured at approximately 27 feet bgs and is thought to be representative of the equilibrated potentiometric surface (LWES 2000; Linebach Funkhouser 2002a). Well logs for domestic wells located between the site and Cow Creek indicate these wells were drilled to depths ranging from 80 to 295 feet bgs and first encountered groundwater between 12 to 265 feet bgs (OWRD 2017). Static water levels in these wells range from 12 to 160 feet bgs, indicating that the regional aquifer is likely confined in the area of the site (OWRD 2017).

7.1.3 Drinking Water Targets

Groundwater within the 4-mile TDL is used for domestic drinking water purposes. Domestic well logs are maintained by the Oregon Water Resources Division (OWRD). A search of the OWRD internet database for domestic wells located downgradient of the site between the site and Cow Creek (Township 30 South, Range 6 West, Sections 27, 28, 29, 32, and 33) indicated the presence of approximately 19 domestic water wells (OWRD 2017). The number of people served by these wells is not known; therefore, the average number of 2.41 persons per household for Douglas County, Oregon, was used to determine well populations (DOC 2017). Based on this information, it is estimated that approximately 46 people are served by domestic groundwater wells (i.e., 19 wells x 2.41 people per well = 45.79). The number of persons served by groundwater wells by distance ring is presented in Table 7-1.

7.1.4 Sample Locations and Results

7.1.4.1 Groundwater Sample Locations

Groundwater samples were collected from four locations (Figure 6-1) between the site and Cow Creek. It was anticipated that a total of six groundwater samples would be collected as part of this SI. However, because refusal was met at borehole location BH01 (discussed below) and given that the proposed borehole location southeast of the upper retention ponds was to be located at a similar elevation in relation to BH01, this borehole was not drilled and hence no sample was collected from it (see Sample Plan Alteration Form in Appendix B). Sample locations are discussed below and are presented on Figure 6-1:

- **BH01:** It was anticipated that one groundwater sample would be collected downgradient of the skulls fine pile (Figure 2-4). Due to refusal being met at approximately 9 feet bgs at this location, a groundwater sample was not collected.
- **BH02:** Two groundwater samples (BH02GW and BH02GW-D) were collected from a temporary wellpoint installed at the west end of the lower

retention/settling pond, near the NPDES discharge point. Groundwater at this location was encountered at approximately 9 feet bgs and the temporary well screen was placed from 9 to 13 feet bgs. The temporary wellpoint at this location was purged for approximately 2 hours in an attempt to stabilize water quality parameters discussed in Section 3.1.1. However, while all other parameters appeared to have been met, the lowest turbidity that could be reached after two hours of purging was 616 NTUs.

- **BH03:** Two groundwater samples (BH03GW and BH03GW-D) were collected from a temporary wellpoint installed in the southeast corner of the lower retention/settling pond. Groundwater at this location was encountered at approximately 8.3 feet bgs and the temporary well screen was placed from 9 to 13 feet bgs. The temporary wellpoint at this location was purged for approximately one hour and 20 minutes to reach the water quality parameters outlined in Section 3.1.1.
- **BH04:** Two groundwater samples (BH04GW and BH04GW-D) were collected from a temporary wellpoint installed east of the lower retention/settling pond. Groundwater at this location was encountered at approximately 2 feet bgs and the temporary well screen was placed from 4 to 8 feet bgs. The temporary wellpoint at this location was purged for approximately 40 minutes to reach the water quality parameters outlined in Section 3.1.1.
- **BH05:** Two groundwater samples (BH05GW and BH05GW-D) were collected from a temporary wellpoint installed between the two upper and lower retention/settling ponds. Groundwater at this location was encountered at approximately 5.8 feet bgs and the temporary well screen was placed from 6 to 10 feet bgs. The temporary wellpoint at this location was purged for approximately one hour to reach the water quality parameters outlined in Section 3.1.1.
- **DW01:** Two groundwater samples (DW01GW and DW01GW-D) were collected from a previously used drinking water well located at the guard shack. Well logs for this well indicate that this well was completed within the regional aquifer and that this aquifer is confined. During sampling, this well pumped dry several times.

7.1.4.2 Groundwater Sample Results

Groundwater sample results are presented in Table 7-2. Total metals analysis detected manganese at elevated concentrations in each of the four shallow groundwater samples (BH02GW, BH03GW, BH04GW, and BH05GW) collected from temporary wellpoints. Chromium and nickel were also detected at elevated concentrations in samples BH02GW and BH05GW. Copper was detected at an elevated concentration only in sample BH05GW.

Dissolved metals analysis detected chromium at elevated concentrations in one groundwater sample (BH02GW-D), as well as manganese in samples BH03GW-D, BH04GW-D, and BH05GW-D collected from temporary wellpoints.

Total metals analysis of water from the guard shack well (DW01GW) detected a total of five TAL metals (barium, copper, lead, manganese, and zinc) at elevated concentrations. Notably, lead was detected at 17.6 µg/L, slightly above the EPA's Safe Drinking Water Act National Primary Drinking Water Regulations maximum contaminant level of 15.0 µg/L. Dissolved metals analysis of water from this well detected barium, manganese, and zinc at elevated concentrations. This well is not currently used for drinking water and it is not likely to be used for drinking in the future.

7.2 Surface Water Migration Pathway

The surface water migration pathway TDL begins at the probable point of entry (PPE) of surface water runoff from the site to a surface water body and extends downstream for 15 miles. Figure 7-2 depicts the surface water migration TDL.

The two-year 24-hour rainfall event for the site is 3.5 inches (NOAA 2017b). The average annual precipitation, as measured at the nearest weather station in Riddle, Oregon, from June 1899 to June 2016, is 30.61 inches (WRCC 2017). The site is not located in a flood plain; however, sources at the site flood annually. Soils at the site consist of primarily of silty clay loam to gravelly loam (USDA 2017). Additionally, it is estimated that between 250 and 1,000 acres of upland drainage, drains through site sources.

Since the average annual precipitation for the area of the site is 30.39 inches, intermittently flowing streams are not considered to be surface water bodies for EPA SIs. Instead, these features are considered to be a component of the overland flow route for surface water runoff.

7.2.1 Overland Pathway and Target Distance Limit

Based on aerial photo interpretation, and observations made during the site visit and SI field work, all streams draining the site are considered to be intermittent. These intermittent streams include the following: Doe Creek, Crawford Branch (which includes drainage from intermittent Rail Gulch and retention/settling ponds), Jerry Creek, and an unnamed drainage. In many cases, the overland drainage routes for site sources through Doe Creek, Crawford Branch, Rail Gulch, and Jerry Creek to perennially-flowing Cow Creek are greater than 2 miles. The overland flow routes for each of these drainages are as follows:

- **Doe Creek:** Surface water runoff from the northwest side of Nickel Mountain travels approximately 1 mile overland to intermittent Doe Creek, then an additional 5 miles overland within Doe Creek to its confluence with Cow Creek.

- **Crawford Branch:** Surface water runoff from the south side of Nickel Mountain travels approximately 0.8 mile to intermittent Crawford Branch, then approximately 2.5 miles within Crawford Branch to its confluence with Cow Creek.
- **Rail Gulch:** Surface water runoff from the southeast side of Nickel Mountain travels approximately 1.2 miles overland to intermittent Rail Gulch, then approximately 1 mile to a culvert that conveys drainage approximately 0.3 mile under the slag/mining byproducts pile. Once Rail Gulch exits the culvert, it drains approximately 0.2 mile south to the intermittent lower retention/settling pond. Once in the lower retention/settling pond, drainage travels an additional 0.32 mile to the NPDES outfall on intermittent Crawford Branch, then another 0.2 mile to Crawford Branch's confluence with Cow Creek.
- **Unnamed Drainage:** Surface water runoff from the southeastern portion of Nickel Mountain travels overland approximately 0.1 mile to the unnamed drainage, then an additional 1.1 miles along this drainage to a culvert under the Riddle Bypass Road. From there, runoff travels an additional 1 mile to Cow Creek.
- **Jerry Creek:** Surface water runoff from the northeast side of Nickel Mountain travels approximately 0.3 mile overland to Jerry Creek, then an additional 3.2 miles to its confluence with Cow Creek.
- **Slag/Mining Byproduct and Retention/Settling Ponds:** Surface water runoff from the slag/mining byproducts area flows into the two upper retention/settling ponds. From the upper retention/settling ponds, surface water intermittently flows approximately 0.4 mile southwest in a ditch to the intermittent lower retention pond, where it then flows an additional 0.7 mile in the lower retention/settling pond to the NPDES outfall on Crawford Branch. Once in Crawford Branch, drainage travels another 0.27 mile to its confluence with Cow Creek.

One PPE exists for the site where surface water runoff enters Cow Creek from intermittent Crawford Branch. The site's 15-mile TDL starts at this PPE and continues 7.5 miles in Cow Creek, to its confluence with the South Umpqua River. The 15-mile TDL concludes 7.5 miles downstream within the South Umpqua River (Figure 7-2).

Cow Creek's flow rate, as measured near Riddle, Oregon, is 1,043 cubic feet per second (cfs) (USGS 2017a). The flow rate for the South Umpqua River as measured at Tiller, Oregon (approximately 27 miles upriver from its confluence with Cow Creek), is 1,250 cfs (USGS 2017b) and is 3,337 cfs measured approximately 20 miles downriver from its confluence with Cow Creek (USGS 2017c).

7.2.1.1 Cow Creek Sample Locations

Surface water and co-located sediment samples were collected from seven location on Cow Creek. It was anticipated that samples would be collected from nine locations on Cow Creek; however, due to access limitations, only seven were collected. Sediment and surface water sample locations are presented on Figure 6-1, Figure 7-3, and Figure 7-4, and are discussed below in the order they were collected.

- **CC01:** Two surface water samples (CC01SW and CC01SW-D) and one co-located sediment sample (CC01SD) were collected on the southwest bank of Cow Creek, slightly upstream of the Lawson Acres subdivision drinking water intake, approximately 6.5 miles downstream of the PPE. Surface water quality measurements obtained prior to sample collection indicated a pH of 5.78 and a turbidity of 6.4 NTUs. Sediment sample CC01SD was from 0 to 6 inches bgs and consisted of dark grayish brown well-graded sand.
- **CC02:** Two surface water samples (CC02SW and CC02SW-D) and one co-located sediment samples (CC02SD) were collected on the north bank of Cow Creek slightly upstream of the City of Riddle's drinking water intake, approximately 5.25 miles downstream of the site's PPE. Surface water quality measurements obtained prior to sample collection indicated a pH of 6.99 and a turbidity of 6.6 NTUs. Sediment sample CC02SD was from 0 to 6 inches bgs and consisted of brown, well-graded sand with silt.
- **CC03:** Two surface water samples (CC03SW and CC03SW-D) and one co-located sediment sample (CC03SD) were collected on the south bank of Cow Creek under the Canyonville-Riddle Bypass Road overpass, approximately 0.34 mile upstream of the City of Riddle's drinking water intake. Surface water quality measurements obtained prior to sample collection indicated a pH of 7 and a turbidity of 5.7 NTUs. Sediment sample CC03SD was from 0 to 6 inches bgs and consisted of brown, well-graded sand with silt.
- **CC04:** Two surface water samples (CC04SW and CC04SW-D) and one co-located sediment sample (CC04SD) were collected on the north bank of Cow Creek, under the Glenbrook Loop Road overpass, approximately 1 mile downstream of the site's PPE. Surface water quality measurements obtained prior to sample collection indicated a pH of 7.37 and a turbidity of 7.94 NTUs. Sediment sample CC04SD was from 0 to 6 inches bgs and consisted of brown, well-graded sand with silt.
- **CC05:** Two surface water samples (CC05SW and CC05SW-D) and one co-located sediment sample (CC05SD) were collected on the north bank of Cow Creek, approximately 0.6 mile downstream of the site's PPE. Surface water quality measurements obtained prior to sample collection indicated a pH of 7.34 and a turbidity of 11.8 NTUs. Sediment sample CC05SD was from 0 to 6 inches bgs and consisted of brown, well-graded sand with silt.

- **CC06:** Two surface water samples (CC06SW and CC06SW-D) and one co-located sediment sample (CC06SD) were collected on the north bank of Cow Creek, approximately 300 feet upstream of the site's PPE. Attempts were made to collect these samples at the site's PPE; however, due to high flow, the PPE could not be safely approached. Surface water quality measurements obtained prior to sample collection indicated a pH of 7.29 and a turbidity of 2.6 NTUs. Sediment sample CC06SD was from 0 to 2 inches bgs and consisted of dark gray sandy gravel.
- **CC07:** Two surface water samples (CC07SW and CC07SW-D) and one co-located sediment sample (CC07SD) were collected on the south bank of Cow Creek, approximately 4.8 miles upstream of the site's PPE, south of confluence of Doe Creek and Cow Creek. Surface water quality measurements obtained prior to sample collection indicated a pH of 7.28 and a turbidity of 13.4 NTUs. Sediment sample CC07SD was from 0 to 2 inches bgs and consisted of brown, well-graded sand.

7.2.1.2 Cow Creek Sample Results

Surface water sample results are presented in Table 7-3 and sediment sample results are presented in Table 7-4.

Surface water sample results indicate that manganese was the only analyte detected at elevated concentrations in the surface waters of Cow Creek. Manganese was detected in sample CC07SW submitted for total metals analysis, as well as samples CC02SW-D and CC05SW-D submitted for dissolved metals analysis.

Sediment sample results indicate that cadmium was the only TAL metal detected at elevated concentrations in the sediments of Cow Creek (samples CC01SD, CC02SD, CC04SD, and CC05SD).

7.2.1.3 Nearby Drainages/Tributaries Sample Locations

An assessment of Doe Creek, Crawford Branch, Rail Gulch, Jerry Creek, and the unnamed drainage was completed to assess potential runoff from the former nickel mine located above the site. In most cases surface water and sediment samples were collected from two locations on each drainages/tributary, one as close to the headwaters as possible, and the other near its confluence with Cow Creek. Sample locations are presented on Figure 6-1 and Figure 7-4 and are discussed below.

- **Doe Creek:** Two surface water samples (DC01SW and DC01SW-D) and one co-located sediment sample (DC01SD) were collected from Doe Creek slightly above its confluence with Cow Creek. Surface water quality measurements obtained prior to sample collection indicated a pH of 7.36 and a turbidity of 2.3 NTUs. Sediment sample DC01SD was from 0 to 2 inches bgs and consisted of well-graded gravel with silt. Two additional surface water samples (DC02SW and DC02SW-D) and one co-

located sediment sample (DC02SD) were collected from Doe Creek near its headwaters, below the former nickel mine. Surface water quality measurements obtained prior to sample collection indicated a pH of 7.36 and a turbidity of 1.8 NTUs. Sediment sample DC02SD was collected from 0 to 2 inches bgs and consisted of well-graded gravel with silt.

- **Crawford Branch:** Two surface water samples (CB01SW and CB01SW-D) and one co-located sediment sample (CB01SD) were collected from Crawford Branch between the site's NPDES discharge point and Cow Creek. Based on conversations with site representatives and observations made during the SI field event, construction to replace a washed out culvert on Crawford Branch had just been completed. The above samples were collected downgradient of the disturbed area created by the culvert replacement. Surface water quality measurements obtained prior to sample collection indicated a pH of 8.48 and a turbidity of 4.9 NTUs. Sediment sample CB01SD was from 0 to 3 inches bgs and consisted of well-graded sand with silt. Two additional surface water samples (CB02SW and CB02SW-D) and one co-located sediment sample (CB02SD) were collected from Crawford Branch, upgradient of the site's NPDES discharge point. Surface water quality measurements obtained prior to sample collection indicated a pH of 8.7 and a turbidity of 3.4 NTUs. Sediment sample CB02SD was collected from 0 to 3 inches bgs and consisted of well-graded sand with silt.
- **Rail Gulch:** Two surface water samples (RG01SW and RG01SW-D) and one co-located sediment sample (RG01SD) were collected from Rail Gulch, approximately 500 feet south of the slag/mining byproduct pile. Surface water quality measurements obtained prior to sample collection indicated a pH of 8.18 and a turbidity of 0.0 NTUs. Sediment sample RG01SD was from 0 to 3 inches bgs and consisted of slag-like material with orange-brown sand. Two additional surface water samples (RG02SW and RG02SW-D) and one co-located sediment sample (RG02SD) were collected from Rail Gulch approximately 0.44 mile above the former smelter facility. Surface water quality measurements obtained prior to sample collection indicated a pH of 8.37 and a turbidity of 11.28 NTUs. Sediment sample RG02SD was collected from 0 to 3 inches bgs and consisted of fine brown sand.
- **Jerry Creek:** Like the other drainages/tributaries, surface water and sediment samples were to be collected from the upper and lower portions of Jerry Creek. However, due to access limitations, samples were not collected from the upper portion of Jerry Creek. Two surface water samples (JC01SW and JC01SW-D) and one co-located sediment sample (JC01SD) were collected from Jerry creek where it flows under the Riddle Bypass Road. Surface water quality measurements obtained prior to sample collection indicated a pH of 7.49 and a turbidity of 10.3 NTUs.

Sediment sample RG01SD was from 0 to 3 inches bgs and consisted of brown inorganic silt with trace sand.

- **Unnamed Drainage:** Two surface water samples (UD01SW and UD01SW-D) and one co-located sediment sample (UD01SD) were collected from the unnamed drainage where it flows under the Riddle Bypass Road. Surface water quality measurements were not recorded at this sample location. Sediment sample RG01SD was from 0 to 3 inches bgs and consisted of inorganic silt with sand. One additional sediment sample (UD02SD) was collected from the unnamed drainage above the former smelter facility. A surface water sample was not collected from this location because no surface water was present at the time of sampling.

7.2.1.4 Nearby Drainages/Tributaries Sample Results

Surface water and sediment sample results from the nearby intermittent drainages/tributaries are presented in Tables 7-5 and Table 7-6, respectively.

- **Doe Creek:** Sample results indicate that other than common earth crust metals, no analytes were detected in the surface water samples collected from either the lower portion (DC01SW and DC01SW-D) or the upper portion (DC02SW and DC02SW-D) of Doe Creek. Cadmium was the only TAL metal detected at elevated concentration in both the lower (DC01SD) and upper (DC02SD) sediment samples collected from Doe Creek.
- **Crawford Branch:** One TAL metal (chromium) was detected at elevated concentrations in both samples collected from the lower (CB01SW and CB01SW-D), as well as both samples collected from the upper (CB02SW and CB02SW-D) portion of Crawford Branch. Sediment sample results indicate the presence of several TAL metals at elevated concentrations in the samples collected from Crawford Branch. Cadmium, chromium, and nickel were detected at elevated concentrations in both the lower (CB01SD) and upper (CB02SD) sediment samples collected Crawford Branch. An elevated concentration cobalt was detected in only the lower sample, while antimony and selenium were only detected at elevated concentrations in the upper sample.
- **Rail Gulch:** One TAL metal (chromium) was detected at elevated concentrations in the surface water samples (RG01SW and RG01SW-D) collected from the lower portion Rail Gulch. Nickel was also detected in sample RG01SW at an elevated concentration. Other than common earth crust metals, no analytes were detected in the surface water samples collected from the upper portion of Rail Gulch. A total of five TAL metals (antimony, cadmium, chromium, cobalt, and nickel) were detected at elevated concentrations in both the lower (RG01SD) and upper (RG02SD) sediment samples. An elevated concentration of selenium was detected in the upper sample as well.

- **Jerry Creek:** Other than common earth crust metals, no analytes were detected in the surface water sample collected from the lower portion of Jerry Creek. Sediment sample results indicate the presence of three TAL metals (chromium, cobalt, and nickel) at elevated concentrations.
- **Unnamed Drainage:** Other than common earth crust metals, no analytes were detected in the surface water sample collected from the lower portion of the unnamed drainage. One TAL metal (cadmium) was detected at elevated concentrations in both the upper (UD01SD) and lower (UD02SD) sediment samples collected from the unnamed drainage. Nickel was also detected at an elevated concentration in the lower sample.

7.2.1.5 South Umpqua River

As outlined in the SQAP developed for GNS SI, co-located surface water and sediment samples were to be collected on the South Umpqua River slightly upstream of the City of Tri-City and the City of Myrtle Creek surface water intakes. However, due to time constraints, these samples were not collected (see Appendix B).

7.2.2 Drinking Water Targets

A search of the Oregon Public Health Drinking Water Data Online database revealed four surface water intakes within the 15-mile TDL. Two of these intakes, belonging to the City of Riddle (serving a population of 1,300 people) and the Lawson Acres subdivision (serving a population of 75 people), are located on Cow Creek. The other two surface water intakes, located on the South Umpqua River, serve the Cities of Tri-City (with a population of 3,500 people) and Myrtle Creek (with a population of 3,460 people) (OPH 2017). There are also 1,727 students and teachers served by the above surface water intakes within the TDL.

In addition to use as drinking water, surface water within the 15-mile TDL is used to irrigate 5 acres or more of commercial food crops or forage crops and for watering of commercial livestock.

7.2.3 Human Food Chain Targets

Sport fishing occurs on both Cow Creek and the South Umpqua River. Sport catch from Cow Creek and the South Umpqua River is recorded by the Oregon Department of Fish and Wildlife (ODFW) for the entire waterbody, not from different survey areas/units. It is estimated that approximately 17% of Cow Creek and 6% of the South Umpqua River lie within the 15-mile TDL.

Based on the most recent (2013) ODFW sport fishing catch report that includes Cow Creek, only five winter Steelhead (*Oncorhynchus mykiss*) were harvested from Cow Creek. However, based on ODFW sport fishing regulations, no limit is in place on the size or number of smallmouth bass (*Micropterus dolomieu*) that can be harvested from Cow Creek. The most recent (2015) ODFW sport fishing

catch report indicates that Chinook salmon (*Oncorhynchus tshawytscha*) and coho salmon (*Oncorhynchus kisutch*), as well as steelhead (*Oncorhynchus mykiss*), are harvested from the South Umpqua River; smallmouth bass are likely harvested too. To determine fish weight, the number of fish was multiplied by the average pound for the individual species. Fish catch data are presented in Table 7-7. Commercial fishing does not take place within the 15-mile TDL. (ODFW 2017a, 2017b)

Subsistence fishing also takes place within the 15-mile TDL. Chinook salmon, coho salmon, winter steelhead, and smallmouth bass are harvested within the TDL (Mackie 2017). Information regarding substance harvest totals could not be located.

7.2.4 Environmental Targets

Within the 15-mile TDL, both Cow Creek and the South Umpqua River provide critical habitat for the federally listed threatened Oregon Coast coho salmon (*Oncorhynchus kisutch*) (NOAA 2017a; USFWS 2017a). There are also approximately 12.45 miles of wetland frontage within the TDL. Additionally, there are 8.69 miles of wetland frontage on Cow Creek within the TDL. No wetland frontage is present on the South Umpqua River within the 15-mile TDL. The closest wetland to the site within the surface water migration pathway is located on Cow Creek, at the PPE (USFWS 2017b). Wetlands are depicted on Figures 6-1, 7-3, and 7-4.

Seven samples (CC01SD through CC07SD) were collected from Cow Creek. Two of these samples (CC04SD and CC05SD) were collected from wetlands present on Cow Creek within the 15 mile TDL. As mentioned in Section 7.2.1.2, cadmium was the only analyte detected at elevated concentrations in the sediment samples collected from Cow Creek and manganese was the only analyte detected at elevated concentrations in the surface water samples collected from Cow Creek. Although cadmium was similarly detected in both source and target samples, due to the narrow range of cadmium concentrations detected among all samples, it is believed that the cadmium concentrations detected in Cow Creek may be indicative of naturally occurring concentrations. Significant concentrations of manganese were not detected in on-site sources; therefore, the elevated concentrations of manganese detected in surface waters from Cow Creek are not attributable to the site.

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8 Summary and Conclusions

The GNS site is located approximately 3.25 miles southwest of Riddle, Oregon, in Douglas County. The site is surrounded by rural, agricultural, and/or undeveloped land and lies on the southeastern flank of Nickel Mountain. The site originally operated as a nickel mine and smelter for approximately 40 years, beginning in the late 1940s, and was the only manufacturer of ferro-nickel (an iron and nickel alloy) in the United States. As a result of former site operations, portions of the site have been extensively filled and/or covered by large piles of slag/mining byproduct. These byproducts include slag piles and skull piles (i.e., more finely crushed slag). At these piles' widest point, they stretch approximately 0.75 mile across. Current site operations include washing and sorting the slag byproduct for sale. More than 40 related products are produced for a variety of purposes, including road surfacing, sports field drainage material, roofing material, material for foundry moldings, and abrasives for sandblasting operations (ARI 2004).

Several investigations have been conducted at the site, focusing on the former smelter area. These investigations revealed that SVOC and TPH contamination was prevalent at several source areas. As a result of the investigations, several removal/remedial actions occurred, resulting in contaminants associated with these areas having been remediated to concentrations at or below ODEQ cleanup standards.

The SI field sampling event was conducted from November 27 through December 1, 2017. A total of 87 samples were collected. Sampled media included surface water, sediment, and groundwater. All samples collected during this SI were submitted for off-site fixed laboratory analysis for PCBs, SVOCs, TAL metals, dissolved TAL metals, and TPH-Dx (in varying combinations; see Table 3-1). Sample results were compared to site-specific background concentrations.

8.1 Sources

The two upper retention/settling ponds were identified as potential sources of contamination. These ponds encompass an approximate area of 143,530 SF and 244,364 SF, with the larger of the two ponds being situated at a slightly lower elevation than the smaller pond. Currently, the lower of these two ponds is used to store and recirculate water used by Green Diamond in on-site operations. Surface water from these upper retention/settling ponds ultimately drains into a large lower retention/settling pond that encompass an approximate area of 2,834,032 SF. The depths of these ponds are not known.

Surface water sample results indicate that chromium was the only analyte detected at significant concentrations in the lower retention/settling pond, as well as both upper retention/settling ponds. A total of eight TAL metals (antimony,

cadmium, chromium, cobalt, mercury, nickel, selenium, and zinc) were detected at significant concentrations in one or more of the sediment samples collected from the lower retention/settling pond. A total of six TAL metals (antimony, cadmium, chromium, lead, mercury, and nickel) were detected at significant concentrations in one or more of the sediment samples collected from the upper retention/settling ponds. Detections of TAL metals in the lower retention/settling pond were more numerous and, in general, exhibited higher concentrations when compared to the two upper retention/settling ponds. Diesel range and motor oil range TPHs were the only other analytes detected in any of the source samples, and were only detected in sediment sample UP02SD, which was collected from the larger of the two upper retention/settling ponds.

8.2 Targets

8.2.1 Groundwater

Groundwater samples were collected from three temporary wellpoints located downgradient of the lower retention/settling pond, one temporary wellpoint located approximately between the two upper and lower retention/settling ponds, and one formerly used drinking water well located at the guard shack.

Analytical results from groundwater samples collected from temporary wellpoints indicate that four TAL metals were detected at elevated concentrations. Total metals analysis detected chromium at elevated concentrations in two samples, copper at elevated concentrations in one sample, manganese at elevated concentrations in all four samples, and nickel at elevated concentrations in two samples. Dissolved metals analysis detected chromium at elevated concentrations in one sample and manganese in three samples.

Total metals results from the formerly used drinking water well indicate the presence of five TAL metals (barium, copper, lead, manganese, and zinc) at elevated concentrations. Notably, lead was detected at 17.6 µg/L, slightly above the EPA's National Primary Drinking Water Regulations maximum contaminant level of 15.0 µg/L. Dissolved metals sample results detected elevated concentrations of barium, manganese, and zinc in this sample.

8.2.2 Cow Creek

Surface water and co-located sediment samples were collected from seven locations on Cow Creek: five downstream of the site's PPE and two upstream of the site's PPE.

Total metals surface water sample results indicate that manganese was the only metal detected at elevated concentrations in the surface water samples collected from Cow Creek. One sample, CC07SW, was collected upstream of the site's PPE and contained this single elevated concentration of manganese. Dissolved metals analysis detected manganese at elevated concentrations in two samples collected downstream of the site's PPE. Manganese was not likewise detected at significant concentrations in sources at the site. Cadmium was the only analyte

detected at elevated concentrations in the sediment samples collected from Cow Creek, and was only detected in samples collected downstream of the site's PPE.

8.2.3 Nearby Drainages/Tributaries

Surface water and co-located sediment samples were collected from five nearby drainages/tributaries to Cow Creek. In most cases, surface water and sediment samples were collected from two locations on each drainages/tributary with one as close to the headwaters as possible and the other near its confluence with Cow Creek.

Surface water sample results indicate the presence of elevated concentrations of total and dissolved chromium in two samples and total nickel in one sample collected from the lower portions of the nearby drainages/tributaries. In the upper portions of the nearby drainages/tributaries, total chromium was detected in two samples and dissolved chromium was detected in one sample at an elevated concentrations. Elevated concentrations of antimony, cadmium, chromium, cobalt, and nickel were detected in the sediment samples collected from the lower and upper portions of the nearby drainages/tributaries, while selenium was only found in the upper portions of the nearby drainages/tributaries.

8.3 Conclusions

Based on the results of the SI sampling event, the retention/settling ponds located at the GNS site contain sources of CERCLA-regulated hazardous substances. Surface water, sediment, and groundwater samples indicate the presence of TAL metals, at elevated concentrations with respect to background concentrations.

Elevated concentrations of chromium and nickel were detected in the shallow groundwater at the site. Detections of these analytes may be attributable to the site, as each of these analytes were similarly detected in on-site sources. Elevated concentrations of manganese detected in the shallow groundwater are not attributable to site sources, as they were not similarly detected in on-site sources. Even though several TAL metals were detected at elevated concentrations in the former drinking water well, and were similarly detected in on-site sources, these detections are not believed to be attributable to the site since this well is completed in the regional confined aquifer.

Elevated concentrations of manganese were detected in surface waters from Cow Creek cannot be attributable to the site because significant concentrations of manganese were not detected in on-site sources. Elevated concentrations of cadmium detected in sediment samples collected from Cow Creek are thought to be indicative of naturally occurring background concentrations and are most likely not attributable to the site sources given the narrow range of cadmium concentrations detected in Cow Creek, in addition to the narrow range of cadmium concentrations detected in the nearby drainages/tributaries.

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Figures

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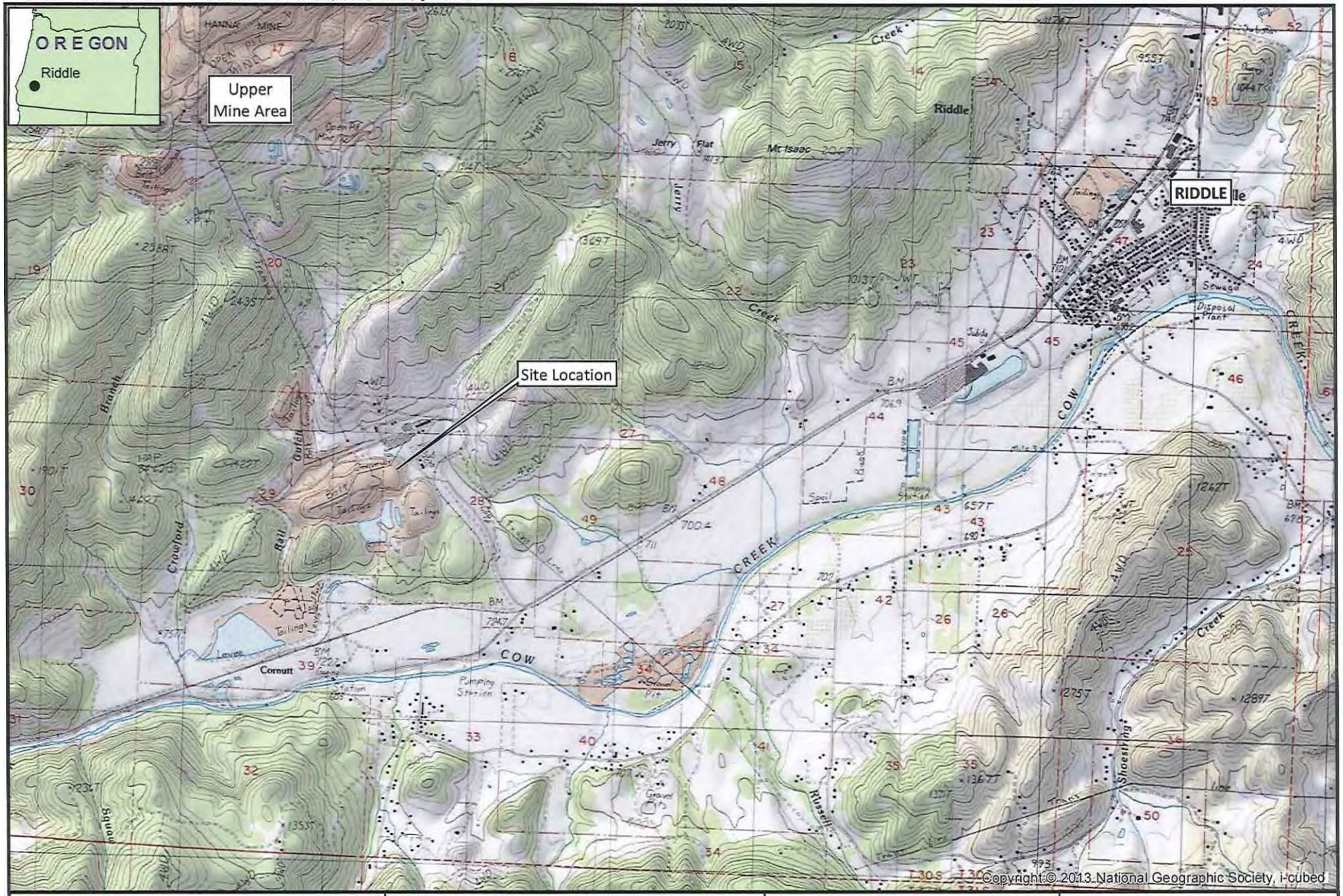

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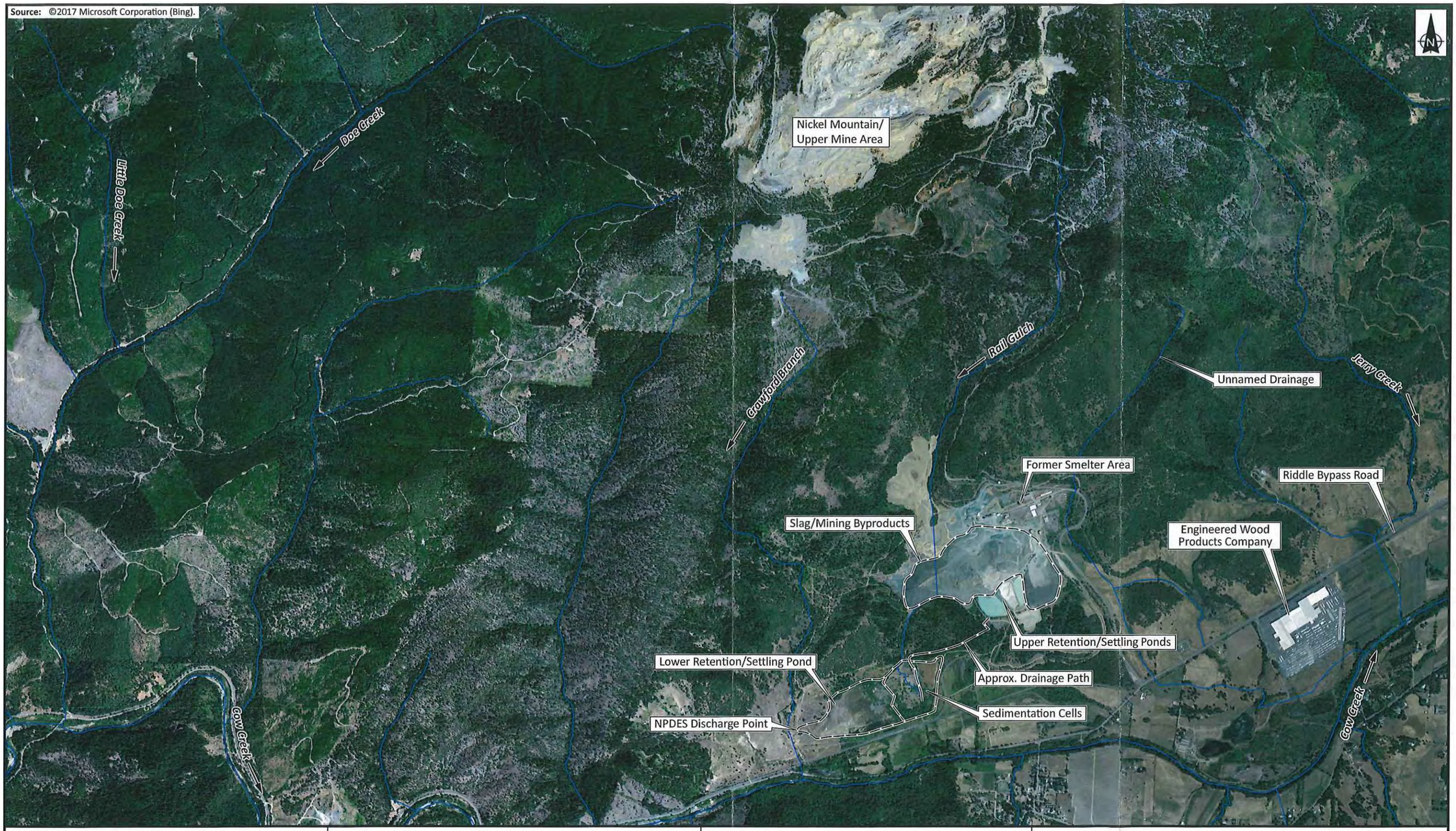
GLENBROOK NICKEL SMELTER
Riddle, Oregon

