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OREGON
ENVIRONMENTAL QUALITY
COMMISSION MEETING
MATERIALS 08/07/1992

DEQ

State of Oregon
Department of Environmental Quality

Notice

Special Meeting

ENVIRONMENTAL QUALITY COMMISSION

Friday, August 7, 1992
9:30 a.m.

Conference Room 3a
Department of Environmental Quality Offices
811 S. W. 6th Avenue
Portland, Oregon 97204

The Commission will consider the independent Contractor's report which responds to specific technical questions regarding selected provisions of the proposed rules on chemical mining. The Commission will also consider the proposed rules on chemical mining, and may elect to adopt the rules as proposed on December 13, 1991, adopt the rules with modifications, or continue discussions on the proposed rules and provide further guidance to the Department on the matter.

TRC

TRC Environmental Consultants, Inc.

FINAL

REPORT OF FINDINGS ON SPECIFIC TECHNICAL ISSUES

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STATE OF OREGON PROPOSED CHEMICAL MINING RULES

PREPARED UNDER AUTHORIZATION
ODEQ CONTRACT NO. 71-92

PREPARED FOR:

State of Oregon
Department of Environmental Quality
Portland, Oregon

PREPARED BY:

TRC Environmental Consultants, Inc.
Englewood, Colorado

Project No. 11958-Q82

July 21, 1992

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1.0 INTRODUCTION

1.1 Overview

TRC Environmental Consultants, Inc. (TRC) was retained by the State of Oregon Department of Environmental Quality (ODEQ) to provide an independent evaluation of and advice on specific technical questions relating to proposed rule-making documents pertaining to impending regulation of chemical mining activities. TRC's designated assignment, reflecting the title of this document, was clearly defined with regard to provision of Technical Advice on Chemical Mining Rules, as limited to addressing pertinent rule excerpts and affected parties' concerns as described in the February 7, 1992 Request for Proposal (RFP) document, as prepared and distributed by ODEQ.

Based on information provided in the RFP, it is TRC's understanding that the State of Oregon, Environmental Quality Commission (Commission) is considering adoption of rules to require mining operations using cyanide or other toxic chemicals to protect soils, groundwater, surface waters, and wildlife from contamination or harm by process solutions and waste waters. The protective measures required by the proposed rules include triple liner systems, cyanide recovery and re-use, and chemical detoxification and engineered cover systems for facility closure.

During regulatory development and drafting of the proposed Oregon Administrative Rules Chapter 340 - Division 43 - "Chemical Mining", the public participation process, as required by law, has resulted in identification of a number of concerns (related to technical issues) from various parties to the process. Mining companies and mining trade associations have argued that some of the requirements are unnecessarily stringent, unproven or unavailable. Conversely, environmental protection organizations have argued that the proposed rules may not be adequately protective in certain respects. Extensive debate on these and related policy issues within the Commission and ODEQ has culminated in this review process, wherein TRC has been asked to address in detail the identified technical issues.

The review process was initiated through a May 5, 1992 public meeting wherein ODEQ presented discussion of the policy and intent under which the review would be conducted; TRC presented discussion of corporate qualifications, project team qualifications, disclosure and clarification of potential conflicts of interest, and its technical approach to conducting the evaluation and review. Interested parties were given an opportunity to pose questions on policy (to ODEQ representatives) and on the technical approach (to TRC).

Although numerous technical professionals and/or firms were offered as points of contact by parties interested in the outcome of the evaluation and review, TRC elected to limit direct inquiries (to these designated individuals and/or firms) to those instances requiring specific information beyond that readily available in the literature, so as to eliminate perceived or actual appearance of influence in the process. Only in those cases requiring direct inquiry (such as proprietary cyanide detoxification process technologies, etc.) was such a method employed. Numerous professional papers, texts and treatises prepared by those technical professionals were accessed as part of the data gathering process, as were applicable technical guidance documents as prepared by the U.S. EPA and/or various states (as deemed by TRC to be representative of appropriate state mining regulatory programs for operations similar in scope and/or magnitude to those which the Commission desires to regulate, e.g., chemical mining). A complete record of all references is provided in Appendix A-1 of the document.

To commence technical review, TRC project team members reviewed the record of the rulemaking in ODEQ's offices and were provided copies (as requested by TRC) of relevant documents. In addition, TRC received a document (delivered to the attention of Mr. Harold Sawyer and subsequently forwarded) prepared on behalf of the Oregon Mining Council (by CH2M Hill and Stoel Rives Boley Jones & Grey), entitled "Issue Paper on ODEQ's Proposed Chemical Mining Rules". In addition, a listing of reference materials was provided by The Wilderness Society; all of which were incorporated into this study. An indicated additional list was to have been presented as provided by the Mineral Policy Center, however, that addendum was not received by TRC. As such, TRC initiated direct contact with the Mineral Policy Center (both Washington D.C. and the Bozeman, Montana field office) to obtain certain materials deemed by the Mineral Policy Center to be pertinent technical discussions of the issues of concern. TRC did not at any time attempt to establish contact or receive direct contact from any of the identified concerned parties, inclusive of the Oregon Mining Council, the Northwest Mining Association, Atlas Minerals Company, or the Wilderness Society. Communications from all factions were as a matter of policy directed through Mr. Harold Sawyer. A complete record of all contacts is provided in Appendix A-2. A brief outline of the qualifications of each individual member of the TRC project team participating in the compilation of this report is provided in Appendix A-3.

The contract provided for TRC to prepare a draft report for submittal to ODEQ, with ultimate distribution to identified concerned parties for review and comment. Concerned parties were then allotted seven (7) days for review and comments were delivered directly to ODEQ. Based on review of the draft report, and individual comment letters ODEQ issued a letter response to TRC, along with copies of all comments received from concerned parties.

Based on the ODEQ letter response (dated July 2, 1992), TRC was directed to make certain deletions pertaining to summarization of findings (which were designated by ODEQ as inappropriate and out of scope) and to incorporate, to the extent deemed appropriate by TRC, certain comments regarding clarifications and/or revisions to the draft report text, inclusive of those submitted by concerned parties.

TRC has compiled a comment/response section for integration into the final report, which is provided as Appendix B-1. In that section, TRC has assembled individual comments extracted verbatim from the July 2, 1991 ODEQ letter. Each comment is then responded to, as appropriate. For instance, where ODEQ identified technical errors or misstatements within the text, TRC has acknowledged the comment and amended the text accordingly. The overall result of the process is a final report that addresses all requests and incorporates all directives issued by ODEQ. For ready reference, TRC has also appended unabridged versions of the ODEQ Request for Proposal and Proposed Rule Draft in Appendices C-1 and C-2, respectively.

It is important to note that, due to the structuring of the RFP, each issue was addressed in a stand-alone manner; no provision within the scope of work (RFP) was allowed for evaluation of the cumulative impact, or redundancies effected by application of all proposed rule measures at a single facility. However, it is of utmost importance that the reader fully understand that TRC's findings would differ significantly if such cumulative impacts were assessed (for example, if a liner system is accepted as capable of achieving stated Commission policy for preventing release to the environment, the proposed follow-on measures (cyanide removal and reuse, and hazardous waste type covers) provide little, if any, material reduction in the potential for release (other than an overall reduction in volume consumed over the project duration) of toxic chemicals or metals. To take it one step further, it is even more apparent to TRC that if a policy-achieving liner is employed in conjunction with detoxification, there is an even lesser material reduction to be achieved by additionally covering the detoxified waste.

Conversely, TRC recognizes, and has emphasized, that site-specific circumstances may, in some instances, warrant application of all prescriptive measures. However, this would generally be the exception, rather than the rule.

1.2 Record of Findings

TRC has conducted extensive research and evaluation into the various proposed regulatory components, individually and collectively, while striving to remain within the bounds of "technical evaluation", and while doing so, not entering into areas perceived by TRC or parties to this effort, as representative of "policy evaluation". While TRC has attempted to provide a concise declaration of findings in this section, it cannot be over-stated that the supporting discussion and review presented in Sections 2.0 through 4.0 of this document are critical to the interpretation of the declaration of findings and any subsequent policy decisions forthcoming. The level of detail presented is representative of the complexity of the issues. Likewise, due to the structuring of the RFP, the cumulative result of all proposed rule components, while significant, is not portrayed. However, following are the summarized findings of the evaluation and review of each individual issue.

- **Question 1:** WILL EITHER OR BOTH LINER SYSTEMS MEET THE STATED POLICY OBJECTIVE OF THE COMMISSION?

[The Commission establishes as policy that a liner, leak detection and leak collection system are necessary to assure that any leak will be detected before toxic materials escape from the liner system and are released to the environment. (Note: The Commission considers that the environment begins at the bottom of the last liner.) These systems must assure that if a leak is found, sufficient time is available to allow for the repair of the leak and clean up of any leaked material before there is a release to the environment. Natural conditions, such as depth to groundwater or net rainfall, shall be considered as additional protection but not in lieu of the protection required by the required engineered protection].

NOTE: Three liner systems, as briefly described below, were evaluated for their ability to achieve stated Commission policy:

(1) ODEQ proposed in Rule 340-43-065(4) a heap leach pad liner system consisting of triple liner system consisting of two flexible membrane liners (with 12-inches of permeable material containing a leak detection system between the liners) overlying a 36-inch thick low permeability soil/clay liner.

(2) A double-liner system with between liner leak detection was identified in the Request for Proposal as having been proposed by the Oregon Mining Council. A flexible membrane liner is utilized as the primary liner, overlying a geotextile leak detection layer in direct contact with an underlying low permeability, 12-inch thick, soil/clay liner.

(3) TRC also evaluated a wide range of alternative liner systems, and elected to put forward a design based upon use of a composite primary liner consisting of a flexible membrane liner (FML) over a variable thickness clay subliner, overlying a 12-inch layer of permeable materials (or engineered equivalent) containing a leak detection system, which in turn overlies a 12-inch layer of low permeability soil/clay material. The design employs geotextile materials for liner reinforcement, as appropriate. While this design configuration is not intended to represent the sole recommended design alternative, it does represent one potential (or reasonable variant thereof) alternative capable of achieving stated Commission policy.

Method to Answer or Address Question:

(1) Are each of the various liner systems proposed technically feasible?

- The OAR 340-43-065(4) Triple Liner System is technically feasible.
- The OMC Double Liner System is technically feasible.
- The Alternative Candidate Liner System is technically feasible.

(2) **Will each of the various liner systems meet the stated Commission Policy?**

- The OAR 340-43-065(4) Triple Liner System will generally meet the stated Commission Policy.
- The OMC Double Liner System will have difficulty meeting the stated Commission Policy.
- The Alternative Candidate Liner System will meet the stated Commission Policy.

(3) **For those liner systems which will meet the stated Commission policy, what level of certainty for achieving this policy do you assign to each system?**

- Using assigned values (refer to Section 2.3 for discussion), mathematically generated weighted average levels of certainty (the greater the number, the higher the level of certainty) are as follows:

Liner System	*Equal Weight on All Components*	*Emphasis on Lower Components*	*Emphasis on Upper Components*
OAR 340 Triple Liner	28.0	51.0	61.0
OMC Double Liner	19.0	41.0	35.0
Alternative Candidate Triple Liner	29.0	62.0	54.0

(4) **Are there other liner systems which will achieve this policy and what level of certainty for achieving this policy do you assign to each?**

- There are a number of other liner systems which will achieve this policy. TRC selected one (the Alternative Candidate Triple Liner) for additional analysis, the results of which are presented above.

- There are a number of variations on the permeable zone component of the Alternative Candidate Triple Liner System (as well as for the OAR 340 system permeable zone) that can also achieve this policy with equivalent levels of certainty while offering varying cost advantages (based on the simple comparison of typical costs for installation) over the proposed Alternative Candidate Liner System. The presented Alternative Candidate Liner System design purposefully incorporated certain components equivalent to those in the OAR 340-43-065(4) system, however, alternative engineered geodrain materials for those components have been identified and evaluated as capable of performing at an equivalent level of certainty.

Question 2: DO THE REQUIREMENTS FOR REMOVAL AND REUSE OF CYANIDE MATERIALLY REDUCE TOXICITY AND POTENTIAL FOR LONG-TERM CYANIDE AND TOXIC METALS RELEASE FROM MILL TAILINGS?

[The Commission establishes as policy that the toxicity and potential for long-term cyanide and toxic metals release from mill tailings should be reduced to the greatest degree practicable through tailings treatment.]

NOTE: ODEQ proposed in Rule 340-43-070(1) that mill tailings shall be treated by cyanide removal and reuse prior to disposal. Additional treatment shall be also be used, if necessary, to reduce the weak acid dissociable (WAD) cyanide content in the liquid fraction of the tailings to 30 parts per million (ppm), or less.

Method to Answer or Address Question:

(1) Are removal and reuse technically feasible?

- Removal and reuse are technically feasible, but limit the operator to technologies with limitations on operating efficiency.

- The process has been demonstrated in practical application, for example, at the Golden Cross Mine in New Zealand, operated by Cyprus Gold Company, as well as at the DeLamar (silver) Mine in Idaho, operated by NERCO Minerals.

- Engineering firms are available to design and oversee construction.

- Materials and equipment are available to construct.

(2) **Do removal and reuse (evaluated separately) materially reduce the toxicity and potential for long-term cyanide and toxic metals release from mill tailings?**

- Removal of cyanide from tailings <u>does</u> materially <u>reduce</u> the <u>cyanide toxicity</u> and potential for long-term release. Cyanide removal <u>may</u>, dependent on the specific tailings chemistry, <u>contribute to a reduction</u> in toxicity and potential for release of <u>toxic metals</u> over the long-term.