Figure 1-1
SITE VICINITY MAP

Date : 2/27/2018



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Seattle, Washington

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Approximate Scale in Feet

GLENBROOK NICKEL SMELTER
Riddle, Oregon

Figure 2-1
SITE MAP

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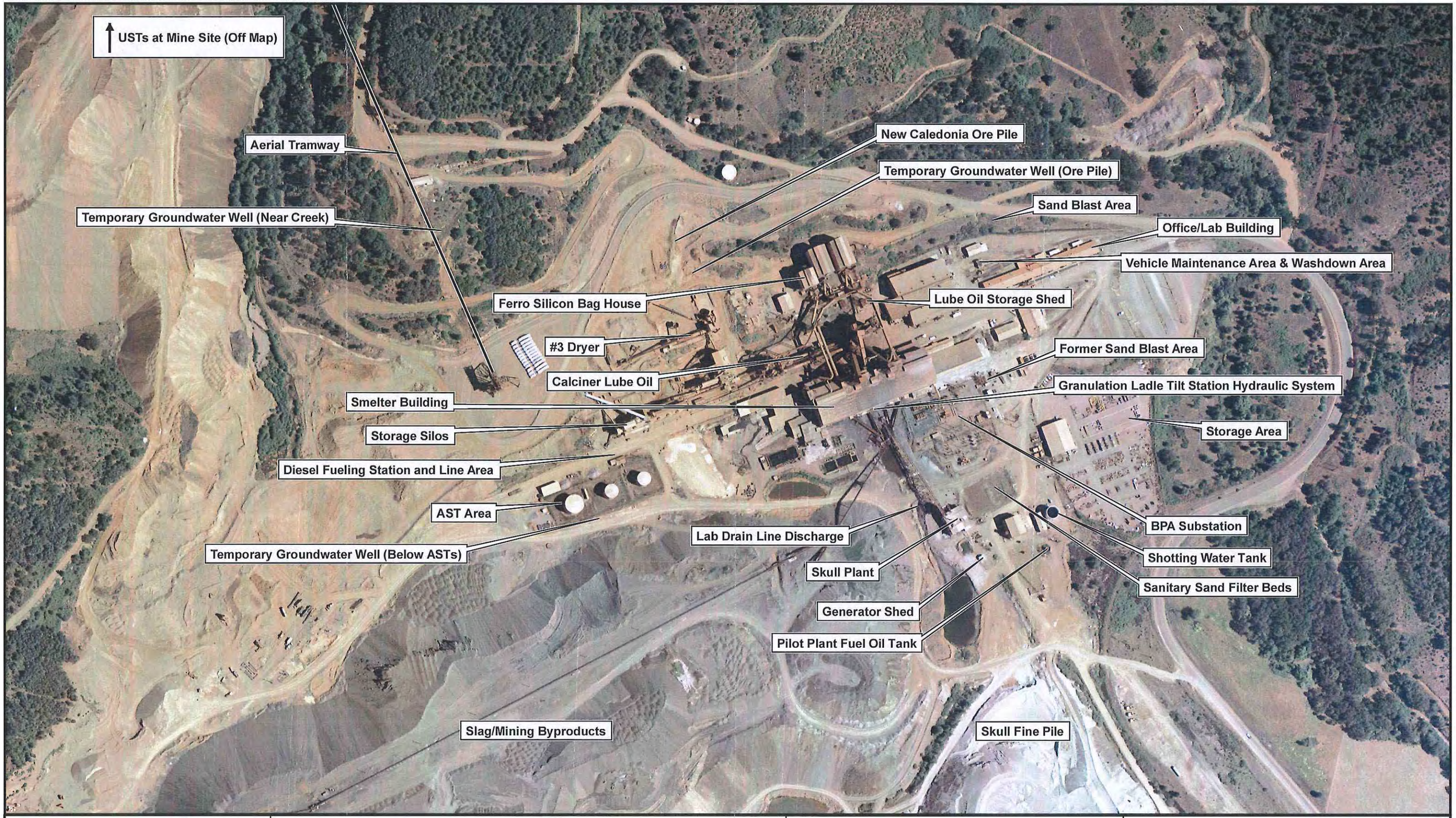

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GLENBROOK NICKEL SMELTER
Riddle, Oregon

Figure 2-2
HISTORIC SITE FEATURES

Date : 2/27/2018

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LEGEND FOR AREAS OF CONCERN

1 – Sand Blast Area
2 – Lab Drain Line Discharge
3 – Former Sand Blast Area
4 – Sanitary Sand Filter Beds
5 – Granulation Ladle Tilt Station
6 – Lube Oil Storage Shed
7 – Ferro Silicon Bag House
8 – Calciner Lube Oil
9 – #3 Dryer
10 – Diesel Fueling Station
11 – AST Area
12 – Pilot Plant Fuel Oil Tank
13 – Vehicle Maintenance and Washdown Area
14 – Generator Shed
15 – USTs at Mine Site (Off Map)
16 – Temporary Groundwater Well (Near Creek)
17 – Temporary Groundwater Well (Off Map and Below Middle Ponds)
18 – Temporary Groundwater Well (Off Map and Below Lower Ponds)
19 – Temporary Groundwater Well (Below AST Area)
20 – BPA Substation
21 – Temporary Groundwater Well (Ore Pile)
22 – New Caledonia Ore Pile
23 – Shotting Water Tank
24 – Slag/Mining Byproducts

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GLENBROOK NICKEL SMELTER
Riddle, Oregon

Figure 2-3
AUGUST 2000 AREAS OF CONCERN

Date : 2/27/2018

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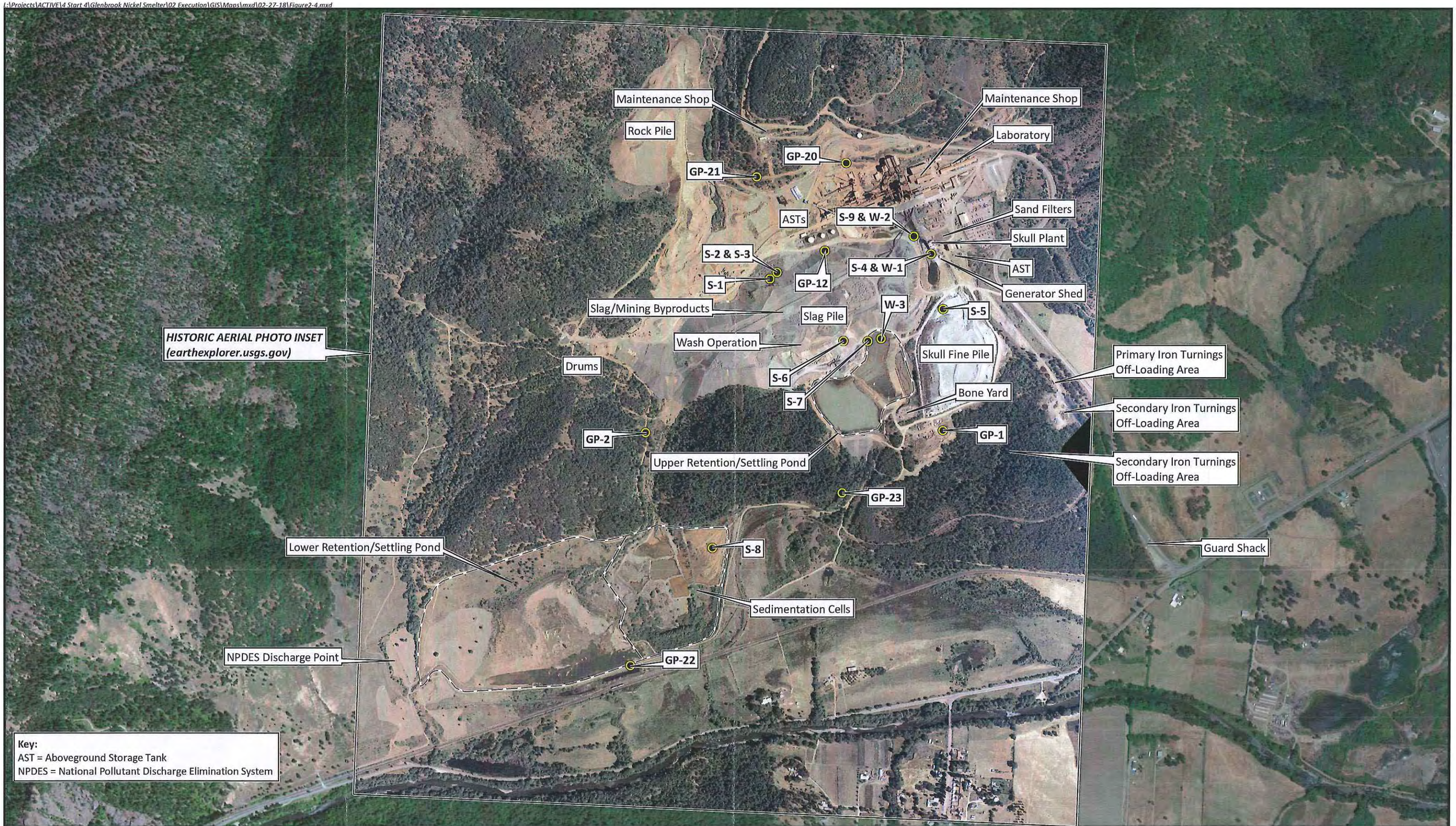

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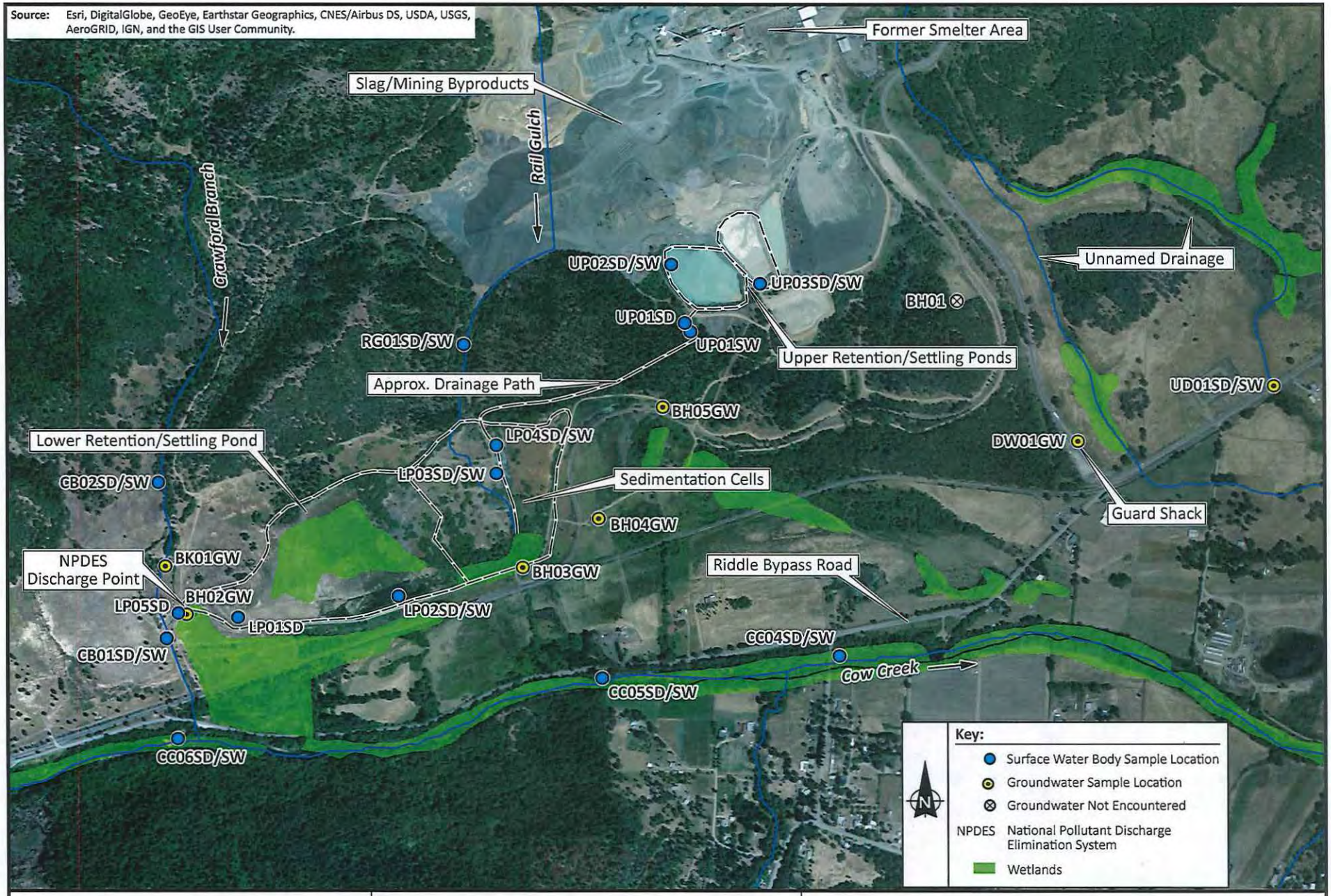
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

GLENBROOK NICKEL SMELTER
Riddle, Oregon

Figure 2-4
PHASE II SAMPLE LOCATIONS AND LOCATIONS OF GP-12, 20, 21, 22, 23

Date : 2/27/2018



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GLENBROOK NICKEL SMELTER
Riddle, Oregon

Figure 6-1
SAMPLE LOCATIONS ON AND NEAR SITE

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Approximate Scale in Feet

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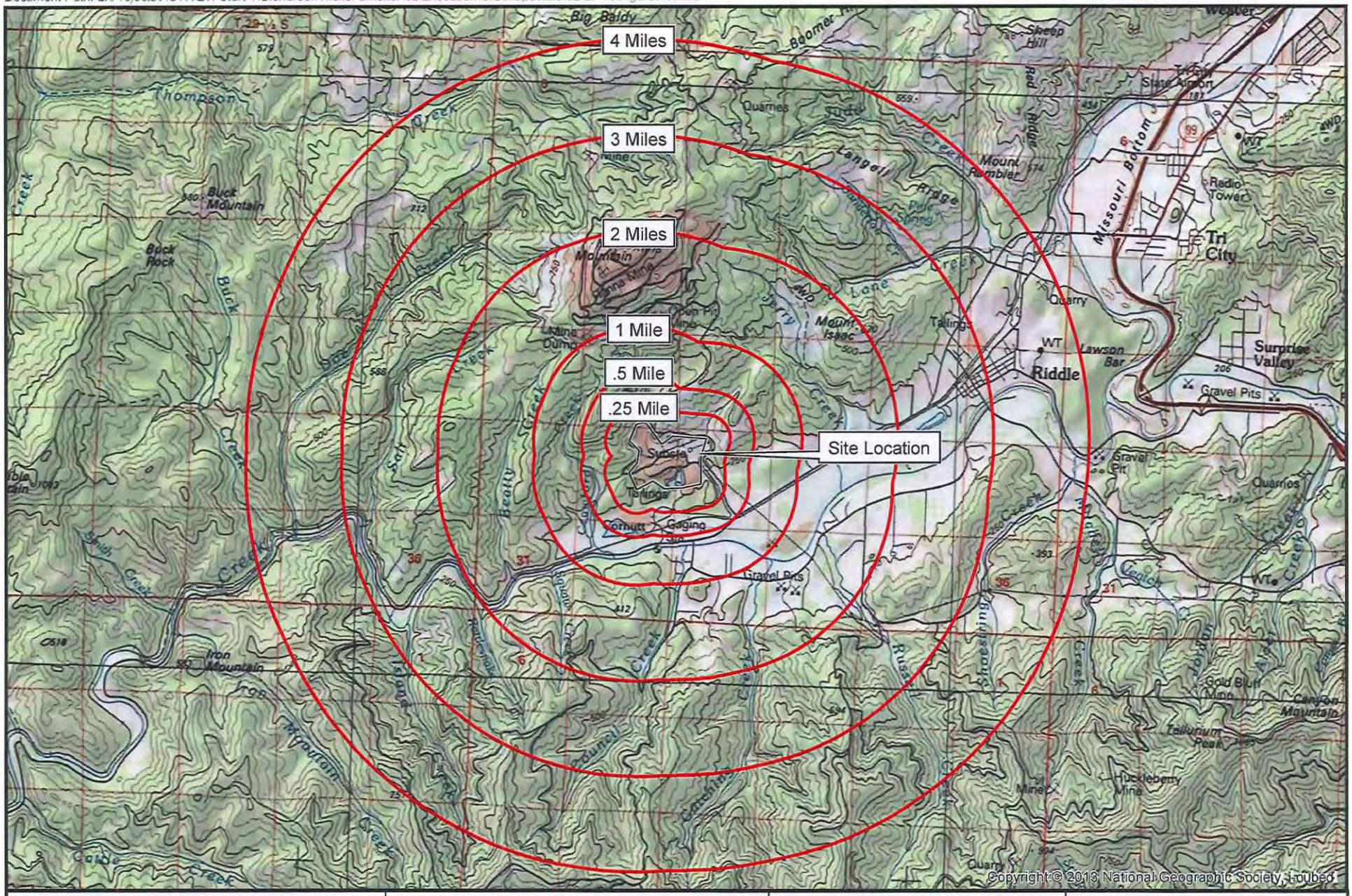

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0 0.5 1 Miles

GLENBROOK NICKEL SMELTER
Riddle, Oregon

Figure 7-1
4-MILE MAP

Date : 2/27/2018

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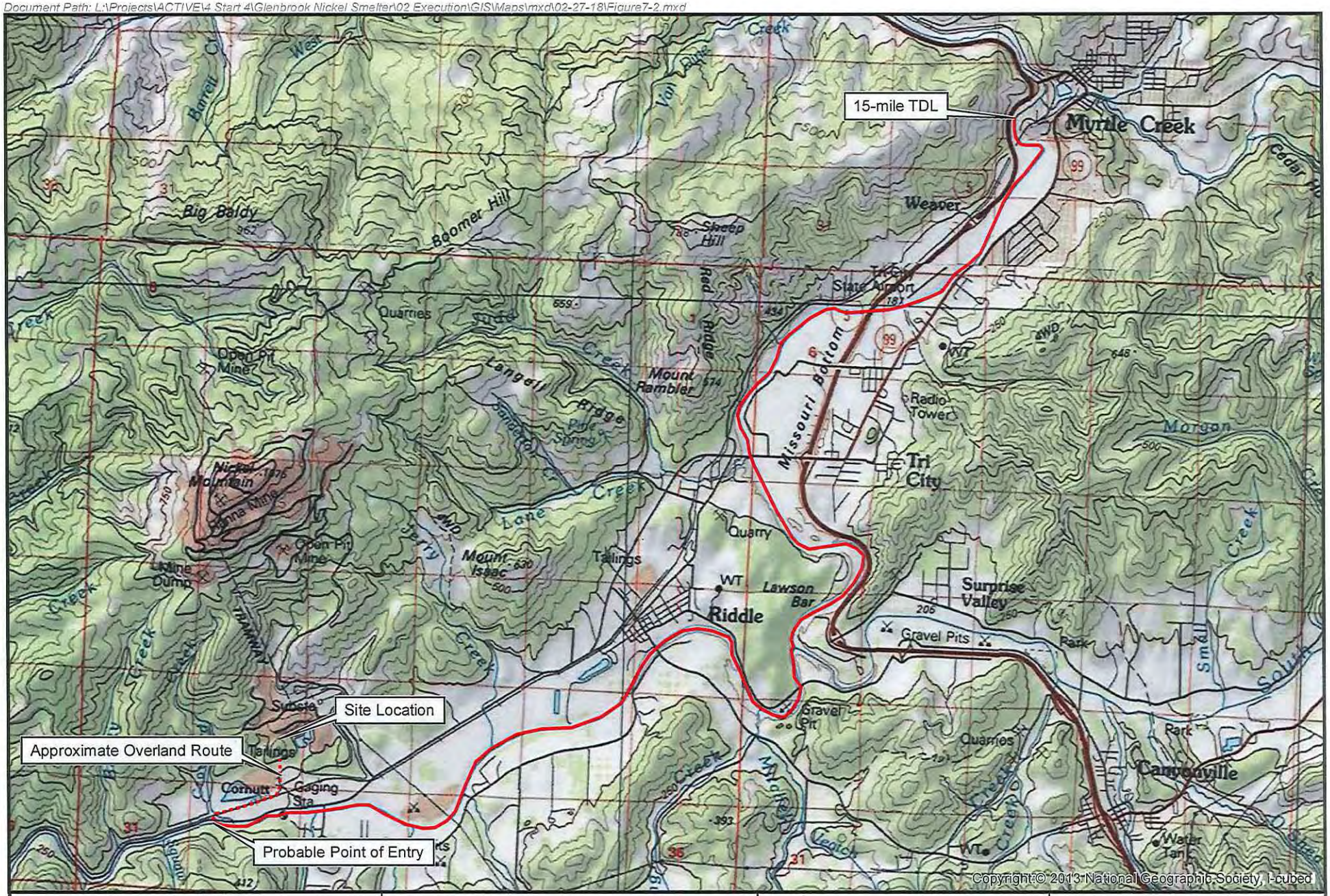

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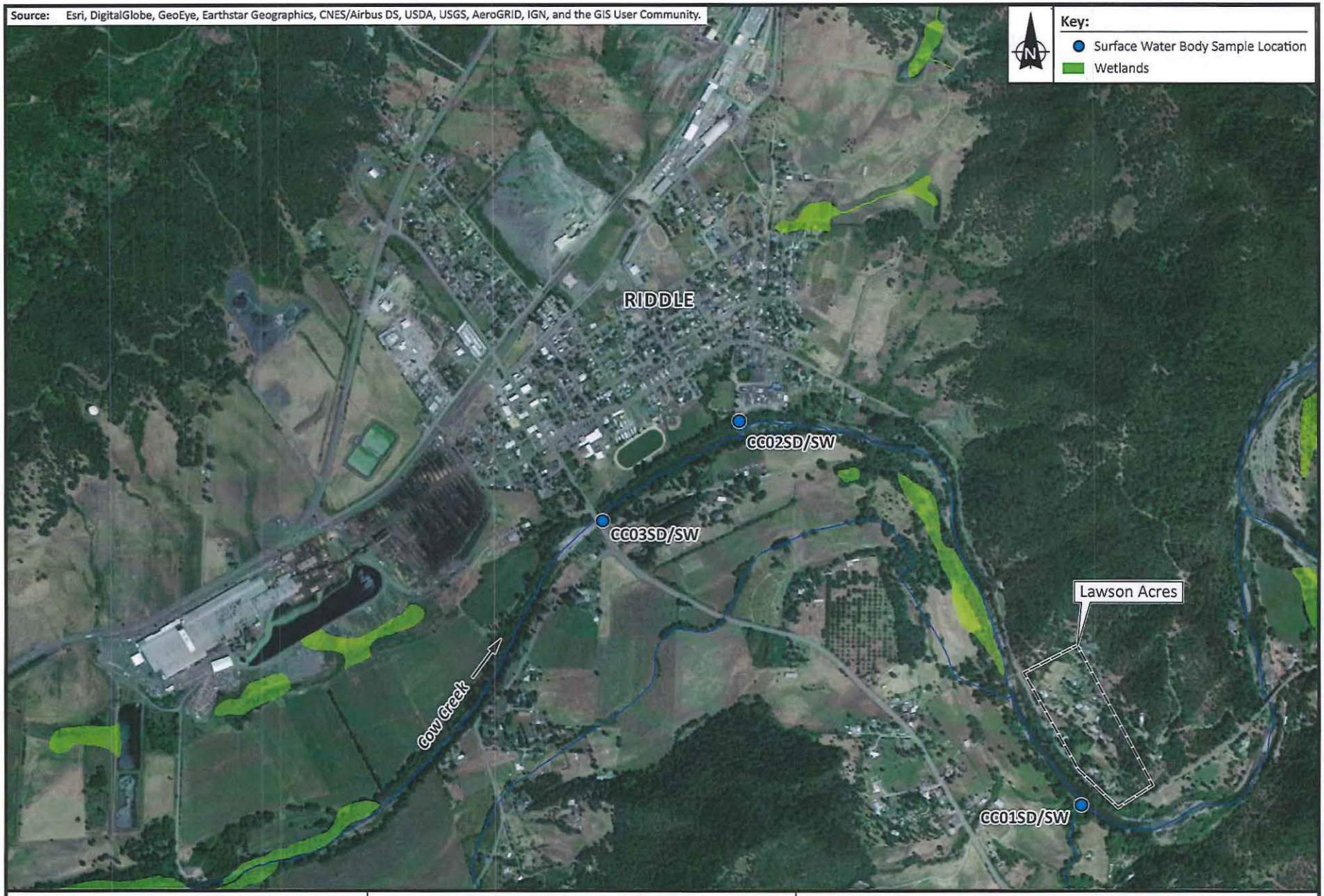
N

0 0.5 1 Miles

GLENBROOK NICKEL SMELTER
Riddle, Oregon

Figure 7-2
15-MILE MAP

Date : 2/27/2018



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Seattle, Washington

GLENBROOK NICKEL SMELTER
Riddle, Oregon

0 1,000 2,000
Approximate Scale in Feet

Figure 7-3
COW CREEK SAMPLE LOCATIONS NEAR CITY OF RIDDLE

Date:	Drawn by:	
2/27/18	AES	10:START-IV\17030006\fig 7-3

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User.

Key:
- Surface Water Body Sample Location
- NPDES National Pollutant Discharge Elimination System
- Wetlands

DC02SD/SW
Little Doe Creek
Doe Creek
Nickel Mountain/ Upper Mine Area
Rail Gulch
BK02SD/SW
RG02SD/SW
See Figure 6-1
Unnamed Drainage
Jenny Creek
Crawford Branch
Former Smelter Area
UD02SD
Slag/Mining Byproducts
Riddle Bypass Road
JC01SD/SW
Upper Retention/Settling Ponds
Engineered Wood Products Company
Lower Retention/Settling Pond
Approx. Drainage Path
BK01SD/SW
DC01SD/SW
CC07SD/SW
Cow Creek
NPDES Discharge Point
Sedimentation Cells
CC04SD/SW
CC05SD/SW
CC06SD/SW
Cow Creek

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Seattle, Washington

0 1,500 3,000
Approximate Scale in Feet

GLENBROOK NICKEL SMELTER
Riddle, Oregon

Figure 7-4
BACKGROUND AND NEAR SITE DRAINAGE/TRIBUTARY SAMPLE LOCATIONS

Date:	Drawn by:	
3/5/18	AES	10:START-IV\17030006\fig 7-4

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Tables

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Table 2-1 Summary of Areas of Concern

Area of Concern	Description	Media Sampled/ Number of Samples	Analyses	Detections Above ODEQ Cleanup Levels	Further Investigation Warranted
AOC-R-1 - Sand Blast Area	Slag (Green Diamond granules) used for sand blast cleaning of equipment and parts. Potential lead paint waste.	Soil/3	Lead	None	No
AOC-R-2 - Lab Drain Line Discharge Point	Discharge point of drain line from sinks and drains in the laboratory. Potential discharge of lab	Sediment/2	VOC, PAHs, Metals	None	No
AOC-R-3 - Former Sand Blast Area	Former are used for sand blasting. Potential lead paint waste.	Soil/2	Lead	None	No
AOC-R-4 - Sanity Sand Filter Beds	Sand filter beds that received sanitary waste from the site's septic tanks.	Soil/2	VOC, PAHs, Metals	Arsenic in both samples, though below background level	Yes
AOC-R-5 - Granulation Ladle Tilt Station Hydraulic System	Hydraulic fluid used in the operation of the Granulation Ladle.	Soil/4	PAH	Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, and	Yes
AOC-R-6 - Lube Oil Storage Area	Drum storage of lube oils and greases in shed and one outside AST for used oil storage.	Soil/1	TPH, PCB, VOCs, PAHs	TPH-Oil, Arsenic	Yes
AOC-R-7 - Ferro Silicon Bag House	Air emission control equipment.	Dust/Soil/2	Lead	None	No
AOC-R-8 - Calciner Lube Oil	Lube oils used in the operation of the calciners.	Soil/4	PAH	Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, and, Chrysene, Dibenz(ah)anthracene, Indeno(1,2,3-cd)pyrene	Yes
AOC-R-9 - #3 Dryer	Lube oils used in the operation of the dryer.	Soil/3	PAH	None	No
AOC-R-10 - Diesel Fueling Station and Line Area	Fueling station and product distribution lines under the roadway.	Soil/10 Groundwater/1	TPH, PAH	TPH-Diesel, TPH-Oil	Yes
AOC-R-11 - AST Area	Diesel fuel and bunker-C ASTs	Soil/6	TPH, PAH	None	No
AOC-R-12 - Pilot Plant Fuel Oil Tank	Fuel oil AST	Soil/2	TPH, PAH	TPH-Oil, Benzo(a)pyrene	Yes
AOC-R-13 - Vehicle Maintenance and Wash-down Area	Concrete pad, sump, and drains used for Washing and Equipment Maintenance	Soil/2	VOC, PAH, Metals	Arsenic	Yes
AOC-R-14 - Generator Shed	Small shed housing generators/motors behind skull plant	Soil/1	TPH, PAH	None	No
AOC-R-15 - USTs at Mine Site	3,000 gallons gasoline and 10,000 gallons used oil USTs at mine site (top of mountain)	Soil/4	TPH, PCB, VOCs, BTEX	None	No
AOC-R-16 - Near Creek above Smelter Building	Creek running down mountain.	Groundwater/1	Total and Dissolved Metals	Nickel (dissolved)	No
AOC-R-17 - Below Two Middle Ponds	Part of the NPDES for the facility	Groundwater/1	Total and Dissolved Metals	None (dissolved)	No
AOC-R-18 - Below Lower Pond	Part of the NPDES for the facility	Groundwater/1	Total and Dissolved Metals	None (dissolved)	No
AOC-R-19 - Below AST Area	Area downgradient from diesel fuel and Bunker-C ASTs.	Groundwater/1	TPH, PAH, Metals	None (dissolved)	No

Table 2-1 Summary of Areas of Concern

Area of Concern	Description	Media Sampled/ Number of Samples	Analyses	Detections Above ODEQ Cleanup Levels	Further Investigation Warranted
AOC-R-20 - BPA Substation	Equipment pads	Soil/20 (April 2000), 40 (June 2000) Equipment wipe/6 (April 2000)	TPH, PCB, 1,1,1-TCA	PCBs, TPH-Diesel, TPH-Oil	Yes
AOC-R-21 - Below New Caledonia Ore pile	Area downgradient from New Caledonia Ore Pile	Groundwater/1	Metals	None (dissolved)	No
AOC-R-22 - New Caledonia Ore Pile	Stockpile of New Caledonia Ore northwest of smelter building	Ore	Nickle, chromium, Manganese	None (dissolved)	No
AOC-R-23 - Shotting Water Tank	Location of former water storage tank, added as AOC	Soil/1	TPH, VOCs, PAHs	Not provided	Yes

Key:

AOC = Area of Concern
AST = Aboveground Storage Tank
BPA = Bonneville Power Association
BTEX = Benzene, Toluene, Ethylbenzene, Xylenes
NPDES = National Pollutant Discharge Elimination System
ODEQ = Oregon Department of Environmental Quality
PAH = Polynuclear Aromatic Hydrocarbons
PCBs = Polychlorinated Biphenyls
TPH-D = Total Petroleum Hydrocarbons - Diesel Fuel
TPH-G = Total Petroleum Hydrocarbons - Gasoline
UST = Underground Storage Tank .
VOCs = Volatile Organic Compounds

Table 3-1 Sample Summary

Station Location	EPA Regional Tracking Number	CLP Sample Number	Sample Date	Sample Time	Sample Matrix	Sample Depth (inches)	Sampler	Total Metals	Dissolved Metals	SVOCs / PCBs	TPH-Dx	SVOCs	PCBs	Description
Cow Creek														
Sediment Samples														
CC01SD	17484019	JHPH9	11/27/2017	16:09	Surface Sediment	0 to 6	D. Pulvino	X	--	X	X	--	--	Dark grayish brown well graded sand
CC02SD	17484020	JHPJ0	11/28/2017	10:32	Surface Sediment	0 to 6	D. Pulvino	X	--	X	X	--	--	Brown well graded sand with silt
CC03SD	17484021	JHPJ1	11/28/2017	12:44	Surface Sediment	0 to 6	D. Pulvino	X	--	X	X	--	--	Brown well graded sand with silt
CC04SD	17484022	JHPJ2	11/28/2017	13:34	Surface Sediment	0 to 6	D. Pulvino	X	--	X	X	--	--	Brown well graded sand with silt
CC05SD	17484023	JHPJ3	11/28/2017	15:21	Surface Sediment	0 to 6	D. Pulvino	X	--	X	X	--	--	Brown well graded sand with silt
CC06SD	17484024	JHPJ4	11/29/2017	9:35	Surface Sediment	0 to 2	D. Pulvino	X	--	X	X	--	--	Dark gray sandy gravel
CC07SD	17484025	JHPJ5	11/29/2017	10:52	Surface Sediment	0 to 2	D. Pulvino	X	--	X	X	--	--	Brown well graded sand
Surface Water Samples														
CC01SW	17484071	JHPP1	11/27/2017	15:54	Surface Water	NA	D. Pulvino	X	--	--	X	X	X	Clear, no odor
CC02SW	17484073	JHPP3	11/28/2017	9:56	Surface Water	NA	D. Pulvino	X	--	--	X	X	X	Clear, no odor
CC03SW	17484075	JHPP5	11/28/2017	12:29	Surface Water	NA	D. Pulvino	X	--	--	X	X	X	Clear, no odor
CC04SW	17484077	JHPP7	11/28/2017	13:20	Surface Water	NA	D. Pulvino	X	--	--	X	X	X	Clear, no odor
CC05SW	17484079	JHPP9	11/28/2017	15:01	Surface Water	NA	D. Pulvino	X	--	--	X	X	X	Slightly turbid, no odor
CC06SW	17484081	JHPQ1	11/29/2017	9:25	Surface Water	NA	D. Pulvino	X	--	--	X	X	X	Clear, no odor
CC07SW	17484083	JHPQ3	11/29/2017	10:42	Surface Water	NA	D. Pulvino	X	--	--	X	X	X	Slightly turbid, no odor
CC01SW-D	17484072	MJHPP2	11/27/2017	16:06	Surface Water Dissolved	NA	D. Pulvino	--	X	--	--	--	--	Clear, no odor
CC02SW-D	17484074	MJHPP4	11/28/2017	10:08	Surface Water Dissolved	NA	D. Pulvino	--	X	--	--	--	--	Clear, no odor
CC03SW-D	17484076	MJHPP6	11/28/2017	12:35	Surface Water Dissolved	NA	D. Pulvino	--	X	--	--	--	--	Clear, no odor
CC04SW-D	17484078	MJHPP8	11/28/2017	13:33	Surface Water Dissolved	NA	D. Pulvino	--	X	--	--	--	--	Clear, no odor
CC05SW-D	17484080	MJHPQ0	11/28/2017	15:06	Surface Water Dissolved	NA	D. Pulvino	--	X	--	--	--	--	Slightly turbid, no odor
CC06SW-D	17484082	MJHPQ2	11/29/2017	9:25	Surface Water Dissolved	NA	D. Pulvino	--	X	--	--	--	--	Clear, no odor
CC07SW-D	17484084	MJHPQ4	11/29/2017	10:42	Surface Water Dissolved	NA	D. Pulvino	--	X	--	--	--	--	Slightly turbid, no odor
Crawford Branch														
Sediment Samples														
CB01SD	17484008	JHPG8	11/29/2017	10:57	Surface Sediment	0 to 3	J. Fetters	X	--	X	X	--	--	Well graded sand with silt
CB02SD	17484009	MJHPG9	11/29/2017	11:47	Surface Sediment	0 to 3	J. Fetters	X	--	--	--	--	--	Well graded sand with silt
Surface Water Samples														
CB01SW	17484049	JHPL9	11/29/2017	10:54	Surface Water	NA	J. Fetters	X	--	--	X	X	X	Clear, no odor
CB02SW	17484051	MJHPM1	11/29/2017	11:44	Surface Water	NA	J. Fetters	X	--	--	--	--	--	Clear, no odor
CB01SW-D	17484050	MJHPM0	11/29/2017	10:54	Surface Water Dissolved	NA	J. Fetters	--	X	--	--	--	--	Clear, no odor
CB02SW-D	17484052	MJHPM2	11/29/2017	11:44	Surface Water Dissolved	NA	J. Fetters	--	X	--	--	--	--	Clear, no odor