- Reuse of cyanide <u>does not</u> reduce the <u>cyanide toxicity</u> or potential for long-term cyanide and toxic metals release from mill tailings. It does reduce the total quantity of cyanide reagent consumed over the life of the operation. There is a material reduction in operating efficiency when cyanide reuse is employed, in comparison to chemical destruction techniques, particularly at lower concentrations of cyanide in process solutions.

(3) **What is the level of certainty you give to the answers provided above?**

- The generic level of certainty that <u>removal and reuse</u> are technically feasible is high, however, removal and reuse limits the available technology that can be applied to either solid/liquid separation or AVR (acidification/volatilization/reneutralization) processes, which may not provide maximum removal under many tailing chemistry conditions.

- The level of certainty that removal of cyanide materially reduces the toxicity and potential for long-term cyanide release from mill tailings is high.

- The level of certainty that removal of cyanide materially reduces the toxicity and potential for long-term toxic metals release from mill tailings is variable, again dependent upon the specific tailings chemistry.

- The level of certainty that reuse of cyanide materially reduces the toxicity and potential for long-term cyanide release from mill tailings is nil. Reuse does not in any way contribute to a reduction of "toxicity" or potential for release of solutions released to tailings, as reagent concentration in process solutions ideally remains constant at all times. It simply reduces the quantity of make-up reagent required over the life of the operation.

- The level of certainty that reuse of cyanide materially reduces the toxicity and potential for long-term toxic metals release from mill tailings is nil. Reuse does not in any way impact toxicity or potential for release as reagent concentration in process solutions ideally remains constant at all times. It simply reduces the quantity of make-up reagent required over the life of the operation.

(4) **Are there other tailings treatment technologies which will equally, or more effectively achieve the policy of the Commission?**

- There are a number of tailings treatment technologies which will equally or more effectively achieve the stated policy of the Commission. In addition, these technologies are oftentimes technically more appropriate than removal and reuse under given tailings chemistry, offer significant economic advantage, greater operational flexibility, and result in more efficient utilization of resources. These technologies are discussed in Section 3.1.4

Question 3: DO THE REQUIREMENTS OF DETOXIFICATION (CYANIDE REMOVAL BY RINSING) OF THE HEAP AND COVERING OF THE HEAP AND TAILINGS FACILITY TO EXCLUDE AIR AND

WATER MATERIALLY REDUCE THE LIKELIHOOD OF ANY RELEASE TO THE ENVIRONMENT OF TOXIC CHEMICALS AND METALS CONTAINED IN THE HEAP OVER THE LONG TERM?

[Note: The Commission establishes as policy that the closure of the heap leach and tailings disposal facilities will prevent release to the environment of toxic chemicals contained in the facility.]

Method to Answer or Address Question:

(1) **Are detoxification and covering (as prescribed in this rule) technically feasible?**

- Detoxification and covering of heap leach facilities is technically feasible.

- Detoxification and covering of tailings facilities is technically feasible.

(2) **Do detoxification and covering (evaluated separately and together) materially reduce the likelihood of a release of toxic chemicals and metals to the environment?**

<u>Heap Leach Facilities</u>

◆ *Toxic Chemical Release Potential*

- Detoxification of heap leach materials (spent ore) does materially reduce the likelihood of a release of toxic chemicals to the environment.

- Covering of heap leach materials (spent ore) without prior detoxification does not materially reduce the likelihood of a release of toxic chemicals to the environment.

- Covering of decommissioned heap leach facilities, following detoxification of cyanide concentrations within the spent ore, may materially reduce the likelihood of a release of toxic chemicals to the environment in some instances, but this primarily results from the contribution of detoxification. Conversely, covering in addition to detoxification, if applied inappropriately, can adversely affect control of releases of toxic chemicals to the environment.

- *Toxic Metal Release Potential*

- Detoxification of heap leach materials (spent ore) does not materially reduce the likelihood of a releae of toxic metals to the environment.

- Covering of heap leach materials (spent ore) without prior detoxification does materially reduce the likelihood of a release of toxic metals to the environment.

- Covering of decommissioned heap leach facilities, following detoxification of cyanide concentrations within the spent ore, where spent ore chemistry dictates (due to acid-generating potential), does materially reduce the likelihood of a release of toxic metals to the environment. However, where acid-generating potential is not a concern, little, if any additional benefit is realized toward materially reducing the likelihood of a release of toxic metals to the environment by covering after detoxification.

<u>Tailings Facilities</u>

- *Toxic Chemical Release Potential*

- Detoxification of mill tailings does materially reduce the likelihood of a release of toxic chemicals to the environment.

- Covering of mill tailings without prior detoxification does not materially reduce the likelihood of a release of toxic chemicals to the environment, except in the case of net precipitative buildup.

- Covering of decommissioned tailings facilities, following detoxification of the cyanide concentrations within the tails, in most instances does not materially reduce the likelihood of a release of toxic chemicals to the environment. Conversely, covering may inhibit further reduction of toxic chemicals by natural degradation.

◆ *Toxic Metal Release Potential*

- Detoxification of mill tailings may not materially reduce the likelihood of a release of toxic metals to the environment.

- Covering of mill tailings without prior detoxification may not materially reduce the likelihood of a release of toxic metals to the environment, except in the case of net precipitative buildup.

- Covering of decommissioned tailings facilities, following detoxification of the cyanide concentrations within the tails, in some instances may materially reduce the likelihood of a release of toxic metals to the environment, primarily as a result of reducing the potential for acid generation and resultant mobilization of toxic metals.

(3) What is the level of certainty you give to the answers provided above?

- Level of certainty of findings described above is high. Level of certainty with respect to application of findings varies with given site conditions (i.e., in many instances, prescriptive proposed rule requirements may function favorably; likewise, in many instances the prescriptive rule requirements may function with adverse consequences, resulting in non-achievement of Commission policy).

(4) Are there other technologies which will equally, or more effectively achieve the policy of the Commission?

- There are variants on the proposed technologies that can equally or more effectively achieve the policy of the Commission. Specific site conditions dictate where variants on detoxification and/or cover requirements are appropriate.

- Specifically, once heap leach or tailing materials are detoxified, typical earthen cover systems can equally or more effectively achieve the policy of the Commission at significant economic advantage over prescriptive composite liner systems designed for "hazardous waste" impoundment cover systems.

TRC was assigned the task of evaluating specific technical aspects of varying environmental protective measures related to chemical mining. This in-depth evaluation has resulted in findings, as described above, that indicate that in many instances, there is no single prescriptive design standard that will achieve the stated Commission policies in all instances. TRC has reported these findings as depicted in the foregoing responses to direct questions; TRC, by recording these findings is in no way making any statement(s) with regard to policy.

Due to the heavy emphasis from the various commentators challenging TRC's finding that there is no single prescriptive design standard that will achieve the stated Commission policies in all instances, TRC (as part of scope of work for each issue, pertaining to the method for response to the question on availability of alternative technologies) conducted further investigation into identification of chemical mining operations that have been recognized by reputable and technically knowledgeable constituencies as exhibiting exemplary operational records and achievements relative to design, operation, and closure.

A prominent representative mine facility identified in this investigation is Coeur d' Alene Mines Thunder Mountain Mine, located adjacent to the Frank Church River of No Return Wilderness Area (Payette National Forest) in central Idaho. This facility was presented the first "Environmental Leadership Award" in October, 1991 [Ref 47]. The Environmental Leadership Award was developed by the DuPont Corporation to recognize those mining companies which "place corporate environmental stewardship fully in line with public desires and expectations". The award selection committee was comprised of members providing a representative cross-section of leading industry, political, and environmental constituencies. In order to assess potential alternatives capable of equally or more effectively achieving Commission Policy, TRC contacted representatives of Coeur d'Alene Mines to determine design and operational configurations employed at the Thunder Mountain Mine. According to Coeur d'Alene Mines, design components of interest included:

- A liner system, consisting of, (from the bottom up): a compacted soil/clay base liner (taking advantage of site specific conditions which offer extensive natural clay deposits underlying the heap leach pad location); an aggregate leak detection and drainage layer consisting of minus 2-inch washed aggregate; an 80 mil HDPE flexible membrane liner, and; a 6-inch sealed asphalt layer. These liner components were then complemented with a sized 18-inch ore layer to facilitate leachate collection, thereby reducing hydraulic head buildup upon the liner system.

- Cyanide detoxification was accomplished through alkaline chlorination rinse cycle applications, ultimately achieving less than 0.2 mg/L free cyanide (and approximately equivalent concentrations of WAD cyanide) as determined through stabilized 2-hour interval testing over a 24-hour period. Detoxified spent ore was then removed from the heap and placed in a waste unit; spreading was utilized to maximize benefits of continued volatilization and ultraviolet degradation. Predetermined volumes of spent tailings have also been utilized in backfilling of selected mine pit areas.

- Cover of the waste units referred to above consisted of, again, advantageous utilization of site-specific conditions by employing a naturally occurring compacted clay base prior to deposition of the spent ore; subsequent placement of a 6-inch compacted clay cover; and ultimately, application of topsoil/growth medium to establish a vegetative cover. Provisions were made for surface water diversion to minimize infiltration and erosion potential.

What TRC has determined from this investigation into alternative technologies capable of equally or more effectively achieving the Commission policy is that the policy can be effectively achieved through alternative design configurations. It is important to note that each aspect examined for this award-winning operation differs substantially from the prescriptive design standards contained within the ODEQ proposed rules for chemical mining. Perhaps more importantly, it can be noted that the successfully engineered design was heavily founded upon maximum utilization of site-specific conditions and attributes. Without the allowance for flexibility in design, many of the site-specific attributes would not have been utilized.

What is the desired level of protection? Base

to do that in performance standards,

combine performance standards, design specs

starting point for discussion is high?

2.0 QUESTIONS ON LINER SYSTEM DESIGN STANDARDS

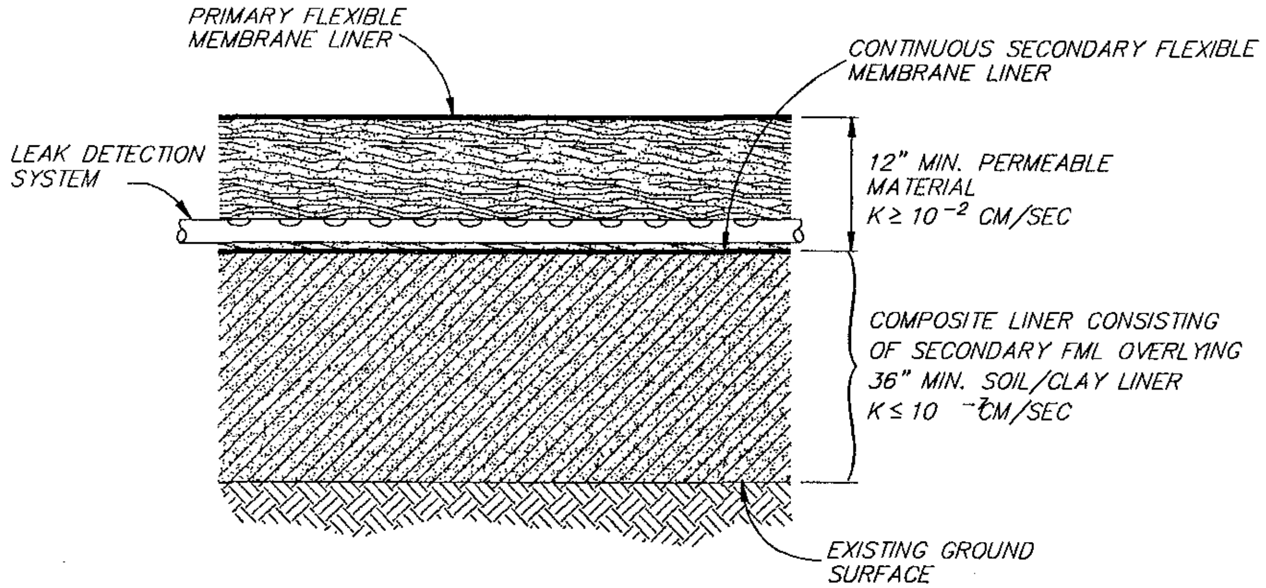
2.1 Introduction

In this section of the report, TRC has addressed each of the four heap leach pad liner system questions pertaining to evaluation of the following two liner systems: 1) the proposed OAR 340-43-065(4) triple-liner system, and 2) the double liner system (identified in the RFP as being proposed by the Oregon Mining Council). In addition, these questions have been addressed with regard to the evaluation of an "alternative candidate" liner system, selected for possible consideration by the ODEQ. Discussion pertaining to the evaluation of alternative liner system configurations as well as to the selection process for the alternative candidate liner system is presented in Section 2.4 of this report. A description of each of the three heap leach pad liner systems evaluated is provided in the following paragraphs.

TRC notes, for clarification, that the following discussion pertains solely to heap leach pad liner system evaluations. Evaluation of these liner systems for suitability or practicality of use as tailing impoundment liner systems is beyond the scope of the RFP.

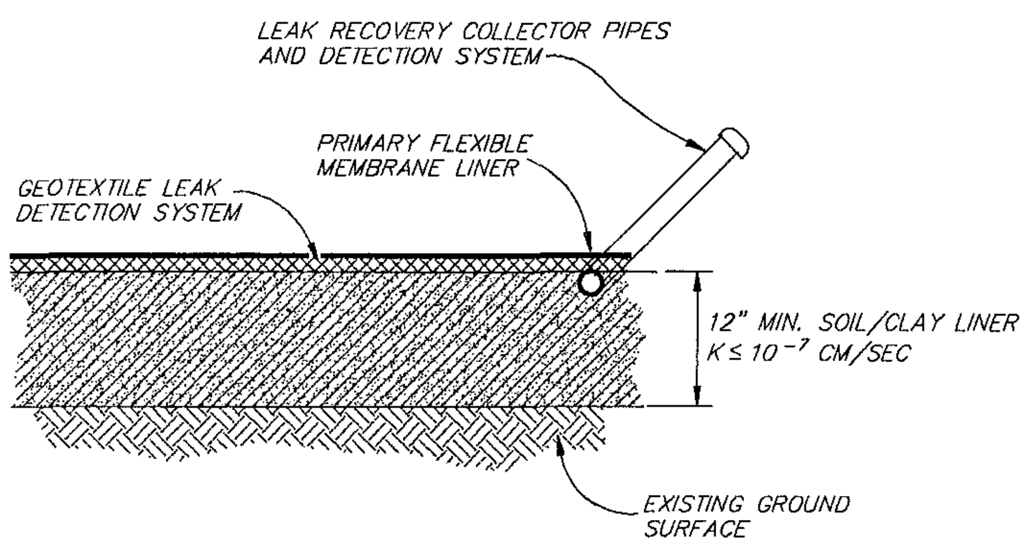
The proposed OAR 340-43-065(4) triple-liner system (Figure 2-1A) is comprised of a leak detection piping system (situated in 12 inches of permeable material) between primary and secondary continuous flexible membrane liners (FML's). The permeable material is required to possess a minimum permeability of 10^{-2} cm/sec. A third (bottom) liner consisting of a 36-inch thick layer of low permeability soil/clay materials, possessing a maximum permeability of 10^{-7} cm/sec underlies the top two liners and the leak detection system layer. The leak detection system is to be capable of detecting a leachate leakage rate of 400 gallons per day per acre (gpd/ac), within 10-weeks of leakage initiation.

The double-liner system (Figure 2-1B) is comprised of a primary liner of continuous FML overlying a 12-inch thick soil/clay bottom liner possessing a maximum permeability of 10^{-7} cm/sec. The two liners are proposed to be separated by a geotextile layer to be tied to collector pipes spaced at appropriate intervals used to detect leakage within the prescribed 10-week time period.



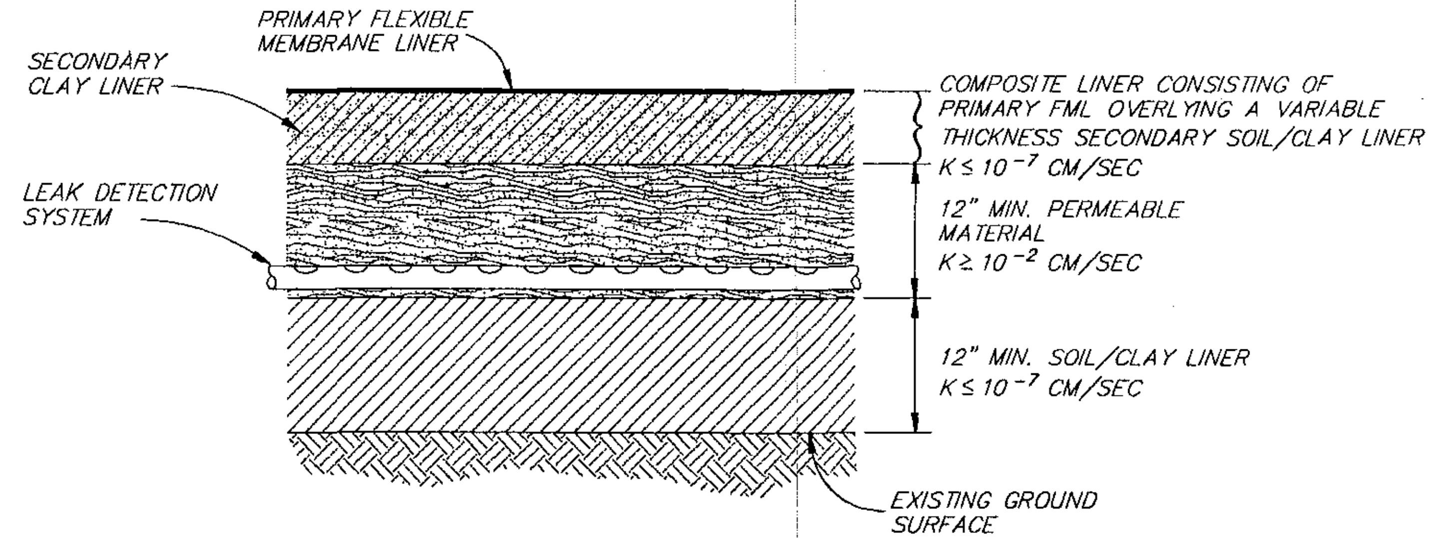
a) PROPOSED RULE 340-43-065(A) LEACH PAD LINER

(NOT TO SCALE)



b) PROPOSED DOUBLE LINER SYSTEM

(NOT TO SCALE)



NOTES

1) GEODRAIN (OR EQUIVALENT) MAY BE SUBSTITUTED FOR PERMEABLE MATERIAL DRAINAGE LAYER, WHERE CONDITIONS ALLOW.

2) PREFABRICATED FML/BENTONITE CLAY COMPOSITE SUBLINER MAY BE SUBSTITUTED FOR THE COMPOSITE PRIMARY FML OVERLYING VARIABLE THICKNESS OF CLAY, WHERE CONDITIONS ALLOW.

c) ALTERNATIVE CANDIDATE LINER SYSTEM

(NOT TO SCALE)

PREPARED FOR: **STATE OF OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY**

PREPARED BY: TRC Environmental Consultants, Inc.

LINER SYSTEMS EVALUATED

FIGURE 2-1

The "alternative candidate" liner system (Figure 2-1C) can be considered a triple-liner system (similar to the OAR 340 triple-liner system) or a double-liner with a composite primary component. The liner system selected is comprised of a composite liner system consisting of a primary continuous FML situated directly over a secondary low permeability clay subliner. The composite liner overlies the leak detection system layer, consisting of a 12-inch layer of permeable material possessing a minimum permeability of 10^{-2} cm/sec and containing a leak detection piping system. The underlying bottom clay/soil liner consists of a 12-inch layer of low permeability soil/clay materials, possessing a maximum permeability of 10^{-7} cm/sec. A separate layer of geotextile materials or other cushioning materials is recommended, when necessary, to cushion the composite liner from both the heaped ore material and the permeable material component of the leak detection system layer.

Evaluations of the three liner systems were conducted in order to technically address the four liner system questions posed by the ODEQ. The questions are restated as follows:

Question 1: Is each of the liner systems proposed technically feasible?

Question 2: Will each of the various liner systems meet the stated Commission policy?

Question 3: For those liner systems which meet the stated Commission policy, what level of certainty would be assigned to each system?

Question 4: Are there other liner systems which will achieve this policy and what level of certainty would be assigned to each system?

In addition to the technical evaluation, typical costs associated with the installation of the various liner system configurations have been developed (Section 2.5) for comparative analysis.

The approach for addressing each of the questions was based on TRC's knowledge and expertise, as well as utilization of published information and technical data currently available from sources such as the U.S. EPA, other regulatory agencies and state jurisdictions; the Society of Mining Engineers (SME), the American Society of Civil Engineers (ASCE), the Geosynthetics Research Institute and other reliable sources.

2.1 Technical Review and Evaluation of Liner Systems Feasibility

2.1.1 Introduction

In order to address Question 1, (Are the various liner systems technically feasible?), a technical review and evaluation of the three liner systems was conducted with regard to each system's expected: 1) Performance Characteristics; 2) Operation, Maintenance and Repair Considerations; and 3) Construction Feasibility. Items considered for each of the three evaluation categories, are summarized in the following subsections.

1) <u>Performance Characteristics Considerations</u>

a) Evaluation of the leak detection and collection system's ability to achieve the stated Commission policy.

b) Evaluation of the leak detection system's deterioration potential with regard to various external stimuli, including clogging, effects of surface loadings and environmental considerations.

c) Evaluation of the liner systems with regard to permeability and ability to achieve the stated Commission policy.

d) Evaluation of geotechnical considerations with respect to each liner system, including: ability to withstand typical pad loading activities, strength, stability, sliding and slippage potential, as well as settlement considerations.

e) Evaluation of the liner systems with regard to providing sufficient factors of safety or replication in the design, should distress to the system occur.

f) Evaluation of the liner systems with respect to the leak detection and collection system's ability to be utilized to identify locations of leakage in the primary liner system.

2) Operational, Maintenance, and Repair Considerations

a) Evaluation of the expected ease of operations in carrying out normal maintenance procedures and repair of the liner systems.

b) Evaluation of the liner systems with respect to being expanded or constructed in stages corresponding to ongoing ore loading and pad expansion.

c) Evaluation of each liner system with regard to remedial operations, in the event a leak would occur.

d) Evaluation of decommissioning and long term post closure maintenance considerations which could affect the liner system's long term functionality.

3) Construction Feasibility Considerations

a) Evaluations of Quality Assurance/Quality Control (QA/QC) considerations necessary for successful construction of each liner system.

b) Evaluations of the level of complexity and the potential for problems which may arise due to the limitations and variances in the construction of each liner system.

The technical evaluations for each of the liner systems are presented in the following report subsections. Due to the extensive discussion pertaining to geotextile and related products (which comprise various liner and other components of each liner system) the following glossary is provided.

GLOSSARY

A general discussion of terminology used in the geotextile industry is in order to clarify certain discussions contained within this section. Accepted convention [Ref 6] is as follows:

Geotextile - *Any permeable textile used with foundation, soil, rock, earth, or any other geotechnical engineering-related material as an integral part of a human-made project, structure or system.*

Geogrid - *A deformed or nondeformed gridlike polymeric material formed by intersecting ribs joined at the junctions used for reinforcement with foundation, soil, rock, earth or any other geotechnical engineering-related material as an integral part of a human-made project structure or system. Geogrids are typically used to enhance stability and/or minimize settlement in structures such as embankments, retaining walls, or foundations constructed upon soft materials.*

Geonet - *A netlike polymeric material formed from intersecting ribs integrally joined at the junctions used for drainage with foundation, soil, rock, earth or any other geotechnical-related material as an integral part of a human-made project, structure, or system. Geonets are typically used for subgrade drainage applications such as under pond or landfill liners or behind retaining walls.*

Geomembrane - *An essentially impermeable membrane used as a liquid or vapor barrier with foundation, soil, rock, earth or any other geotechnical engineering-related materials as an integral part of a human-made project, structure, or system. Geomembranes are typically used as liners, barriers, or pond linings due to their relative impermeability.*

Geocomposite - *A manufactured material using geotextiles, geogrids, geonets, and/or geomembranes in laminated or composite form.*

Geosynthetics - *The generic term for all synthetic materials used in geotechnical engineering applications; it includes geotextiles, geogrids, geonets,*

2.1.2 *Proposed OAR 340-43-065(4) Liner System (hereafter referred to as "OAR 340 Triple Liner System)*

2.1.2.1 Performance Characteristics (OAR 340 Triple-Liner System)

a) Leak Detection System (OAR 340 Triple-Liner System)

The leak detection system as proposed for the OAR 340 triple-liner system (see Figure 1(a)), utilizes a 12-inch layer of permeable material possessing a minimum permeability of 10^{-2} cm/sec in conjunction with a leak detection piping system. The leak detection system is situated between the primary flexible membrane liner (FML) and the secondary FML. The secondary FML is situated directly on a 36-inch thick bottom liner to be constructed of soil/clay materials, possessing a maximum permeability of 10^{-7} cm/sec.

The leak detection system as proposed adequately achieves the stated EQC policy requirements for leak detection and adequacy of time for repair of a leak and clean up of material leakage prior to its release into the environment.

The ability of the leak detection system to detect leakage of toxic solutions to the environment including a leak detection rate of 400 gpd/acre (assuming steady-state conditions) is a function not only of the permeability of the material in which the leak detection piping system is situated, but also, the pipe size, spacing, length of piping and slope of the leak detection system layer. Also of related importance are the locations and distances of the leak detection system monitoring locations from a potential leakage source. Leakage from the primary liner to the detection system for the proposed liner system consists of two types of fluid flow; 1) seepage flow of the leachate from a membrane defect through the permeable material, to the detection piping system and 2) conduit flow of the leachate through the leak detection piping system to the monitoring location. The proposed rule requirement that leakage be detected within a 10-week period after its initiation will require that the leak detection system be designed in conjunction with the particular heap pad site. Factors such as the pad's layout, areal extent and slope, will affect the spacing, diameter and layout of the leak detection piping system, as well as the location of the monitoring points. In order to detect leakage within the specified time period, the seepage and conduit flow velocities must be analyzed for selection of appropriate monitoring locations. It should be noted that the velocity components of leachate flow within the leak detection system will be a function of the pad slope, material permeability, and the leak detection pipe size and layout. It should be noted that the hydraulic head within the leak detection layer would be hydraulically connected to the secondary liner. As such, operational /hydraulic head should be minimized as much as possible to reduce the seepage rate through the secondary liner and to reduce the potential of toxic material release to the environment.

The leak detection system was evaluated with regard to its deterioration potential. Factors related to the flow of leachate through the system have been considered as resulting from leakage through the primary liner, in addition to factors unrelated to leakage.

Damage to the leak detection system can result during the construction of the liner system and/or as a result of operations on the pad, including placing of the ore on the pad. Environmental factors or other natural causes may also contribute to the system's deterioration potential, and are discussed in the following paragraphs.

During construction of the liner system, the leak detection piping system, which commonly consists of perforated flexible corrugated pipe or PVC piping, may be subjected to excessive stresses. This will generally occur if a sufficient depth of cover is not provided above the piping materials, or if excessively heavy equipment is driven over the otherwise adequately covered piping system. In general, the cover materials will provide an arching effect over the piping system, thereby reducing the stresses directly experienced by the piping. Ore placement will also contribute to the stresses experienced by the piping system. Often, however, the greatest stresses experienced by liner system components will be those occurring during the pad's construction, thus emphasizing the importance of construction quality assurance/quality control programs.