Table 3-1 Sample Summary

Station Location	EPA Regional Tracking Number	CLP Sample Number	Sample Date	Sample Time	Sample Matrix	Sample Depth (inches)	Sampler	Total Metals	Dissolved Metals	SVOCs / PCBs	TPH-Dx	SVOCs	PCBs	Description
Doe Creek														
Sediment Samples														
DC01SD	17484011	MJHPH1	11/29/2017	11:26	Surface Sediment	0 to 2	D. Pulvino	X	--	--	--	--	--	Well graded gravel with silt
DC02SD	17484012	MJHPH2	11/29/2017	14:01	Surface Sediment	0 to 2	D. Pulvino	X	--	--	--	--	--	Well graded gravel with silt
Surface Water Samples														
DC01SW	17484055	MJHPM5	11/29/2017	11:16	Surface Water	NA	D. Pulvino	X	--	--	--	--	--	Clear, no odor
DC02SW	17484057	MJHPM7	11/29/2017	14:01	Surface Water	NA	D. Pulvino	X	--	--	--	--	--	Clear, no odor
DC01SW-D	17484056	MJHPM6	11/29/2017	11:16	Surface Water Dissolved	NA	D. Pulvino	--	X	--	--	--	--	Clear, no odor
DC02SW-D	17484058	MJHPM8	11/29/2017	14:01	Surface Water Dissolved	NA	D. Pulvino	--	X	--	--	--	--	Clear, no odor
Jerry Creek														
Sediment Samples														
JC01SD	17484017	MJHPH7	11/30/2017	13:35	Surface Sediment	0 to 3	D. Pulvino	X	--	--	--	--	--	Brown inorganic silt with sand
Surface Water Samples														
JC01SW	17484067	MJHPN7	11/30/2017	13:25	Surface Water	NA	D. Pulvino	X	--	--	--	--	--	Clear, no odor
JC01SW-D	17484068	MJHPN8	11/30/2017	13:25	Surface Water Dissolved	NA	D. Pulvino	--	X	--	--	--	--	Clear, no odor
Rail Gulch														
Sediment Samples														
RG01SD	17484013	JHPH3	11/30/2017	9:00	Surface Sediment	0 to 3	D. Pulvino	X	--	X	X	--	--	Orangish brown sand, MS/MSD, TPH-Dx duplicate
RG02SD	17484014	MJHPH4	11/30/2017	13:00	Surface Sediment	0 to 3	D. Pulvino	X	--	--	--	--	--	Brown fine sand
Surface Water Samples														
RG01SW	17484059	JHPM9	11/30/2017	8:45	Surface Water	NA	D. Pulvino	X	--	--	X	X	X	Clear, no odor, MS/MSD, TPH-Dx duplicate
RG02SW	17484061	MJHPN1	11/30/2017	12:55	Surface Water	NA	D. Pulvino	X	--	--	--	--	--	Slightly turbid, no odor, MS/MSD
RG01SW-D	17484060	MJHPN0	11/30/2017	8:45	Surface Water Dissolved	NA	D. Pulvino	--	X	--	--	--	--	Clear, no odor, MS/MSD
RG02SW-D	17484062	MJHPN2	11/30/2017	12:55	Surface Water Dissolved	NA	D. Pulvino	--	X	--	--	--	--	Clear, no odor
Unnamed Drainage														
Sediment Samples														
UD01SD	17484015	JHPH5	11/30/2017	13:24	Surface Sediment	0 to 3	J. Fetters	X	--	X	X	--	--	Inorganic silt with sand
UD02SD	17484016	MJHPH6	11/30/2017	12:20	Surface Sediment	0 to 3	D. Pulvino	X	--	--	--	--	--	Light brown/tan sand
Surface Water Samples														
UD01SW	17484063	JHPN3	11/30/2017	13:19	Surface Water	NA	J. Fetters	X	--	--	X	X	X	Clear, no odor, MS/MSD, TPH-Dx duplicate
UD01SW-D	17484064	MJHPN4	11/30/2017	13:19	Surface Water Dissolved	NA	J. Fetters	--	X	--	--	--	--	Clear, no odor
Lower Retention/Settling Pond														
Sediment Samples														
LP01SD	17484004	JHPG4	11/29/2017	12:17	Surface Sediment	0 to 3	J. Fetters	X	--	X	X	--	--	Brown inorganic loamy sand, no surface water present
LP02SD	17484005	JHPG5	11/29/2017	12:40	Surface Sediment	0 to 3	J. Fetters	X	--	X	X	--	--	Brown inorganic silt
LP03SD	17484006	JHPG6	11/29/2017	13:46	Surface Sediment	0 to 3	J. Fetters	X	--	X	X	--	--	Light brown/tan inorganic silt
LP04SD	17484007	JHPG7	11/29/2017	14:23	Surface Sediment	0 to 3	J. Fetters	X	--	X	X	--	--	Light brown/tan inorganic silt
LP05SD	17484010	JHPH0	11/29/2017	11:15	Surface Sediment	0 to 6	J. Fetters	X	--	X	X	--	--	Brown well-graded sand with silt, no surface water present

Table 3-1 Sample Summary

Station Location	EPA Regional Tracking Number	CLP Sample Number	Sample Date	Sample Time	Sample Matrix	Sample Depth (inches)	Sampler	Total Metals	Dissolved Metals	SVOCs / PCBs	TPH-Dx	SVOCs	PCBs	Description
Surface Water Samples														
LP02SW	17484043	JHPL3	11/29/2017	12:40	Surface Water	NA	J. Fetters	X	--	--	X	X	X	Slightly turbid, no odor
LP03SW	17484045	JHPL5	11/29/2017	13:46	Surface Water	NA	J. Fetters	X	--	--	X	X	X	Clear, no odor
LP04SW	17484047	JHPL7	11/29/2017	14:23	Surface Water	NA	J. Fetters	X	--	--	X	X	X	Clear, no odor
LP02SW-D	17484044	MJHPL4	11/29/2017	12:40	Surface Water Dissolved	NA	J. Fetters	--	X	--	--	--	--	Slightly turbid, no odor
LP03SW-D	17484046	MJHPL6	11/29/2017	13:46	Surface Water Dissolved	NA	J. Fetters	--	X	--	--	--	--	Clear, no odor
LP04SW-D	17484048	MJHPL8	11/29/2017	14:23	Surface Water Dissolved	NA	J. Fetters	--	X	--	--	--	--	Clear, no odor
Upper Retention Pond/Settling Pond														
Sediment Samples														
UP01SD	17484000	JHPG0	11/30/2017	10:05	Surface Sediment	0 to 3	J. Fetters	X	--	X	X	--	--	Gray silt with gravel, MS/MSD, TPH-Dx duplicate
UP02SD	17484001	JHPG1	11/30/2017	10:50	Surface Sediment	0 to 3	D. Pulvino	X	--	X	X	--	--	Dark brown silt with high organic content, TPH-Dx duplicate
UP03SD	17484002	JHPG2	11/30/2017	11:20	Surface Sediment	0 to 3	D. Pulvino	X	--	X	X	--	--	Slag/mining byproduct with light gray suspended material
Surface Water Samples														
UP01SW	17484033	JHPK3	11/30/2017	9:50	Surface Water	NA	D. Pulvino	X	--	--	X	X	X	Clear, no odor, MS/MSD, TPH-Dx duplicate
UP02SW	17484035	JHPK5	11/30/2017	10:30	Surface Water	NA	D. Pulvino	X	--	--	X	X	X	Turbid, no odor, TPH-Dx duplicate
UP03SW	17484037	JHPK7	11/30/2017	11:10	Surface Water	NA	D. Pulvino	X	--	--	X	X	X	Turbid, no odor
UP01SW-D	17484034	MJHPK4	11/30/2017	9:50	Surface Water Dissolved	NA	D. Pulvino	--	X	--	--	--	--	Clear, no odor, MS/MSD
UP02SW-D	17484036	MJHPK6	11/30/2017	10:30	Surface Water Dissolved	NA	D. Pulvino	--	X	--	--	--	--	Turbid, no odor
UP03SW-D	17484038	MJHPK8	11/30/2017	11:10	Surface Water Dissolved	NA	D. Pulvino	--	X	--	--	--	--	Turbid, no odor
Groundwater Samples														
BH02GW	17484095	JHPR5	11/28/2017	13:16	Groundwater	NA	K. Marcy	X	--	--	X	X	X	Clear, no odor
BH03GW	17484097	JHPR7	11/28/2017	14:00	Groundwater	NA	K. Marcy	X	--	--	X	X	X	Clear, no odor
BH04GW	17484099	JHPR9	11/28/2017	15:00	Groundwater	NA	K. Marcy	X	--	--	X	X	X	Clear, no odor
BH05GW	17484101	JHPS1	11/28/2017	16:30	Groundwater	NA	K. Marcy	X	--	--	X	X	X	Clear, no odor
BH02GW-D	17484096	MJHPR6	11/28/2017	13:16	Groundwater Dissolved	NA	K. Marcy	--	X	--	--	--	--	Clear, no odor
BH03GW-D	17484098	MJHPR8	11/28/2017	14:00	Groundwater Dissolved	NA	K. Marcy	--	X	--	--	--	--	Clear, no odor
BH04GW-D	17484100	MJHPS0	11/28/2017	15:00	Groundwater Dissolved	NA	K. Marcy	--	X	--	--	--	--	Clear, no odor
BH05GW-D	17484102	MJHPS2	11/28/2017	16:30	Groundwater Dissolved	NA	K. Marcy	--	X	--	--	--	--	Clear, no odor
Domestic Well														
DW01GW	17484115	JHPT5	11/30/2017	14:50	Groundwater	NA	J. Fetters	X	--	--	X	X	X	Guard building
DW01GW-D	17484116	MJHPT6	11/30/2017	14:50	Groundwater Dissolved	NA	J. Fetters	--	X	--	--	--	--	Guard building

Table 3-1 Sample Summary

Station Location	EPA Regional Tracking Number	CLP Sample Number	Sample Date	Sample Time	Sample Matrix	Sample Depth (inches)	Sampler	Total Metals	Dissolved Metals	SVOCs / PCBs	TPH-Dx	SVOCs	PCBs	Description
Background Samples														
Sediment Samples														
BK01SD	17484030	JHPK0	11/29/2017	12:14	Surface Sediment	0 to 3	D. Pulvino	X	--	X	X	--	--	Brown well graded sand with silt
BK02SD	17484031	MJHPK1	11/29/2017	13:25	Surface Sediment	0 to 3	D. Pulvino	X	--	--	--	--	--	Tan well graded gravel with silt
Surface Water Samples														
BK01SW	17484105	JHPS5	11/29/2017	12:04	Surface Water	NA	D. Pulvino	X	--	--	X	X	X	Clear, no odor
BK02SW	17484107	MJHPS7	11/29/2017	13:15	Surface Water	NA	D. Pulvino	X	--	--	--	--	--	Clear, no odor
BK01SW-D	17484106	MJHPS6	11/29/2017	12:04	Surface Water Dissolved	NA	D. Pulvino	--	X	--	--	--	--	Clear, no odor
BK02SW-D	17484108	MJHPS8	11/29/2017	13:15	Surface Water Dissolved	NA	D. Pulvino	--	X	--	--	--	--	Clear, no odor
Groundwater														
BK01GW	17484111	JHPT1	11/29/2017	10:00	Groundwater	NA	J. Fetters	X	--	--	X	X	X	Clear, no odor
BK01GW-D	17484112	MJHPT2	11/29/2017	10:00	Groundwater Dissolved	NA	J. Fetters	--	X	--	--	--	--	Clear, no odor
Investigation Derived Waste														
ID01WT	17484118	JHPT8	11/30/2017	11:00	Water	NA	J. Fetters	X	--	--	X	X	X	Decontamination water
Rinsate Sample														
RI01WT	17484117	JHPT7	11/30/2017	11:42	Water	NA	J. Fetters	X			X	X	X	Rinsate blank collected from Geoprobe well screen and casing
RI0TWT-D	17484104	MJHPS4	11/30/2017	11:42	Groundwater Dissolved	NA	J. Fetters	--	X	--	--	--	--	Rinsate blank collected from Geoprobe well screen and casing

Key:

-- = Not Analyzed
CLP = Contract Laboratory Program
EPA = United States Environmental Protection Agency
NA = Not applicable
PCB = Polychlorinated Biphenyl
SVOCs = Semivolatile Organic Compounds
TPH-Dx = Diesel Range Total Petroleum Hydrocarbons

Table 3-2 Sample Coding

Digits	Description	Code	Example
1,2	Source Code	BK	Background
		CB	Crawford Branch
		CC	Cow Creek
		DC	Doe Creek
		JC	Jerry Creek
		LP	Lower Retention/Settling Pond
		RG	Rail Gulch
		UD	Unnamed Drainage
		UP	Upper Retention/Settling Pond
3,4	Consecutive Number	01	First number of source code
5,6	Matrix Code	GW	Ground Water
		GW-D	Dissolved Ground Water
		SD	Sediment
		SW	Surface Water
		WT	Water

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Table 6-1 Settling/Retention Pond Surface Water Analytical Results Summary

EPA Sample ID	17484105	17484106	17484107	17484108	17484033	17484034	17484035	17484036	17484037	17484038	17484043	17484044	17484045	17484046	17484047	17484048
Station Location Description	BK01SW	BK01SW-D	BK02SW	BK02SW-D	UP01SW	UP01SW-D	UP02SW	UP02SW-D	UP03SW	UP03SW-D	LP02SW	LP02SW-D	LP03SW	LP03SW-D	LP04SW	LP04SW-D
CLP Sample Number	JHPS5	MJHPS6	MJHPS7	MJHPS8	JHPK3	MJHPK4	JHPK5	MJHPK6	JHPK7	MJHPK8	JHPL3	MJHPL4	JHPL5	MJHPL6	MJHPL7	MJHPL8
Sample Location	Cow Creek Background		Little Doe Creek Background		Upper Settling/Retention Pond						Lower Settling/Retention Pond					
Target Analyte List Metals (total) (ug/L)																
Calcium	**7360**	--	**9080**	--	**7220**	--	4500 JQ	--	3900 JQ	--	**6370**	--	4590 JQ	--	**5030**	--
Chromium	1.1 JQ (SQL = 10)	--	2.4 JQ (SQL = 10)	--	**50.2**	--	**123**	--	**65.3**	--	**19.7**	--	**54.7**	--	**41.1**	--
Iron	**515**	--	**405**	--	**131**	--	**306**	--	**715**	--	**402**	--	**168**	--	**154**	--
Magnesium	4340 JQ	--	**11700**	--	**33200 JH**	--	**39800 JH**	--	**40100 JH**	--	**45800**	--	**37200**	--	**38800**	--
Manganese	**19.5**	--	2.8 JQ (SQL = 15)	--	15 U	--	**18.4**	--	15 U	--	**49.1**	--	3.2 JQ	--	2.7 JQ	--
Sodium	5000 U	--	5000 U	--	**6860**	--	**7800**	--	**5770**	--	**6700**	--	**7010**	--	**6990**	--
Target Analyte List Metals (dissolved) (ug/L)																
Calcium	--	**6680**	--	**8660**	--	**7140**	--	4310 JQ	--	3860 JQ	--	**5970**	--	4490 JQ	--	4770 JQ
Chromium	--	10 U	--	10 U	--	**47.1**	--	**118**	--	**33.6**	--	**12.5**	--	**47**	--	**35**
Magnesium	--	3740 JQ	--	**11100**	--	**32500**	--	**38600**	--	**38400**	--	**42100**	--	**35400**	--	**35900**
Sodium	--	5000 U	--	5000 U	--	**6900**	--	**7660**	--	**5850**	--	**6470**	--	**7120**	--	**6800**

Notes:

Bold type indicates the sample result is above the contract required quantitation limit.

Underlined type and shading indicates the sample result is elevated as defined in Section 5.

Key:

CLP = Contract Laboratory Program

EPA = United States Environmental Protection Agency

H = High Bias

J = The associated numerical value is an estimated quantity because the reported concentrations were less than the sample quantitation limits or because quality control criteria limits were not met.

Q = Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit.

SQL = Sample Quantitation Limit

U = The material was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.

ug/L = micrograms per liter

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Table 6-2 Settling/Retention Pond Sediment Analytical Results Summary

EPA Sample ID	17484030	17484031	17484000	17484001	17484002	17484004	17484005	17484006	17484007	17484010
Location ID	BK01SD	BK02SD	UP01SD	UP02SD	UP03SD	LP01SD	LP02SD	LP03SD	LP04SD	LP05SD
CLP Sample Number	JHPK0	MJHPK1	JHPG0	JHPG1	JHPG2	JHPG4	JHPG5	JHPG6	JHPG7	JHPH0
Sample Depth (inches bgs)	0 to 3	0 to 3	0 to 3	0 to 3	0 to 3	0 to 3	0 to 3	0 to 3	0 to 3	0 to 6
Location Description	Cow Creek Background	Little Doe Creek Background	Upper Settling /Retention Ponds			Lower Settling/Retention Pond				
Target Analyte List Metals (mg/kg)										
Aluminum	16600	17600	19800	11800	2750	21700	19800	8130	10100	14300
Antimony	1.9 JQ (SQL = 10.8)	2.4 JQ (SQL = 7.6)	3 JQ	7.4 JL	21.1 JL	10.5 JL	11.3 JL	24.6 JL	26.7 JL	2.5 JQ
Arsenic	4.5	6.6	17	1.9	1.1 U	2.6	2.1	2 U	1.7 U	2.9
Barium	107	134	170	160	22.8 U	90.4	76.6	39.8 U	45.2	58.2
Cadmium	0.84 U	0.63 U	2	0.5 U	1.5	4.3	6.9	3.5	4.3	1.5
Calcium	4670	4950	1580	2510	2010	2600	1900	1650	1650	2810
Chromium	79.5 JH	129 JH	156	1440	1390	739	858	1580	1710	146
Cobalt	12.1	31.1	22.3	59	25	92.7	146	79.1	93.7	20.5
Copper	30.9	33.3	42.4	95.2	13.8	42.7	43	69.3	46.9	26
Iron	29900	36300	41200	40700	30300	88300	133000	68800	58400	31500
Lead	8.3	10.7	18.5 JL	143 JL	5.2 JL	26.5 JL	18.5 JL	24.8 JL	22.6 JL	6.4 JL
Magnesium	9650	13600	10600	27200	47500	45700	61900	62700	45500	15300
Manganese	371	1160	548	450	489	909	849	703	665	565
Mercury	0.17 U	0.12 U	0.062 JQ	0.23	0.12 U	0.053 JQ	0.095 JQ	0.086 JQ	0.76	0.03 JQ
Nickel	91.3	223	464	4350	843	6560	11900	5450	4760	904
Potassium	943	1010	2420	788	569 U	1710	1080	996 U	856 U	671
Selenium	1.3 JQ (SQL = 6.3)	1.9 JQ (SQL = 4.4)	4.7	4.7	3.4 JQ	9	10.4	8.3	9	3.8
Vanadium	57	76.3	62.9	74.9	12.2	70	71.5	41.3	56.5	42.1
Zinc	103	76.1	109	334	30.4	135	114	197	348	101
Semivolatile Organic Chemicals (ug/kg)										
Dimethylphthalate	630	–	380	450 JQ	320	600	490	780	570	350
Total Petroleum Hydrocarbons (mg/kg)										
Diesel Range Organics	34 U	–	27 U	1900	24 U	29 U	31 U	39 U	33 U	21 U
Motor Oil Range Organics	85 U	–	68 U	2000	59 U	72 U	78 U	98 U	83 U	52 U

Notes:

Bold type indicates the sample result is above the contract required quantitation limit.

Underlined type and shading indicates the sample result is elevated as defined in Section 5.

Key:

bgs = below ground surface
CLP = Contract Laboratory Program
EPA = United States Environmental Protection Agency
H = High Bias
J = The associated numerical value is an estimated quantity because the reported concentrations were less than the sample quantitation limits or because quality control criteria limits were not met.
L = Low Bias
mg/kg = milligrams per kilogram
Q = Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit.
SQL = Sample quantitation limit
U = The material was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.
ug/kg = micrograms per kilogram

Table 7-1 Domestic Groundwater Drinking Water Population by Distance Ring between Glenbrook Nickel Smelter Site and Cow Creek

Distance Ring (miles)	Number of Wells (a)	Total Population Served (a x 2.41)
0 – ¼	0	0
¼ – ½	1 Domestic Well	2
½ - 1	12 Domestic Wells	29
1 – 2	6 Domestic Wells	14
2 – 3	0	0
3 – 4	0	0
	Total	**46**

Source: OWRD 2017.

Note: The average number of persons per household for Douglas County, Oregon, of 2.41 was used. Population values were rounded to the nearest whole number.

Table 7-2 Shallow Groundwater Analytical Results Summary

EPA Sample ID	17484111	17484112	17484095	17484096	17484097	17484098	17484099	17484100	17484101	17484102	17484115	17484116
Location ID	BK01GW	BK01GW-D	BH02GW	BH02GW-D	BH03GW	BH03GW-D	BH04GW	BH04GW-D	BH05GW	BH05GW-D	DW01GW	DW01GW-D
CLP Sample Number	JHPT1	MJHPT2	JHPR5	MJHPR6	JHPR7	MJHPR8	JHPR9	MJHPS0	JHPS1	MJHPS2	JHPT5	MJHPT6
Station Location Description	Background		Lower Settling/Retention Pond						Below Upper Settling/Retention Pond		Guard Shack Well	
Target Analyte List Metals (total) ug/L												
Aluminum	200 U	--	6570	--	47.9 JQ	--	320	--	6100	--	966	--
Barium	200 U	--	200 U	--	200 U	--	200 U	--	200 U	--	1060	--
Calcium	11600	--	9740	--	8890	--	7700	--	15900	--	13500	--
Chromium	3.6 JQ (SQL=10)	--	47.3	--	0.91 JQ	--	5.7 JQ	--	39.1	--	10 U	--
Copper	25 U	--	8.2 JQ	--	25 U	--	25 U	--	25.1	--	85.7	--
Iron	140	--	9280	--	145	--	650	--	8480	--	1990	--
Lead	10 U	--	2.8 JQ	--	10 U	--	1.8 JQ	--	4.4 JQ	--	17.6	--
Magnesium	56300	--	50000	--	39900	--	42400	--	19100	--	2160 JQ	--
Manganese	6.9 JQ (SQL=15)	--	143	--	229	--	25.9	--	160	--	121	--
Nickel	9.2 JQ (SQL=40)	--	101	--	14.2 JQ	--	24.2 JQ	--	57.9	--	40 U	--
Sodium	5000 U	--	5000 U	--	5000 U	--	5500	--	14500	--	263000	--
Zinc	33.9 JQ (SQL=60)	--	35.4 JQ	--	12.6 JQ	--	2 JQ	--	27.5 JQ	--	4150	--
Target Analyte List Metals (dissolved) ug/L												
Barium	--	40.9 JQ (SQL=60)	--	29.1 JQ	--	11.1 JQ	--	17.6 JQ	--	49.9 JQ	--	1020
Calcium	--	11500	--	9110	--	8660	--	7310	--	15100	--	13200
Chromium	--	10 U	--	10	--	10 U	--	10 U	--	10 U	--	10 U
Iron	--	80.8 JQ	--	20.2 JQ	--	100	--	29.3 JQ	--	309	--	247
Magnesium	--	54400	--	44900	--	38200	--	38900	--	16400	--	1790 JQ
Manganese	--	6.5 JQ (SQL=15)	--	13.2 JQ	--	230	--	15.6	--	67.6	--	106
Sodium	--	5000 U	--	5000 U	--	5000 U	--	5330	--	14500	--	246000
Zinc	--	31.1 JQ (SQL=60)	--	9.4 JQ	--	12 JQ	--	60 U	--	8 JQ	--	2380

Notes:

Bold type indicates the sample result is above the contract required quantitation limit.

Underlined type and shading indicates the sample result is elevated as defined in Section 5.

Key:

CLP = Contract Laboratory Program

EPA = United States Environmental Protection Agency

ID = Identification

J = The associated numerical value is an estimated quantity because the reported concentrations were less than the sample quantitation limits or because quality control criteria limits were not met.

Q = Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit.

SQL = Sample quantitation limit

U = The material was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.

ug/L = micrograms per liter

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Table 7-3 Cow Creek Surface Water Analytical Results Summary

EPA Sample ID	17484105	17484106	17484071	17484072	17484073	17484074	17484075	17484076	17484077	17484078	17484079	17484080	17484081	17484082	17484083	17484084
Location ID	BK01SW	BK01SW-D	CC01SW	CC01SW-D	CC02SW	CC02SW-D	CC03SW	CC03SW-D	CC04SW	CC04SW-D	CC05SW	CC05SW-D	CC06SW	CC06SW-D	CC07SW	CC07SW-D
CLP Sample Number	JHPS5	MJHPS6	JHPP1	MJHPP2	JHPP3	MJHPP4	JHPP5	MJHPP6	JHPP7	MJHPP8	JHPP9	MJHPQ0	JHPQ1	MJHPQ2	JHPQ3	MJHPQ4
Station Location Description	Background		Cow Creek													
Target Analyte List Metals (total) ug/L																
Aluminum	**300**	--	**329**	--	**247**	--	**251**	--	**235**	--	**260**	--	**260**	--	**1070**	--
Calcium	**7360**	--	**7120**	--	**9170**	--	**7310**	--	**7090**	--	**7340**	--	**7430**	--	**7570**	--
Iron	**515**	--	**383**	--	**319**	--	**301**	--	**274**	--	**322**	--	**330**	--	**1390**	--
Magnesium	4340 JQ	--	4190 JQ	--	**5800**	--	4420 JQ	--	4380 JQ	--	4710 JQ	--	4770 JQ	--	4710 JQ	--
Manganese	**19.5**	--	10.1 JQ	--	**27.6**	--	7.3 JQ	--	6.1 JQ	--	7.7 JQ	--	8.5 JQ	--	**64.2**	--
Target Analyte List Metals (dissolved) ug/L																
Calcium	--	**6680**	--	**6550**	--	**8820**	--	**7030**	--	**6690**	--	**6870**	--	**7370**	--	**6840**
Iron	--	56.9 JQ	--	55.2 JQ	--	27 JQ	--	6.6 JQ	--	44.1 JQ	--	40.1 JQ	--	11.7 JQ	--	**196**
Magnesium	--	3740 JQ	--	3730 JQ	--	**5360**	--	4010 JQ	--	4050 JQ	--	4250 JQ	--	**7190**	--	3800 JQ
Manganese	--	3 JQ (SQL = 15)	--	2.6 JQ	--	**20.3**	--	0.68 JQ	--	1.9 JQ	--	**26.6**	--	1.6 JQ	--	2.9 JQ

Notes: Bold type indicates the sample result is above the contract required quantitation limit.

Underlined type and shading indicates the sample result is elevated as defined in Section 5.

Key:

CLP = Contract Laboratory Program

EPA = United States Environmental Protection Agency

ID = Identification

J = The associated numerical value is an estimated quantity because the reported concentrations were less than the sample quantitation limits or because quality control criteria limits were not met.

Q = Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit.

SQL = Sample Quantitation Limit

ug/L = micrograms per liter

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Table 7-4 Cow Creek Sediment Analytical Results Summary

EPA Sample ID	17484030	17484019	17484020	17484021	17484022	17484023	17484024	17484025
Location ID	BK01SD	CC01SD	CC02SD	CC03SD	CC04SD	CC05SD	CC06SD	CC07SD
CLP Sample Number	JHPK0	JHPH9	JHPJ0	JHPJ1	JHPJ2	JHPJ3	JHPJ4	JHPJ5
Sample Depth (inches bgs)	0 to 3	0 to 6	0 to 6	0 to 6	0 to 6	0 to 6	0 to 2	0 to 2
Location Description	Background	Cow Creek						
Target Analyte List Metals (mg/kg)								
Aluminum	16600	12800	17100	13600	15300	15700	14700	14400
Arsenic	4.5	3.5	4.6	4.6	4.7	4.4	5.1	5.7
Barium	107	76.5	103	78.8	83.7	87.2	99.2	90.3
Cadmium	0.84 U	1.2	1.3	0.56 U	1.4	1.4	0.58 U	0.61 U
Calcium	4670	4270	4490	3950	3310	3800	3050	3570
Chromium	79.5 JH	77.1	92.1	62 JH	92.1	90	64.8 JH	59.8 JH
Cobalt	12.1	9.6	12.5	11.6	12.7	13.2	10.3	14.2
Copper	30.9	20.5	26.7	25.8	26	25.9	45	29
Iron	29900	23800	27300	28200	27800	28200	30200	30400
Lead	8.3	6 JL	9 JL	7.7	7.4 JL	7.2 JL	8.6	7.5
Magnesium	9650	8850	11300	10500	14200	13600	10100	11400
Manganese	371	322	371	470	431	453	401	530
Nickel	91.3	80.9	116	93.5	121	117	69	108
Potassium	943	830	1060	804	1010	1050	1130	992
Vanadium	57	43.8	49.7	47.2	43.7	45.4	42.2	48.1
Zinc	103	72.5	118	80	94.5	92.4	90.5	94.9
Semivolatile Organic Chemicals (ug/kg)								
Dimethylphthalate	630	330	290	410	470	360	300	270

Notes:

Bold type indicates the sample result is above the contract required quantitation limit.

Underlined type and shading indicates the sample result is elevated as defined in Section 5.

Key:

bgs = Below Ground Surface

CLP = Contract Laboratory Program

EPA = United States Environmental Protection Agency

H = High Bias

J = The associated numerical value is an estimated quantity because the reported concentrations were less than the sample quantitation limits c because quality control criteria limits were not met.

L = Low Bias

mg/kg = milligrams per kilogram

U = The material was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.

ug/kg = micrograms per kilogram

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Table 7-5 Near-Site Drainages Surface Water Analytical Results Summary

EPA Sample ID	17484105	17484106	17484055	17484056	17484049	17484050	17484059	17484060	17484067	17484068	17484063	17484064	17484107	17484108	17484057	17484058	17484051	17484052	17484061	17484062
Station Location Description	BK01SW	BK01SW-D	DC01SW	DC01SW-D	CB01SW	CB01SW-D	RG01SW	RG01SW-D	JC01SW	JC01SW-D	UD01SW	UD01SW-D	BK02SW	BK02SW-D	DC02SW	DC02SW-D	CB02SW	CB02SW-D	RG02SW	RG02SW-D
CLP Sample Number	JHPS5	MJHPS6	MJHPM5	MJHPM6	JHPL9	MJHPM0	JHPM9	MJHPN0	MJHPN7	MJHPN8	JHPN3	MJHPN4	MJHPS7	MJHPS8	MJHPM7	MJHPM8	MJHPM1	MJHPM2	MJHPN1	MJHPN2
Sample Location	Cow Creek Background		Lower Doe Creek		Lower Crawford Branch		Lower Rail Gulch		Lower Jerry Creek		Lower Unnamed Drainage		Little Doe Creek Background		Upper Doe Creek		Upper Crawford Branch		Upper Rail Gulch	
Target Analyte List Metals (total) ug/L																				
Aluminum	**300**	--	**230**	--	49.7 JQ	--	200 U	--	200 U	--	200 U	--	**362**	--	**251**	--	23.8 JQ	--	200 U	--
Calcium	**7360**	--	**8800**	--	**9990**	--	**9050**	--	**8200**	--	**24800**	--	**9080**	--	**8130**	--	**9560**	--	3300 JQ	--
Chromium	1.1 JQ (SQL = 10)	--	1.8 JQ	--	**12.9**	--	**76.4**	--	10 U	--	10 U	--	2.4 JQ (SQL = 10)	--	1.1 JQ	--	**14.4**	--	10 U	--
Iron	**515**	--	**291**	--	**109**	--	56.5 JQ	--	24.5 JQ	--	16.8 JQ	--	**405**	--	**300**	--	62.7 JQ	--	83.8 JQ	--
Magnesium	4340 JQ	--	**15900**	--	**46400**	--	**57600 JH**	--	**37000 JH**	--	**27400 JH**	--	**11700**	--	**22900**	--	**42400 JH**	--	**46600 JH**	--
Manganese	**19.5**	--	3.2 JQ	--	2 JQ	--	15 U	--	15 U	--	15 U	--	2.8 JQ (SQL = 15)	--	5.2 JQ	--	15 U	--	15 U	--
Nickel	3.2 JQ (SQL = 40)	--	4.1 JQ	--	7.6 JQ	--	**42.7**	--	40 U	--	40 U	--	5.3 JQ (SQL = 40)	--	3.5 JQ	--	40 U	--	40 U	--
Sodium	5000 U	--	**5330**	--	5000 U	--	**5810**	--	5000 U	--	**9190**	--	5000 U	--	5000 U	--	5000 U	--	5000 U	--
Target Analyte List Metals (dissolved) ug/L																				
Calcium	--	**6680**	--	**8160**	--	**9350**	--	**9050**	--	**8160**	--	**25400**	--	**8660**	--	**7450**	--	**9620**	--	3420 JQ
Chromium	--	10 U	--	10 U	--	**11.2**	--	**78.1**	--	10 U	--	10 U	--	10 U	--	10 U	--	**12.8**	--	10 U
Magnesium	--	3740 JQ	--	**14400**	--	**42400**	--	**58700**	--	**36800**	--	**28300**	--	**11100**	--	**20000**	--	**42400**	--	**47800**
Sodium	--	5000 U	--	**5040**	--	5000 U	--	**5770**	--	5000 U	--	**9460**	--	5000 U	--	5000 U	--	5000 U	--	5000 U

Notes: Bold type indicates the sample result is above the contract required quantitation limit.