Damage to the leak detection piping system may also result from exposure to environmental conditions such as ultraviolet radiation (sunlight), adverse weather conditions, bacteria and fungi, while the materials are being stored or constructed [Ref 1, 2, 3]. Even after the piping materials are installed, they may be subjected to these factors, including heating and cooling cycles, which may in some environments, result in overstress or fatigue of the materials [Ref 3, 4].

During the leak detection system's operation (assuming leakage through the primary liner may be occurring), the system can become clogged with fines, either originating from within the ore or in the permeable drainage material surrounding the pipe [Ref 1, 4]. The fines may clog the permeable drainage material and the perforations of the leak detection piping system, reducing the conveyance capacity of the system. Therefore, the permeable materials should be selected cautiously to avert clogging potential. The allowable fines content present within the material may also be specified as a gradation requirement [Ref 1]. The use of filter fabrics or a filtered gradation specification will also aid in protecting the components of the leak detection system from clogging. Similar requirements may be applicable to the surface leachate collection and recovery system, to reduce its potential for clogging as well as to reduce buildup of leachate (hydraulic) head over the primary liner.

b) Permeability Considerations (OAR 340 Triple-Liner System)

The ability of the proposed liner system to meet the requirements of the Commission policy with respect to permeability was evaluated for each component of the system, including the primary liner, the leak detection system, and the secondary and bottom liners.

The primary liner is to consist of a continuous flexible membrane geosynthetic liner. As a result, the liner should possess a permeability well below the ODEQ proposed 10^{-7} cm/sec., provided the liner is installed properly and in conjunction with a QA/QC program. This permeability should adequately satisfy the Commission requirements, since any leakage through the primary liner will be detected within a short time frame due to the thinness of the FML and the infinitesimal breakthrough time to the leak detection system of any leakage. The resulting permeability of the liner will be a function of the number of liner defects resulting from its installation and operations on the pad. Precautions should be taken, therefore, to minimize the occurrence of pinhole leaks, seam leaks, tears and punctures. Standard practices have shown that the occurrence of such liner defects can be substantially reduced with a properly conducted QA/QC program and operations plan [Refs 1, 4, 5]. Minimizing the number of seams will also help, for example, by utilizing larger width FML materials. In addition, the utilization of geotextiles and/or cushioning materials such as sand, will generally reduce the potential for liner damage from construction operations. Protection of the liner from the overlying ore and the underlying permeable drainage materials may be beneficial, particularly if the materials exhibit sufficient angularity to puncture the primary liner [Ref 4]. Standard puncture resistance tests should be conducted to determine the appropriate stress levels at which puncturing would occur with (and without) the use of protective cushioning or geotextile materials [Ref 6].

The leak detection system's permeable material layer should meet the EQC policy. In general the ODEQ-proposed permeability of 10^{-2} cm/sec will ensure "free draining materials". Materials of this permeability are commonly used to convey greater amounts of flow than could be expected from leakage in a heap leach pad. Such permeable materials are utilized for underdrains in other areas of application of subdrains. In general, the gradation of the permeable material will provide a good indication of the material's permeability, including the amount of fines present within the material. If the permeability of the material is questionable (for example, as a result of the presence of excessive fines or indications that the material has the potential for deterioration) permeability and other appropriate tests should be performed on representative material samples. The presence of fines in the material, may give rise to the potential for self-clogging of the material and the clogging of the perforations of the leak detection piping system. If the potential for clogging exists, appropriate measures should be taken such as the development of a gradation or filter criteria, or utilization of filter fabrics [Ref 1].

The secondary (or middle) liner, like the primary FML, should meet the permeability requirements of the EQC policy, provided its installation is performed in conjunction with a QA/QC program. However, a geotextile layer (or other cushioning material) may be required above the liner to reduce the potential for damage from the overlying leak detection system permeable materials. The use of a secondary FML directly on top of a low permeability clay liner, often referred to as a composite liner system, has been shown to significantly reduce the rates of potential leakage through a FML, due to the close interface of the clay with the synthetic liner [Refs 7, 8]. Such use of a composite liner is generally considered good engineering practice, due to the clay's ability to close-up or fill-in around a FML defect and reduce, if not, mitigate leakage occurrence. This is in contrast to the discouraged practice of placing the synthetic liner directly over more permeable materials, with larger voids, such as aggregate drainage materials. Such materials do not provide as close of a contact with the FML, can encourage leakage to occur, and can further contribute to the deterioration of the defect [Ref 9].

The bottom soil/clay liner as proposed, is to be comprised of a 36-inch thick layer of soil/clay materials, with an ODEQ-proposed maximum permeability of 10^{-7} cm/sec. This permeability requirement should satisfy the EQC requirements by providing sufficient time for leak detection prior to toxic release into the environment. This proposed rule permeability requirement will require the use of soils with relatively large percentages of clay content. The permeability requirement will also require that the soils be subjected to large compactive efforts. It may also be necessary to provide additives such as bentonite or other soil or chemical admixtures to the soil, to achieve the permeability requirement. Once the liner is constructed, it will be necessary to maintain it in a moist condition to reduce the potential for desiccation cracking. This may be achieved by sprinkling the liner with water and covering it immediately with the secondary liner, or with some other material, such as sand, to retard moisture loss. The occurrence of desiccation cracking could result in the clay liner's permeability being in excess of the prescribed, 10^{-7} cm/sec permeability value. There is no guarantee that dessication cracking can be prevented from occurring in clay liners. However, the potential for moisture loss is generally reduced as the liner becomes thicker in depth, since drying of the outer liner surface does not affect the deeper clay particles as much, particularly the further away from the liner's surface and drying influences the deeper clay particles are. If desiccation cracking has been found to occur, and extends through the full profile of the liner, leachate escape (provided the secondary liner (FML) is defective) into the environment may immediately occur.

c) <u>Geotechnical Considerations (OAR 340 Triple-Liner System)</u>

Evaluations of the liner system with regard to geotechnical considerations were conducted including stability, sliding and slippage, as well as settlement and strength considerations.

A key component of analyses pertaining to stability, sliding and slippage is the interface friction angle, which represents the contact angle between two materials possessing frictional resistance. The higher the friction angle is, the more a material possesses an increased ability to withstand sliding. Generally, the interface friction angles along geomembrane contacts are lower than the individual material strengths and will control heap stability. For these types of interfaces, two friction angles are generally considered: 1) peak strength-friction angle; and, 2) residual strength-friction angle. The peak strength-friction angle represents the frictional angle corresponding to the material's peak strength, whereas, the residual friction angle represents the material's friction angle after its peak strength has been achieved and the material has just become mobile and started to slide. The residual friction angle is, most generally, always less than the peak angle. For some geosynthetic material and soil interfaces, movement on the order of one millimeter can cause the material to transcend from its peak strength to residual strength state.

The interface of the primary liner with the heaped ore and the underlying leak detection permeable material generally results in friction angles varying in the range of between 26 and 29 degrees for HDPE liners, for example, [Ref 4, 10], and will vary depending on the type of liner used. Stability is generally not a problem for this type of an interface, except on very steep slopes where textured liners may be indicated in lieu of standard "smooth" liners. Geotextiles are often used in conjunction with the primary liner to increase its puncture resistance to the ore, or underlying granular materials. A typical range of interface friction angle values for FML/geotextile interfaces is between 7.3 and 11.3 degrees [Ref 4, 10], and is dependent on the type of FML liner and geotextile used. As a consequence, the use of geotextiles to increase the FML's puncture resistance must be done with caution, due to the relatively low interface friction values that can result.

The secondary FML has two interfaces, an interface with the leak detection permeable material layer and one with the bottom clay liner. The interface angle for the FML liner and permeable material layer lies within the same of range of values as those values for the primary liner/ore interface (26 to 29 degrees). The FML secondary liner/clay liner interface friction angle can range from as low as 6 degrees to as high as 25 degrees, [Refs 4, 10], depending on the nature of the soil/clay liner and the FML material. Consequently, the FML/clay liner interface is most always analyzed (for stability purposes) as a potential failure surface.

The soil/clay liner and subgrade interface friction angle will vary, depending upon the material components of the subgrade and the soil/clay liner materials. In some cases this interface may be a potential failure surface. A summary of typical interface friction angle values, is provided in Table 1 for the various interfaces discussed.

TABLE 2-1
Interface Friction Values [Ref 10]

MATERIALS	*FRICTION ANGLE (°)*
PVC rough in contact with Clay	9.6* - 26.2
PVC smooth in contact with Clay	6.1* - 25
PVC rough in contact with Sand	25 - 27
PVC smooth in contact with Sand	21 - 25
PVC in contact with Ore	33
PVC rough in contact with Geo-textile	23
PVC smooth in contact with Geo-textile	21
HDPE in contact with Clay	13
HDPE in contact with Sand	17 - 27
HDPE in contact with Ore	26 - 29
HDPE in contact with Geotextile	7.3* - 11.3

** Residual Value*

Sliding or slippage of the liner system could occur as a result of overstressing the primary and secondary FML's, causing them to stretch or slip, primarily as a result of construction operations and ore being deposited on the pad [Ref 4, 10]. Sliding along the bottom clay liner/secondary liner interface may similarly occur, particularly for liner systems constructed on steeper sites. The integrity of the FML seams is important with regard to the stability of the liner system and pad. Overstressing of the seams can cause them to peel or tear, initiating slippage or sliding, which may result in a condition of instability. In addition, due to the plastic nature of the FML's, secondary, creep induced stresses may be experienced by the FML materials. Sequenced ore loading techniques can be utilized to reduce the potential for overstressing a particular section of the pad and underlying FML's by attempting to balance the ore-induced, incremental applied stresses throughout the pad. Since the loading of ore on the liner system can induce tensile stresses upon the liner components (particularly on steeper sites and side slopes) it is oftentimes important to ensure that the liner is not overstressed in any one particular part of the heap. Consequently, ore loading can be sequenced to ensure that the height, location and areal extent of the ore material are established in such an ordered manner so as to cause the liner system to be in equilibrium to the greatest extent feasible. As a result, frictional resistance (up to the near the peak strength of the interface) can be mobilized to restrain the liner from excessive tensile stresses and movement, which can lead to tears and pullout of anchorage. Sequencing may be especially beneficial for pads constructed on steeper sites.

Differential settlements of the pad may also occur, causing disproportionate stresses to be transferred to the liner system, which in turn can overstress the liner system's components and affect their integrities. Differential settlement may also affect the integrity of the leak detection piping system due to unequal settlements along its length. Kinking of the leak detection piping system, disconnections at the pipe joints or their complete pull-out, or unacceptable deflections along the length of the piping, may result, as may the occurrence of low points or sumps in the system. The occurrence of low points in the system may cause portions of the system to flow in a pressure flow configuration, as opposed to the more desirable configuration of gravity flow.

A properly designed pregnant (mineral-bearing) solution recovery system, situated between the primary liner and the ore, can reduce the amount of leachate head buildup over the primary liner and liner system as a whole. In addition, the system should enhance the stability of the heap, and reduce the potential for leachate seepage through the primary liner. A well designed surface leachate recovery system can serve as an effective mechanism against potential leak occurrences and/or the occurrence of more serious liner system problems. Proposed Rule OAR 340-43-065(6) specifies maximum hydraulic head of 24-inches within the heap.

d) <u>Distress Considerations, (OAR 340 Triple-Liner System)</u>

Evaluations of the proposed liner system were conducted with regard to the system's potential to be distressed. Evaluations of the liner system's degree of redundancy, including the system components, were considered relative to the system's response to the distressed conditions.

The proposed triple-liner system offers a high safety factor due to the replication provided by the three liners and the leak detection system. In addition, the bottom liner's prescribed 36-inch thickness of low permeability soil/clay materials provides a high degree of protection to the environment, in the event leachate escapes through both the primary and secondary liners. The placement of the secondary liner directly on the top of the bottom clay liner (providing a composite liner) should effectively reduce the amount of leakage potentially escaping through a secondary liner defect, as a result of the close FML/clay liner interface. The FML liners, however, could be subject to punctures from both the overlying ore or the underlying permeable leak detection materials, if sufficient angularity of materials is allowed. The puncture resistance of FML's may be increased through use of geotextiles or other such cushioning materials. In this system, the primary FML represents the weakest component of the liner system due to its lack of protection (puncture resistance) both on its surface and underside, assuming cushioning materials are not utilized. Punctures occurring to the liner could potentially become larger and leakage rates more progressive with time, potentially leading to liner failure even with the use of cushioning materials. Where the primary liner is the weakest system component, it would be expected that the secondary and bottom liners, out of necessity, would need to provide a higher degree of secondary protection. The entire liner system would be better served, however, if the primary liner provided greater protection and was more reliable as a primary defense against leakage. Less reliance would then be placed on the other two liners, since the likelihood of their utilization as secondary defense mechanisms would be reduced. The leak detection system, which provides the second line of defense, should intercept leakage through the primary liner defect and convey it away from the defect. The utilization of a surface solution collection and recovery system, consisting of permeable materials and/or a perforated piping system (placed along the surface of the primary liner, beneath the ore) will further reduce the potential for seepage through the primary liner by reducing leachate head buildup in the ore. It would also enhance the heaped ore's stability by reducing the fluid levels within the ore, and is particularly effective where heap leaching is subject to wet weather conditions.

The leak detection and collection system proposed for the liner system, which consists of a combination of permeable drainage materials and a leak detection piping system, also offers a high degree of replication. This is because the permeable materials surrounding the piping system should in most instances possess the capacity to adequately convey leachate leakage by gravity flow to a collection point, even if the leak detection piping system were unable to function. This assumes, of course, that clogging of the material does not occur.