Underlined type and shading indicates the sample result is elevated as defined in Section 5.

Key:

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Q = Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit.

SQL = Sample Quantitation Limit

U = The material was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.

ug/L = micrograms per liter

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Table 7-6 Near-Site Drainages Sediment Analytical Results Summary

EPA Sample ID	17484030	17484011	17484008	17484013	17484017	17484015	17484031	17484012	17484009	17484014	17484016
Location ID	BK01SD	DC01SD	CB01SD	RG01SD	JC01SD	UD01SD	BK02SD	DC02SD	CB02SD	RG02SD	UD02SD
CLP Sample Number	JHPK0	MJHPH1	JHPG8	JHPH3	MJHPH7	JHPH5	MJHPK1	MJHPH2	MJHPG9	MJHPH4	MJHPH6
Sample Depth	0 to 3	0 to 2	0 to 3	0 to 3	0 to 3	0 to 3	0 to 3	0 to 2	0 to 3	0 to 3	0 to 3
Station Location Description	Cow Creek Background	Lower Doe Creek	Lower Crawford Branch	Lower Rail Gulch	Lower Jerry Creek	Lower Unnamed Drainage	Little Doe Creek Background	Upper Doe Creek	Upper Crawford Branch	Upper Rail Gulch	Upper Unnamed Drainage
Target Analyte List Metals (mg/kg)											
Aluminum	16600	19100	13400	2820	14600	22400	17600	20200	11800	13000	22900
Antimony	1.9 JQ (SQL =10.8)	7.5 UJL	9.1 JL	40.7 JL	6.1 JQ	9 UJL	2.4 JQ (SQL = 7.6)	6.8 UJL	10.3 JL	13.5 JL	1.9 JQ
Arsenic	4.5	6.5	1.2	1.1 U	4	6.1	6.6	7	1.2 U	1.3 U	16.6
Barium	107	123	81	22.7 U	131	221	134	145	98.9	58.1	262
Cadmium	0.84 U	1.7	2.1	2.8	0.78 U	2	0.63 U	1.8	2.3	3.1	0.78
Calcium	4670	1900	7360	567 U	3310	3500	4950	1650	7030	7640	4500
Chromium	79.5 JH	79.3	530	2630	359 JH	135 JH	129 JH	67	622	849	64.5 JH
Cobalt	12.1	17.6	38.6	113	47.2	29.3	31.1	16.6	45.8	100	22.4
Copper	30.9	31	18.9	13.6	35.6	41.8	33.3	33.4	15.5	19.7	64
Iron	29900	36300	42200	52800	39400	35000	36300	35900	48900	56200	57400
Lead	8.3	9.4 JL	5.2 JL	4.3 JL	15.8	24	10.7	10.7 JL	4.7 JL	5.1 JL	16.9
Magnesium	9650	14600	57900	59300	47400	10500	13600	10700	86900	85500	9390
Manganese	371	541	586	986	444	370	1160	572	571	1020	724
Nickel	91.3	149	770	3120	1050	858	223	164	1160	2770	167
Potassium	943	1090	723	567 U	1470	2180	1010	1240	585 U	650 U	2620
Selenium	1.3 JQ (SQL = 6.3)	4 JQ	4.3	5.4	2.1 JQ	3.2 JQ	1.9 JQ (SQL = 4.4)	4.2	4.4	5.7	2.9 JQ
Vanadium	57	50.9	49.5	23	58.5	66.8	76.3	49.4	52.4	60.7	94.4
Zinc	103	80.8	48.6	65	70.4	124	76.1	95.2	48.1	50.8	118
Semivolatile Organic Chemicals (ug/kg)											
Dimethylphthalate	630	--	500	130 JQ	--	340	--	--	--	--	--

Notes: Bold type indicates the sample result is above the contract required quantitation limit.

Underlined type and shading indicates the sample result is elevated as defined in Section 5.

Key:

bgs = below ground surface

CLP = Contract Laboratory Program

EPA = United States Environmental Protection Agency

H = High Bias

J = The associated numerical value is an estimated quantity because the reported concentrations were less than the sample quantitation limits or because quality control criteria limits were not met.

L = Low Bias

mg/kg = milligrams per kilogram

Q = Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit.

SQL = Sample Quantitation Limit

U = The material was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.

ug/kg = micrograms per kilogram

Table 7-7 Sport Catch Data within the 15-Mile Target Distance Limit

Species	Number Harvested (a)	Average Pounds per Fish (b)	Percent of Harvest within TDL (c)	Pounds Harvested within TDL (a x b) x c
Sport Catch (Cow Creek)				
Winter Steelhead (*Oncorhynchus mykiss*)	5	6	17%	5.1
Smallmouth Bass (*Micropterus dolomieu*)	NA	NA	NA	25*
Sport Catch (South Umpqua River)				
Spring Chinook salmon (*Oncorhynchus tshawytscha*)	16	22	6%	21.12
Fall Chinook salmon (*Oncorhynchus tshawytscha)*	40	22	6%	52.8
Winter Steelhead (*Oncorhynchus mykiss*)	1,643	6	6%	591.48
Coho salmon (*Oncorhynchus kisutch*)	16	8	6%	7.68
Total (rounded to nearest integer)				**703**

Sources: ODFW 2017a; ODFW 2017b; Wydoski 2003

Note: * Data not available, pounds harvested are estimated.

Key:
NA = Not Available
TDL = Target Distance Limit

APPENDIX 7

Sanborn Map Report

Nickel Mountain

Nickel Mountain Quarry

Winston, OR 97496

Inquiry Number: 6175862.3

September 01, 2020

Certified Sanborn® Map Report

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

Certified Sanborn® Map Report

09/01/20

Site Name:

Nickel Mountain
Nickel Mountain Quarry
Winston, OR 97496
EDR Inquiry # 6175862.3

Client Name:

Alpine Environmental Consultants, LLC
12208 Antioch Road
White City, OR 97503
Contact: Jonathan Williams

The Sanborn Library has been searched by EDR and maps covering the target property location as provided by Alpine Environmental Consultants, LLC were identified for the years listed below. The Sanborn Library is the largest, most complete collection of fire insurance maps. The collection includes maps from Sanborn, Bromley, Perris & Browne, Hopkins, Barlow, and others. Only Environmental Data Resources Inc. (EDR) is authorized to grant rights for commercial reproduction of maps by the Sanborn Library LLC, the copyright holder for the collection. Results can be authenticated by visiting www.edrnet.com/sanborn.

The Sanborn Library is continually enhanced with newly identified map archives. This report accesses all maps in the collection as of the day this report was generated.

Certified Sanborn Results:

Certification # 2343-4F11-9BB8

PO # NA

Project Nickel Mountain

UNMAPPED PROPERTY

This report certifies that the complete holdings of the Sanborn Library, LLC collection have been searched based on client supplied target property information, and fire insurance maps covering the target property were not found.

Sanborn® Library search results

Certification #: 2343-4F11-9BB8

The Sanborn Library includes more than 1.2 million fire insurance maps from Sanborn, Bromley, Perris & Browne, Hopkins, Barlow and others which track historical property usage in approximately 12,000 American cities and towns. Collections searched:

- ☑ Library of Congress
- ☑ University Publications of America
- ☑ EDR Private Collection

The Sanborn Library LLC Since 1866™

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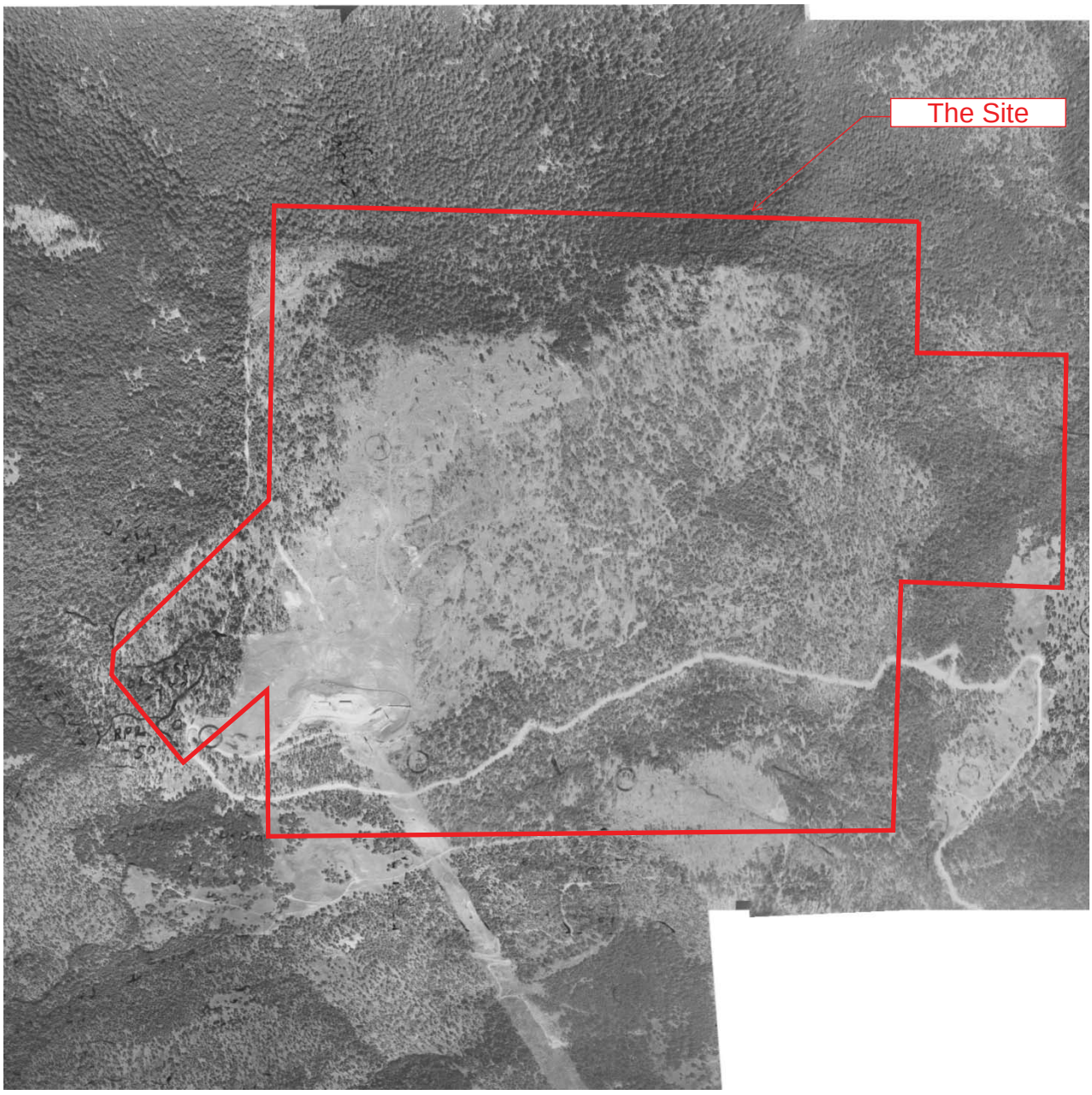
APPENDIX 8

Historical Aerial Photographs



ALPINE ENVIRONMENTAL CONSULTANTS, LLC

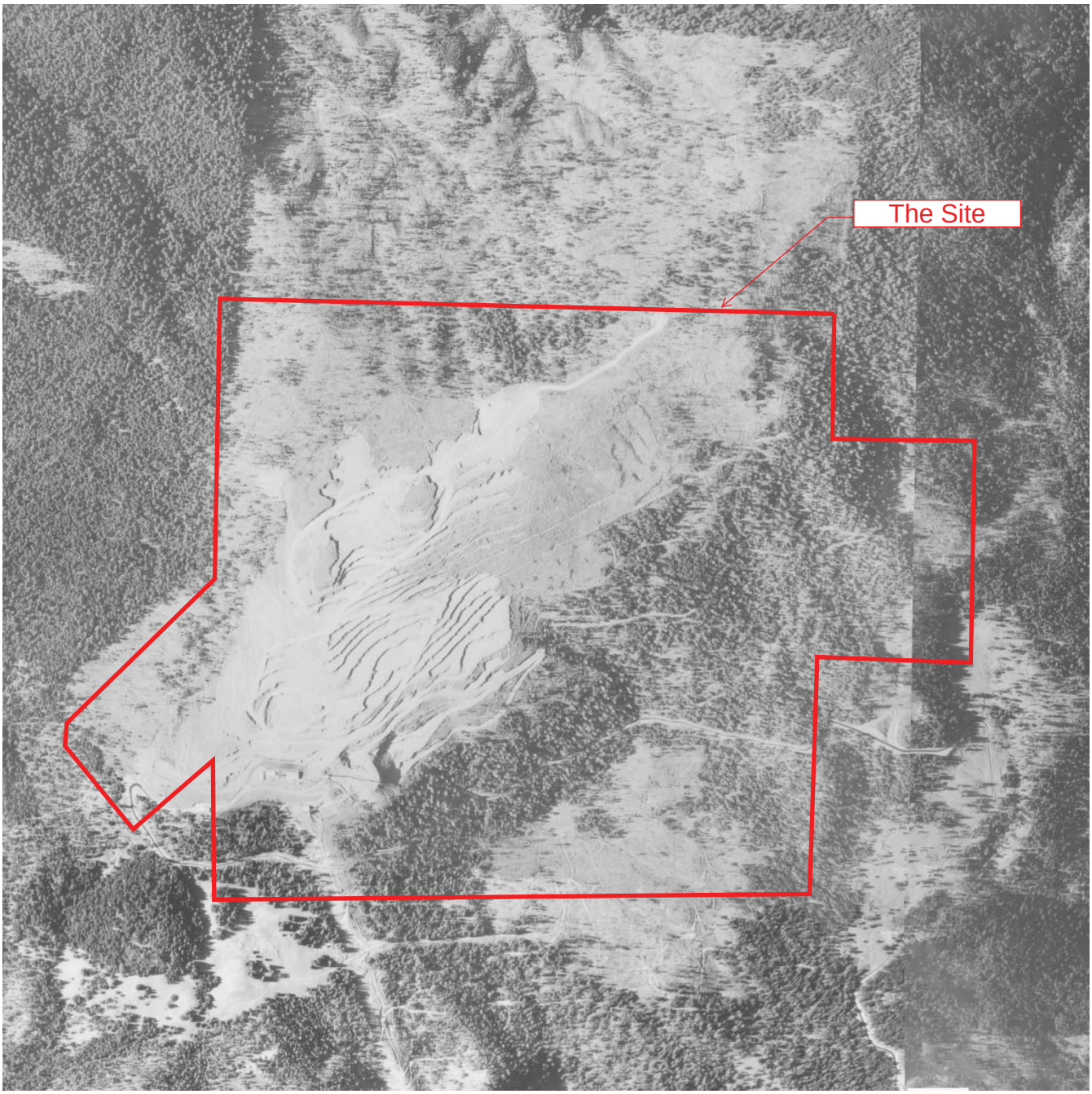
AERIAL PHOTO 1954

SOURCE: UNIVERSITY OF OREGON

Nickel Mine Quarry

Douglas County, Oregon

Map and Taxlot 3006W16 TL 200; 3006W17 TL 100 and TL 200; and 3006W18 TL 400 and TL 500



ALPINE ENVIRONMENTAL CONSULTANTS, LLC

AERIAL PHOTO 1960

SOURCE: UNIVERSITY OF OREGON

Nickel Mine Quarry
Douglas County, Oregon
Map and Taxlot 3006W16 TL 200; 3006W17 TL 100 and TL 200; and 3006W18 TL 400 and TL 500

ALPINE ENVIRONMENTAL CONSULTANTS, LLC

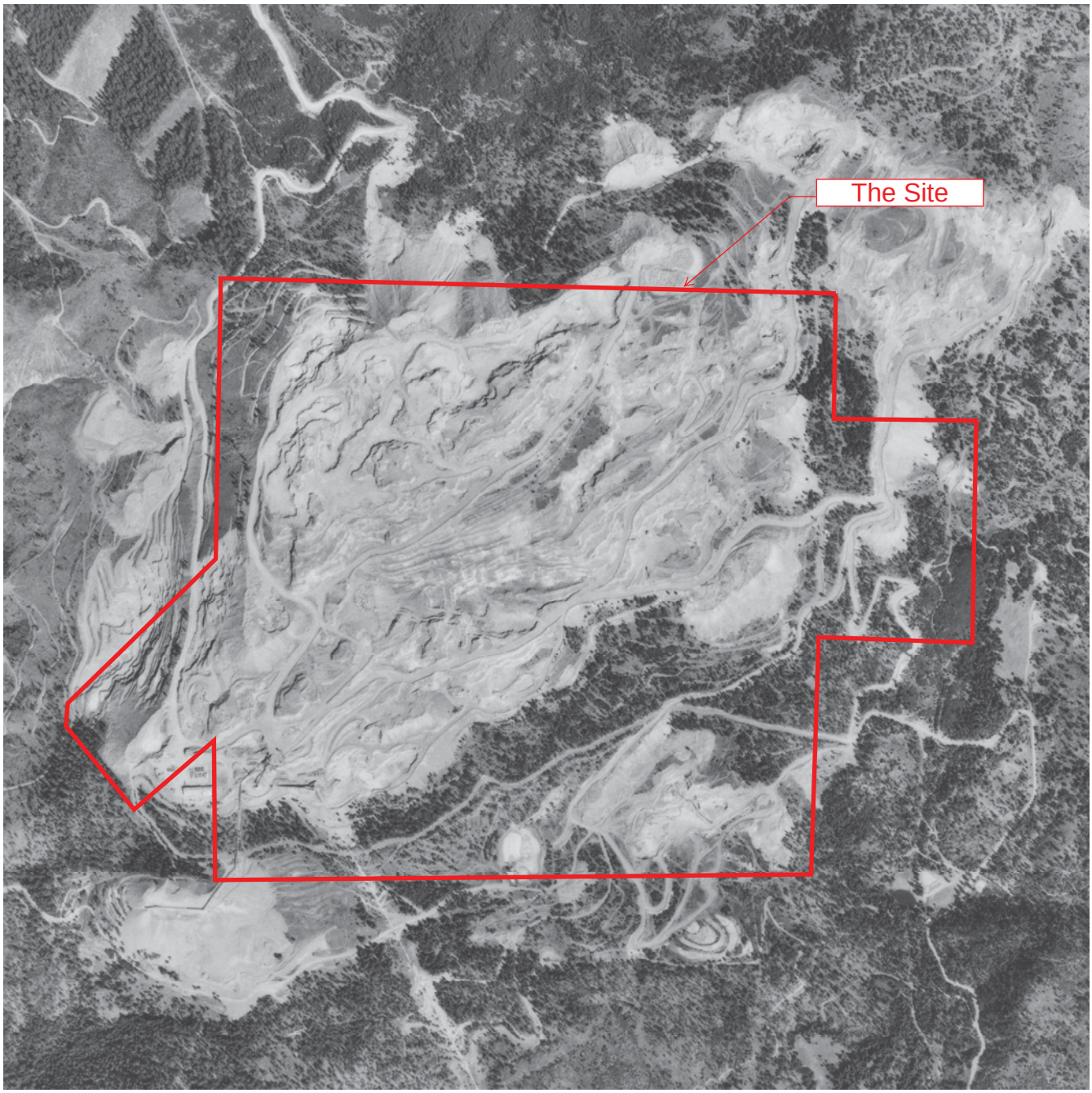
AERIAL PHOTO 1971

SOURCE: UNIVERSITY OF OREGON

Nickel Mine Quarry

Douglas County, Oregon

Map and Taxlot 3006W16 TL 200; 3006W17 TL 100 and TL 200; and 3006W18 TL 400 and TL 500

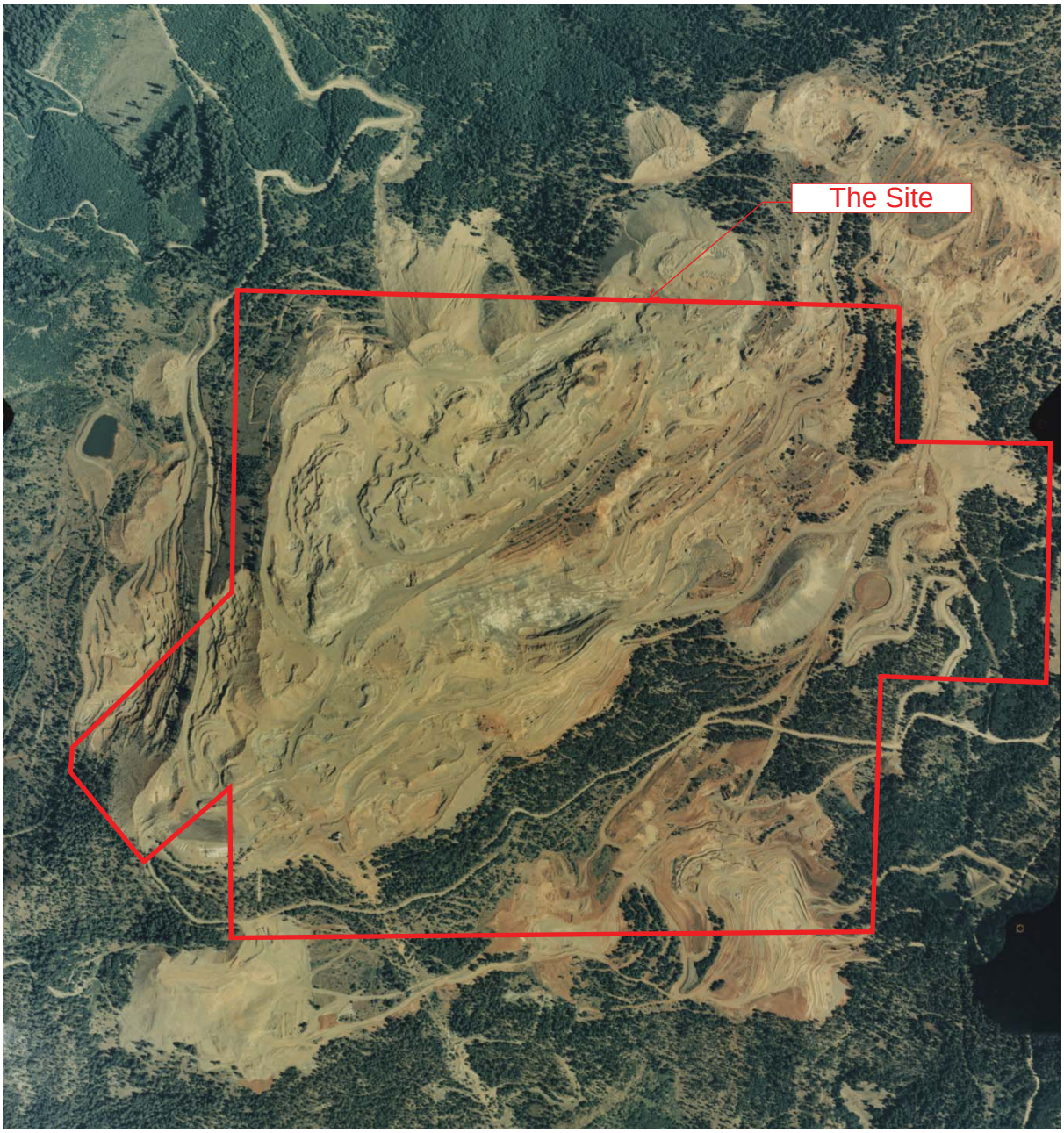


ALPINE ENVIRONMENTAL CONSULTANTS, LLC

AERIAL PHOTO 1982

SOURCE: UNIVERSITY OF OREGON

Nickel Mine Quarry
Douglas County, Oregon
Map and Taxlot 3006W16 TL 200; 3006W17 TL 100 and TL 200; and 3006W18 TL 400 and TL 500



ALPINE ENVIRONMENTAL CONSULTANTS, LLC

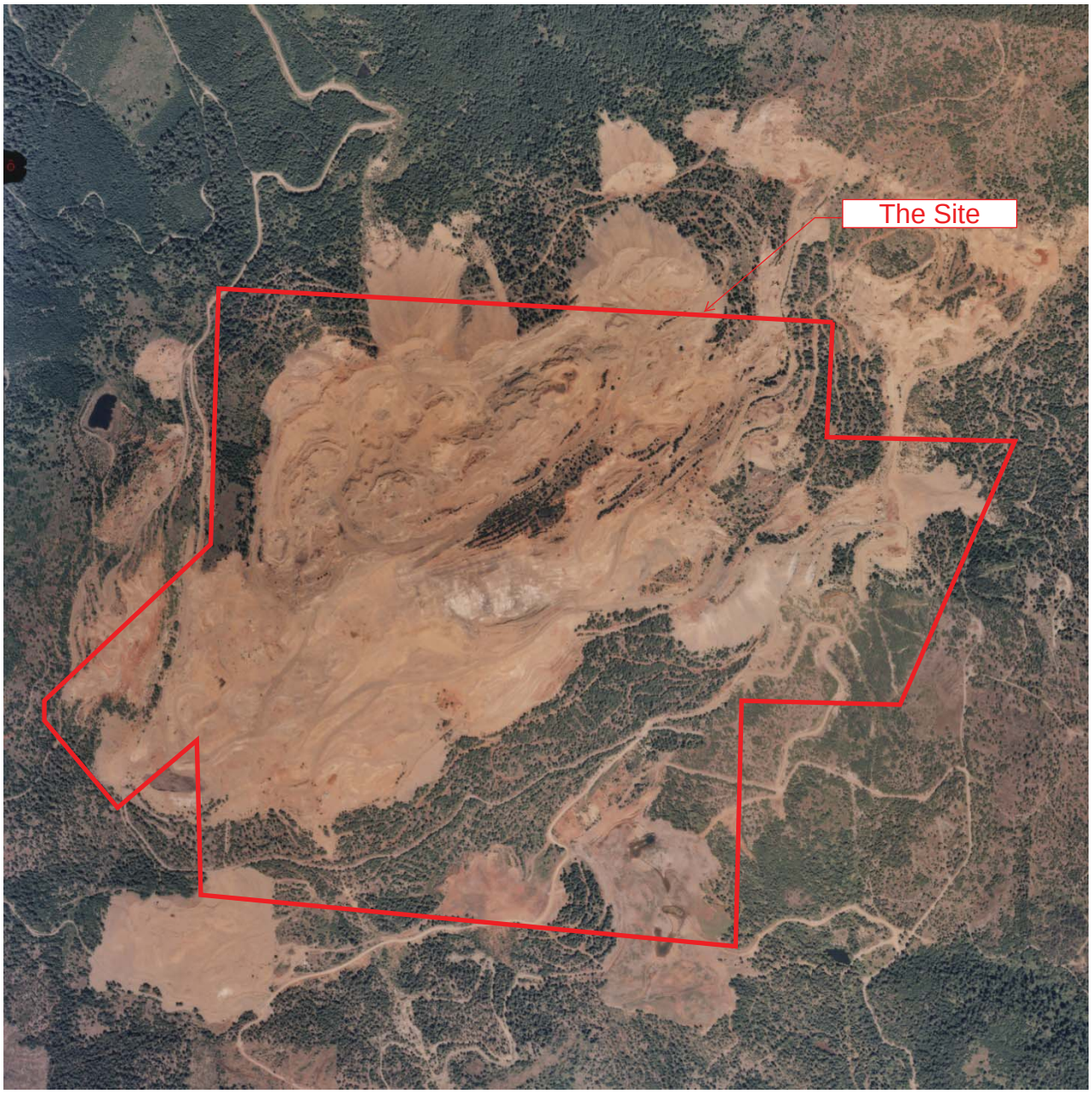
AERIAL PHOTO 1994

SOURCE: UNIVERSITY OF OREGON

Nickel Mine Quarry

Douglas County, Oregon

Map and Taxlot 3006W16 TL 200; 3006W17 TL 100 and TL 200; and 3006W18 TL 400 and TL 500



ALPINE ENVIRONMENTAL CONSULTANTS, LLC

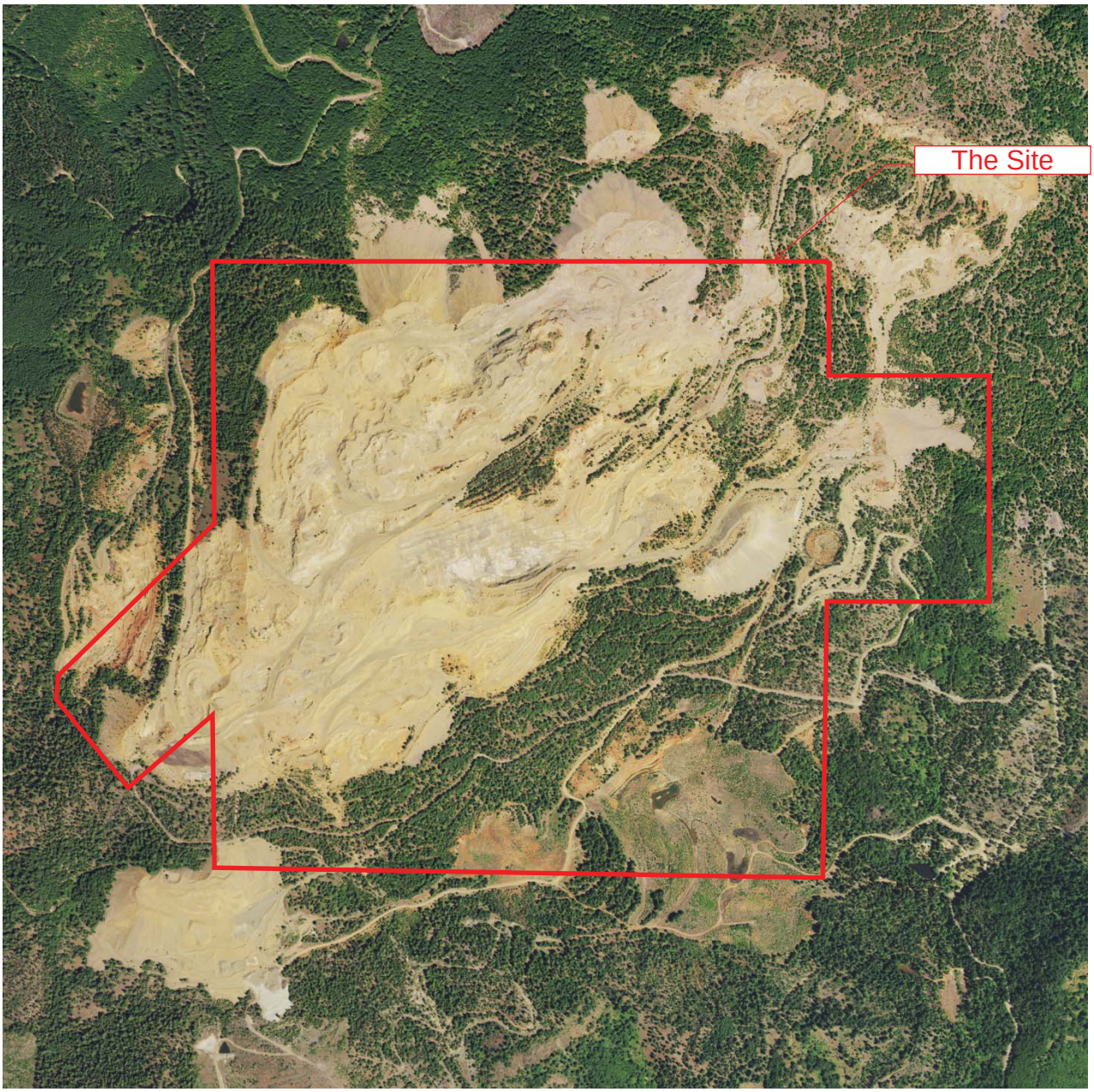
AERIAL PHOTO 2004

SOURCE: UNIVERSITY OF OREGON

Nickel Mine Quarry

Douglas County, Oregon

Map and Taxlot 3006W16 TL 200; 3006W17 TL 100 and TL 200; and 3006W18 TL 400 and TL 500



ALPINE ENVIRONMENTAL CONSULTANTS, LLC

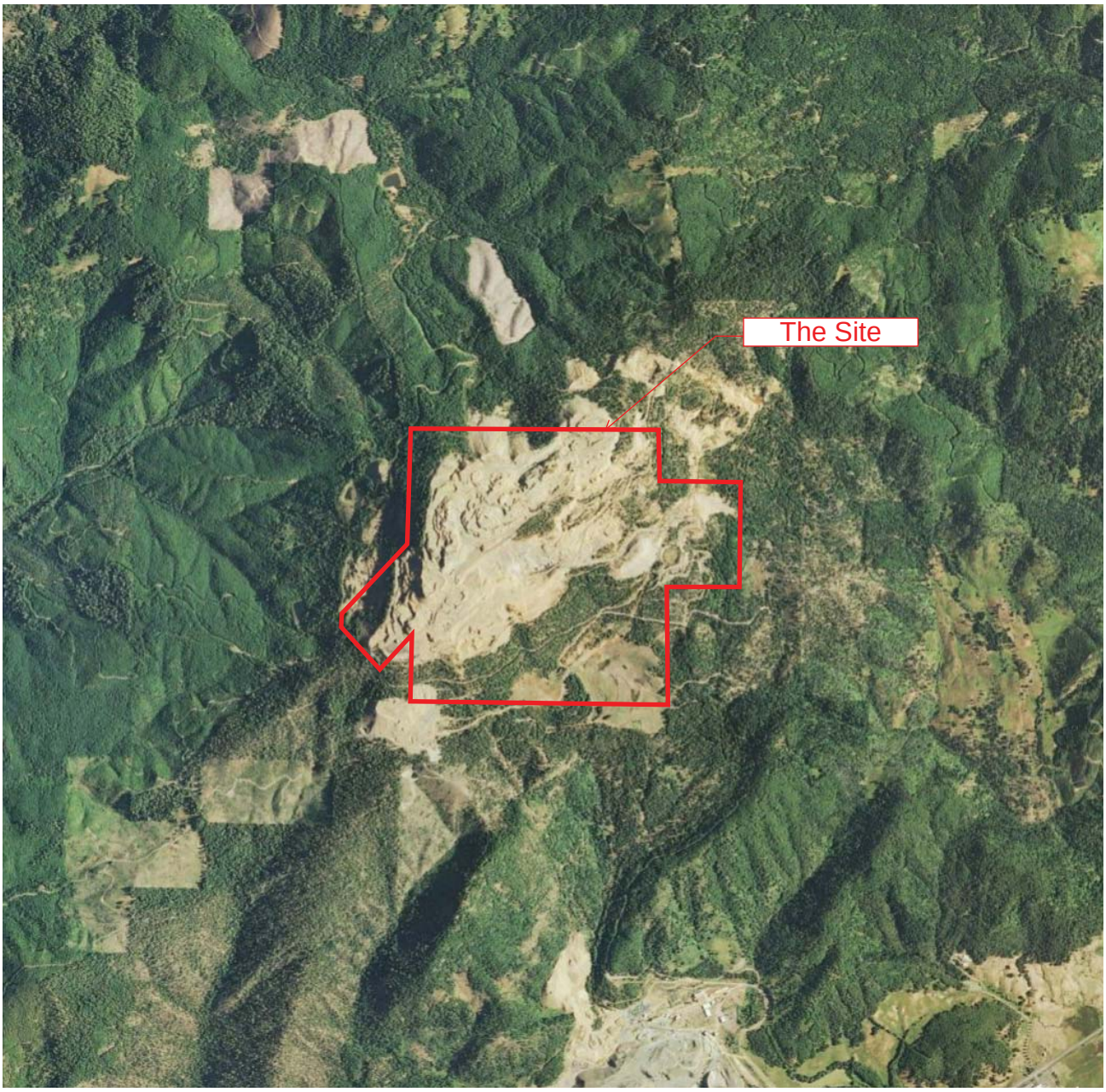
AERIAL PHOTO 2014

SOURCE: UNIVERSITY OF OREGON

Nickel Mine Quarry

Douglas County, Oregon

Map and Taxlot 3006W16 TL 200; 3006W17 TL 100 and TL 200; and 3006W18 TL 400 and TL 500



ALPINE ENVIRONMENTAL CONSULTANTS, LLC

AERIAL PHOTO 2015

SOURCE: GOOGLE EARTH

Nickel Mine Quarry

Douglas County, Oregon

Map and Taxlot 3006W16 TL 200; 3006W17 TL 100 and TL 200; and 3006W18 TL 400 and TL 500

APPENDIX 9

Historical City Directories

Nickel Mountain
Nickel Mountain Quarry
Winston, OR 97496

Inquiry Number: 6175862.5
September 03, 2020

The EDR-City Directory Image Report

Environmental Data Resources Inc

6 Armstrong Road
Shelton, CT 06484
800.352.0050
www.edrnet.com

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SECTION

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Findings

City Directory Images

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

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EXECUTIVE SUMMARY

DESCRIPTION

Environmental Data Resources, Inc.'s (EDR) City Directory Report is a screening tool designed to assist environmental professionals in evaluating potential liability on a target property resulting from past activities. EDR's City Directory Report includes a search of available city directory data at 5 year intervals.

RECORD SOURCES

EDR's Digital Archive combines historical directory listings from sources such as Cole Information and Dun & Bradstreet. These standard sources of property information complement and enhance each other to provide a more comprehensive report.

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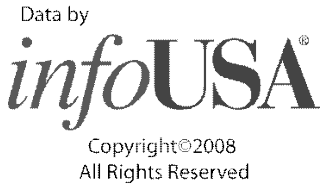

RESEARCH SUMMARY

The following research sources were consulted in the preparation of this report. A check mark indicates where information was identified in the source and provided in this report.

Year	Target Street	Cross Street	Source
2017	☐	☑	EDR Digital Archive
2014	☐	☑	EDR Digital Archive
2010	☐	☑	EDR Digital Archive
2005	☐	☑	EDR Digital Archive
2000	☐	☑	EDR Digital Archive
1995	☐	☑	EDR Digital Archive
1992	☐	☑	EDR Digital Archive

FINDINGS

TARGET PROPERTY STREET

Nickel Mountain Quarry
Winston, OR 97496

No Addresses Found

FINDINGS

CROSS STREETS

Year	*CD Image*	*Source*
BOYER RD		
2017	pg. A1	EDR Digital Archive
2014	pg. A3	EDR Digital Archive
2010	pg. A5	EDR Digital Archive
2005	pg. A7	EDR Digital Archive
2000	pg. A9	EDR Digital Archive
1995	pg. A11	EDR Digital Archive
1992	pg. A13	EDR Digital Archive
RIDDLE BY PASS RD		
2017	pg. A2	EDR Digital Archive
2014	pg. A4	EDR Digital Archive
2010	pg. A6	EDR Digital Archive
2005	pg. A8	EDR Digital Archive
2000	pg. A10	EDR Digital Archive
1995	pg. A12	EDR Digital Archive
1992	pg. A14	EDR Digital Archive

City Directory Images

Target Street	Cross Street	Source
-	✓	EDR Digital Archive

BOYER RD 2017

431	SCHARRINGHAUSEN, ANDREW D
510	GRAHAM, MICHELLE R
532	CHANDLER, CRAIG
550	TOWER TIMBER SERVICES
1475	LIGHT, DARREN
1479	LIGHT, DARREN L
1841	THOMPSON, ALIEN D
2100	KLUMPH, DENNIS A

Target Street	Cross Street	Source
-	✓	EDR Digital Archive

RIDDLE BY PASS RD 2017

656 HERBERT LUMBER CO
HERBERT, LYNN
LYNN HERBERT LOWBOY
839 CONDON, FRANK X
1281 ZULEGER, PATRICIA A
1471 DAVENPORT, CHRISTOPHER N
1959 ANDERSON, TOR A
2127 JASPER, STEVEN I
2168 S A SCHUYLER & SON INC SHOP
3343 PALMER, JAMES L
3601 SUMMERS, JACK C
4177 E & L MANUFACTURING
4179 PAULEY, DANIEL L
4744 SAILY, GREGORY S
5130 DAIGLE, JEROME K
5208 MARTIN, JAMES W
5300 WILSON, RYAN L

Target Street	Cross Street	Source
-	✓	EDR Digital Archive

BOYER RD 2014

431	SCHARRINGHAUSEN, ANDREW D
510	GRAHAM, MICHELLE R
511	OCCUPANT UNKNOWN,
532	CHANDLER, JODI
550	TOWER TIMBER SERVICES
1479	LIGHT, DARREN L
1718	OCCUPANT UNKNOWN,
1841	THOMPSON, ALIEN D
2100	KLUMPH, DENNIS A

Target Street	Cross Street	Source
-	✓	EDR Digital Archive

RIDDLE BY PASS RD 2014

652 OCCUPANT UNKNOWN,
656 HERBERT LUMBER CO
HERBERT, LYNN
LYNN HERBERT LOWBOY
658 OCCUPANT UNKNOWN,
839 FRANK, CONDON
1121 JOHNSON, CURTIS C
1125 HOWARD, LYLE W
1232 OCCUPANT UNKNOWN,
1281 ZULEGER, PATRICIA A
1471 TAYLOR, JAMES D
1699 IVES, RANDY W
1951 OCCUPANT UNKNOWN,
1959 ANDERSON, TOR A
2020 OCCUPANT UNKNOWN,
2127 JASPER, STEVEN I
2168 S A SCHUYLER & SON INC SHOP
2787 THOMS, DENNIS J
3343 PALMER, JAMES L
3601 NICHOLS, MILDRED D
4177 E & L MANUFACTURING
4179 PAULEY, DANIEL L
4744 SAILY, GREGORY S
4937 OCCUPANT UNKNOWN,
5093 OCCUPANT UNKNOWN,
5115 OCCUPANT UNKNOWN,
5130 DAIGLE, JROME K
5208 MARTIN, JAMES W
5300 WILSON, FRED B
5362 OCCUPANT UNKNOWN,

Target Street	Cross Street	Source
-	✓	EDR Digital Archive

BOYER RD 2010

532	WIGLE, RICHARD C
550	TOWER TIMBER SVC
1475	LIGHT, DARREN
1479	LIGHT, LYIE L
1718	THOMPSON, ROBERT F
1841	THOMPSON, ALIEN S
2100	HAUSOTTER, DAVID E

Target Street	Cross Street	Source
-	✓	EDR Digital Archive

RIDDLE BY PASS RD 2010

290	EGAN, MICHAEL J
658	STRATTON, RICHARD F
839	CONDON, FRANK X
1121	JOHNSON, CURTIS
	TOWER TIMBER SVC INC
1125	HOWARD, LYLE W
1281	ZULEGER, PATRICIA A
1471	TAYLOR, JAMES D
1699	IVES, RANDY W
1959	ANDERSON, TOR A
2127	JASPER, STEVEN I
2168	S A SCHUYLER & SON INC SHOP
2787	THOMS, DENNIS J
3343	SCHULER, GARY D
3601	MILLER, GARY R
4177	E & L MFG
4179	OCCUPANT UNKNOWN,
4744	SAILY, ROBERT C
5130	DAIGLE, RACHEL R
5208	MARTIN, JAMES W
5300	OCCUPANT UNKNOWN,
5362	JONES, MARY

Target Street	Cross Street	Source
-	✓	EDR Digital Archive

BOYER RD 2005

365	MCMILLEN, CASEY
431	OCCUPANT UNKNOWN, S W TRANSPORT SW TRANSPORT
510	HARRINGTON, D
532	WIGLE, CLOID B
1475	BEHLKE, STACEY A
1479	LIGHT, LYIE L
1718	THOMPSON, ROBERT F
1841	THOMPSON, ALIEN S
2100	HAUSOTTER, DAVID E

Target Street	Cross Street	Source
-	✓	EDR Digital Archive

RIDDLE BY PASS RD 2005

290	EGAN, MICHAEL J
315	DARRELL EDMUND BROWN
656	HERBERT LUMBER CO
658	STRATTON, RICHARD F
839	FX LUMBER
	OCCUPANT UNKNOWN,
1121	PRIEST, VERA M
1125	HOWARD, LYLE W
1281	ZULEGER, PATRICIA A
1471	TAYLOR, JAMES D
1699	IVES, RANDY W
1959	SCONCE, CHRIS M
2123	DICKERSON, ED
2127	JASPER, STEVEN I
2787	OCCUPANT UNKNOWN,
3064	ROSEBURG FOREST PRODUCTS CO
3343	MARTIN, LARRY S
3601	NICHOLS, JAMES E
4177	E & L MANUFACTURING INC
4179	PULLEN, DARRELL
4500	ROSEBURG FOREST PRODUCTS
4744	SAILY, ROBERT C
5130	DAIGLE, RACHEL M

Target Street	Cross Street	Source
-	✓	EDR Digital Archive

BOYER RD 2000

365	BOOTS, TED
400	BONN, JOSEPH S
532	WIGLE, CLOID B
537	GREEN, FRED
1479	LIGHT, LYLE
1718	THOMPSON, ROBERT F
1841	THOMPSON, ALLEN
2100	HAUSOTTER, DAVID

Target Street	Cross Street	Source
-	✓	EDR Digital Archive

RIDDLE BY PASS RD 2000

656 HERBERT LUMBER COMPANY
4177 E & L MANUFACTURING
5093 GLENBROOK NICKEL COMPANY

Target Street	Cross Street	Source
-	✓	EDR Digital Archive

BOYER RD 1995

400	BONN, JOSEPH
532	WIGLE, CLOID B
533	NEWCOMB, MILO M
537	GIBSON, GEORGE M
1479	LIGHT, LYLE L
1718	THOMPSON, ROBERT F
1841	THOMPSON, ALLEN
2100	HAUSOTTER, DAVID E

Target Street	Cross Street	Source
-	✓	EDR Digital Archive

RIDDLE BY PASS RD 1995

656 HERBERT LUMBER CO

Target Street	Cross Street	Source
-	✓	EDR Digital Archive

BOYER RD 1992

110	SMITH, ROBERT I
361	FULLER, M E
365	BRENNER, T J
400	BONN, JOSEPH
532	WIGLE, CLOID B
533	NEWCOMB, MILO M
537	GIBSON, GEORGE M
1475	HAMMOND, WALLACE J
1479	LIGHT, LYLE L
1718	THOMPSON, ROBERT F
1841	THOMPSON, ALLEN
2100	HAUSOTTER, DAVID E
2340	OHARE, M K

Target Street	Cross Street	Source
-	✓	EDR Digital Archive

RIDDLE BY PASS RD 1992

839 CONDON, FRANK X
1959 ESTERBROOK, RICHARD L

APPENDIX 10

Site Reconnaissance Photographs

1. The Site – wetland-like area, southeast corner of Site.

4. The Site – view to the northeast in central portion of Site.

2. The Site – wetland-like area, southeast corner of Site.

5. The Site – waste rock pile in central portion of Site.

3. The Site – view to the north from the southeast corner of the Site.

6. The Site – non-hazardous mining equipment debris in waste rock pile, central portion of Site.

7. The Site – ore dump pocket above the clarifier, eastern portion of Site.

10. The Site – revegetation in the clarifier footprint.

8. The Site and adjoining property – view to the east of waste rock, eastern portion of Site.

11. The Site – view to the west of waste rock from the clarifier.

9. The Site – view of the clarifier.

12. The Site – open pit in central portion of Site.

13. The Site and neighboring property – explosives magazine on/near Site boundary, northeastern corner of Site.

16. The Site – linear open pit, northern portion of Site.

14. The Site and neighboring property – explosives magazine on/near Site boundary, northeastern corner of Site.

17. The Site – ore dump pocket, southwest corner of Site.

15. The Site – ponded water in open pit, north central portion of Site.

18. The Site – ore dump pocket, southwest corner of Site.

19. Adjacent property – former office and truck shop maintenance area, BLM property.

22. The Site and neighboring property – view to the northwest, truck shop area, note mulched area.

20. Adjacent property – former office and truck shop maintenance area, BLM property, note large mulched area.

23. The Site and neighboring property – view to the southeast, truck shop area, note mulched area.

21. Adjacent property – former truck shop maintenance area, note steel rails on floor for tracked equipment, BLM property.

24. The Site and neighboring property – view to the northeast of linear open pit, northern portion of Site.

25. The Site and adjoining properties – view to the northwest of the mulched area near the former truck shop.

26. The Site – view of the ore dump pocket, southwestern corner of Site.

27. The Site and neighboring property – view to the south-southeast of waste rock and valley below.

APPENDIX 11

Environmental Interview Form

PHASE I ESA INTERVIEW

Site name: *Nickel Mtn. LLC, Approximately 748 acres in Douglas County, Oregon*

Name: Rick Barnes Relation to Site: Owner

Interviewed By: *Jonathan Williams* Date: November 8, 2020

If any one answer was obtained from another source, then note the name of the source, their title or position and the date of the interview or complete a separate form

1. What is the current use of the Site? This site is currently used for timber production with plans to process aggregate.

2. Who is the current occupant(s) of the Site? The property is owned by Nickel Mountain, LLC. There are no occupants of the site.

3. Are there any Environmental Liens or activity and land use limitations currently recorded against any portion of the Site? There are no Environmental liens. We have applied for and received A conditional Use Permit from Douglas County for processing rock on the site. Douglas County Planning Department file No. 19-022.

4. Are there any pending, threatened or past litigation or administrative proceeding relevant to hazardous substances or petroleum products on or from the property? No

5. Are there any notices from any governmental entity regarding any possible violation of environmental laws or possible litigation relating to hazardous substances or petroleum products on or from the property. No

6. Is the Site being offered for sale for less than its full market value because of any environmental conditions associated with the Site? No

7. Has there ever been an enforcement action or notice from a local regulatory agency or EPA about the Site? If yes, explain. None while we have owned the property and I am not aware of any prior to our purchase.

8. Are there any helpful documents available (see Helpful Documents Request Form)?
We have had several phase one assessments performed on the property. One dated September 15, 2000 with an Addendum dated April 5, 2001 by Land and Water Evironmental Services. An additional Phase 1 Environmenal Assessement was conducted for neighboring property by Maul Foster & Alongi, Inc. 11/6/2015.

9. Do you know of any environmental conditions associated with the Site? If yes, explain.
The property is the site of the Nickel Mine operated by Hanna Mining Corporation from 1954 - 1987 and then operated by Glenbrook Nickel Company into the 1990's when it was closed permanently. The site has been reclaimed as required.

10. Does the Site currently have any industrial uses? Including: gasoline or diesel storage and fueling facility, automotive or engine repair shop, trucking or bus depot, painting or auto body shop, chrome plating facility, commercial printer, photo developing laboratory, dry cleaner, timber or secondary wood products mill, junkyard or landfill, chemical storage or mixing facility, mine or mineral processing facility and manufacturing facility. The location is the site of the Hanna Nickel mine (Later opperated by Glenbrook Nickel). All required reclaimation has been completed.

11. If yes, what are they? The Nickel mine. Mining ceased in the late1990's.

    There has been no mining during Nickel Mountain, LLC ownership.

12. Has the Site ever had an industrial use in the past that is not currently active? If yes, explain.
    Yes, it was the site of the Hanna Nickle Mine and last mined by Glenbrook Nickel.

13. Are there currently on-Site, or has there ever been, any USTs or ASTs storing hazardous materials or petroleum products in quantities of 55 gallons or more? None that I know of.

14. Has there ever been a spill of hazardous materials or petroleum products in a quantity greater than 25 gallons that has not been cleaned up? If yes, explain. None that I know of.

15. Does the Site generate hazardous waste in quantities regulated by a local regulatory agency or EPA? If yes explain. No

16. Does the Site discharge stormwater or wastewater under a permit from a regulatory agency or EPA? If yes, explain. No

17. Do any of the adjacent properties have any industrial uses? If yes, what are they?
    Neighbor to the south (Nickel Mountain Rock) periodically processes rock. Most adjacent landowners are in forest use.

18. Have the adjacent properties had any industrial uses in the past that are not evident? If yes, explain. Not that I am aware of.

19. When was the Site first developed?
    There are mining claims from the 1800's but the major development of the mine was in the early 1950's.

20. When was each building developed? There are the reminants of one small building (rougly 10' x 10') that was used for storage during mining by the previous owners. We have not used this building.

21. How does the Site obtain potable water, electricity, natural gas, and telephone service?
    There is none.

22. Is there is a private well? If yes, do you have any knowledge that the well is contaminated?

There is not a private well on this site.

23. How are any Site buildings heated?

There are no heated buildings on the site.

24. What is the sewage disposal system for the Site, and what is the age of the system? Has the Site ever used a septic system or cesspool tank?

There has been no sewage disposal system on the site during our ownership. I have no knowledge about systems for previous owners.

25. Are there any floor drains or catch basins on the Site? If yes, where do they discharge? Have they ever discharged to an on site leach field? Ponds were constructed for sediment control during the mining and reclaimation operations.

26. Is there currently garbage or storm sewer service to the Site? Since?

No

27. Has there ever been any landfilling of garbage at the Site? If yes, explain.

Not that I am aware of.

28. Has there ever been any dumping on-Site of:

- Soil from contaminated or unknown sources, There are stockpiles of soil and rock from the previous mining operations.
- Drums or liquids,
  We have found some empty drums on the site and have removed most of them.
  I am not aware of any liquids.
- Asbestos building materials, None that I am aware of
- Automotive or industrial batteries, or None that I am aware of.
- Any other hazardous or industrial waste? Not that I am aware of.

APPENDIX 12

Phase II Environmental Site Assessment

Phase II Environmental Site Assessment

Nickel Mountain 745-Acre Area
Map and Taxlot 3006W17 TL 200 and TL 100, 3006W18 TL 400 and TL 500, and an Approximately 65-Acre Portion of 3006W16 TL 200
Riddle, Oregon 97469

Prepared by:

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Prepared for:

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April 16, 2021

ALPINE ENVIRONMENTAL CONSULTANTS, LLC

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LIST OF ACRONYMS AND ABBREVIATIONS

AEC	Alpine Environmental Consultants, LLC
AWQC	Aquatic Water Quality Criteria
BLM	Biotic Ligand Model
CCC	Chronic Continuous Concentration
DEQ	Department of Environmental Quality
ESA	Environmental Site Assessment
mg/L	milligrams per liter
MRL	method reporting limit
RBC	Risk Based Concentration
SPLP	Synthetic Precipitation Leachate Procedure
TL	tax lot
µg/L	micrograms per liter
USEPA	United States Environmental Protection Agency

1 EXECUTIVE SUMMARY

Alpine Environmental Consultants, LLC (AEC) conducted a Phase II Environmental Site Assessment (ESA) at the property identified as the approximately 745-Acre Nickel Mountain Property (the Site). The Site is located near Riddle, Oregon and occupies four tax lots (identified as Map and Taxlot 3006W17 TL 200 and TL 100 and 3006W18 TL 400 and TL 500) and an approximately 65-acre portion of a fifth tax lot (identified as 3006W16 TL 200) for a total of approximately 745 acres. The Site consists of rugged terrain with little or no topsoil and/or vegetation, some vegetated areas, and some remnant features of a historical nickel mine. These remnant features include pits, waste rock stockpiles, roads, two ore dump pockets, an ore clarifier, a shed formerly used as an explosives magazine, and the foundations of the mine office and truck/maintenance shop. The current owner of the Site is Nickel Mountain, LLC. The first four tax lots are planned to be purchased by LTM, Incorporated dba Knife River Materials (Knife River Materials). The fifth tax lot will be under Knife River Materials royalty.

Based on research conducted in support of the Phase I ESA and based on AEC's understanding about Knife River Materials' intentions to export rock products developed from the historical waste rock piles of the mine, AEC developed concerns about potential environmental issues associated with the Site. Specifically, potential environmental issues included the following:

- Historical mining operations, combined with naturally occurring conditions, could be adversely impacting surface water quality and ecological receptors at the Site and downstream of the Site. Ecological receptors of concern include wildlife drinking surface water at the Site and downstream of the Site, as well as aquatic receptors (e.g. fish) living in ponds and streams at the Site and downstream of the Site.
- Rock products developed at the Site, such as base rock and ¾-inch minus aggregate, will be exported to off-Site customers. There is the potential for metals to leach from these rock products at concentrations that could adversely impact off-Site human and ecological receptors.

The objectives of the Phase II ESA were to collect representative Site-specific surface water and rock samples and analyze them for relevant metals to determine if unacceptable risks to human and ecological receptors are present or if these potential environmental issues can be eliminated from further concern.

AEC conducted the Phase II ESA at the Site on January 16, 2021. The Phase II ESA included the collection of two surface water samples and five composite rock samples representative of the five waste rock stockpiles that Knife River Materials plans to mine.

The two surface water samples were analyzed for the following constituents:

- Total calcium and total magnesium by U.S. Environmental Protection Agency (USEPA) Method 6020B.
- Calculated hardness by Standard Method (SM) 2340B.
- pH by SM 4500.
- Dissolved metals by USEPA Method 6020B. The 17 metals included antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, thallium, vanadium, and zinc.

The five composite rock samples were analyzed for the following constituents:

- The rock samples were first crushed by Apex Laboratories to generate a particle size distribution approximately equivalent to ¾-minus aggregate, including fines. Using the Representative Subsampling Method, approximately 100 gram samples of coarse and fine material were developed.
- The 100 gram samples were then processed by the USEPA Synthetic Precipitation Leachate Procedure (SPLP) to generate leachate approximately equivalent to that which would be generated by rain water.
- The leachate was then analyzed for metals by USEPA Method 6020B. The 17 metals included antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, thallium, vanadium, and zinc.

Based on an evaluation of the dissolved metals analytical results for the surface water samples, no reported metals concentrations exceeded risk-based concentrations (RBCs) for wildlife ingestion of surface water. However, the concentrations of copper in surface water samples SW-1 (9.51 micrograms per liter [μg/L]) and SW-2 (8.44 μg/L) did exceed the Aquatic Water Quality Criterion (AWQC) for fresh water of 5.5 μg/L. Because the bioavailability and toxicity of copper is dependent on Site-specific water chemistry, the Biotic Ligand Model (BLM) was run using both Site-specific and assumed water chemistry data input. The results of the BLM indicate Site-specific dissolved copper concentrations measured in surface water samples SW-1 and SW-2 do not present unacceptable risks to aquatic receptors at the Site.

The analytical results for the five composite rock samples representative of the five waste rock stockpiles reported only one metal in one sample at a concentration that exceeded the laboratory method reporting limits (MRLs) for the SPLP method. Specifically, nickel was reported at a concentration of 927 μg/L in composite rock sample SP-5 (i.e. collected from stockpile number 5). The reported nickel concentration of 927 μg/L in composite rock sample SP-5 exceeds the AWQC RBC for nickel of 161 of μg/L. However, it should be noted the SPLP Method involves mixing 2 liters of synthetic rain with 100 grams of sample material. During sample preparation of the composite rock samples, 15 percent of each of the rock samples consisted of very fine-grained material (i.e. 70 microns or smaller). This sample preparation method purposely generated material with a much higher surface area than will be present in ¾-minus aggregate, so the metals results are biased high relative to the rock products that will

be generated during Knife River Materials' future rock processing activities. Furthermore, the amount of nickel available for dissolution can be expected to decrease significantly over time as the materials are exposed to ongoing precipitation. Accordingly, the risk associated with the leaching of nickel from exported rock products exposed to precipitation is considered acceptable.

Based on the analytical results for the samples collected during this Phase II ESA, combined with the results of the BLM, the aforementioned potential environmental issues can be eliminated from further concern.

2 INTRODUCTION

On behalf of LTM, Incorporated dba Knife River Materials (Knife River Materials), Alpine Environmental Consultants, LLC (AEC) has prepared this report to present the findings of the Phase II Environmental Site Assessment (ESA) conducted at the property identified as the approximately 745-Acre Nickel Mountain Property (the Site). The Site is located near Riddle, Oregon and occupies four tax lots (identified as Map and Taxlot 3006W17 TL 200 and TL 100 and 3006W18 TL 400 and TL 500) and an approximately 65-acre portion of a fifth tax lot (identified as 3006W16 TL 200) for a total of approximately 745 acres. The Site consists of rugged terrain with little or no topsoil and/or vegetation, some vegetated areas, and some remnant features of a historical nickel mine. These remnant features include pits, waste rock stockpiles, roads, two ore dump pockets, an ore clarifier, a shed formerly used as an explosives magazine, and the foundations of the mine office and truck/maintenance shop. The current owner of the Site is Nickel Mountain, LLC. The first four tax lots are planned to be purchased by Knife River Materials. The fifth tax lot will be under Knife River Materials' royalty.

2.1 Site Description

The Site is known as Nickel Mountain. It is located in Township 30 South, Range 6 West, Sections 16, 17, and 18 of the Willamette Meridian. The Site occupies four tax lots and a portion of a fifth tax lot for a total of approximately 745 acres. The information pertaining to these tax lots is as follows:

- Map and Taxlot 3006W17 TL 100, Property ID R37554, 160 acres;
- Map and Taxlot 3006W17 TL 200, Property ID R37570, 480 acres;
- Map and Taxlot 3006W18 TL 400, Property ID R37618, 24.17 acres;
- Map and Taxlot 3006W18 TL 500, Property ID R37610, 16.53 acres;
- Map and Taxlot 6006W16 TL 200, Property ID R37530, 320 acres, of which approximately 65 acres are included in the Site.

The Site is illustrated on **Figure 1** through **Figure 4**.

2.2 Site Background

The Site consists of relatively rugged topography which slopes steeply around Nickel Mountain. The assumed groundwater flow direction at the Site is radial outward from Nickel Mountain towards various creeks that are tributaries of Cow Creek and/or the South Umpqua River.

Historically, the Site consisted of undeveloped vegetated land until the 1950s, when a nickel surface mine started to operate at the Site and on the adjacent properties. The nickel mine was

operated by Hanna Mining Corporation from 1954 through 1987 and then by Glenbrook Nickel Company into the 1990's when it was closed permanently. Subsequently, portions of the mined area that were not exempt from state requirements were reclaimed. Currently, the Site consists mostly of rugged terrain with little or no topsoil and/or vegetation and of some revegetated areas and remnant features of the historical nickel mine. These remnant features include pits, waste rock stockpiles, roads, two ore dump pockets, an ore clarifier, a shed formerly used as an explosives magazine, and the foundations of the mine office and truck/maintenance shop.

The Site is planned to be used by Knife River Materials to mine and crush at least five of the waste rock piles at the Site. The current owner of the Site applied for and received a conditional use permit from Douglas County for processing rock at the Site. The Site is currently zoned as Farm-Forest. The neighboring properties are zoned as Farm-Forest and Timberland Resource.

2.3 Objectives

AEC initiated a Phase I investigation at the Site in September 2020 and conducted Site visits in December 2020 and January 2021. Based on research conducted in support of the Phase I ESA, AEC developed concerns about potential environmental issues associated with the Site and given AEC's understanding about Knife River Materials' intentions to export rock products developed from the historical waste rock piles of the mine. Specifically, potential environmental issues included the following:

- Historical mining operations, combined with naturally occurring conditions, could be adversely impacting surface water quality and ecological receptors at the Site and downstream of the Site. Ecological receptors of concern include wildlife drinking surface water at the Site and downstream of the Site, as well as aquatic receptors (e.g. fish) living in ponds and streams at the Site and downstream of the Site.
- Rock products developed at the Site, such as base rock and ¾-inch minus aggregate, will be exported to off-Site customers. There is the potential for metals to leach from these rock products at concentrations that could adversely impact off-Site human and ecological receptors.

The objectives of the Phase II ESA were to collect representative Site-specific surface water and rock samples and analyze them for relevant metals to determine if unacceptable risks to human and ecological receptors are present or if these potential environmental issues can be eliminated from further concern.

The Phase II ESA investigation process is presented in **Section 3**, data evaluation is presented in **Section 4**, and Conclusions and Recommendations are presented in **Section 5**.

3 PHASE II ESA INVESTIGATION

The Phase II ESA field work was conducted on January 16, 2021 and included the collection of two surface water samples and five composite rock samples from the five waste rock piles AEC understands Knife River Materials intends to mine in the future. A summary of the field methods and observations is presented in **Section 3.1** and **Section 3.2**. The analytical results of the surface water and composite rock samples and their interpretation are included in **Section 4**. Conclusions and recommendations are presented in **Section 5**. Photographic documentation is included in **Appendix 1**, the complete laboratory results are included in **Appendix 2**, and data files from the Biotic Ligand Model (BLM) are presented in **Appendix 3**. The location of the Site is shown on **Figure 1** through **Figure 3** and the surface water and composite rock sample locations are shown on **Figure 4**. The dissolved metals analytical results for the two surface water samples are summarized in **Table 1** and the Synthetic Precipitation Leachate Procedure (SPLP) metals analytical results for the five composite rock samples are summarized in **Table 2.**

3.1 Surface Water Sampling

On January 16, 2021, Mr. Jonathan Williams of AEC was accompanied by Mr. Rick Barnes, the Site Owner, during collection of the surface water and rock samples. Two surface water samples, identified as SW-1 and SW-2, were collected. The approximate surface water sample locations are illustrated on **Figure 4**. Surface water sample SW-1 was collected from a relatively small unnamed stream located adjacent to an access road east of rock stockpile number 1 on the east side of the Site. This stream was flowing from a ditch and observations suggest this stream likely only flows intermittently during the winter and spring and/or after significant precipitation events. Surface water sample SW-2 was collected from a rock-lined channel approximately 50 yards south and below a constructed wetland identified as “Grampy’s Watering Hole.” Surface water sample SW-2 was collected on the southeast corner of the Site near the headwaters of Rail Creek, and the presence of obligate wetland plants suggests this stream is perennial.

Both surface water samples were collected by dipping laboratory-supplied sample containers directly into the streams and filling them up, taking precautions to minimize disturbance of the stream bottom to minimize or eliminate turbidity. The water flowing in both streams was clear with minimal turbidity. Upon return to AEC’s office on the afternoon of January 16, 2021, the surface water samples for dissolved metals analyses were filtered using disposable single-use 0.45-micron filters and transferred into laboratory provided sample containers containing acid as an appropriate preservative.

3.2 Rock Sampling

A total of five composite rock samples were collected, one from the base of each of the five waste rock stockpiles Knife River Materials intends to mine. The approximate locations of these five composite rock samples, identified as SP-1 through SP-5, are illustrated on **Figure 4**. Each composite rock sample consisted of five cobble sized rocks (i.e. approximately 4 to 6 inches wide and 1 to 2 inches thick) that were collected over an approximately 100 square-foot area at each of the waste rock stockpiles. The rocks were placed into labeled 1-gallon Ziploc plastic bags.

3.3 Laboratory Analyses

All of the surface water and composite rock samples were placed in an iced cooler and submitted to Apex Laboratories, LLC (Apex Laboratories) in Tigard, Oregon using standard AEC chain-of-custody protocols.

The two surface water samples were analyzed for the following constituents:

- Total calcium and total magnesium by USEPA Method 6020B.
- Calculated hardness by SM 2340B.
- pH by SM 4500.
- Dissolved metals by USEPA Method 6020B. The 17 metals included antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, thallium, vanadium, and zinc.

The five composite rock samples were analyzed for the following constituents:

- The rock samples were first crushed by Apex Laboratories to generate a particle size distribution approximately equivalent to and even finer than ¾-minus aggregate, including fines. Using the Representative Subsampling Method, approximately 100 gram samples of coarse and fine material were developed.
- The 100 gram samples were then processed by the USEPA SPLP method to generate leachate approximately equivalent to that which would be generated by rain water.
- The leachate was then analyzed for metals by USEPA Method 6020B. The 17 metals included antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, thallium, vanadium, and zinc.

A copy of the final analytical laboratory report is included as **Appendix 2**. The methods used to crush the composite rock samples to generate samples approximately equivalent to and even finer than ¾-minus aggregate, including photographs, is also included in **Appendix 2**. The metals analytical results for the two surface water samples are summarized in **Table 1** and the SPLP metals analytical results are summarized in **Table 2.** The dissolved metals and SPLP metals results presented in **Table 1** and **Table 2** were compared to risk-based concentrations (RBCs) developed by the Oregon Department of Environmental Quality (DEQ) for wildlife ingestion of surface water and to Aquatic Water Quality Criteria (AWQC) RBCs for aquatic receptors. The

methods used to develop RBCs for wildlife ingestion and the AWQC were obtained from the *Tables and Appendices for Conducting Ecological Risk Assessments* guidance document dated September 2020.

4 DATA EVALUATION

4.1 Surface Water

The surface water dissolved metals results are included in **Appendix 2** and summarized in **Table 1**. The analytical results reported five metals at concentrations that exceed the laboratory MRLs in both surface water samples. These dissolved metals included barium, chromium, copper, lead, and nickel. None of these reported metals concentrations exceeded the relevant RBCs with the exception of copper. The dissolved copper concentrations in surface water samples SW-1 and SW-2 were 9.51 μg/L and 8.44 μg/L, respectively. Both of these reported dissolved copper concentrations exceeded the AWQC RBC for fresh water of 5.5 μg/L. Please note the MRLs for some of the metals were higher than their respective AWQC RBCs, and these are highlighted in bold blue font in **Table 1**.

It should be noted the source rock for the nickel ore at the Site consists of peridotite, a magnesium-rich and iron-rich rock that originated as a deep ocean crustal rock thrust up onto the North American continental plate during the formation of the Klamath Mountains. Most peridotites also contain elevated concentrations of metals, including but not limited to nickel and copper. It is likely the elevated copper concentrations detected in the two surface water samples are naturally occurring and associated with infiltration through and runoff over rocks at the Site.

Many metals, including copper, form various ion complexes in surface water and groundwater. The toxicity of these metals to ecological receptors, including copper, is dependent on the general chemistry of the water, which affects their bioavailability. The general chemistry of concern includes pH and other ions, especially calcium and magnesium. Calcium and magnesium affect water hardness. In general, metals become less toxic and bioavailable the harder the water. Based on the total calcium and total magnesium concentrations for surface water samples SW-1 and SW-2, the calculated hardness of water is 171 and 160 milligrams per liter (mg/L) as calcium carbonate, respectively. These calculated hardness values qualify the water as hard to very hard, and suggest metals such as copper will have low bioavailability and toxicity to aquatic receptors.

To further evaluate the toxicity and bioavailability of dissolved copper to aquatic receptors, AEC ran the Biotic Ligand Model (BLM) using both Site-specific and assumed water quality data for the Coastal area of Oregon. AEC utilized version 3.41.2.45 of the BLM model developed in 2015 by Windward Environmental, LLC. The methods and assumptions used in the model were consistent with DEQ's *Implementation of the Freshwater Aquatic Life Water Quality Standards for Copper* guidance document. This document is undated, but it followed the Oregon

Environmental Commission's new rules for copper toxicity in surface water adopted on November 2, 2016.

Following the methods and assumptions described in DEQ's *Implementation of the Freshwater Aquatic Life Water Quality Standards for Copper* guidance document, AEC entered the following data into the BLM Model to evaluate copper toxicity in surface water at the Site:

- Temperature – Assumed to be the mean daily temperature in January based on data presented by the Western Regional Climate Center for Riddle, Oregon during the period June 1, 1899 through June 9, 2016. Based on these data, the average mean temperature was assumed to be 5.42 degrees Celsius.
- pH – The measured pH values in surface water samples SW-1 and SW-2 were 8.41 and 8.23, respectively. It should be noted these pH values are basic, indicating acid mine drainage is not an issue.
- Dissolved organic carbon – Assumed a value for the Coastal area of 8.3 mg/L.
- Humic acid percentage – Assumed humic acid constitutes 10 percent for the organic acid content per the BLM guidance.
- Calcium – The measured total calcium concentrations in surface water samples SW-1 and SW-2 were 1.74 mg/L and 1.44 mg/L, respectively.
- Copper – The measured dissolved copper concentrations in surface water samples SW-1 and SW-2 were 9.51 μg/L and 8.44 μg/L, respectively.
- Magnesium – The measured total magnesium concentrations in surface water samples SW-1 and SW-1 were 40.4 mg/L and 37.9 mg/L, respectively.
- Sodium – Assumed a value for the Coastal area of 4.3 mg/L.
- Potassium – Assumed a value for the Coastal area of 0.46 mg/L.
- Sulfate – Assumed a value for the Coastal area of 1.90 mg/L.
- Sulfide – Assumed a value of 0.000001 mg/L per the BLM guidance.
- Chloride – Assumed a value for the Coastal area of 3.14 mg/L.
- Alkalinity – The calculated hardness values based on total calcium and total magnesium concentrations for surface water samples SW-1 and SW-2 were 171 mg/L and 160 mg/L as calcium carbonate equivalent, respectively.