The leak detection and collection system should be able to well tolerate differential settlement of the liner system, since the components of the system are not as easily damaged from overstressing (as compared to the settlement effects on more rigid or thinner plastic materials).

Leak detection and collection piping systems have a long history of use in the mining industry, as well as in other industries. They are commonly utilized for other types of solid waste facilities including landfills and hazardous waste facilities. Such systems are currently used in conjunction with the recommended practices of numerous regulatory agencies including the EPA [Ref. 1]. In addition, the long term, in-ground deterioration potential for these types of systems, has been well documented over the years, as compared to a shorter history of use and documentation with regard to the deterioration potential of geosynthetic systems. Similar applications of these types of systems have also been widely utilized for other types of engineering projects. Such projects include, for example, public works and water resources related projects.

2.1.2.2 Operation, Maintenance and Repair Considerations (OAR 340 Triple-Liner System)

Evaluations of the liner system were conducted with respect to operation, maintenance and repair considerations, including those related to the closure/post-closure period.

Operation and maintenance of the proposed liner system should be uneventful, provided that QA/QC measures are subscribed to, during both the facility's operational life and post closure life. Puncturing of the primary liner is the most prevalent problem that occurs on heap leach pads, and generally results from wayward equipment operations, the dropping of equipment or tools on the liner, and the lack of use of cushioning materials to generally protect the liner's surface. As previously discussed, damage may also result from overstressing the liner with excessive heights of ore, or from excessively heavy equipment (which can result in punctures, tears or seam failures, for example).

Maintenance operations pertaining to the leak collection and conveyance channels, as well as the leak collection recovery piping systems, may also pose a threat to the primary liner, particularly if equipment or tools which can easily damage the liner are utilized during the maintenance operations. Damage to the secondary liner can similarly occur.

Procedures for maintaining the leak detection piping system (particularly after occurrence of a leak) should be relatively straight forward including standard pipe maintenance procedures, provided the pipe joints are contiguous and not separated. Hydraulic cleaning of the piping system should also be acceptable as a (post-leakage) maintenance procedure, provided water pressures are kept below the specified pressure level that would cause damage to the piping and the primary or secondary liners. In some cases, fines clogging the perforations of the piping system may be able to be backwashed from their locations by hydraulically flushing the pipe system. Also, hydraulic pressurization of the leak detection system may be utilized, to counteract the downward migration of leachate seepage from a defected primary liner. This may be accomplished by providing a hydraulic backpressure through the leak detection pipes at a pressure approximately equal to, or slightly in excess of, the leachate pressure head at the defect location.

Repair of the leak detection and collection piping system can generally be conducted by utilizing standard repair procedures and will generally not require the expertise of liner specialists. Typically, most repairs can be conducted by field personnel, including pipe installations, replacements and system extensions. If the piping is of sufficient diameter (generally 4-inches or greater) televised equipment may be transported through the piping system to assist with location of defects in the leak detection system or liner systems.

Typically, leach pads are constructed to function as a series of independent "cells" comprising the overall facility. As such, leaks can be easily tracked to an impacted cell through utilization of the leak detection piping system and strategically located observation points.

The leak detection piping system may also be utilized to assist in the identification of locations of liner defects, particularly from the detection of the leachate concentrations and volumes within a particular run of pipe, or for use in conjunction with dye tests used for identifying leak locations. In addition, the detection piping system may also be used in conjunction with acoustic emission tests, also used to determine defect locations [Ref 11]. Acoustic emissions tests utilize microphonic devices or piezoelectric sensors such as transducers to pick up the essentially inaudible vibrations of a leak as it makes its way through various materials (such as the leak detection piping system of a heap leach facility), and amplifies the sounds or vibrations to a remote station or recorder. In some instances, wave guides such as wires are utilized as a medium to be vibrated (throughout a facility) by the fluid as it passes, or collides with, the wire, yielding a detectable vibration.

The permeable material component of the leak detection system should protect the primary liner during tests or maintenance operations conducted on the leak detection system, due to the clearance and cushioning effect it provides between the piping system and the primary liner.

The leak detection system monitoring facilities are generally constructed of riser pipes (or in some cases may "daylight" to a sump) and are directly connected to the leak detection piping system or collection sump. The installation of these facilities (and operation thereof) should be compatible with the leak detection piping system, due to the relatively simple (standard pipe joints) connections between the two components.

In general, repair of geomembranes requires removal of the ore material from the liner (to expose the liner defect) in order to reseam or patch the liner. In some cases, drilling can be done in the immediate vicinity of the defect and a slurry, either bentonite or another suitable grouting material can be injected (through the casing) into the defect to reduce the leakage, or provide a barrier above and around the defect. However, due to the aggregate drainage material placed below many liners (utilized as a leak detection system), care must be taken to ensure the grout is not taken up to a large degree by the aggregate. This can be controlled as a function of slurry thickness, density and grout pressure.

Materials used for repair of the liner system (as well as for pad expansions and staged pad construction) may be stored and handled on-site with relative ease when compared to other types of materials such as geosynthetics.

With regard to closure/post-closure performance, the leak detection piping system should have far less potential for long term deterioration when compared to geosynthetic materials. The leak detection system's permeable material component provides a safety factor for the leachate detection and collection system, in the event that deterioration or clogging of the leak detection piping system would occur. The bottom clay liner also provides a safety factor with regard to post-closure operations, in the event that the primary and secondary synthetic liners would be adversely affected due to environmental conditions over the duration of the post closure period.

2.1.2.3 Construction Feasibility (OAR 340 Triple-Liner System)

The use of geosynthetic materials including flexible membrane liners (FML's) and geotextiles generally requires that experienced construction personnel (familiar with the particular geosynthetic product line and installation procedures) install the geosynthetic components of a liner system [Ref 12]. In addition, a detailed QA/QC program is generally conducted by a third party representative and utilizes standard tests and procedures to ensure that the quality of the materials and their installation(s), are adequate [Ref 12]. Geosynthetic construction materials are very delicate as compared to other types of construction materials. As a consequence, they are relatively easy to damage during transport, unloading, storage or installation. Even after their successful installation, what may be considered normal operations can be detrimental to the geosynthetic material's integrity, depending on thickness and composition.

Environmental factors (such as ultraviolet radiation, adverse weather conditions, and soil conditions, for example) can have a detrimental effect on particular types of geosynthetic materials. In general, most problems associated with geosynthetic materials are related to the seam strengths of the FML or geotextile sheets, and tearing or puncturing of the material from angular rocks or aggregates. In addition, damage may result from a lack of suitable foundation materials, voids beneath the liner, or from movement of the liner on steep slopes due to a lack of appropriate anchorage [Refs 1, 3, 6]. The QA/QC program should assist with reducing the potential for occurrence of these types of problems as well. Even a quality installation of a geosynthetic liner will in almost every case result in some occurrence of defects, however minor. Such defects can be kept from becoming progressively larger by providing cushioning with materials such as geotextiles or other acceptable materials, both above and below the liner. Ideally, the use of low permeability materials placed directly below the synthetic liner, and in close contact with it, will reduce the potential for the enlargement of the defects and significantly reduce the leakage [Ref 7, 9].

The proposed triple-liner system provides relatively good compatibility with staged pad construction methods and/or pad expansions. The components of system should permit fairly compatible connections with newly constructed pad components, while at the same time should permit some reasonable variance or tolerance during the construction process. The leak detection and piping system should permit relatively uneventful pad expansions, provided sufficient slope is available to permit gravity drainage for the new pad area's leachate collection and detection system. The liners should be relatively easy to connect to the new pad's liner components, since slight elevation variances between the new and old pads should be able to be taken up, to a large degree, within the thicknesses of the bottom clay liner or leak detection system.

Materials required to construct the leakage detection system should, generally, be readily available at most mine sites. The leak detection system layer should be relatively easy to construct in conjunction with the perforated piping system, provided adequate cover over the piping is maintained and excessively heavy equipment is cautiously used. If the permeable materials are too angular, geotextiles or other cushioning materials may need to be utilized to reduce the potential for damaging the primary and secondary liners.

Low permeability materials required to construct the 36-inch thick bottom liner will require that a clay borrow source be situated in the vicinity of the mine or that on-site soils possess the ability to be mixed with soil admixtures such as bentonite to achieve the 10^{-7} cm/sec permeability requirements of the liner. Otherwise, it will be necessary to import suitable low permeability materials from off-site locations. The construction of the clay liner should be carried out in conjunction with a QA/QC program to ensure that required performance properties (such as the permeability and strength of the constructed liner) can be achieved. Tests generally conducted include properties and gradation tests, compaction tests, laboratory permeability tests, and as deemed appropriate, in-situ permeability and shear strength tests.

The clay liner should be prevented, as much as is possible, from drying out after its construction, in order to minimize desiccation cracking occurrences, which could adversely affect the overall permeability of the liner. The liner should be maintained in a moist condition until the secondary liner or other appropriate materials can be placed over it, to retard the loss of moisture.

The use of cushioning materials such as sands or geotextiles placed on top of the primary and secondary FML liners should be considered during construction operations, to prevent damage to the liners. The cushioning will protect the secondary liner from the permeable leak detection drainage material and the primary liner from the ore.

2.1.3 Proposed Double-Liner System

2.1.3.1 Performance Characteristics

a) Leak Detection System

The leak detection system as proposed for the double-liner system (as illustrated in Figure 1 (b)), utilizes a geotextile layer, leak detection system situated directly on the surface of the 12-inch thick proposed soil/clay bottom liner, and directly beneath the primary FML liner.

The geotextile material has the capability of transmitting the prescribed leakage rate of 400 gpd/acre, provided certain considerations are addressed prior to its use as a leak detection system. It has been shown that, in general, only nonwoven geotextile materials possess sufficient hydraulic capacity to convey significant amounts of planar flows [Ref 13, 14]. However, since the nonwoven geotextiles are extremely compressible when subjected to large loadings similar to those experienced on a heap leach facility, the conveyance capacity of the geotextile will consequently decrease with time and the magnitude of loading, as depicted in Figure 2-2, [Reference 13]. In addition, the effects of a phenomenon referred to as "clogging" will also reduce the conveyance capacity of geotextiles. Clogging refers to the filling of the void spaces of the geotextile (which are used to convey planar flows) with those materials present in the adjacent layers of the liner system [Ref 6, 13, 29]. In this case, the clogging materials would originate from the primary liner and the clay bottom liner. Based on this infor-

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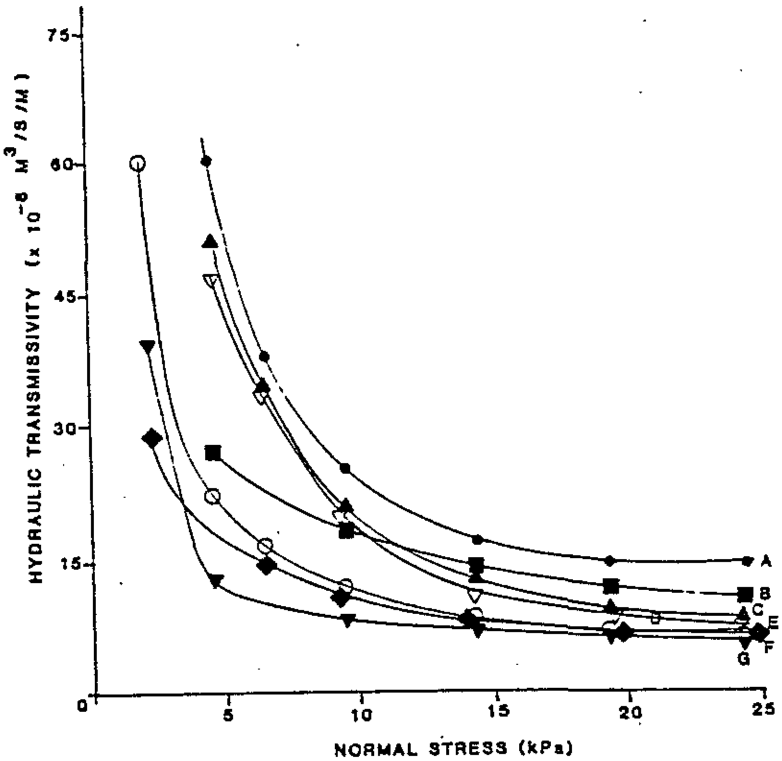

Geotextile	Mass Per Unit Area		Nominal Thickness		Polymer	
	oz/yd²	g/cm²	Mils	mm	Type	Filament
A	16	540	210	5.3	PET	continuous
B	18	600	190	4.7	PET	staple
C	18	600	150	3.8	PP	continuous
D	16	540	160	4.1	PP	continuous
E	12	400	110	2.8	PP	continuous
F	14	470	130	3.3	PP	staple
G	16	540	110	2.8	PET	continuous

[Ref. 13]—*Transmissivity response versus applied normal stress for various needled nonwoven geotextiles. after Koerner and Bove* [5].

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GEOTEXTILE CONVEYANCE versus LOADING

FIGURE 2-2

mation, it is anticipated that for this liner system, intrusion of the primary and bottom clay liner materials into the geotextile would occur, in conjunction with increased stresses on the pad resulting from increased ore deposition. As a result, unless significant factors of safety could be applied to the design of the geotextile leak detection system, its use should be discouraged. Many papers have been published which discuss this shortcoming of the geotextile [Refs 4, 6, 13, 14].

As an option, geonet or alternative geodrain materials can be substituted (as an alternative geosynthetic material) for use as the leak detection system component of the liner system. Geonet materials differ in configuration from geotextiles in that they possess ribs which are spaced at wider intervals than the filament spacings of the geotextiles, providing greater flow capacity, and as such, are capable of achieving stated Commission policy at significant cost savings.