These data were entered into the BLM and the model was run to calculate the Chronic Continuous Concentration (CCC) of copper that present unacceptable risks to aquatic receptors. The BLM output indicates the CCCs for copper in surface water samples SW-1 and SW-2 are 47.9 μg/L and 43.8 μg/L, respectively. Both of these calculated CCC values for copper exceed the measured dissolved concentrations measured in surface water samples SW-1 and SW-2 of 9.51 μg/L and 8.44 μg/L, respectively. Accordingly, the results of the BLM indicate Site-specific dissolved copper concentrations measured in surface water samples SW-1 and SW-2 do not present unacceptable risks to aquatic receptors at the Site. Copies of the BLM data input and output are included in **Appendix 3**.

4.2 Rock Samples

The SPLP metals results are included in **Appendix 2** and summarized in **Table 2**. The analytical results reported only one metal concentration in one sample at a concentration that exceeds the MRLs in the five composite waste rock piles that were processed and analyzed. Specifically, nickel was reported at a concentration of 927 μg/L in composite rock sample SP-5 (i.e. collected from stockpile number 5). Please note the MRLs for some of the metals were higher than their respective AWQC RBCs, and these are highlighted in bold blue font in **Table 2.**

The reported nickel concentration of 927 μg/L in composite rock sample SP-5 exceeds the AWQC RBC for nickel of 161 of μg/L. However, it should be noted the SPLP Method involves mixing 2 liters of synthetic rain with 100 grams of sample material. During sample preparation of the composite rock samples, 15 percent of each of the rock samples consisted of very fine-grained material (i.e. 70 microns or smaller). This sample preparation method purposely generated material with a much higher surface area than will be present in ¾-minus aggregate, so the metals results are biased high relative to the rock products that will be generated during Knife River Materials' future rock processing activities. Furthermore, the amount of nickel available for dissolution can be expected to decrease significantly over time as the materials are exposed to ongoing precipitation. Accordingly, the risk associated with the leaching of nickel from exported rock products exposed to precipitation is considered acceptable.

5 CONCLUSIONS AND RECOMMENDATIONS

The Phase II ESA subsurface investigation conducted at the Site included the collection of two surface water samples (SW-1 and SW-2) and five composite rock samples collected from five waste rock stockpiles (SP1 through SP-5).

The two surface water samples were analyzed for the following constituents:

- Total calcium and total magnesium by USEPA Method 6020B.
- Calculated hardness by SM 2340B.
- pH by SM 4500.
- Dissolved metals by USEPA Method 6020B. The 17 metals included antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, thallium, vanadium, and zinc.

The five composite rock samples were analyzed for the following constituents:

- The rock samples were first crushed by Apex Laboratories to generate a particle size distribution approximately equivalent to ¾-minus aggregate, including fines. Using the Representative Subsampling Method, approximately 100 gram samples of coarse and fine material were developed.
- The 100 gram samples were then processed by the USEPA SPLP method to generate leachate approximately equivalent to that which would be generated by rain water.
- The leachate was then analyzed for metals by USEPA Method 6020B. The 17 metals included antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, thallium, vanadium, and zinc.

Based on an evaluation of the dissolved metals analytical results for the surface water samples, no reported metals concentrations exceeded RBCs for wildlife ingestion of surface water. However, the concentrations of copper in surface water samples SW-1 (9.51 μg/L) and SW-2 (8.44 μg/L) did exceed the AWQC for fresh water of 5.5 μg/L. Because the bioavailability and toxicity of copper is dependent on Site-specific water chemistry, the BLM was run using both Site-specific and assumed water chemistry data input. The results of the BLM indicate Site-specific dissolved copper concentrations measured in surface water samples SW-1 and SW-2 do not present unacceptable risks to aquatic receptors at the Site.

The analytical results for the five composite rock samples representative of the five waste rock stockpiles reported only one metal in one sample at a concentration that exceeds the MRLs for the SPLP method. Specifically, nickel was reported at a concentration of 927 μg/L in composite rock sample SP-5 (i.e. collected from stockpile number 5). The reported nickel concentration of

927 µg/L in composite rock sample SP-5 exceeds the AWQC RBC for nickel of 161 of µg/L. However, it should be noted the SPLP Method involves mixing 2 liters of synthetic rain with 100 grams of sample material. During sample preparation of the composite rock samples, 15 percent of each of the rock samples consisted of very fine-grained material (i.e. 70 microns or smaller). This sample preparation method purposely generated material with a much higher surface area than will be present in ¾-minus aggregate, so the metals results are biased high relative to the rock products that will be generated during Knife River Materials' future rock processing activities. Furthermore, the amount of nickel available for dissolution can be expected to decrease significantly over time as the materials are exposed to ongoing precipitation. Accordingly, the risk associated with the leaching of nickel from exported rock products exposed to precipitation is considered acceptable.

Based on research conducted in support of the Phase I ESA and based on AEC's understanding about Knife River Materials' intentions to export rock products developed from the historical waste rock piles of the mine, AEC developed concerns about potential environmental issues associated with the Site. Specifically, potential environmental issues included the following:

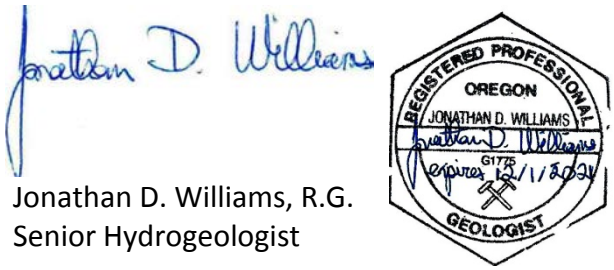
- Historical mining operations, combined with naturally occurring conditions, could be adversely impacting surface water quality and ecological receptors at the Site and downstream of the Site. Ecological receptors of concern include wildlife drinking surface water at the Site and downstream of the Site, as well as aquatic receptors (e.g. fish) living in ponds and streams at the Site and downstream of the Site.
- Rock products developed at the Site, such as base rock and ¾-inch minus aggregate, will be exported to off-Site customers. There is the potential for metals to leach from these rock products at concentrations that could adversely impact off-Site human and ecological receptors.

Based on the analytical results for the samples collected during this Phase II ESA, combined with the results of the BLM, these potential environmental issues can be eliminated from further concern.

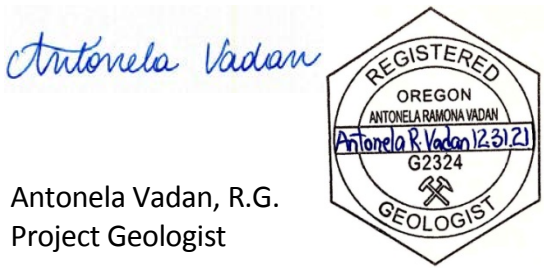
Please feel free to contact Jonathan Williams at 541-944-4685 or jwilliams@alpine-env-llc.com if you have any questions about this Phase II ESA report.

Sincerely,

Alpine Environmental Consultants, LLC



Jonathan D. Williams, R.G.
Senior Hydrogeologist



Antonela Vadan, R.G.
Project Geologist

6 LIMITATIONS

The purpose of an environmental assessment is to reasonably evaluate the potential for or actual impact of past practices on a given site area. In performing an environmental assessment, it is understood that a balance must be struck between a reasonable inquiry into the environmental issues and an exhaustive analysis of each conceivable issue of potential concern. This environmental assessment contains professional opinions as to the environmental issues of concern and/or additional actions, which may be addressed to the property. In rendering its professional opinion, we warrant that services provided hereunder were performed, within the limits described, consistent with current generally accepted environmental consulting principles and practices. No other warranty, express or implied, is made. The following paragraphs discuss the assumptions and parameters under which such an opinion is rendered.

No investigation is thorough enough to exclude the presence of hazardous materials at a given site. If hazardous conditions have not been identified during the assessment, such a finding should not therefore be construed as a guarantee of the absence of such materials on the site, but rather as the result of the services performed within the scope, limitations, and cost of the work performed.

Any opinions or recommendations presented apply to site conditions existing when services were performed. We are unable to report on or accurately predict events that may change the site conditions after the described services are performed, whether occurring naturally or caused by external forces. We assume no responsibility for conditions we were not authorized to investigate, or conditions not generally recognized as environmentally unacceptable when services were performed.

Environmental conditions may exist at the site that cannot be identified by visual observation. Where the scope of services was limited to observations made during site reconnaissance, interviews, review of readily available reports and literature or any combination, any conclusions or recommendations or both are necessarily based in part on information supplied by others, the accuracy or sufficiency of which we may not have independently reviewed.

Where subsurface work was performed, our professional opinions are based in part on interpretation of data from discrete sampling locations that may not represent actual conditions at unsampled locations.

Except where there is express concern of our client, or where specific environmental contaminants have been previously reported by others, naturally occurring toxic substances, potential environmental contaminants inside buildings, or contaminant concentrations that are not of current environmental concern may not be reflected in this document.

We are not responsible for any potential impact of changes in applicable environmental standards, practices, or regulations following performance of services, on the conclusions or recommendations, or both, of the study.

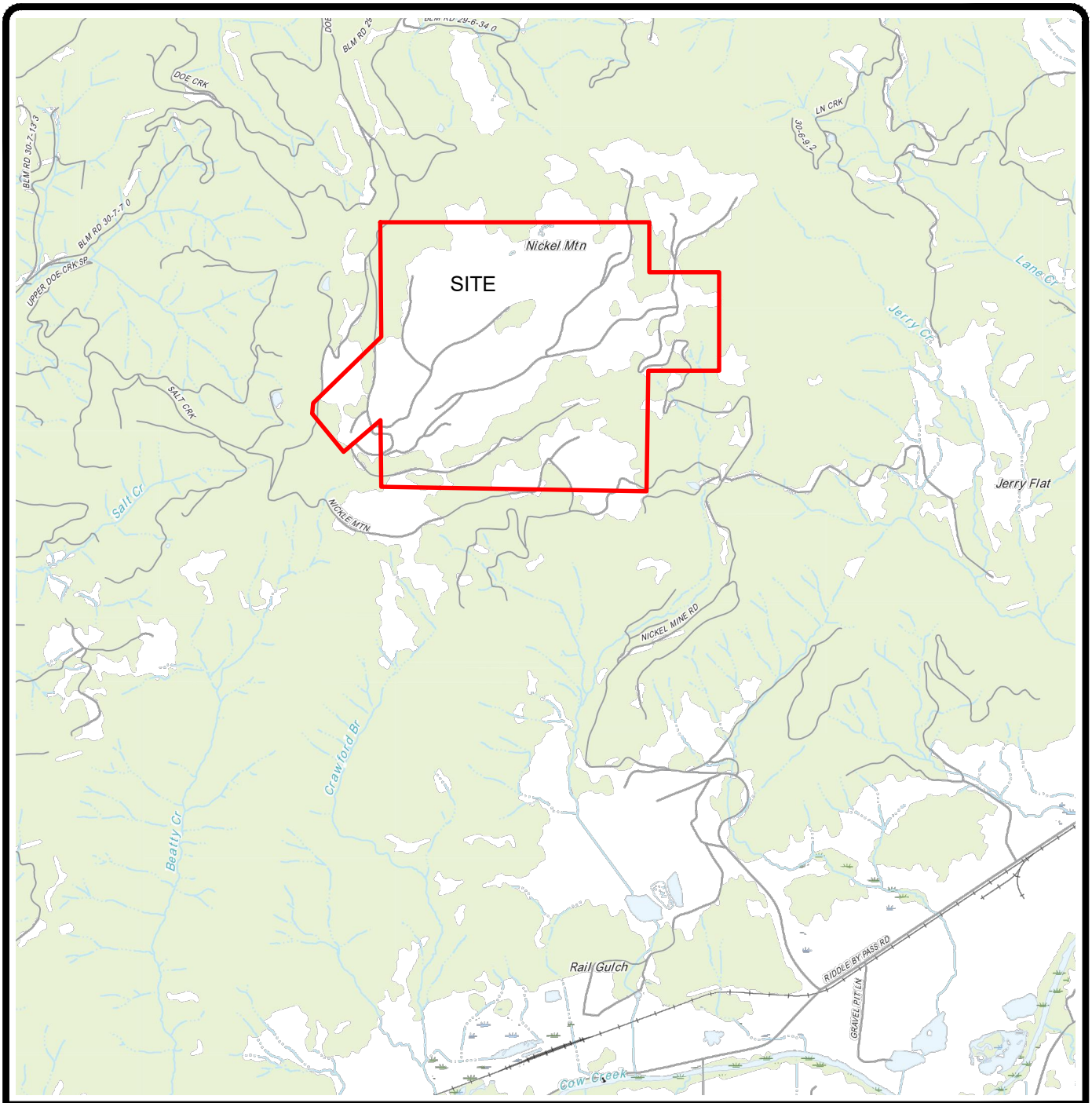
Services hereunder were performed consistent with our agreement and understanding with, and solely for the use of, our client. Opinions and recommendations are intended for the client, purpose, site, location, time frame, and project parameters indicated. We are not responsible for subsequent separation, detachment, or partial use of this document. Any reliance on this report by a third party shall be at such party's sole risk.

7 QUALIFICATIONS OF ENVIRONMENTAL PROFESSIONALS

Mr. Jonathan Williams received a Bachelor of Science degree in Geology, with honors, from Duke University in 1987. He has over 28 years experience working with geologic and environmental reports, including Phase I ESAs. Mr. Williams has been a Registered Geologist in the State of Oregon since 1996, and has 40-hour HAZWOPER training.

Ms. Antonela Vadan holds a Bachelor of Arts and Science in Earth and Environmental Sciences from the University of Illinois at Chicago. She has over 18 years of experience in both the private and public sector. Ms. Vadan has conducted multiple Phase I ESAs. Additional project activities have included risk assessments, remedial investigations/feasibility studies, soil and groundwater investigations, and indoor air quality investigations. Ms. Vadan is a Registered Geologist in the States of Oregon and Washington and has 40-hour HAZWOPER training.

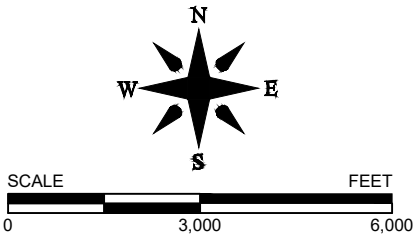
FIGURES



SOURCE: U.S.G.S. 7.5 MINUTE TOPOGRAPHIC QUADRANGLE
NICKEL MOUNTAIN, OR (2020)

LEGEND

APPROXIMATE SITE BOUNDARY

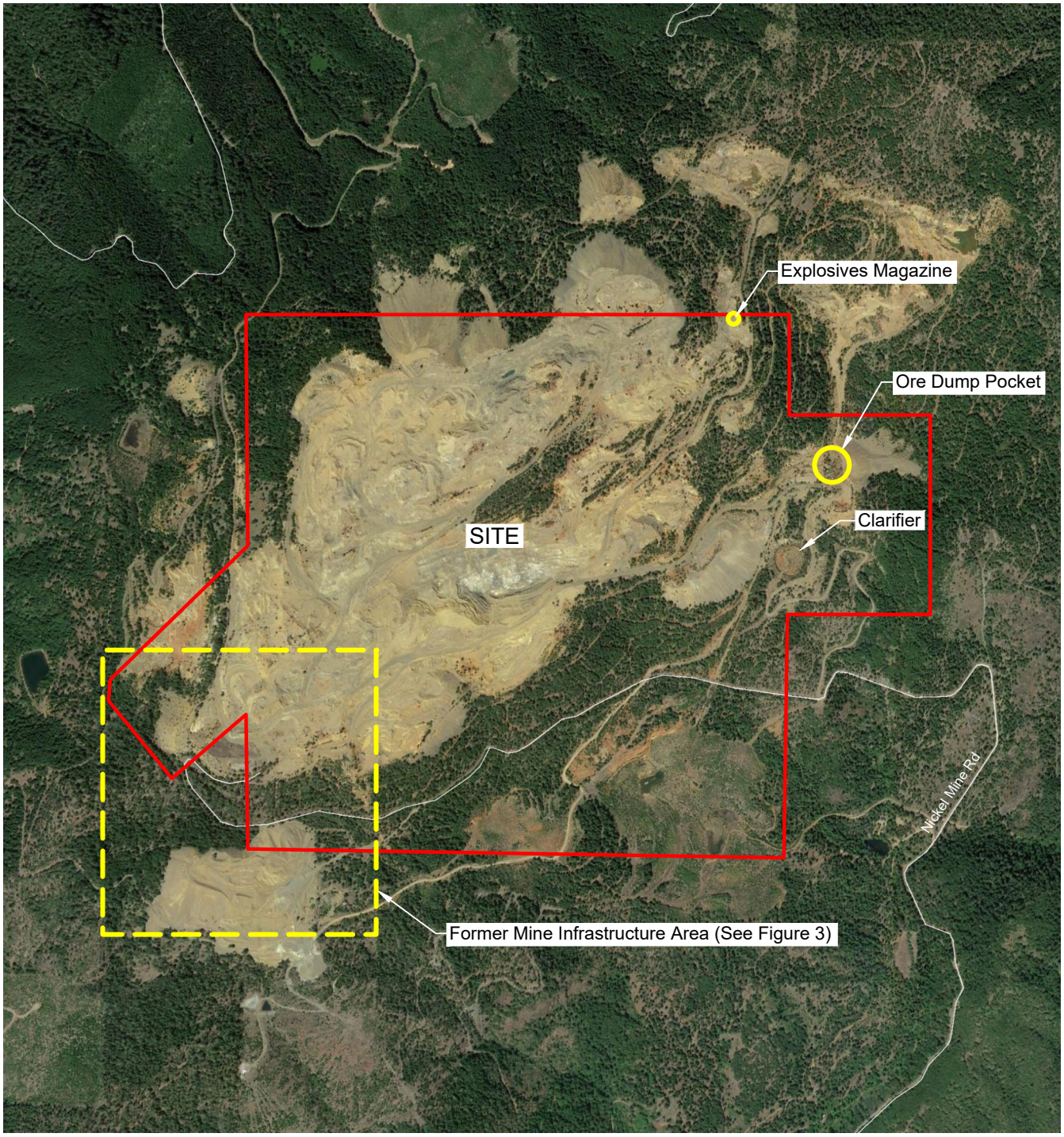


ALPINE ENVIRONMENTAL CONSULTANTS, LLC

DATE: 2/6/21

DRAWN BY: SM

Figure 1
Site Location Map
Phase I/II Environmental Site Assessments
Nickel Mine Quarry
Map and Taxlot 3006W16 TL 200; 3006W17 TL 100 and TL 200; and 3006W18 TL 400 and TL 500
Douglas County, Oregon



SOURCE: Google Earth (2019)

LEGEND

APPROXIMATE SITE BOUNDARY

N
W E
S

SCALE FEET
0 1,500 3,000

ALPINE ENVIRONMENTAL CONSULTANTS, LLC

DATE: 2/6/21 DRAWN BY: SM

Figure 2
Site Layout Map
Phase I/II Environmental Site Assessments
Nickel Mine Quarry
Map and Taxlot 3006W16 TL 200; 3006W17 TL 100 and TL 200; and 3006W18 TL 400 and TL 500
Douglas County, Oregon

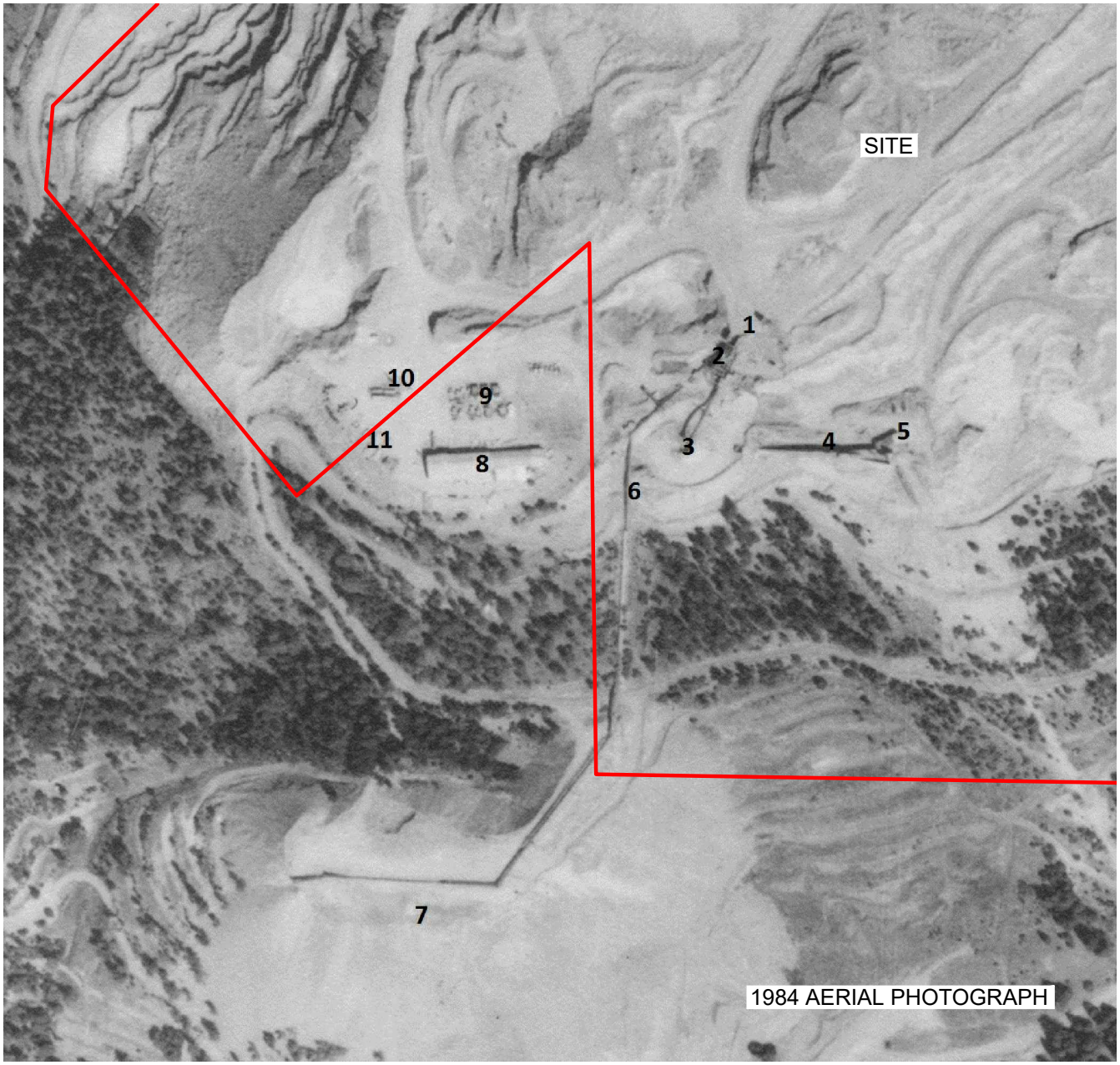


IMAGE SOURCE: University of Oregon

LEGEND

1. Ore dump pocket to the crusher
2. Ore crushing and screening plant
3. Top of crushed ore conveyor and crushed ore stockpile
4. Reclaim conveyor from bottom of crushed ore stockpile to tram station
5. Aerial tram upper loading station
6. Reject conveyor from crushing/screen plant to reject pile
7. Ore reject pile
8. Maintenance shop/warehouse/office building
9. Ready line for mine heavy equipment
10. Possible fuel tanks and dispensers
11. Possible outside warehouse storage and "boneyard"

Approximate Site Boundary

SCALE FEET

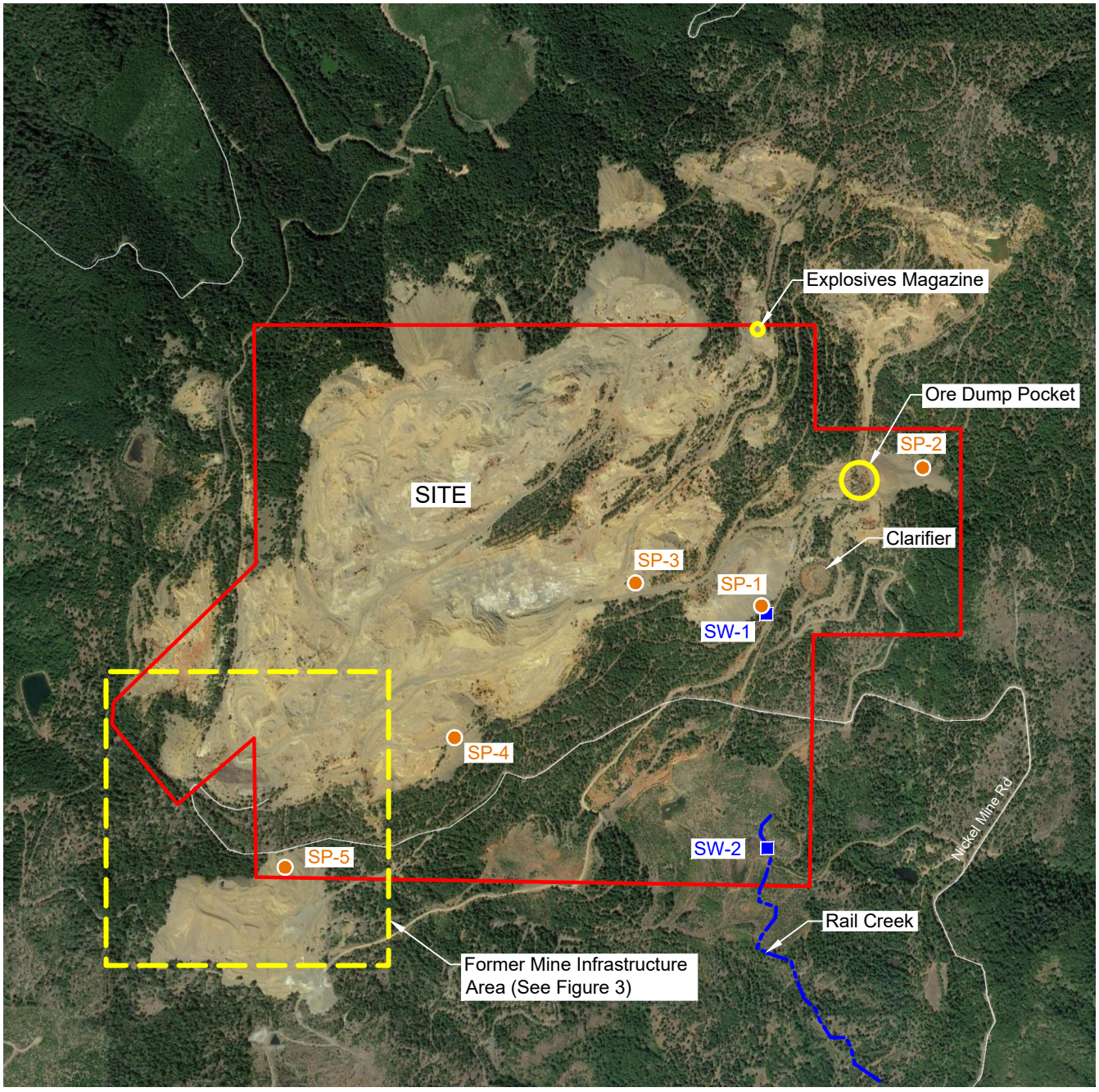
0 400 800

N W E S

ALPINE ENVIRONMENTAL CONSULTANTS, LLC

DATE: 2/6/21 DRAWN BY: SM

Figure 3
Former Mine Infrastructure Area
Phase I/II Environmental Site Assessments
Nickel Mine Quarry
Map and Taxlot 3006W16 TL 200; 3006W17 TL 100 and TL 200; and 3006W18 TL 400 and TL 500
Douglas County, Oregon



SOURCE: Google Earth (2019)

LEGEND

- Approximate Site Boundary
- SP-1 ● Stockpile Rock Sample Location, January 16, 2021, Location Approximate
- SW-1 ■ Surface Water Sample Location, January 16, 2021, Location Approximate

N
W E
S

SCALE FEET
0 1,500 3,000

ALPINE ENVIRONMENTAL CONSULTANTS, LLC

DATE: 2/6/21 DRAWN BY: SM

Figure 4
Rock and Surface Water Sample Location Map
Phase I/II Environmental Site Assessments
Nickel Mine Quarry
Map and Taxlot 3006W16 TL 200; 3006W17 TL 100 and TL 200; and 3006W18 TL 400 and TL 500
Douglas County, Oregon

TABLES

Table 1. Surface Water Samples Analytical Results - Dissolved Metals
Phase II Environmental Site Assessment - Nickel Mountain 745-Acre Area, Riddle, Oregon

	Oregon DEQ RBCs for Wildlife Ingestion of Surface Water (a), (b)				Oregon AWQC RBCs for Fresh Water	Surface Water Samples	
						SW-1	SW-2
	Birds		Mammals			Eastern Portion of the Site, southwest of the Claifier	Southeast corner of the Site on Rail Creek
Parameter	T&E	Non-T&E	T&E	Non-T&E		01/16/21	01/16/21
Dissolved Metals (µg/L) USEPA Method 6020B (ICPMS)							
Antimony	21,000	52,000	690	2,300	NE	1.0U	1.0U
Arsenic	380,000	760,000	560	5,600	150	1.0U	1.0U
Barium	220,000	770,000	6,100	8,800	NE	**4.1**	**3.66**
Beryllium	5,900	82,000	2,900	29,000	NE	0.200U	0.200U
Cadmium	7,100	71,000	4,800	17,000	0.09	**0.200U**	**0.200U**
Chromium (III)	82	2,000	160,000	630,000	24	**2.46**	**2.26**
Cobalt	160	1,600	89	2,200	NE	1.0U	1.0U
Copper	50,000	500,000	22,000	33,000	5.5	**9.51**	**8.44**
Lead	78	780	4,300	16,000	0.54	**0.288**	**0.243**
Mercury	1,000,000	10,000,000	140	710	0.012	**0.0800U**	**0.0800U**
Molybdenum	22,000	220,000	35,000	120,000	NE	1.0U	1.0U
Nickel	1,400	14,000	890	1,400	161	**37.0**	**13.4**
Selenium	4,500	45,000	110,000	1,100,000	4.6	1.0U	1.0U
Silver	490,000	4,900,000	31	310	0.1	**0.200U**	**0.200U**
Thalium	1,400	14,000	31	310	NE	0.200U	0.200U
Vanadium	4,500	45,000	9,400	3,100,000	NE	2.0U	2.0U
Zinc	490,000	4,900,000	560,000	4,400,000	36	4.0U	4.0U

See notes on next page.

Table 1. Surface Water Samples Analytical Results - Dissolved Metals
Phase II Environmental Site Assessment - Nickel Mountain 745-Acre Area, Riddle, Oregon

Notes:

Analytical data in bold font indicates that the value exceeds the laboratory method reporting limit.
Analytical data highlighted in yellow indicates the value exceeded a generic RBC.
The laboratory method reporting limits that exceed one or more RBCs are indicated with bold blue font.

Data Qualifiers:

U - The analyte was analyzed for, but was not detected above the analytical laboratory method reporting limit.

Footnotes:

(a) Risk-Based Concentrations are referenced from the Oregon DEQ's *Tables and Appendices for: Conducting Ecological Risk Assessments* guidance document dated September 2020.
(b) These RBCs are direct ingestion RBCs; bioaccumulative water RBCs are presented under Oregon AWQC RBCs.

Symbols/Acronyms:

AWQC - Ambient Water Quality Criteria
bgs - below ground surface
DEQ - Department of Environmental Quality
ft - feet
NE - No RBC levels are established for this chemical.
µg/L - micrograms per liter
RBC - risk-based concentration
T&E - threatened and endangered species
USEPA - United States Environmental Protection Agency

Table 2. Stockpile Rock Samples Analytical Results - Synthetic Precipitation Leaching Procedure Metals
Phase II Environmental Site Assessment - Nickel Mountain 745-Acre Area, Riddle, Oregon

	Oregon DEQ RBCs for Wildlife Ingestion of Surface Water (a), (b)				Oregon AWQC RBCs for Fresh Water	Stockpile Rock Samples				
						SP-1 (After Processing)	SP-2 (After Processing)	SP-3 (After Processing)	SP-4 (After Processing)	SP-5 (After Processing)
	Birds		Mammals			Eastern Portion of the Site, Southwest of the Claifier	Eastern Boundary, East of the Ore Dump Pocket	East-Central Portion of the Site	Southwestern Portion of the Site	Southwest corner of the Site
Parameter	T&E	Non-T&E	T&E	Non-T&E		01/16/21	01/16/21	01/16/21	01/16/21	01/16/21
SPLP Metals (µg/L) USEPA Method 6020B (ICPMS)										
Antimony	21,000	52,000	690	2,300	NE	200U, X	200U, X	200U, X	200U, X	200U, X
Arsenic	380,000	760,000	560	5,600	150	100U, X	100U, X	100U, X	100U, X	100U, X
Barium	220,000	770,000	6,100	8,800	NE	5,000U, X	5,000U, X	5,000U, X	5,000U, X	5,000U, X
Beryllium	5,900	82,000	2,900	29,000	NE	100U, X	100U, X	100U, X	100U, X	100U, X
Cadmium	7,100	71,000	4,800	17,000	0.09	**100U, X**	**100U, X**	**100U, X**	**100U, X**	**100U, X**
Chromium (III)	82	2,000	160,000	630,000	24	**100U, X**	**100U, X**	**100U, X**	**100U, X**	**100U, X**
Cobalt	160	1,600	89	2,200	NE	**100U, X**	**100U, X**	**100U, X**	**100U, X**	**100U, X**
Copper	50,000	500,000	22,000	33,000	5.5	**200U, X**	**200U, X**	**200U, X**	**200U, X**	**200U, X**
Lead	78	780	4,300	16,000	0.54	**50.0U, X**	**50.0U, X**	**50.0U, X**	**50.0U, X**	**50.0U, X**
Mercury	1,000,000	10,000,000	140	710	0.012	**7.0U, X**	**7.0U, X**	**7.0U, X**	**7.0U, X**	**7.0U, X**
Molybdenum	22,000	220,000	35,000	120,000	NE	200U, X	200U, X	200U, X	200U, X	200U, X
Nickel	1,400	14,000	890	1,400	161	**200U, X**	**200U, X**	**200U, X**	**200U, X**	**927**
Selenium	4,500	45,000	110,000	1,100,000	4.6	**100U, X**	**100U, X**	**100U, X**	**100U, X**	**100U, X**
Silver	490,000	4,900,000	31	310	0.1	**100U, X**	**100U, X**	**100U, X**	**100U, X**	**100U, X**
Thalium	1,400	14,000	31	310	NE	**100U, X**	**100U, X**	**100U, X**	**100U, X**	**100U, X**
Vanadium	4,500	45,000	9,400	3,100,000	NE	200U, X	200U, X	200U, X	200U, X	200U, X
Zinc	490,000	4,900,000	560,000	4,400,000	36	**500U, X**	**500U, X**	**500U, X**	**500U, X**	**500U, X**

See notes on next page.