Similar limitations, however, have also been suggested with regard to the use of these materials as well, primarily due to their limited load carrying capacity and reduced leakage conveyance capacity [Refs 4, 13, 14]. However, if sufficient factors of safety are applied, in conjunction with their greater thickness and conveyance area (as compared to the geotextiles) their use may be acceptable under certain loading conditions. It should be noted however, that the long term reliability and deterioration potential of the geonet drainage systems have yet to be established [Refs 6, 13, 14]. If these questions can be successfully addressed, the geonets may provide satisfactory service, due to their capacity to convey large rates of leakage with a relatively small amount of head buildup in the leak detection system layer. This is a result of their openness and areal extent. Due to their areal extent beneath the leach pad liner system, geonets can generally provide sufficient leakage conveyance capacity even if other portions of the geonet system are blocked. Also, the flow velocities through the geonet materials are substantially greater than the flow velocities through the permeable material/leak detection piping system and geotextile layers previously discussed. As a result, leakage travel times from a liner defect area to a monitoring well location should be substantially reduced with their use. In addition, the presence of fines should not affect the geonet's conveyance capacity as much as their presence would affect geotextiles and permeable drainage material/pipe detection systems. However, larger materials may cause blockage of portions of the geonet system, particularly if geotextiles or other protective materials are not utilized above the geonet layer.

Both geotextile and geonet materials have the potential to be damaged from environmental factors, including ultraviolet degradation and adverse weather conditions, in addition to those potential problems which might occur during their storage, handling and installation. In addition, certain geotextile materials have the potential for deterioration from bacteria, fungi and the chemistry of the soil [Refs 1, 3, 6]. As a result of the geotextile's thinness, punctures or localized stress concentrations experienced by the primary liner would have a greater potential to be transmitted through the geotextile to the clay bottom liner. This could cause subsequent puncturing or localized stress cracking to occur in the bottom liner [Ref 7].

b) Permeability Considerations (Double-Liner System)

The liner system's ability to meet EQC policy with respect to permeability was evaluated for each system component, including the primary liner, geotextile leak detection system, and the bottom clay liner.

Since the primary (or top) liner proposed for the liner system is to consist of a continuous FML geosynthetic liner, it should have a permeability substantially less than 10^{-7} cm/sec, provided it is installed in accordance with appropriate QA/QC measures. The evaluation of the permeability requirements for the OAR 340 triple-liner system primary liner (as presented in Section 2.1.2.1) is directly applicable to this system's primary liner, including the provisions for geotextile use or cushioning above the liner, QA/QC procedures and the surface solution collection system. It should be noted however, that the geotextile's use beneath the primary liner should act as a cushion between the primary liner and the clay bottom liner, up to that stress level where loading conditions (a function of heap height, etc.) surpass the geotextile's capacity to cushion the liners.

The geotextile layer proposed for use as a leak detection system is considered questionable with regard to its ability to meet the ODEQ proposed rule permeable zone requirements (minimum 10^{-2} cm/sec) and the Commission policy statement. As was previously discussed, the geotextile's conveyance capacity is dependent on the loading conditions applied. This results from the compressible nature of the nonwoven geotextile materials [Ref 13]. In addition, the effects of clogging intrusion from both the primary and clay liners into the geotextile or geonet need to be considered with respect to the reduced transmissivity of the materials. It is reported that turbulent flow conditions can occur for planar flow through geotextiles, particularly at higher hydraulic gradients, consequently causing a decrease in the geotextile's conveyance capacity [Ref 15]. Also, clogging of the geotextile (from fines transported with the defect leakage or from the underlying clay liner) should be evaluated in this regard [Refs 1, 13, 14, 15]. Intrusion of adjacent materials into the geonet materials will also reduce the transmissivity.

The 12-inch thick, bottom clay liner, as proposed, is to possess the ODEQ proposed rule maximum permeability of 10^{-7} cm/sec, and should be able to achieve the permeability and leak detection requirements of the stated Commission policy, provided the issues as discussed for the evaluation of the OAR 340 triple-liner system's bottom clay liner are considered (due to their similarities). Since the bottom clay liner is separated from the primary liner and the ore by only the thin geotextile layer, it is possible that damage to the primary liner could also result in damage to the bottom clay liner. As a result, stress cracks or indentations may occur, which could adversely affect the bottom liner's permeability characteristics. In addition, flow of leakage along the geotextile could cause erosion of the surface of the bottom clay liner, potentially leading to movement or damage of the primary liner. Wicking of leakage into the bottom clay liner is also likely to occur due the geotextile's location along the surface of bottom clay liner [Ref 15].

c) Geotechnical Considerations (Double-Liner System)

Evaluations of the double-liner system with regard to geotechnical considerations (including stability, slippage, settlement and strength considerations) were conducted for each component of the system.

The effects of the liner system (on the stability of the heap leach unit) due to the primary liner's interface(s) with the heaped ore and geotextile leak detection system layer, were considered to be the same for this liner system as for the OAR 340 triple-liner system, with the exception that the friction angle for the primary liner/geotextile leak detection system layer will lie within the range between 7.3 and 11.3 degrees. The utilization of the geotextile leak detection system layer (as proposed for this liner system) results in a relatively low interface friction angle between the two geosynthetic material components, and could potentially have a significant effect on the stability of the facility.

The typical interface friction angle between the geotextile and clay liner reportedly lies between 23 and 30 degrees, [Ref 4, 10]. As a result, stability is generally not a concern along this type of an interface, except for facilities constructed on relatively steep slopes. However, movement of the geotextile may be initiated along the interface as a result of other factors, including erosion of the clay bottom liner or movement of the geotextile resulting from overstressing of the seam. Also, tears and punctures would have an obvious detrimental affect on the stability of the interface. In addition, clogging or intrusion of the FML and clay bottom liner materials into the geotextile or geonet could cause asperities to develop, thereby reducing the interface friction of the interface.

The clay bottom liner/subgrade interface friction angle values are a function of the subgrade (site) materials the clay liner is constructed upon. As a result, the construction of the clay bottom liner on smoother subgrade materials may result in low interface friction angles, potentially affecting the stability of the facility. Typical interface friction values for the liner system components were previously presented in Table 1.

Sliding or slippage of the liner system may occur as a result of overstressing the primary FML liner and the geotextile leak detection system, either during construction of the liner system or during deposition of the ore on the pad. Overstressing may cause movements and subsequent tears, or overstressing of the seams of both the primary liner and geotextile. In addition, creep of the primary liner and geotextile or geonet may contribute to movement, particularly for facilities constructed on steeper sites.

Differential settlements occurring to the liner system could cause kinking or over-stressing of both the primary liner and geotextile or geonet materials, causing either tears or seam separation. Kinking could cause a loss of conveyance capacity in the geotextile/geonet, (particularly at the kink location) due to the reduction of its cross-sectional conveyance area.

As was discussed in the proposed OAR 340 triple-liner system evaluation, an effective surface solution collection and recovery system can reduce the buildup of hydraulic head over the primary liner and liner system. A surface solution collection and recovery system should also enhance the stability of the heaped ore.

d) Distress Considerations (Double-Liner System)

The proposed double-liner system offers a low degree of replication, principally due to the geotextile material's use as a leak detection system. The utilization of the geotextile as a leak detection and collection system is generally not recommended due to potential occurrence of problems, as previously discussed. It was determined in those discussions that the geotextile leak detection system (as proposed) could potentially jeopardize the bottom clay liner's functionality in the event of a leakage occurrence and may deteriorate the integrity of the liner as a result of the leak detection system's potential to cause erosion of the liner. In addition, clogging and/or intrusion of the clay bottom liner into the geotextile or geonet may occur. Also of importance is the lack of sufficient depth of cushioning between the clay bottom and FML primary liner. That is, the clay bottom liner could be susceptible to the same potential damage to which the FML primary liner is exposed, as a result of the very minimal separation between the two. The reduced thickness of the clay bottom liner (12-inches) also reduces the factor of safety with regard to desiccation cracking, stress cracking and indentation, in addition to a relative reduction in the breakthrough time of leachate, (as compared to the 36-inch thick liner utilized in the OAR 340 triple-liner system).

Other potential distress occurrences in the double-liner system may include overstressing of the primary liner, including the seams. This distress could be simultaneously experienced by the geotextile material (due to its close proximity to the primary liner), adversely affecting its function. Consequently, both components have the potential to be subjected to, and similarly affected by, the same distress-causing agent [Ref 7].

2.1.3.2 Operation, Maintenance and Repair Considerations (Double-Liner System)

Operation and maintenance of the double-liner system is also questionable due to the thinness of the geotextile leak detection and collection system layer. Although the potential for puncturing of the primary FML liner may be reduced (due to the presence of the geotextile and the underlying clay bottom liner) damage from forces which are in excess of the geotextile's strength may occur to these underlying components, as well. For example, damage to these underlying components may result from overstressing the primary FML liner, due to the intimate contact of the system components. Repair of the primary FML liner may be more difficult as well, due to the close proximity of the components. Also, repairs to the geotextile layer may be more difficult to carry out and could threaten the integrity of the primary FML liner.

Repairs to the leak detection system geotextile layer will generally require the use of geosynthetics repair specialists. Unclogging of fines from the geotextile layer for example, may be difficult, if not impossible, and replacement of a clogged section may be required. Utilization of hydraulic backpressures for cleaning or remediation of the leak detection and collection system is questionable, due to the thinness of the geotextile and its close contact with the primary FML and bottom clay liners (which might be damaged during the process). Storage and handling of the geotextiles may affect the materials. Also, certain geotextile materials are sensitive to ultraviolet radiation from sunlight, weathering, and temperature cycles.

Due to its continuous and unsegmented nature, the utilization of the geotextile for determining leak locations is limited. In addition, the ability to utilize the geotextile leak detection system for assisting with acoustic emissions testing may be limited, due to the thinness of the layer [Ref 11].

The double-liner system would be more difficult to tie into future pad expansions due to the thinness of the system's leak detection layer and lack of the liner system's substantial thickness. Also, riser pipe monitoring wells could be more difficult to connect to the geotextile layer (due to its thinness and the differences in the compatibilities of the more flexible geotextile material and rigid piping). The potential for damage to the geotextile (or its seams) is more likely to occur, as a result of the necessity of such a connection.

The long term deterioration potential of the geotextile has not been time proven, due to its short history of use [Refs 1, 14]. In addition, there are no provisions to ensure that the leak detection system will continue to function, in the event the geotextile material would deteriorate during its operational or post closure life.

2.1.3.3 Construction Feasibility (Double-Liner System)

The feasibility of constructing this double-liner system is, in general, equivalent to that of the proposed OAR 340 triple-liner system, with a few exceptions. The installation of the geotextile materials will require the use of specialized construction personnel in addition to the utilization of a conscientious QA/QC and testing program to ensure construction quality control.

The improper handling and storage of the geotextile materials, as with the other geosynthetic materials, can easily cause them to be damaged. Appropriate care should also be taken to protect the materials from construction equipment and personnel, as well as from prolonged ultraviolet (sunlight) exposure, weathering, and heating/cooling cycles. Geotextiles are not as readily available as conventional construction materials and generally require more quality assurance tests (due to considerations such as seam strength, etc.). In addition, other significant influences or effects, such as clogging and intrusion of the primary and bottom liners into the geotextile drainage layer, must be addressed during both the design and the construction of the double-liner system.

2.1.4 Alternative Candidate Liner System

2.1.4.1 <u>Performance Characteristics (Alternative Candidate Liner System)</u>

a) Leak Detection System (Alternative Candidate Liner System)

The leak detection system as proposed for the alternative candidate liner system is comprised of a 12-inch layer of permeable material possessing the ODEQ proposed rule minimum permeability of 10^{-2} cm/sec, utilized in conjunction with a leak detection piping system. The leak detection system is situated above a 12-inch thick bottom clay liner with a maximum permeability (equivalent to the ODEQ proposed rule) of 10^{-7} cm/sec, and below the composite FML/clay primary or variable thickness secondary clay liner component. The clay secondary liner, as proposed, possesses a maximum permeability of 10^{-7} cm/sec and is of sufficient (variable) thickness to provide adequate contact and strength for the overlying FML primary liner. The purpose of the secondary clay liner is to mitigate potential leakage from the primary FML liner [Refs 7, 8]. A continuous layer of geotextile or other cushioning material may be utilized between the leak detection layer and both the overlying and underlying FML liners, when, for the anticipated loads, the puncture resistance of any one of the three liners is anticipated to be exceeded. In addition, a geotextile layer or cushioning layer may be indicated under certain conditions for use above the primary FML as well, to improve its puncture resistance during ore loading and operations activities. It is recommended that puncture resistance tests be performed to determine the necessity of the geotextile or cushioning layer. The tests should utilize representative ore samples and permeable materials to be used in construction of the leak detection system. Also, the thickness of the secondary clay liner (which underlies the primary FML) should be determined based on sound engineering considerations related to the specific performance requirements for the specific facility and anticipated loading projections. In general, it would be anticipated to range in thickness from approximately 1/8 inch (when implemented as a prefabricated FML/bentonite composite liner) to as much as 6 inches (when implemented as a soil/clay liner underlying the FML). These engineering considerations should ensure that the required strength and permeability requirements of the composite liner system can be maintained for the system to function as an integral unit for the proposed loadings, uses, and site specific environmental conditions.

The leak detection system (as proposed for this liner system) is the same as the leak detection system which was proposed for the OAR 340 triple-liner system. Optionally, and where anticipated site and loading conditions allow, use of an engineered geodrain leak detection system may be implemented in lieu of the 12-inch layer of permeable material. As a result, the evaluation of this system's leak detection system reflects that presented for the OAR 340 triple liner system in Section 2.1.2.1. A geodrain leak detection system (in comparison to graded aggregate as proposed in the OAR 340 triple liner system) provides equivalent capability in achieving stated Commission policy while providing significant economic advantage. Further, a geodrain leak detection system offers at least one advantage over the aggregate in that it will contribute to greater reduction in hydraulic head over the lower component of the liner system, in the event leakage occurs.

b) Permeability Considerations (Alternative Candidate Liner System)

The composite liner is the equivalent of a double-lined system, consisting of a continuous flexible membrane primary liner in direct contact with, or fabricated with, an underlying secondary clay liner. The FML primary liner possesses, on average, a permeability of 10^{-11} cm/sec, while the clay secondary liner possesses a maximum permeability of 10^{-7} cm/sec. The function of the secondary clay liner is to minimize, or inhibit, leakage through the primary FML, in the event of a defect (such as a puncture).