Table 2. Stockpile Rock Samples Analytical Results - Synthetic Precipitation Leaching Procedure Metals
Phase II Environmental Site Assessment - Nickel Mountain 745-Acre Area, Riddle, Oregon

Notes:

Analytical data in bold font indicates that the value exceeds the laboratory method reporting limit.

Analytical data highlighted in yellow indicates the value exceeded a generic RBC.

The laboratory method reporting limits that exceed one or more RBCs are indicated with bold blue font.

Data Qualifiers:

U - The analyte was analyzed for, but was not detected above the analytical laboratory method reporting limit.

X - SPLP Extraction by EPA 1312: The SPLP leach solution measured at 5.20 pH, which is above the method limit of 5.05 pH. Per the client, the exceedance of 0.15 Ph units is acceptable for intended use of data since leachate solution was below typical pH of rain in Oregon.

Footnotes:

(a) Risk-Based Concentrations are referenced from the Oregon DEQ's *Tables and Appendices for: Conducting Ecological Risk Assessments* guidance document dated September 2020.

(b) These RBCs are direct ingestion RBCs; bioaccumulative water RBCs are presented under Oregon AWQC RBCs.

Symbols/Acronyms:

AWQC - Ambient Water Quality Criteria

bgs - below ground surface

DEQ - Department of Environmental Quality

ft - feet

NE - No RBC levels are established for this chemical.

µg/L - micrograms per liter

RBC - risk-based concentration

SPLP - Synthetic Precipitation Leaching Procedure

T&E - threatened and endangered species

USEPA - United States Environmental Protection Agency

APPENDIX 1

Site Photographs

1. Surface water sample SW-1 location

4. Surface water sample SW-2 location, close up.

2. Surface water sample SW-1 location, close up.

5. Example Waste Rock Pile Composite Rock Sample Location, Stockpile Number 2, view to the west.

3. "Grampy's Watering Hole," just upstream of surface water sample location SW-2.

6. Example Waste Rock Pile Composite Rock Sample Location, Stockpile Number 5, view to the south.

APPENDIX 2

Complete Laboratory Analytical Results

Apex Laboratories, LLC

6700 S.W. Sandburg Street
Tigard, OR 97223
503-718-2323
ORELAP ID: **OR100062**

Tuesday, March 2, 2021

Jonathan Williams
Alpine Environmental Consultants
12208 Antioch Road
White City, OR 97503

RE: A1A0836 - Nickel Mountain - AEC2020-2

Thank you for using Apex Laboratories. We greatly appreciate your business and strive to provide the highest quality services to the environmental industry.

Enclosed are the results of analyses for work order A1A0836, which was received by the laboratory on 1/25/2021 at 1:51:00PM.

If you have any questions concerning this report or the services we offer, please feel free to contact me by email at: dthomas@apex-labs.com, or by phone at 503-718-2323.

Please note: All samples will be disposed of within 30 days of sample receipt, unless prior arrangements have been made.

Cooler Receipt Information

(See Cooler Receipt Form for details)

Cooler #1	5.5 degC

This Final Report is the official version of the data results for this sample submission, unless superseded by a subsequent, labeled amended report.
All other deliverables derived from this data, including Electronic Data Deliverables (EDDs), CLP-like forms, client requested summary sheets, and all other products are considered secondary to this report.

Apex Laboratories

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Darwin Thomas, Business Development Director

Apex Laboratories, LLC

6700 S.W. Sandburg Street
Tigard, OR 97223
503-718-2323
ORELAP ID: **OR100062**

Alpine Environmental Consultants	Project: **Nickel Mountain**	
12208 Antioch Road	Project Number: **AEC2020-2**	**Report ID:**
White City, OR 97503	Project Manager: **Jonathan Williams**	**A1A0836 - 03 02 21 1125**

ANALYTICAL REPORT FOR SAMPLES

SAMPLE INFORMATION

Client Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
SP-1---As Received	A1A0836-01	Solid	01/16/21 10:30	01/25/21 13:51
SP-1---After Processing	A1A0836-02	Solid	01/16/21 10:30	01/25/21 13:51
SP-2---As Received	A1A0836-03	Solid	01/16/21 11:15	01/25/21 13:51
SP-2---After Processing	A1A0836-04	Solid	01/16/21 11:15	01/25/21 13:51
SP-3---As Received	A1A0836-05	Solid	01/16/21 10:15	01/25/21 13:51
SP-3---After Processing	A1A0836-06	Solid	01/16/21 10:15	01/25/21 13:51
SP-4---As Received	A1A0836-07	Solid	01/16/21 10:00	01/25/21 13:51
SP-4---After Processing	A1A0836-08	Solid	01/16/21 10:00	01/25/21 13:51
SP-5---As Received	A1A0836-09	Solid	01/16/21 09:45	01/25/21 13:51
SP-5---After Processing	A1A0836-10	Solid	01/16/21 09:45	01/25/21 13:51
SW-1	A1A0836-11	Water	01/16/21 10:45	01/25/21 13:51
SW-2	A1A0836-12	Water	01/16/21 11:40	01/25/21 13:51

Apex Laboratories

Darwin Thomas, Business Development Director

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Apex Laboratories, LLC

6700 S.W. Sandburg Street
Tigard, OR 97223
503-718-2323
ORELAP ID: **OR100062**

Alpine Environmental Consultants	Project: **Nickel Mountain**	
12208 Antioch Road	Project Number: **AEC2020-2**	**Report ID:**
White City, OR 97503	Project Manager: **Jonathan Williams**	**A1A0836 - 03 02 21 1125**

ANALYTICAL CASE NARRATIVE

Work Order: A1A0836

SPLP Extraction by EPA 1312

The SPLP leach solution measured at 5.20 pH, which is above the method limit of 5.05 pH. Per the client, the exceedance of 0.15 pH units is acceptable for intended use of data since leachate solution was below typical pH of rain in Oregon.

Autumn R. Fetty
Technical Compliance Officer
02/08/21

Apex Laboratories

Darwin Thomas, Business Development Director

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Apex Laboratories, LLC

6700 S.W. Sandburg Street
Tigard, OR 97223
503-718-2323
ORELAP ID: **OR100062**

Alpine Environmental Consultants	Project: **Nickel Mountain**	
12208 Antioch Road	Project Number: **AEC2020-2**	**Report ID:**
White City, OR 97503	Project Manager: **Jonathan Williams**	**A1A0836 - 03 02 21 1125**

ANALYTICAL SAMPLE RESULTS

Total Metals by EPA 6020B (ICPMS)

Analyte	Sample Result	Detection Limit	Reporting Limit	Units	Dilution	Date Analyzed	Method Ref.	Notes
SW-1 (A1A0836-11)				**Matrix: Water**				
Batch: 1020026								
Calcium	**1.74**	---	0.600	mg/L	1	02/01/21 16:50	EPA 6020B	
Magnesium	**40.4**	---	0.100	mg/L	1	02/01/21 16:50	EPA 6020B	
SW-2 (A1A0836-12)				**Matrix: Water**				
Batch: 1020026								
Calcium	**1.44**	---	0.600	mg/L	1	02/01/21 16:55	EPA 6020B	
Magnesium	**37.9**	---	0.100	mg/L	1	02/01/21 16:55	EPA 6020B	

Apex Laboratories

Darwin Thomas, Business Development Director

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Apex Laboratories, LLC

6700 S.W. Sandburg Street
Tigard, OR 97223
503-718-2323
ORELAP ID: **OR100062**

Alpine Environmental Consultants	Project: **Nickel Mountain**	
12208 Antioch Road	Project Number: **AEC2020-2**	**Report ID:**
White City, OR 97503	Project Manager: **Jonathan Williams**	**A1A0836 - 03 02 21 1125**

ANALYTICAL SAMPLE RESULTS

Dissolved Metals by EPA 6020B (ICPMS)

Analyte	Sample Result	Detection Limit	Reporting Limit	Units	Dilution	Date Analyzed	Method Ref.	Notes
SW-1 (A1A0836-11)				**Matrix: Water**				
Batch: 1013491								
Antimony	ND	---	0.00100	mg/L	1	01/29/21 21:15	EPA 6020B (Diss)	
Arsenic	ND	---	0.00100	mg/L	1	01/29/21 21:15	EPA 6020B (Diss)	
Barium	**0.00410**	---	0.00100	mg/L	1	01/29/21 21:15	EPA 6020B (Diss)	
Beryllium	ND	---	0.000200	mg/L	1	01/29/21 21:15	EPA 6020B (Diss)	
Cadmium	ND	---	0.000200	mg/L	1	01/29/21 21:15	EPA 6020B (Diss)	
Chromium	**0.00246**	---	0.00100	mg/L	1	01/29/21 21:15	EPA 6020B (Diss)	
Cobalt	ND	---	0.00100	mg/L	1	01/29/21 21:15	EPA 6020B (Diss)	
Copper	**0.00951**	---	0.00200	mg/L	1	01/29/21 21:15	EPA 6020B (Diss)	
Lead	**0.000288**	---	0.000200	mg/L	1	01/29/21 21:15	EPA 6020B (Diss)	
Mercury	ND	---	0.0000800	mg/L	1	01/29/21 21:15	EPA 6020B (Diss)	
Molybdenum	ND	---	0.00100	mg/L	1	01/29/21 21:15	EPA 6020B (Diss)	
Nickel	**0.0370**	---	0.00200	mg/L	1	01/29/21 21:15	EPA 6020B (Diss)	
Selenium	ND	---	0.00100	mg/L	1	01/29/21 21:15	EPA 6020B (Diss)	
Silver	ND	---	0.000200	mg/L	1	01/29/21 21:15	EPA 6020B (Diss)	
Thallium	ND	---	0.000200	mg/L	1	01/29/21 21:15	EPA 6020B (Diss)	
Vanadium	ND	---	0.00200	mg/L	1	01/29/21 21:15	EPA 6020B (Diss)	
Zinc	ND	---	0.00400	mg/L	1	01/29/21 21:15	EPA 6020B (Diss)	
SW-2 (A1A0836-12)				**Matrix: Water**				
Batch: 1013491								
Antimony	ND	---	0.00100	mg/L	1	01/29/21 21:20	EPA 6020B (Diss)	
Arsenic	ND	---	0.00100	mg/L	1	01/29/21 21:20	EPA 6020B (Diss)	
Barium	**0.00366**	---	0.00100	mg/L	1	01/29/21 21:20	EPA 6020B (Diss)	
Beryllium	ND	---	0.000200	mg/L	1	01/29/21 21:20	EPA 6020B (Diss)	
Cadmium	ND	---	0.000200	mg/L	1	01/29/21 21:20	EPA 6020B (Diss)	
Chromium	**0.00226**	---	0.00100	mg/L	1	01/29/21 21:20	EPA 6020B (Diss)	
Cobalt	ND	---	0.00100	mg/L	1	01/29/21 21:20	EPA 6020B (Diss)	
Copper	**0.00844**	---	0.00200	mg/L	1	01/29/21 21:20	EPA 6020B (Diss)	
Lead	**0.000243**	---	0.000200	mg/L	1	01/29/21 21:20	EPA 6020B (Diss)	
Mercury	ND	---	0.0000800	mg/L	1	01/29/21 21:20	EPA 6020B (Diss)	
Molybdenum	ND	---	0.00100	mg/L	1	01/29/21 21:20	EPA 6020B (Diss)	
Nickel	**0.0134**	---	0.00200	mg/L	1	01/29/21 21:20	EPA 6020B (Diss)	
Selenium	ND	---	0.00100	mg/L	1	01/29/21 21:20	EPA 6020B (Diss)	

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503-718-2323
ORELAP ID: **OR100062**

Alpine Environmental Consultants	Project: **Nickel Mountain**	
12208 Antioch Road	Project Number: **AEC2020-2**	**Report ID:**
White City, OR 97503	Project Manager: **Jonathan Williams**	**A1A0836 - 03 02 21 1125**

ANALYTICAL SAMPLE RESULTS

Dissolved Metals by EPA 6020B (ICPMS)

Analyte	Sample Result	Detection Limit	Reporting Limit	Units	Dilution	Date Analyzed	Method Ref.	Notes
SW-2 (A1A0836-12)				**Matrix: Water**				
Silver	ND	---	0.000200	mg/L	1	01/29/21 21:20	EPA 6020B (Diss)	
Thallium	ND	---	0.000200	mg/L	1	01/29/21 21:20	EPA 6020B (Diss)	
Vanadium	ND	---	0.00200	mg/L	1	01/29/21 21:20	EPA 6020B (Diss)	
Zinc	ND	---	0.00400	mg/L	1	01/29/21 21:20	EPA 6020B (Diss)	

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12208 Antioch Road	Project Number: **AEC2020-2**	**Report ID:**
White City, OR 97503	Project Manager: **Jonathan Williams**	**A1A0836 - 03 02 21 1125**

ANALYTICAL SAMPLE RESULTS

SPLP Metals by EPA 6020B (ICPMS)

Analyte	Sample Result	Detection Limit	Reporting Limit	Units	Dilution	Date Analyzed	Method Ref.	Notes
SP-1---After Processing (A1A0836-02)				**Matrix: Solid**				
Batch: 1020266								
Antimony	ND	---	0.200	mg/L	10	02/05/21 18:48	1312/6020B	X
Arsenic	ND	---	0.100	mg/L	10	02/05/21 18:48	1312/6020B	X
Barium	ND	---	5.00	mg/L	10	02/05/21 18:48	1312/6020B	X
Beryllium	ND	---	0.100	mg/L	10	02/05/21 18:48	1312/6020B	X
Cadmium	ND	---	0.100	mg/L	10	02/05/21 18:48	1312/6020B	X
Chromium	ND	---	0.100	mg/L	10	02/05/21 18:48	1312/6020B	X
Cobalt	ND	---	0.100	mg/L	10	02/05/21 18:48	1312/6020B	X
Copper	ND	---	0.200	mg/L	10	02/05/21 18:48	1312/6020B	X
Lead	ND	---	0.0500	mg/L	10	02/05/21 18:48	1312/6020B	X
Mercury	ND	---	0.00700	mg/L	10	02/05/21 18:48	1312/6020B	X
Molybdenum	ND	---	0.200	mg/L	10	02/05/21 18:48	1312/6020B	X
Nickel	ND	---	0.200	mg/L	10	02/05/21 18:48	1312/6020B	X
Silver	ND	---	0.100	mg/L	10	02/05/21 18:48	1312/6020B	X
Thallium	ND	---	0.100	mg/L	10	02/05/21 18:48	1312/6020B	X
Vanadium	ND	---	0.200	mg/L	10	02/05/21 18:48	1312/6020B	X
Zinc	ND	---	0.500	mg/L	10	02/05/21 18:48	1312/6020B	X
SP-1---After Processing (A1A0836-02RE1)				**Matrix: Solid**				
Batch: 1020266								
Selenium	ND	---	0.100	mg/L	10	02/08/21 12:38	1312/6020B	X
SP-2---After Processing (A1A0836-04)				**Matrix: Solid**				
Batch: 1020266								
Antimony	ND	---	0.200	mg/L	10	02/05/21 18:53	1312/6020B	X
Arsenic	ND	---	0.100	mg/L	10	02/05/21 18:53	1312/6020B	X
Barium	ND	---	5.00	mg/L	10	02/05/21 18:53	1312/6020B	X
Beryllium	ND	---	0.100	mg/L	10	02/05/21 18:53	1312/6020B	X
Cadmium	ND	---	0.100	mg/L	10	02/05/21 18:53	1312/6020B	X
Chromium	ND	---	0.100	mg/L	10	02/05/21 18:53	1312/6020B	X
Cobalt	ND	---	0.100	mg/L	10	02/05/21 18:53	1312/6020B	X
Copper	ND	---	0.200	mg/L	10	02/05/21 18:53	1312/6020B	X
Lead	ND	---	0.0500	mg/L	10	02/05/21 18:53	1312/6020B	X
Mercury	ND	---	0.00700	mg/L	10	02/05/21 18:53	1312/6020B	X

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Alpine Environmental Consultants	Project: **Nickel Mountain**	
12208 Antioch Road	Project Number: **AEC2020-2**	**Report ID:**
White City, OR 97503	Project Manager: **Jonathan Williams**	**A1A0836 - 03 02 21 1125**

ANALYTICAL SAMPLE RESULTS

SPLP Metals by EPA 6020B (ICPMS)

Analyte	Sample Result	Detection Limit	Reporting Limit	Units	Dilution	Date Analyzed	Method Ref.	Notes
SP-2---After Processing (A1A0836-04)				**Matrix: Solid**				
Molybdenum	ND	---	0.200	mg/L	10	02/05/21 18:53	1312/6020B	X
Nickel	ND	---	0.200	mg/L	10	02/05/21 18:53	1312/6020B	X
Silver	ND	---	0.100	mg/L	10	02/05/21 18:53	1312/6020B	X
Thallium	ND	---	0.100	mg/L	10	02/05/21 18:53	1312/6020B	X
Vanadium	ND	---	0.200	mg/L	10	02/05/21 18:53	1312/6020B	X
Zinc	ND	---	0.500	mg/L	10	02/05/21 18:53	1312/6020B	X
SP-2---After Processing (A1A0836-04RE1)				**Matrix: Solid**				
Batch: 1020266								
Selenium	ND	---	0.100	mg/L	10	02/08/21 12:43	1312/6020B	X
SP-3---After Processing (A1A0836-06)				**Matrix: Solid**				
Batch: 1020266								
Antimony	ND	---	0.200	mg/L	10	02/05/21 19:08	1312/6020B	X
Arsenic	ND	---	0.100	mg/L	10	02/05/21 19:08	1312/6020B	X
Barium	ND	---	5.00	mg/L	10	02/05/21 19:08	1312/6020B	X
Beryllium	ND	---	0.100	mg/L	10	02/05/21 19:08	1312/6020B	X
Cadmium	ND	---	0.100	mg/L	10	02/05/21 19:08	1312/6020B	X
Chromium	ND	---	0.100	mg/L	10	02/05/21 19:08	1312/6020B	X
Cobalt	ND	---	0.100	mg/L	10	02/05/21 19:08	1312/6020B	X
Copper	ND	---	0.200	mg/L	10	02/05/21 19:08	1312/6020B	X
Lead	ND	---	0.0500	mg/L	10	02/05/21 19:08	1312/6020B	X
Mercury	ND	---	0.00700	mg/L	10	02/05/21 19:08	1312/6020B	X
Molybdenum	ND	---	0.200	mg/L	10	02/05/21 19:08	1312/6020B	X
Nickel	ND	---	0.200	mg/L	10	02/05/21 19:08	1312/6020B	X
Silver	ND	---	0.100	mg/L	10	02/05/21 19:08	1312/6020B	X
Thallium	ND	---	0.100	mg/L	10	02/05/21 19:08	1312/6020B	X
Vanadium	ND	---	0.200	mg/L	10	02/05/21 19:08	1312/6020B	X
Zinc	ND	---	0.500	mg/L	10	02/05/21 19:08	1312/6020B	X
SP-3---After Processing (A1A0836-06RE1)				**Matrix: Solid**				
Batch: 1020266								
Selenium	ND	---	0.100	mg/L	10	02/08/21 12:58	1312/6020B	X

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White City, OR 97503	Project Manager: **Jonathan Williams**	**A1A0836 - 03 02 21 1125**

ANALYTICAL SAMPLE RESULTS

SPLP Metals by EPA 6020B (ICPMS)

Analyte	Sample Result	Detection Limit	Reporting Limit	Units	Dilution	Date Analyzed	Method Ref.	Notes
SP-4---After Processing (A1A0836-08)				**Matrix: Solid**				
Batch: 1020266								
Antimony	ND	---	0.200	mg/L	10	02/05/21 19:13	1312/6020B	X
Arsenic	ND	---	0.100	mg/L	10	02/05/21 19:13	1312/6020B	X
Barium	ND	---	5.00	mg/L	10	02/05/21 19:13	1312/6020B	X
Beryllium	ND	---	0.100	mg/L	10	02/05/21 19:13	1312/6020B	X
Cadmium	ND	---	0.100	mg/L	10	02/05/21 19:13	1312/6020B	X
Chromium	ND	---	0.100	mg/L	10	02/05/21 19:13	1312/6020B	X
Cobalt	ND	---	0.100	mg/L	10	02/05/21 19:13	1312/6020B	X
Copper	ND	---	0.200	mg/L	10	02/05/21 19:13	1312/6020B	X
Lead	ND	---	0.0500	mg/L	10	02/05/21 19:13	1312/6020B	X
Mercury	ND	---	0.00700	mg/L	10	02/05/21 19:13	1312/6020B	X
Molybdenum	ND	---	0.200	mg/L	10	02/05/21 19:13	1312/6020B	X
Nickel	ND	---	0.200	mg/L	10	02/05/21 19:13	1312/6020B	X
Silver	ND	---	0.100	mg/L	10	02/05/21 19:13	1312/6020B	X
Thallium	ND	---	0.100	mg/L	10	02/05/21 19:13	1312/6020B	X
Vanadium	ND	---	0.200	mg/L	10	02/05/21 19:13	1312/6020B	X
Zinc	ND	---	0.500	mg/L	10	02/05/21 19:13	1312/6020B	X
SP-4---After Processing (A1A0836-08RE1)				**Matrix: Solid**				
Batch: 1020266								
Selenium	ND	---	0.100	mg/L	10	02/08/21 13:03	1312/6020B	X
SP-5---After Processing (A1A0836-10)				**Matrix: Solid**				
Batch: 1020266								
Antimony	ND	---	0.200	mg/L	10	02/05/21 19:18	1312/6020B	X
Arsenic	ND	---	0.100	mg/L	10	02/05/21 19:18	1312/6020B	X
Barium	ND	---	5.00	mg/L	10	02/05/21 19:18	1312/6020B	X
Beryllium	ND	---	0.100	mg/L	10	02/05/21 19:18	1312/6020B	X
Cadmium	ND	---	0.100	mg/L	10	02/05/21 19:18	1312/6020B	X
Chromium	ND	---	0.100	mg/L	10	02/05/21 19:18	1312/6020B	X
Cobalt	ND	---	0.100	mg/L	10	02/05/21 19:18	1312/6020B	X
Copper	ND	---	0.200	mg/L	10	02/05/21 19:18	1312/6020B	X
Lead	ND	---	0.0500	mg/L	10	02/05/21 19:18	1312/6020B	X
Mercury	ND	---	0.00700	mg/L	10	02/05/21 19:18	1312/6020B	X

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12208 Antioch Road	Project Number: **AEC2020-2**	**Report ID:**
White City, OR 97503	Project Manager: **Jonathan Williams**	**A1A0836 - 03 02 21 1125**

ANALYTICAL SAMPLE RESULTS

SPLP Metals by EPA 6020B (ICPMS)

Analyte	Sample Result	Detection Limit	Reporting Limit	Units	Dilution	Date Analyzed	Method Ref.	Notes
SP-5---After Processing (A1A0836-10)				**Matrix: Solid**				
Molybdenum	ND	---	0.200	mg/L	10	02/05/21 19:18	1312/6020B	X
Nickel	**0.927**	---	0.200	mg/L	10	02/05/21 19:18	1312/6020B	**X**
Silver	ND	---	0.100	mg/L	10	02/05/21 19:18	1312/6020B	X
Thallium	ND	---	0.100	mg/L	10	02/05/21 19:18	1312/6020B	X
Vanadium	ND	---	0.200	mg/L	10	02/05/21 19:18	1312/6020B	X
Zinc	ND	---	0.500	mg/L	10	02/05/21 19:18	1312/6020B	X
SP-5---After Processing (A1A0836-10RE1)				**Matrix: Solid**				
Batch: 1020266								
Selenium	ND	---	0.100	mg/L	10	02/08/21 13:23	1312/6020B	X

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ANALYTICAL SAMPLE RESULTS

Total Hardness (Calculated) by SM 2340B (6020B)

Analyte	Sample Result	Detection Limit	Reporting Limit	Units	Dilution	Date Analyzed	Method Ref.	Notes
SW-1 (A1A0836-11)				**Matrix: Water**				
(Calculated)								
Hardness	**171**	---	1.91	mg CaCO3/L	1	02/01/21 16:50	SM 2340B	
SW-2 (A1A0836-12)				**Matrix: Water**				
(Calculated)								
Hardness	**160**	---	1.91	mg CaCO3/L	1	02/01/21 16:55	SM 2340B	

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ANALYTICAL SAMPLE RESULTS

Conventional Chemistry Parameters

Analyte	Sample Result	Detection Limit	Reporting Limit	Units	Dilution	Date Analyzed	Method Ref.	Notes
SW-1 (A1A0836-11)				**Matrix: Water**				
Batch: 1013278								
pH	**8.41**	---		pH Units	1	01/25/21 16:23	SM 4500-H+ B	**H-12**
pH Temperature (deg C)	**21.3**	---		pH Units	1	01/25/21 16:23	SM 4500-H+ B	**H-12**
SW-2 (A1A0836-12)				**Matrix: Water**				
Batch: 1013278								
pH	**8.23**	---		pH Units	1	01/25/21 16:27	SM 4500-H+ B	**H-12**
pH Temperature (deg C)	**19.7**	---		pH Units	1	01/25/21 16:27	SM 4500-H+ B	**H-12**

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QUALITY CONTROL (QC) SAMPLE RESULTS

Total Metals by EPA 6020B (ICPMS)

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Spike Amount	Source Result	% REC	% REC Limits	RPD	RPD Limit	Notes
Batch 1020026 - EPA 3015A							**Water**					
Blank (1020026-BLK1)			Prepared: 02/01/21 11:24		Analyzed: 02/01/21 16:10							
EPA 6020B												
Calcium	ND	---	0.600	mg/L	1	---	---	---	---	---	---	
Magnesium	ND	---	0.100	mg/L	1	---	---	---	---	---	---	
LCS (1020026-BS1)			Prepared: 02/01/21 11:24		Analyzed: 02/01/21 16:15							
EPA 6020B												
Calcium	2.65	---	0.600	mg/L	1	2.78	---	95	80-120%	---	---	
Magnesium	2.58	---	0.100	mg/L	1	2.78	---	93	80-120%	---	---	
Duplicate (1020026-DUP1)			Prepared: 02/01/21 11:24		Analyzed: 02/01/21 16:30							
QC Source Sample: Non-SDG (A1A0798-01)												
Calcium	**32.1**	---	0.600	mg/L	1	---	32.3	---	---	0.7	20%	
Magnesium	**9.32**	---	0.100	mg/L	1	---	9.36	---	---	0.4	20%	
Matrix Spike (1020026-MS1)			Prepared: 02/01/21 11:24		Analyzed: 02/01/21 16:35							
QC Source Sample: Non-SDG (A1A0798-01)												
EPA 6020B												
Calcium	34.7	---	0.600	mg/L	1	2.78	32.3	86	75-125%	---	---	
Magnesium	11.7	---	0.100	mg/L	1	2.78	9.36	84	75-125%	---	---	

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QUALITY CONTROL (QC) SAMPLE RESULTS

Dissolved Metals by EPA 6020B (ICPMS)

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Spike Amount	Source Result	% REC	% REC Limits	RPD	RPD Limit	Notes
Batch 1013491 - Matrix Matched Direct Inject							**Water**					
Blank (1013491-BLK1)			Prepared: 01/29/21 09:58		Analyzed: 01/29/21 20:20							
EPA 6020B (Diss)												
Antimony	ND	---	0.00100	mg/L	1	---	---	---	---	---	---	
Arsenic	ND	---	0.00100	mg/L	1	---	---	---	---	---	---	
Barium	ND	---	0.00100	mg/L	1	---	---	---	---	---	---	
Beryllium	ND	---	0.000200	mg/L	1	---	---	---	---	---	---	
Cadmium	ND	---	0.000200	mg/L	1	---	---	---	---	---	---	
Chromium	ND	---	0.00100	mg/L	1	---	---	---	---	---	---	
Cobalt	ND	---	0.00100	mg/L	1	---	---	---	---	---	---	
Copper	ND	---	0.00200	mg/L	1	---	---	---	---	---	---	
Lead	ND	---	0.000200	mg/L	1	---	---	---	---	---	---	
Mercury	ND	---	0.0000800	mg/L	1	---	---	---	---	---	---	
Molybdenum	ND	---	0.00100	mg/L	1	---	---	---	---	---	---	
Nickel	ND	---	0.00200	mg/L	1	---	---	---	---	---	---	
Selenium	ND	---	0.00100	mg/L	1	---	---	---	---	---	---	
Silver	ND	---	0.000200	mg/L	1	---	---	---	---	---	---	
Thallium	ND	---	0.000200	mg/L	1	---	---	---	---	---	---	
Vanadium	ND	---	0.00200	mg/L	1	---	---	---	---	---	---	
Zinc	ND	---	0.00400	mg/L	1	---	---	---	---	---	---	
LCS (1013491-BS1)			Prepared: 01/29/21 09:58		Analyzed: 01/29/21 20:25							
EPA 6020B (Diss)												
Antimony	0.0263	---	0.00100	mg/L	1	0.0278	---	95	80-120%	---	---	
Arsenic	0.0525	---	0.00100	mg/L	1	0.0556	---	95	80-120%	---	---	
Barium	0.0499	---	0.00100	mg/L	1	0.0556	---	90	80-120%	---	---	
Beryllium	0.0249	---	0.000200	mg/L	1	0.0278	---	90	80-120%	---	---	
Cadmium	0.0525	---	0.000200	mg/L	1	0.0556	---	95	80-120%	---	---	
Chromium	0.0518	---	0.00100	mg/L	1	0.0556	---	93	80-120%	---	---	
Cobalt	0.0520	---	0.00100	mg/L	1	0.0556	---	94	80-120%	---	---	
Copper	0.0528	---	0.00200	mg/L	1	0.0556	---	95	80-120%	---	---	
Lead	0.0533	---	0.000200	mg/L	1	0.0556	---	96	80-120%	---	---	
Mercury	0.00105	---	0.0000800	mg/L	1	0.00111	---	95	80-120%	---	---	
Molybdenum	0.0270	---	0.00100	mg/L	1	0.0278	---	97	80-120%	---	---	
Nickel	0.0520	---	0.00200	mg/L	1	0.0556	---	94	80-120%	---	---	
Selenium	0.0256	---	0.00100	mg/L	1	0.0278	---	92	80-120%	---	---	

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Darwin Thomas, Business Development Director

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503-718-2323
ORELAP ID: **OR100062**

Alpine Environmental Consultants	Project: **Nickel Mountain**	
12208 Antioch Road	Project Number: **AEC2020-2**	**Report ID:**
White City, OR 97503	Project Manager: **Jonathan Williams**	**A1A0836 - 03 02 21 1125**

QUALITY CONTROL (QC) SAMPLE RESULTS

Dissolved Metals by EPA 6020B (ICPMS)

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Spike Amount	Source Result	% REC	% REC Limits	RPD	RPD Limit	Notes
Batch 1013491 - Matrix Matched Direct Inject							**Water**					
LCS (1013491-BS1)			Prepared: 01/29/21 09:58		Analyzed: 01/29/21 20:25							
Silver	0.0276	---	0.000200	mg/L	1	0.0278	---	99	80-120%	---	---	
Thallium	0.0281	---	0.000200	mg/L	1	0.0278	---	101	80-120%	---	---	
Vanadium	0.0531	---	0.00200	mg/L	1	0.0556	---	96	80-120%	---	---	
Zinc	0.0533	---	0.00400	mg/L	1	0.0556	---	96	80-120%	---	---	
Duplicate (1013491-DUP1)			Prepared: 01/29/21 09:58		Analyzed: 01/29/21 21:00							
QC Source Sample: Non-SDG (A1A0770-09)												
Antimony	ND	---	0.00100	mg/L	1	---	ND	---	---	---	20%	
Arsenic	**0.00108**	---	0.00100	mg/L	1	---	0.00108	---	---	0.7	20%	
Barium	**0.0709**	---	0.00100	mg/L	1	---	0.0720	---	---	1	20%	
Beryllium	ND	---	0.000200	mg/L	1	---	ND	---	---	---	20%	
Cadmium	ND	---	0.000200	mg/L	1	---	ND	---	---	---	20%	
Chromium	**0.00417**	---	0.00100	mg/L	1	---	0.00387	---	---	8	20%	
Cobalt	**0.00583**	---	0.00100	mg/L	1	---	0.00579	---	---	0.7	20%	
Copper	**0.00567**	---	0.00200	mg/L	1	---	0.00586	---	---	3	20%	
Lead	**0.000634**	---	0.000200	mg/L	1	---	0.000605	---	---	5	20%	
Mercury	ND	---	0.0000800	mg/L	1	---	ND	---	---	---	20%	
Molybdenum	**0.00392**	---	0.00100	mg/L	1	---	0.00403	---	---	3	20%	
Nickel	**0.00618**	---	0.00200	mg/L	1	---	0.00625	---	---	1	20%	
Selenium	ND	---	0.00100	mg/L	1	---	ND	---	---	---	20%	
Silver	ND	---	0.000200	mg/L	1	---	ND	---	---	---	20%	
Thallium	ND	---	0.000200	mg/L	1	---	ND	---	---	---	20%	
Vanadium	**0.0146**	---	0.00200	mg/L	1	---	0.0146	---	---	0.1	20%	
Zinc	**0.00635**	---	0.00400	mg/L	1	---	0.00641	---	---	0.9	20%	
Matrix Spike (1013491-MS1)			Prepared: 01/29/21 09:58		Analyzed: 01/29/21 21:05							
QC Source Sample: Non-SDG (A1A0770-09)												
EPA 6020B (Diss)												
Antimony	0.0283	---	0.00100	mg/L	1	0.0278	ND	102	75-125%	---	---	
Arsenic	0.0550	---	0.00100	mg/L	1	0.0556	0.00108	97	75-125%	---	---	
Barium	0.122	---	0.00100	mg/L	1	0.0556	0.0720	89	75-125%	---	---	
Beryllium	0.0256	---	0.000200	mg/L	1	0.0278	ND	92	75-125%	---	---	
Cadmium	0.0549	---	0.000200	mg/L	1	0.0556	ND	99	75-125%	---	---	
Chromium	0.0562	---	0.00100	mg/L	1	0.0556	0.00387	94	75-125%	---	---	

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503-718-2323
ORELAP ID: **OR100062**

Alpine Environmental Consultants	Project: **Nickel Mountain**	
12208 Antioch Road	Project Number: **AEC2020-2**	**Report ID:**
White City, OR 97503	Project Manager: **Jonathan Williams**	**A1A0836 - 03 02 21 1125**

QUALITY CONTROL (QC) SAMPLE RESULTS

Dissolved Metals by EPA 6020B (ICPMS)

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Spike Amount	Source Result	% REC	% REC Limits	RPD	RPD Limit	Notes
Batch 1013491 - Matrix Matched Direct Inject							**Water**					
Matrix Spike (1013491-MS1)			Prepared: 01/29/21 09:58		Analyzed: 01/29/21 21:05							
QC Source Sample: Non-SDG (A1A0770-09)												
Cobalt	0.0578	---	0.00100	mg/L	1	0.0556	0.00579	94	75-125%	---	---	
Copper	0.0563	---	0.00200	mg/L	1	0.0556	0.00586	91	75-125%	---	---	
Lead	0.0542	---	0.000200	mg/L	1	0.0556	0.000605	96	75-125%	---	---	
Mercury	0.00104	---	0.0000800	mg/L	1	0.00111	ND	93	75-125%	---	---	
Molybdenum	0.0325	---	0.00100	mg/L	1	0.0278	0.00403	103	75-125%	---	---	
Nickel	0.0571	---	0.00200	mg/L	1	0.0556	0.00625	92	75-125%	---	---	
Selenium	0.0251	---	0.00100	mg/L	1	0.0278	ND	90	75-125%	---	---	
Silver	0.0286	---	0.000200	mg/L	1	0.0278	ND	103	75-125%	---	---	
Thallium	0.0286	---	0.000200	mg/L	1	0.0278	ND	103	75-125%	---	---	
Vanadium	0.0684	---	0.00200	mg/L	1	0.0556	0.0146	97	75-125%	---	---	
Zinc	0.0587	---	0.00400	mg/L	1	0.0556	0.00641	94	75-125%	---	---	