It has been demonstrated that the presence of a low permeability clay liner directly beneath and in close contact with a FML significantly reduces or eliminates the amount of leakage through the primary FML [Ref. 7, 8]. This is a result of the underlying clay's tendency to close up, or fill in by swelling, the primary liner defect upon being wetted by the leak. In many cases, the leak becomes virtually undetectable. Conversely, it has been shown that for FML liners situated over more permeable materials (as with the OAR 340 Triple-Liner System) the FML primary liner defects tend to progressively worsen, causing greater amounts of leakage to occur [Ref. 9].

The leak detection system (as proposed for this alternative candidate liner system) should be able to satisfy the stated Commission policy, subject to the same considerations presented in Section 2.1.2.1 (b), pertaining to the gradation requirements of the permeable material, the percentage of fines present, and to clogging of the leak detection piping system. The proposed leak detection system is identical to that proposed in the OAR 340 triple-liner system. As indicated previously, use of a geodrain leak detection system may be appropriate under given conditions; such a system should achieve the proposed rule permeability requirements and may provide certain operational advantages along with economic benefits, as discussed earlier.

The bottom clay/soil liner (as proposed for this alternative candidate liner system) is similar to the 36-inch thick bottom liner which is proposed for the OAR 340 Triple-Liner System, with the exception that it is 12-inches in thickness. This bottom liner should satisfy the stated Commission policy with respect to permeability, subject to the considerations presented in Section 2.1.2.1 (b) for the OAR 340 triple-liner system. It should be noted that in these thickness ranges, a reduction in thickness of the liner would not affect the permeability, but would correspondingly lessen the travel time of any potential leakage through it. Assuming saturated conditions and a hydraulic head buildup of 12-inches over the proposed bottom liner (utilizing Darcy's law) it would take approximately 5 years for the wetted front to traverse the 12-inch thick liner, as opposed to approximately 22 years to traverse the 36-inch thick liner. As a result of these relatively long travel times (for either liner thickness) it is demonstrated that even the shorter 5-year breakthrough travel time period provides sufficient time to remediate a leak.

c) Geotechnical Considerations (Alternative Candidate Liner System)

Evaluations of the alternative candidate liner system with regard to geotechnical considerations were performed, including stability, slippage, settlement and strength considerations for each liner system component.

The utilization of the surface composite liner system, comprised of a FML primary liner underlain by a clay secondary liner, will result in an average interface friction angle value ranging between 6 and 25 degrees, depending upon the type of FML used and the clay liner's soil properties [Ref. 4, 10]. If a geotextile is utilized above the FML to increase its puncture resistance from the ore, an average FML/geotextile interface friction value between 7.3 and 11.3 degrees will result. Average friction values for the ore/FML interface would range from 26 to 29 degrees without the utilization of the geotextile. For the clay/geotextile layer interface, a friction value lying between 23 and 30 degrees may be expected. The geotextile-permeable material layer interface function value is estimated to range in excess of 25 degrees, depending on the angularity of the permeable materials.

The permeable material-geotextile interface along the surface of the bottom clay liner should result in interface friction angles in excess of 25 degrees, whereas, if the geotextile is not utilized, the interface angle of the permeable material and clay surface would be expected to be in excess of 25 degrees, as well. The interface friction angle between the geotextile (if utilized) and the bottom clay liner would be expected to range between 23 and 30 degrees. The interface friction angle between the bottom clay liner and the subgrade material will vary, depending on the composition of the subgrade.

Sliding or slippage of the liner system may occur as a result of overstressing the primary FML (including the seams) either during construction or pad operations. Sliding may also occur along the interface of the FML/clay composite liner if the interface friction angle between the two liners is relatively low. Creep of the primary liner may also contribute to sliding or slippage, particularly on steeper pads. If geotextiles are utilized to increase the puncture resistance of the FML and clay liners, then the potential for sliding should be investigated relative to the geotextile/FML interface and the geotextile/clay (bottom) liner interface. If the geotextiles are utilized, they could also be subject to the creep effects.

Differential settlement experienced by the liner system could result in overstressing of the FML's, clay subliners and geotextile layers, possibly resulting in tears or seam separations in the geosynthetics, or cracking of the clay subliners. Also, the leak detection piping system could be affected by differential settlement which could cause kinking, separation of the pipe joints, or unacceptable deflections along the length of the piping system (creating low points and locales of pressure flow).

An effectively designed solution collection and recovery system should be utilized above the composite primary liner to reduce the buildup of head over the liner system and to enhance the stability of the heap.

d) Distress Considerations (Alternative Candidate Liner System)

Evaluations of the alternative candidate liner system were made with regard to the system's potential to be distressed, including considerations such as component replication and the components' anticipated response(s) to such distress.

The proposed liner system is essentially a triple-lined system with a composite liner offering a relatively high degree of replication due to the use of the composite liner. In addition, the leak detection system layer offers a high degree of replication due to the combined use of the permeable drainage material and the leak detection and collection system piping system. The bottom clay liner provides adequate protection to the environment and has been reduced in thickness to 12-inches (from the OAR 340 triple-liner system's 36-inch thick bottom liner requirement) to reflect the greater protection factor provided by the surface composite liner. In addition, the bottom clay subliner should be well protected (by the 12-inch leak detection system layer) from potential puncture, indentation and cracking from surface impacts.

2.1.4.2 Operation, Maintenance and Repair Considerations (Alternative Candidate Liner System)

Both operation and maintenance of the alternative liner system should be relatively straight forward, provided appropriate QA/QC measures are observed during its operational (and post closure) life to minimize the potential for damage to the primary composite liner and leak detection systems. The operation, maintenance and repair considerations evaluated for this system are identical to those developed for the OAR 340 triple-liner system discussed in Section 2.1.2.2. It should be noted that the composite liner should provide excellent long term protection from damage through the closure/post-closure periods, due to the attached clay secondary liner's ability to reduce leakage from punctures occurring to the primary FML liner.

2.1.4.3 Construction Feasibility (Alternative Candidate Liner System)

The feasibility of constructing the alternative candidate liner system would be similar to that of the OAR 340 triple-liner system. An exception would be the potential for use of prefabricated composite liners, such as FML/bentonite composite liners [Ref. 15, 16, 17]. Prefabrication of composite liner components can enhance the resulting quality of a liner system's construction, due to its subjection to close factory tolerances and quality control measures during the manufacturing process. The other considerations for the feasibility evaluation are given in Section 2.1.2.3 of this document (as presented for the OAR 340 triple-liner system's construction feasibility).

2.2 Evaluation of the Liner Systems' Ability to Meet Commission Policy

2.2.1 Introduction

In order to address Question 2, (Will each of the various liner systems meet the stated EQC policy?), the technical reviews evaluated each of the three liner systems' ability to meet the Commission policy requirements, as discussed in the following subsections.

2.2.2 Proposed OAR 340 Triple-Liner System

As a result of the evaluation, it has been determined that the triple-liner system generally meets the stated Commission policy requirements. However, there are situations (discussed following) that could arise in which the system could potentially fall short of meeting these requirements.

The triple-liner system's primary liner is determined to be the weakest component of the system, due to the fact that it is situated directly above the permeable drainage material component of the leak detection system. Consequently, in the event of a primary liner defect, leakage would occur at a greater rate and most likely become progressively worse (as compared to a design configuration where the primary liner is situated directly over and in direct contact with, a layer of low permeability materials). Direct contact with an underlying low permeability layer has been shown to diminish the deterioration potential of such defects and the resulting rates of leakage. In addition, the use of geotextile or other cushioning materials to protect and increase the puncture resistance of both the surface and undersides of the primary liner may be necessary, particularly if the design puncture resistance of the FML is exceeded due to excessive loadings, or errant operations or accidents on the pad such as dropped tools, cigarette burns, etc. The surface of the secondary liner which is situated immediately below the leak detection layer, should in turn be provided with a geotextile protective or cushioning layer, to decrease the likelihood of puncture.

The leak detection and collection system may be subjected to clogging with fines during the occurrence of a leakage event. The flow of fines (with the leak) could emanate from the ore or permeable drainage materials utilized for the construction of the leak detection system. Clogging of the system could cause the permeability of the leak detection drainage materials to decrease to below the minimum (free draining) permeability value of 10^{-2} cm/sec. In addition, clogging of the perforations of the leak detection piping could occur, thereby affecting the system's effectiveness to collect the leakage from the permeable drainage materials. The piping system's ability to detect the prescribed leakage rate of 400 gpd/ac, within the prescribed 10-week time period, could be adversely affected. The utilization of filter materials and fabrics, graded filter criteria, and/or reduction in the percentage of fines present within the permeable drainage materials (as a material gradation requirement) would reduce the potential for such occurrences.

2.2.3 Proposed Double-Liner System

Evaluation of the technical review conducted for this double-liner system indicates that it would have difficulty meeting the stated Commission policy requirements. This determination results partly from the fact that the system is neither triple nor composite lined, in conjunction with a bottom soil/clay liner of 12-inches in thickness, (as opposed to the ODEQ proposed requirement of 36-inches). While the 12-inch bottom liner would prevent leakage from entering the environment for a period in excess of 5 years, that would be subject to the liner's and leak detection layer's sustainable integrity. As discussed, the bottom liner's integrity is susceptible to damage due to its direct contact with the overlying primary FML. In addition to these deficiencies, the system's leak detection system (proposed to be comprised of a geotextile layer) is questionable, due to the potential for a reduction in the system's transmissivity (which is due to the influence that the loading of ore will have on the compressive state of the geotextile) and the potential for intrusion of the surrounding materials, eventually clogging the system. Further, use of the geotextile material as a drainage medium directly on the surface of the 12-inch bottom clay liner could potentially contribute to erosion of the bottom liner. Due to the thinness of the geotextile material, and otherwise lack of a cushion between the clay bottom liner and primary liner, the bottom clay liner is also highly susceptible to ultimate damage from causes inflicting damage to the primary liner (such as indentations, punctures, or stress cracking).

2.2.4 Proposed Alternative Candidate Liner System

The alternative candidate liner system was evaluated with regard to meeting the requirements of the Commission policy. The double-lined composite system is comprised of a composite primary

FML and secondary clay liner. The secondary clay liner, situated directly below and in direct contact with the primary FML, has the ability to significantly reduce the rate of leakage through primary FML defects, in the event that damage (such as puncturing) occurs to the primary liner. Reduction in the leakage rate through the defect would be generally attributable to the composite liner's ability to close-up the defect when wetted by the leakage. Although the secondary liner may be susceptible to damage affecting the primary liner (due to its direct contact) it is still considered more effective to utilize a secondary liner in a composite liner configuration, as opposed to utilization of a primary FML directly over permeable materials, such as proposed for the OAR 340 triple-liner system [Ref. 7, 8, 9].

The leak detection system proposed for this alternative candidate liner system is the same as that proposed for the OAR 340 triple-liner system. As a result, the potential for clogging of this system should be evaluated, as discussed in Section 2.2.2. Where an engineered geodrain leak detection system is considered, similar evaluation should be conducted.

In the event that both the composite liner and leak detection components of the liner system failed, the 12-inch thick bottom clay liner would prevent leakage from entering the environment for a period indicated to be in excess of 5 years. This time period should permit sufficient time to mitigate and/or remediate any defects in the liner system. This travel time estimate assumes a maximum head buildup of 1-foot over the bottom clay liner; saturated flow conditions; and has been determined using Darcy's Law.

2.3 Level of Certainty Evaluation for the Liner Systems

2.3.1 Introduction

Level of certainty assessments (in order to address Question 3) were conducted for each of the three liner systems, with respect to the three categories evaluated in the technical review sections: 1) Performance Characteristics; 2) Operation, Maintenance and Repair Considerations; and, 3) Construction Feasibility Considerations.

For the evaluation, a level of certainty rating was performed for each liner system component based on a rating scale, defined as follows: 0-(Failure); 1-(Poor); 2- (Average); 3-(Above Average); and 4

(Excellent). Various weighting factor scenarios were considered for each of the three categories, including equal and varied weighting factor schemes for each liner system component. This was done to gain insight as to the degree of sensitivity associated with each liner system component for a particular category evaluation. The weighting factors applied to each scenario utilized a 3-point scale with a value of 3 representing three times more weight or importance (as compared to the weighted value of 1, representing the least important component weight).

The following weighting factor scenarios were established: 1) Equal weights to all liner system components, (i.e. all components considered equal); 2) incremental descending weights from the primary liner component to the bottom liner component, (i.e. uppermost components considered as most crucial); and 3) incremental ascending weights from the primary liner component to the bottom liner component (i.e. lowermost components considered as most crucial).

Discussion of the assigned level of certainty ratings for each component of the three liner systems is presented in the following subsections for each of the three categories evaluated. Assigned level of certainty was multiplied by the weight factor for the component, resulting in a weighted average category score. Weighted average category scores were summed to attain a "total weighted score", which provides the relative level of certainty for the liner system. The greater the total weighted score, the greater the level of certainty (of achieving stated Commission policy) for the liner system.

Results of the analyses (Tables 2-2 through 2-4) indicate consistently higher categorical and total levels of certainty for the OAR 340 Triple-Liner and the Alternative Candidate Liner Systems, irrespective of the weighting scenario.