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12208 Antioch Road	Project Number: **AEC2020-2**	**Report ID:**
White City, OR 97503	Project Manager: **Jonathan Williams**	**A1A0836 - 03 02 21 1125**

QUALITY CONTROL (QC) SAMPLE RESULTS

SPLP Metals by EPA 6020B (ICPMS)

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Spike Amount	Source Result	% REC	% REC Limits	RPD	RPD Limit	Notes
Batch 1020266 - EPA 1312/3015							**Solid**					
Blank (1020266-BLK1)			Prepared: 02/05/21 16:54 Analyzed: 02/05/21 18:38									
1312/6020B												
Antimony	ND	---	0.200	mg/L	10	---	---	---	---	---	---	TCLP
Arsenic	ND	---	0.100	mg/L	10	---	---	---	---	---	---	TCLP
Barium	ND	---	5.00	mg/L	10	---	---	---	---	---	---	TCLP
Beryllium	ND	---	0.100	mg/L	10	---	---	---	---	---	---	TCLP
Cadmium	ND	---	0.100	mg/L	10	---	---	---	---	---	---	TCLP
Chromium	ND	---	0.100	mg/L	10	---	---	---	---	---	---	TCLP
Cobalt	ND	---	0.100	mg/L	10	---	---	---	---	---	---	TCLP
Copper	ND	---	0.200	mg/L	10	---	---	---	---	---	---	TCLP
Lead	ND	---	0.0500	mg/L	10	---	---	---	---	---	---	TCLP
Mercury	ND	---	0.00700	mg/L	10	---	---	---	---	---	---	TCLP
Molybdenum	ND	---	0.200	mg/L	10	---	---	---	---	---	---	TCLP
Nickel	ND	---	0.200	mg/L	10	---	---	---	---	---	---	TCLP
Silver	ND	---	0.100	mg/L	10	---	---	---	---	---	---	TCLP
Thallium	ND	---	0.100	mg/L	10	---	---	---	---	---	---	TCLP
Vanadium	ND	---	0.200	mg/L	10	---	---	---	---	---	---	TCLP
Zinc	ND	---	0.500	mg/L	10	---	---	---	---	---	---	TCLP
Blank (1020266-BLK2)			Prepared: 02/05/21 16:54 Analyzed: 02/08/21 12:28									
1312/6020B												
Selenium	ND	---	0.100	mg/L	10	---	---	---	---	---	---	Q-16, TCLP
LCS (1020266-BS1)			Prepared: 02/05/21 16:54 Analyzed: 02/05/21 18:43									
1312/6020B												
Antimony	0.932	---	0.200	mg/L	10	1.00	---	93	80-120%	---	---	TCLP
Arsenic	4.77	---	0.100	mg/L	10	5.00	---	95	80-120%	---	---	TCLP
Barium	9.23	---	5.00	mg/L	10	10.0	---	92	80-120%	---	---	TCLP
Beryllium	2.29	---	0.100	mg/L	10	2.50	---	92	80-120%	---	---	TCLP
Cadmium	0.919	---	0.100	mg/L	10	1.00	---	92	80-120%	---	---	TCLP
Chromium	4.59	---	0.100	mg/L	10	5.00	---	92	80-120%	---	---	TCLP
Cobalt	2.34	---	0.100	mg/L	10	2.50	---	93	80-120%	---	---	TCLP
Copper	2.45	---	0.200	mg/L	10	2.50	---	98	80-120%	---	---	TCLP
Lead	4.72	---	0.0500	mg/L	10	5.00	---	94	80-120%	---	---	TCLP
Mercury	0.0894	---	0.00700	mg/L	10	0.100	---	89	80-120%	---	---	TCLP

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ORELAP ID: **OR100062**

Alpine Environmental Consultants	Project: **Nickel Mountain**	
12208 Antioch Road	Project Number: **AEC2020-2**	**Report ID:**
White City, OR 97503	Project Manager: **Jonathan Williams**	**A1A0836 - 03 02 21 1125**

QUALITY CONTROL (QC) SAMPLE RESULTS

SPLP Metals by EPA 6020B (ICPMS)

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Spike Amount	Source Result	% REC	% REC Limits	RPD	RPD Limit	Notes
Batch 1020266 - EPA 1312/3015							**Solid**					
LCS (1020266-BS1)			Prepared: 02/05/21 16:54 Analyzed: 02/05/21 18:43									
Molybdenum	0.911	---	0.200	mg/L	10	1.00	---	91	80-120%	---	---	TCLP
Nickel	2.36	---	0.200	mg/L	10	2.50	---	95	80-120%	---	---	TCLP
Silver	0.958	---	0.100	mg/L	10	1.00	---	96	80-120%	---	---	TCLP
Thallium	2.46	---	0.100	mg/L	10	2.50	---	98	80-120%	---	---	TCLP
Vanadium	2.34	---	0.200	mg/L	10	2.50	---	94	80-120%	---	---	TCLP
Zinc	4.72	---	0.500	mg/L	10	5.00	---	94	80-120%	---	---	TCLP
LCS (1020266-BS2)			Prepared: 02/05/21 16:54 Analyzed: 02/08/21 12:33									
1312/6020B												
Selenium	0.923	---	0.100	mg/L	10	1.00	---	92	80-120%	---	---	Q-16, TCLP
Duplicate (1020266-DUP1)			Prepared: 02/05/21 16:54 Analyzed: 02/05/21 18:58									
QC Source Sample: SP-2---After Processing (A1A0836-04)												
1312/6020B												
Antimony	ND	---	0.200	mg/L	10	---	ND	---	---	---	20%	
Arsenic	ND	---	0.100	mg/L	10	---	ND	---	---	---	20%	
Barium	ND	---	5.00	mg/L	10	---	ND	---	---	---	20%	
Beryllium	ND	---	0.100	mg/L	10	---	ND	---	---	---	20%	
Cadmium	ND	---	0.100	mg/L	10	---	ND	---	---	---	20%	
Chromium	ND	---	0.100	mg/L	10	---	ND	---	---	---	20%	
Cobalt	ND	---	0.100	mg/L	10	---	ND	---	---	---	20%	
Copper	ND	---	0.200	mg/L	10	---	ND	---	---	---	20%	
Lead	ND	---	0.0500	mg/L	10	---	ND	---	---	---	20%	
Mercury	ND	---	0.00700	mg/L	10	---	ND	---	---	---	20%	
Molybdenum	ND	---	0.200	mg/L	10	---	ND	---	---	---	20%	
Nickel	ND	---	0.200	mg/L	10	---	ND	---	---	---	20%	
Silver	ND	---	0.100	mg/L	10	---	ND	---	---	---	20%	
Thallium	ND	---	0.100	mg/L	10	---	ND	---	---	---	20%	
Vanadium	ND	---	0.200	mg/L	10	---	ND	---	---	---	20%	
Zinc	ND	---	0.500	mg/L	10	---	ND	---	---	---	20%	
Duplicate (1020266-DUP2)			Prepared: 02/05/21 16:54 Analyzed: 02/08/21 12:48									
QC Source Sample: SP-2---After Processing (A1A0836-04)												

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Alpine Environmental Consultants	Project: **Nickel Mountain**	
12208 Antioch Road	Project Number: **AEC2020-2**	**Report ID:**
White City, OR 97503	Project Manager: **Jonathan Williams**	**A1A0836 - 03 02 21 1125**

QUALITY CONTROL (QC) SAMPLE RESULTS

SPLP Metals by EPA 6020B (ICPMS)

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Spike Amount	Source Result	% REC	% REC Limits	RPD	RPD Limit	Notes
Batch 1020266 - EPA 1312/3015							**Solid**					
Duplicate (1020266-DUP2)			Prepared: 02/05/21 16:54		Analyzed: 02/08/21 12:48							
QC Source Sample: SP-2---After Processing (A1A0836-04)												
1312/6020B												
Selenium	ND	---	0.100	mg/L	10	---	ND	---	---	---	20%	Q-16, X
Matrix Spike (1020266-MS1)			Prepared: 02/05/21 16:54		Analyzed: 02/05/21 19:03							
QC Source Sample: SP-2---After Processing (A1A0836-04)												
1312/6020B												
Antimony	0.970	---	0.200	mg/L	10	1.00	ND	97	50-150%	---	---	
Arsenic	4.90	---	0.100	mg/L	10	5.00	ND	98	50-150%	---	---	
Barium	9.56	---	5.00	mg/L	10	10.0	ND	96	50-150%	---	---	
Beryllium	2.33	---	0.100	mg/L	10	2.50	ND	93	50-150%	---	---	
Cadmium	0.944	---	0.100	mg/L	10	1.00	ND	94	50-150%	---	---	
Chromium	4.70	---	0.100	mg/L	10	5.00	ND	94	50-150%	---	---	
Cobalt	2.38	---	0.100	mg/L	10	2.50	ND	95	50-150%	---	---	
Copper	2.52	---	0.200	mg/L	10	2.50	ND	101	50-150%	---	---	
Lead	4.71	---	0.0500	mg/L	10	5.00	ND	94	50-150%	---	---	
Mercury	0.0919	---	0.00700	mg/L	10	0.100	ND	92	50-150%	---	---	
Molybdenum	0.936	---	0.200	mg/L	10	1.00	ND	94	50-150%	---	---	
Nickel	2.42	---	0.200	mg/L	10	2.50	ND	97	50-150%	---	---	
Silver	0.985	---	0.100	mg/L	10	1.00	ND	99	50-150%	---	---	
Thallium	2.51	---	0.100	mg/L	10	2.50	ND	101	50-150%	---	---	
Vanadium	2.39	---	0.200	mg/L	10	2.50	ND	96	50-150%	---	---	
Zinc	4.87	---	0.500	mg/L	10	5.00	ND	97	50-150%	---	---	
Matrix Spike (1020266-MS2)			Prepared: 02/05/21 16:54		Analyzed: 02/08/21 12:53							
QC Source Sample: SP-2---After Processing (A1A0836-04)												
1312/6020B												
Selenium	0.936	---	0.100	mg/L	10	1.00	ND	94	50-150%	---	---	Q-16, X

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12208 Antioch Road	Project Number: **AEC2020-2**	**Report ID:**
White City, OR 97503	Project Manager: **Jonathan Williams**	**A1A0836 - 03 02 21 1125**

QUALITY CONTROL (QC) SAMPLE RESULTS

Conventional Chemistry Parameters

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Spike Amount	Source Result	% REC	% REC Limits	RPD	RPD Limit	Notes
Batch 1013278 - Method Prep: Aq							**Water**					
Duplicate (1013278-DUP1)			Prepared: 01/25/21 16:00		Analyzed: 01/25/21 16:25							
QC Source Sample: SW-1 (A1A0836-11)												
SM 4500-H+ B												
pH	**8.38**	---		pH Units	1	---	8.41	---	---	0.4	2%	H-12
pH Temperature (deg C)	**20.2**	---		pH Units	1	---	21.3	---	---	5	30%	H-12
Reference (1013278-SRM1)			Prepared: 01/25/21 16:00		Analyzed: 01/25/21 16:17							
SM 4500-H+ B												
pH	6.02	---		pH Units	1	6.00		100	33333-101.666	---	---	
pH Temperature (deg C)	20.3	---		pH Units	1	20.0		102	50-200%	---	---	
Reference (1013278-SRM2)			Prepared: 01/25/21 16:00		Analyzed: 01/25/21 16:30							
SM 4500-H+ B												
pH	7.98	---		pH Units	1	8.00		100	98.75-101.25%	---	---	
pH Temperature (deg C)	20.2	---		pH Units	1	20.0		101	50-200%	---	---	

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12208 Antioch Road	Project Number: **AEC2020-2**	**Report ID:**
White City, OR 97503	Project Manager: **Jonathan Williams**	**A1A0836 - 03 02 21 1125**

SAMPLE PREPARATION INFORMATION

Total Metals by EPA 6020B (ICPMS)

Prep: EPA 3015A

Lab Number	Matrix	Method	Sampled	Prepared	Sample Initial/Final	Default Initial/Final	RL Prep Factor
Batch: 1020026							
A1A0836-11	Water	EPA 6020B	01/16/21 10:45	02/01/21 11:24	45mL/50mL	45mL/50mL	1.00
A1A0836-12	Water	EPA 6020B	01/16/21 11:40	02/01/21 11:24	45mL/50mL	45mL/50mL	1.00

Dissolved Metals by EPA 6020B (ICPMS)

Prep: Matrix Matched Direct Inject

Lab Number	Matrix	Method	Sampled	Prepared	Sample Initial/Final	Default Initial/Final	RL Prep Factor
Batch: 1013491							
A1A0836-11	Water	EPA 6020B (Diss)	01/16/21 10:45	01/29/21 09:58	45mL/50mL	45mL/50mL	1.00
A1A0836-12	Water	EPA 6020B (Diss)	01/16/21 11:40	01/29/21 09:58	45mL/50mL	45mL/50mL	1.00

SPLP Metals by EPA 6020B (ICPMS)

Prep: EPA 1312/3015

Lab Number	Matrix	Method	Sampled	Prepared	Sample Initial/Final	Default Initial/Final	RL Prep Factor
Batch: 1020266							
A1A0836-02	Solid	1312/6020B	01/16/21 10:30	02/05/21 16:54	10mL/50mL	10mL/50mL	1.00
A1A0836-02RE1	Solid	1312/6020B	01/16/21 10:30	02/05/21 16:54	10mL/50mL	10mL/50mL	1.00
A1A0836-04	Solid	1312/6020B	01/16/21 11:15	02/05/21 16:54	10mL/50mL	10mL/50mL	1.00
A1A0836-04RE1	Solid	1312/6020B	01/16/21 11:15	02/05/21 16:54	10mL/50mL	10mL/50mL	1.00
A1A0836-06	Solid	1312/6020B	01/16/21 10:15	02/05/21 16:54	10mL/50mL	10mL/50mL	1.00
A1A0836-06RE1	Solid	1312/6020B	01/16/21 10:15	02/05/21 16:54	10mL/50mL	10mL/50mL	1.00
A1A0836-08	Solid	1312/6020B	01/16/21 10:00	02/05/21 16:54	10mL/50mL	10mL/50mL	1.00
A1A0836-08RE1	Solid	1312/6020B	01/16/21 10:00	02/05/21 16:54	10mL/50mL	10mL/50mL	1.00
A1A0836-10	Solid	1312/6020B	01/16/21 09:45	02/05/21 16:54	10mL/50mL	10mL/50mL	1.00
A1A0836-10RE1	Solid	1312/6020B	01/16/21 09:45	02/05/21 16:54	10mL/50mL	10mL/50mL	1.00

Conventional Chemistry Parameters

Prep: Method Prep: Aq

Lab Number	Matrix	Method	Sampled	Prepared	Sample Initial/Final	Default Initial/Final	RL Prep Factor
Batch: 1013278							
A1A0836-11	Water	SM 4500-H+ B	01/16/21 10:45	01/25/21 16:00	20mL/20mL	20mL/20mL	NA
A1A0836-12	Water	SM 4500-H+ B	01/16/21 11:40	01/25/21 16:00	20mL/20mL	20mL/20mL	NA

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Darwin Thomas, Business Development Director

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6700 S.W. Sandburg Street
Tigard, OR 97223
503-718-2323
ORELAP ID: **OR100062**

Alpine Environmental Consultants	Project: **Nickel Mountain**	
12208 Antioch Road	Project Number: **AEC2020-2**	**Report ID:**
White City, OR 97503	Project Manager: **Jonathan Williams**	**A1A0836 - 03 02 21 1125**

QUALIFIER DEFINITIONS

Client Sample and Quality Control (QC) Sample Qualifier Definitions:

Apex Laboratories

H-12	Sample analysis was performed >15 minutes after sample collection. Consult regulator or permit manager to determine the usability of data for intended use.
Q-16	Reanalysis of an original Batch QC sample.
TCLP	This batch QC sample was prepared with TCLP or SPLP fluid from preparation batch 1020263.
X	See Case Narrative.

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REPORTING NOTES AND CONVENTIONS:

Abbreviations:

DET Analyte DETECTED at or above the detection or reporting limit.

ND Analyte NOT DETECTED at or above the detection or reporting limit.

NR Result Not Reported

RPD Relative Percent Difference. RPDs for Matrix Spikes and Matrix Spike Duplicates are based on concentration, not recovery.

Detection Limits: Limit of Detection (LOD)

Limits of Detection (LODs) are normally set at a level of one half the validated Limit of Quantitation (LOQ).
If no value is listed ('-----'), then the data has not been evaluated below the Reporting Limit.

Reporting Limits: Limit of Quantitation (LOQ)

Validated Limits of Quantitation (LOQs) are reported as the Reporting Limits for all analyses where the LOQ, MRL, PQL or CRL are requested. The LOQ represents a level at or above the low point of the calibration curve, that has been validated according to Apex Laboratories' comprehensive LOQ policies and procedures.

Reporting Conventions:

Basis: Results for soil samples are generally reported on a 100% dry weight basis.
The Result Basis is listed following the units as " dry", " wet", or " " (blank) designation.

" dry" Sample results and Reporting Limits are reported on a dry weight basis. (i.e. "ug/kg dry")
See Percent Solids section for details of dry weight analysis.

" wet" Sample results and Reporting Limits for this analysis are normally dry weight corrected, but have not been modified in this case.

" " Results without 'wet' or 'dry' designation are not normally dry weight corrected. These results are considered 'As Received'.

QC Source:

In cases where there is insufficient sample provided for Sample Duplicates and/or Matrix Spikes, a Lab Control Sample Duplicate (LCS Dup) may be analyzed to demonstrate accuracy and precision of the extraction batch.

Non-Client Batch QC Samples (Duplicates and Matrix Spike/Duplicates) may not be included in this report. Please request a Full QC report if this data is required.

Miscellaneous Notes:

" --- " QC results are not applicable. For example, % Recoveries for Blanks and Duplicates, % RPD for Blanks, Blank Spikes and Matrix Spikes, etc.

" *** " Used to indicate a possible discrepancy with the Sample and Sample Duplicate results when the %RPD is not available. In this case, either the Sample or the Sample Duplicate has a reportable result for this analyte, while the other is Non Detect (ND).

Blanks:

Standard practice is to evaluate the results from Blank QC Samples down to a level equal to ½ the Reporting Limit (RL).
-For Blank hits falling between ½ the RL and the RL (J flagged hits), the associated sample and QC data will receive a 'B-02' qualifier.
-For Blank hits above the RL, the associated sample and QC data will receive a 'B' qualifier, per Apex Laboratories' Blank Policy.
For further details, please request a copy of this document.

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REPORTING NOTES AND CONVENTIONS (Cont.):

Blanks (Cont.):

Sample results flagged with a 'B' or 'B-02' qualifier are potentially biased high if the sample results are less than ten times the level found in the blank for inorganic analyses, or less than five times the level found in the blank for organic analyses.

'B' and 'B-02' qualifications are only applied to sample results detected above the Reporting Level.

Preparation Notes:

Mixed Matrix Samples:

Water Samples:

Water samples containing significant amounts of sediment are decanted or separated prior to extraction, and only the water portion analyzed, unless otherwise directed by the client.

Soil and Sediment Samples:

Soil and Sediment samples containing significant amounts of water are decanted prior to extraction, and only the solid portion analyzed, unless otherwise directed by the client.

Sampling and Preservation Notes:

Certain regulatory programs, such as National Pollutant Discharge Elimination System (NPDES), require that activities such as sample filtration (for dissolved metals, orthophosphate, hexavalent chromium, etc.) and testing of short hold analytes (pH, Dissolved Oxygen, etc.) be performed in the field (on-site) within a short time window. In addition, sample matrix spikes are required for some analyses, and sufficient volume must be provided, and billable site specific QC requested, if this is required. All regulatory permits should be reviewed to ensure that these requirements are being met.

Data users should be aware of which regulations pertain to the samples they submit for testing. If related sample collection activities are not approved for a particular regulatory program, results should be considered estimates. Apex Laboratories will qualify these analytes according to the most stringent requirements, however results for samples that are for non-regulatory purposes may be acceptable.

Samples that have been filtered and preserved at Apex Laboratories per client request are listed in the preparation section of the report with the date and time of filtration listed.

Apex Laboratories maintains detailed records on sample receipt, including client label verification, cooler temperature, sample preservation, hold time compliance and field filtration. Data is qualified as necessary, and the lack of qualification indicates compliance with required parameters.

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White City, OR 97503	Project Manager: **Jonathan Williams**	**A1A0836 - 03 02 21 1125**

LABORATORY ACCREDITATION INFORMATION

ORELAP Certification ID: OR100062 (Primary Accreditation) - EPA ID: OR01039

All methods and analytes reported from work performed at Apex Laboratories are included on Apex Laboratories' ORELAP Scope of Certification, with the exception of any analyte(s) listed below:

Apex Laboratories

Matrix	Analysis	TNI_ID	Analyte	TNI_ID	Accreditation

All reported analytes are included in Apex Laboratories' current ORELAP scope.

Secondary Accreditations

Apex Laboratories also maintains reciprocal accreditation with non-TNI states (Washington DOE), as well as other state specific accreditations not listed here.

Subcontract Laboratory Accreditations

Subcontracted data falls outside of Apex Laboratories' Scope of Accreditation.
Please see the Subcontract Laboratory report for full details, or contact your Project Manager for more information.

Field Testing Parameters

Results for Field Tested data are provded by the client or sampler, and fall outside of Apex Laboratories' Scope of Accreditation.

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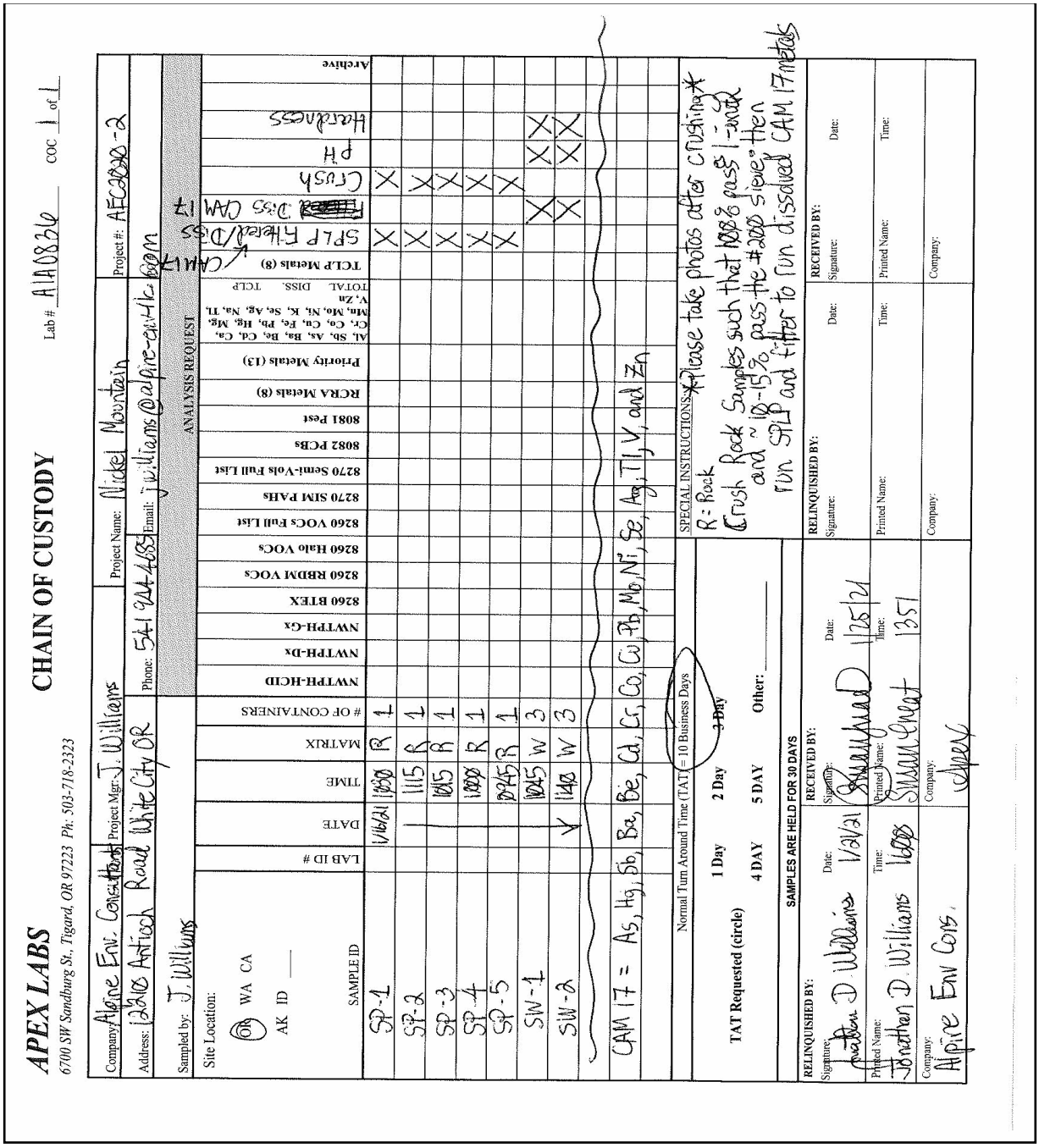

APEX LABS
6700 SW Sandburg St., Tigard, OR 97223 Ph: 503-718-2323

CHAIN OF CUSTODY

Lab # A1A0836 COC 1 of 1

Company: Alpine Env. Consultants | Project Mgr.: J. Williams | Project Name: Nickel Mountain | Project #: AEC2020-2

Address: 12208 Antioch Road White City OR | Phone: 541 944 4685 | Email: jwilliams@alpine-ew.com

Sampled by: J. Williams

Site Location: OR WA CA AK ID ___

ANALYSIS REQUEST

SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	8260 BTEX	8260 RBDM VOCs	8260 Halo VOCs	8260 VOCs Full List	8270 SIM PAHs	8270 Semi-Vols Full List	8082 PCBs	8081 Pest	RCRA Metals (8)	Priority Metals (13)	Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Hg, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Tl, V, Zn TOTAL DISS. TCLP	TCLP Metals (8)	SPLP Filtered/Diss CAM17	~~Filtered~~ Diss CAM17	Crush	pH	Hardness	Archive
SP-1		1/16/21	1030	R	1																X		X			
SP-2			1115	R	1																X		X			
SP-3			1015	R	1																X		X			
SP-4			1000	R	1																X		X			
SP-5			0945	R	1																X		X			
SW-1			1045	W	3																	X		X	X	
SW-2		✓	1140	W	3																	X		X	X	

CAM 17 = As, Hg, Sb, Ba, Be, Cd, Cr, Co, Cu, Pb, Mo, Ni, Se, Ag, Tl, V, and Zn

Normal Turn Around Time (TAT) = 10 Business Days

TAT Requested (circle): 1 Day 2 Day 3 Day 4 DAY 5 DAY Other: ___

SAMPLES ARE HELD FOR 30 DAYS

SPECIAL INSTRUCTIONS: *Please take photos after crushing*
R = Rock
Crush Rock Samples such that 100% pass 1-inch and ~10-15% pass the #200 sieve. then run SPLP and filter to run dissolved CAM 17 metals

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: Jonathan D. Williams	Signature: [signature]	Signature:	Signature:
Date: 1/21/21	Date: 1/25/21	Date:	Date:
Printed Name: Jonathan D. Williams	Printed Name: Susan Great	Printed Name:	Printed Name:
Time: 1600	Time: 1351	Time:	Time:
Company: Alpine Env Cons.	Company: Apex	Company:	Company:

Apex Laboratories

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12208 Antioch Road	Project Number: **AEC2020-2**	**Report ID:**
White City, OR 97503	Project Manager: **Jonathan Williams**	**A1A0836 - 03 02 21 1125**

APEX LABS COOLER RECEIPT FORM

Client: Alpine Env Consultants Element WO#: A1A0836

Project/Project #: Nickel Mountain / AEC2020-2

Delivery Info:

Date/time received: 1/25/21 @ 1351 By: (8)

Delivered by: Apex____ Client____ ESS____ FedEx X UPS____ Swift____ Senvoy____ SDS____ Other____

Cooler Inspection Date/time inspected: 1/25/21 @ 1351 By: (8)

Chain of Custody included? Yes X No _____ Custody seals? Yes_____ No X

Signed/dated by client? Yes X No _____

Signed/dated by Apex? Yes Y No _____

	Cooler #1	Cooler #2	Cooler #3	Cooler #4	Cooler #5	Cooler #6	Cooler #7
Temperature (°C)	5.5						
Received on ice? (Y/N)	Y						
Temp. blanks? (Y/N)	Y						
Ice type: (Gel/Real/Other)	real						
Condition:	melty						

Cooler out of temp? (Y/(N)) Possible reason why: _____

Green dots applied to out of temperature samples? Yes/(No)

Out of temperature samples form initiated? Yes/(No)

Sample Inspection: Date/time inspected: 1/25/21 @ 1400 By: (8)

All samples intact? Yes ___ No Y Comments: _____

Bottle labels/COCs agree? Yes X No ___ Comments: _____

COC/container discrepancies form initiated? Yes ___ No X

Containers/volumes received appropriate for analysis? Yes X No ___ Comments: _____

Do VOA vials have visible headspace? Yes ___ No ___ NA X

Comments _____ ab 1/29/21

Water samples: pH checked: Yes X No ___ NA ___ pH appropriate? Yes ~~X~~ No X NA ___

Comments: SW-1 + SW-2 pH ~7

Additional information: _____

Labeled by: (8) Witness: JS Cooler Inspected by: (8)

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Darwin Thomas, Business Development Director

Alpine Environmental Consultants
Nickel Mountain Project AEC2020-2
Apex Laboratories, LLC WO# A1A0836
Representative Subsampling Method (RSM)

RSM SAP processing documentation and summary images

(1) – Original Rock Samples

(2) – 3/4” , 3/8” , 2 mm diameter Sieves

(3) Japanese 2-D Slabcake < 3/8” dia..

(4) Sectorial Splitting Subsamples < 2mm dia.

(5) Sorted crushed rock

(6) Zirconia puck mill grind < 70 micron dia

(7) SP RSM samples 85 gram <3/8 + 15 gram < 70u dia. total of 100grams for EPA SPLP leachate procedure

Nickel Mountain Rock Samples

SP-1

SP-2

Nickel Mountain Rock Samples

SP-3

SP-4

Nickel Mountain Rock Samples

SP-4 Close Image

SP-5

(2) – 3/4” , 3/8” , 2 mm diameter Sieves

SP- Sieve Stack looking down to 3/8”

SP- + 0.75” on top to be further crushed

3) Japanese 2-D Slabcake < 3/8” dia

SP- <3/8” + 2 mm diameter

SP- Ferrous material <3/8 on magnet

(4) Sectorial Splitting Subsamples < 2mm dia.

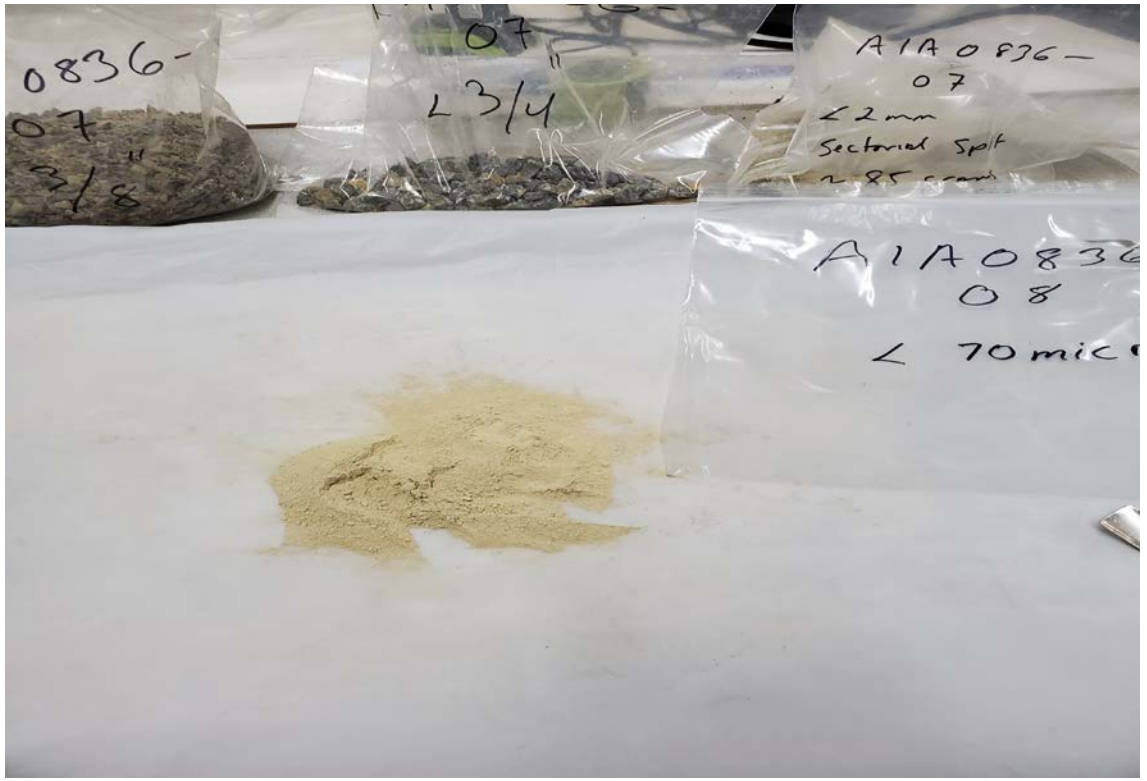
Sectorial Splitting < 2 mm particles

Sectorial Splitter hopper from above

(5) Sorted crushed rock
(6) Zirconia puck mill grind < 70 micron dia.

SP-5

SP-4 example of powered < 70 micron dia.



SP-1, SP-2, SP-3, SP-4, SP-5 Ready for SPLP
RSM 85 grams <3/8” + 15 grams <70 microns

APPENDIX 3

Biotic Ligand Model Data Files

Description: Nickel Mountain Water Quality Data Collected January 16, 2021

Current Selections

Prediction Mode: Toxicity Metal: Cu Water Type: Freshwater

Organism/Test Info: US EPA WQC calculation

Site Chemistry | Simplified Site Chemistry

	Site Name	Sample Name	Temp.	pH	Cu	DOC	HA	Ca	Mg	Na	K	SO4	Cl	Alkalinity	S
			C		ug/L	mg C/L	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L CaCO3	mg/L
1	Nickel Mountain	Surface Water SW-1	5.42	8.41	9.51	8.3	10	1.74	40.4	4.3	0.46	1.9	3.14	171	1E-006
2	Nickel Mountain	Surface Water SW-2	5.42	8.28	8.44	8.3	10	1.44	37.9	4.3	0.46	1.9	3.14	160	1E-006
3															
4															

Ver 3.41.2.12g, build 2015-10-12

C:\Program Files (x86)\Biotic Ligand Model - Research Mode\Model\CuOH5%le_10-11-07.dat

C:\Program Files (x86)\Biotic Ligand Model - Research Mode\Model\Nickel Mountain Data File.blm

/S C:\PROGRAM FILES (X86)\BIOTIC LIGAND MODEL - RESEARCH MODE\MODEL\NICKEL MOUNTAIN DATA FILE.SCR, /W /QQ /VER3.41 /O3 /K1 /L

Site Label	Sample Label	Final Acute Value (FAV), ug/L	CMC (CMC=FAV/2), ug/L	CCC (CCC=FAV/ACR), u	Cu ug/L	Acute Toxic Units (Acute TU=Cu/CMC	Chronic To (Chronic TU	Censored Flag (0 = quantified, 1 = BDL)
"Nickel Mountain	"Surface Water SW-	154.19	77.10	47.89	9.51	0.12	0.20	0.00
"Nickel Mountain	"Surface Water SW-	141.13	70.57	43.83	8.44	0.12	0.19	0.00