2.3.2 Proposed OAR 340 Triple-Liner System

a) Performance Characteristics Rankings

The primary liner was assigned a rating value of 2, since the liner was considered to be representative of only an average synthetic liner system based on its potential for puncture (resulting from the underlying permeable drainage material).

TABLE 2-2
Level of Certainty Evaluation (Equal Weighting)

LINER SYSTEM COMPONENT	RULE 340 TRIPLE-LINER SYSTEM	PROPOSED DOUBLE-LINER SYSTEM	ALTERNATIVE CANDIDATE LINER SYSTEM	WEIGHT FACTORS
OPERATIONS/MAINTENANCE/REPAIRS CHARACTERISTICS				
Primary Liner	2.00	3.00	4.00	1.00
Leachate Detection and Collection System	4.00	1.00	4.00	1.00
Secondary Liner System	4.00	1.00	2.00	1.00
Category Weighted Score	10.00	5.00	10.00	
PERFORMANCE CHARACTERISTICS				
Primary Liner	2.00	3.00	4.00	1.00
Leachate Detection and Collection System	4.00	1.00	4.00	1.00
Secondary Liner System	4.00	2.00	2.00	1.00
Category Weighted Score	10.00	6.00	10.00	
FEASIBILITY OF CONSTRUCTION				
Primary Liner	2.00	3.00	3.00	1.00
Leachate Detection and Collection System	3.00	2.00	3.00	1.00
Secondary Liner System	3.00	3.00	3.00	1.00
Category Weighted Score	8.00	8.00	9.00	
Total Weighted Score	28.00	19.00	29.00	

TABLE 2-3
Level of Certainty Evaluation (Incremental Descending Weighting)
(e.g. Greater Emphasis on Upper System Components)

LINER SYSTEM COMPONENT	RULE 340 TRIPLE-LINER SYSTEM	PROPOSED DOUBLE-LINER SYSTEM	ALTERNATIVE CANDIDATE LINER SYSTEM	WEIGHT FACTORS
OPERATIONS/MAINTENANCE/REPAIRS CHARACTERISTICS				
Primary Liner	2.00	3.00	4.00	3.00
Leachate Detection and Collection System	4.00	1.00	4.00	2.00
Secondary Liner System	4.00	1.00	2.00	1.00
Category Weighted Score	18.00	12.00	22.00	
PERFORMANCE CHARACTERISTICS				
Primary Liner	2.00	3.00	4.00	3.00
Leachate Detection and Collection System	4.00	1.00	4.00	2.00
Secondary Liner System	4.00	2.00	2.00	1.00
Category Weighted Score	18.00	13.00	22.00	
FEASIBLITY OF CONSTRUCTION				
Primary Liner	2.00	3.00	3.00	3.00
Leachate Detection and Collection System	3.00	2.00	3.00	2.00
Secondary Liner System	3.00	3.00	3.00	1.00
Category Weighted Score	15.00	16.00	18.00	
Total Weighted Score	51.00	41.00	62.00	

TABLE 2-4
Level of Certainty Evaluation (Incremental Ascending Weighting)
(e.g., Greater Emphasis on Lower System Components)

LINER SYSTEM COMPONENT	RULE 340 TRIPLE-LINER SYSTEM	PROPOSED DOUBLE-LINER SYSTEM	ALTERNATIVE CANDIDATE LINER SYSTEM	WEIGHT FACTORS
OPERATIONS/MAINTENANCE/REPAIRS CHARACTERISTICS				
Primary Liner	2.00	3.00	4.00	1.00
Leachate Detection and Collection System	4.00	1.00	4.00	2.00
Secondary Liner System	4.00	1.00	2.00	3.00
Category Weighted Score	22.00	8.00	18.00	
PERFORMANCE CHARACTERISTICS				
Primary Liner	2.00	3.00	4.00	1.00
Leachate Detection and Collection System	4.00	1.00	4.00	2.00
Secondary Liner System	4.00	2.00	2.00	3.00
Category Weighted Score	22.00	11.00	18.00	
FEASIBILITY OF CONSTRUCTION				
Primary Liner	2.00	3.00	3.00	1.00
Leachate Detection and Collection System	3.00	2.00	3.00	2.00
Secondary Liner System	3.00	3.00	3.00	3.00
Category Weighted Score	17.00	16.00	18.00	
Total Weighted Score	61.00	35.00	54.00	

The leachate collection system was assigned a value of 4, due to its material makeup and replication (and particularly due to the provision of the leak detection piping system). The secondary FML and clay bottom liners were assigned a value of 4, due to the composite nature of the secondary liner component and the 36-inch thickness of the clay liner.

b) Operation, Maintenance, and Repair Rankings

The primary liner was assigned a value of 2, due to the fact that it would require somewhat cautious operations, and would require maintenance and repair procedures on an average frequency, primarily due to the liner being situated directly on top of the permeable drainage leak detection material. The leak detection system was assigned a value of 4 due to its relative ease in being operated, maintained and repaired (in the event of a leak), as compared to other types of leak detection systems. The secondary/bottom liner system was rated a value of 4, due to its thickness, composite liner nature, and the fact that it is well-cushioned (by the permeable leak detection drainage material) from potential primary liner damaging influences.

c) Construction Feasibility Rankings

A value of 2 was assigned to the primary liner due to its geosynthetic nature, and since its feasibility of being constructed in a quality manner would be only average, due to its installation directly over the leak detection permeable drainage material. A value of 3 was assigned to the leak detection and collection system layer, since its feasibility of being constructed in a quality manner would be expected to be above average. The secondary liner/bottom liner system was assigned a value of 3 since its feasibility of being constructed in a quality manner would generally be expected to be above average.

2.3.3 Proposed Double-Liner System

a) Performance Characteristics Rankings

A value of 3 was assigned to the primary liner since the utilization of a geotextile layer (in lieu of the permeable drainage material below the liner) would give the primary liner above-average performance characteristics. A value of 1 was assigned to the geotextile leak detection and collection system, due to its anticipated below-average performance and lack of recommendations in the literature for its use as a drainage medium under high loadings. A value of 2 was assigned to the secondary liner system, due to its 12-inch thickness and anticipated average performance.

b) Operation, Maintenance and Repair Rankings

A value of 3 was assigned to the primary liner since its operation, maintenance and repair suitability should be somewhat above average, due the presence of the underlying geotextile material and absence of underlying permeable drainage materials. A value of 1 was assigned to the geotextile leak detection and collection system, since its thinness will severely limit procedures which can be performed with regard to system operation, maintenance and repair after a leak occurrence. A value of 1 was assigned to the secondary/bottom liner system since it would be highly susceptible to damage from operations occurring on the primary liner (and due to the lack of sufficient cushioning between the primary liner and the bottom liner).

c) Construction Feasibility Rankings

A value of 3 was assigned to the primary liner, due to the presence of a geotextile layer below the primary liner and its positive effects on the installation quality of the primary liner. A value of 2 was assigned to the geotextile leak detection system, since the material will require numerous seams and will be situated directly on top of the clay bottom liner (which will make the feasibility of its installation only average). A value of 3 was assigned to the bottom liner's construction feasibility, due to the above-average expectation that it can be constructed in a quality manner, and with earthen materials.

2.3.4 *Alternative Candidate Liner System*

a) Performance Characteristics Rankings

A value of 4 was assigned to the primary liner due to the fact it is a composite liner, and is anticipated to perform very well. A value of 4 was assigned to the leak detection system due to its material makeup and replication (by virtue of the provision of the leak detection and collection piping system). The secondary/bottom liner system was assigned a value of 2 due to its 12-inch thickness and anticipated average performance.

b) Operation, Maintenance and Repair Rankings

A value of 4 was assigned to the primary liner system due its composite liner components; its expected reduction in damage to the liner from operations; and, its expected reduction in frequency of maintenance and repair operations. The leak detection system was assigned a value of 4 due its ability to be operated, repaired and maintained relatively easily, and particularly due to the use of the leak detection piping system. The secondary/bottom liner was assigned a value of 2, primarily due to the fact that it is relatively well cushioned from the potential damaging effects of pad operations (by the leak detection system layer) but has a 12-inch thickness.

c) Construction Feasibility Rankings

The primary liner was assigned an above average value of 3 due to its composite nature. The leak detection system was also assigned a value of 3 due to the relative ease associated with its construction. The secondary/bottom liner system was assigned a value of 3 due to its above average feasibility of being constructed in a quality manner.

2.4 Evaluations of Other Liner Systems

2.4.1 Introduction

To evaluate features of the previously discussed proposed liner systems, and to select an alternative candidate liner system for further evaluation, TRC reviewed a number of alternative liner systems (in order to address Question 4) and evaluated each with regard to its general ability to meet stated Commission policy requirements. Various liner systems were reviewed in the literature, including product information provided by manufacturers of geosynthetic materials. In addition, a review of liner systems as required by various state regulatory agencies was performed.

2.4.2 Alternative Liner Systems

As a result of the literature and product information review, it was determined that numerous liner system configurations are utilized throughout the U.S. and other parts of the world. Essentially, for the purposes of this report, the liner systems have been classified (according to their components) as being comprised of 1) earthen materials with little or no use of geosynthetic materials, 2) geosynthetic liner systems with little or no use of earthen materials and 3) combinations of the above liner systems (which includes composite liner systems). Discussions of these three types of liner systems are given in the following paragraphs.

a) Earthen Liner Systems

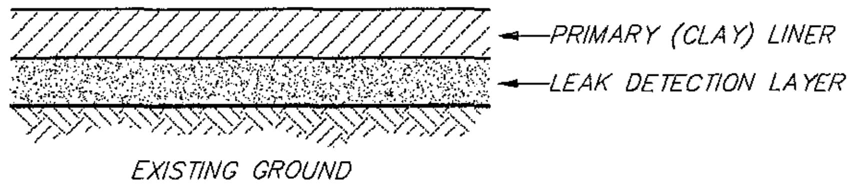
Earthen liners are comprised of compacted, low permeability natural soil materials and are used as either single or multiple liner systems. When multiple earthen liners are used, they are generally separated by a leak detection system consisting of permeable drainage materials (which often include leak detection piping systems). The leak detection piping system generally consists of perforated PVC or corrugated piping. The use of earthen liner systems, solely, is becoming less common [Ref 6], since their permeability is far in excess of the lower permeability that may be obtained with the use of synthetic liners. However, because of their greater thickness as compared to synthetic liners, their use permits longer breakthrough times in the event of a leak, which can be advantageous due to the increase in the time available to mitigate leakage to the environment. However, a major drawback is that by the time a leak may be detected, the defect in the system may be very dated. Synthetic liner systems, on the other hand, due to their extreme thinness and extremely short breakthrough times, will permit a leak to be detected much faster. Some typical earthen liner systems are illustrated in Figure 2-3.

b) Geosynthetic Liner Systems

Geosynthetic liner systems are comprised of synthetic liner components, such as flexible membrane liners, utilized in single liner or multiple liner systems, and are typically separated by a layer of synthetic drainage materials such as geonets or geodrains. Due to their polymeric or plastic nature, the liners possess very low permeability values. However, due to their thinness, leakage (through the synthetic liner, in the event a defect occurs) will have a very short breakthrough time, generally permitting immediate detection. In addition, the geosynthetic liner systems, when used by themselves, are relatively weak materials and must be engineered with extreme care (Figures 2-4 and 2-5) and often must be reinforced with geotextiles or geogrids, and when indicated, properly anchored to avert sliding. The use of geosynthetic liner systems, without the additional use of earthen materials, is often limited to pond liner applications due to the reduced and equal-all-around fluid pressures acting upon the liner. Potential for sliding and slippage is essentially due to the low interface friction angle that usually results between the synthetic materials. Typical geosynthetic liner systems are illustrated in Figure 2-6.

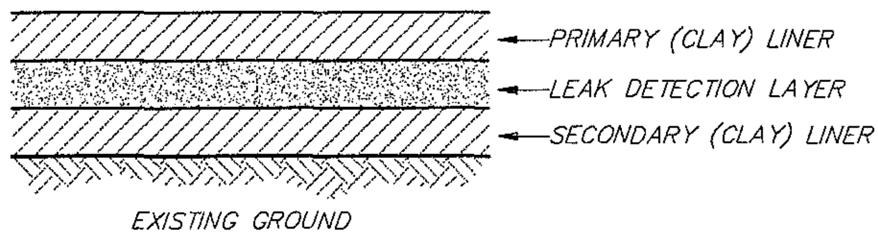
c) Composite Geosynthetic and Earthen Liner Systems

Over the past decade, various combination liner systems have been developed which utilize multiple components comprised of both earthen and geosynthetic materials. Essentially, the utilization of combinations of the two materials, as in a liner system, takes advantage of the low permeability of the geosynthetic materials and the strength and increased breakthrough time of the thicker, earthen material components. The



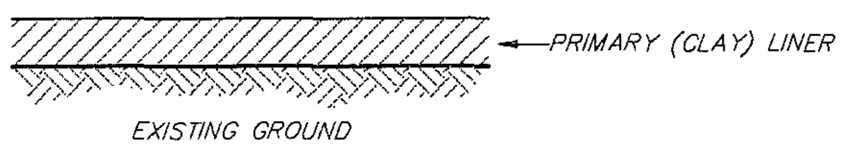
SINGLE LINER WITH LEAK DETECTION SYSTEM

(NOT TO SCALE)



DOUBLE LINER WITH LEAK DETECTION SYSTEM

(NOT TO SCALE)



SINGLE LINER WITHOUT LEAK DETECTION SYSTEM

(NOT TO SCALE)

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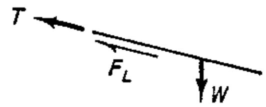
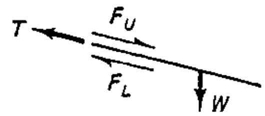
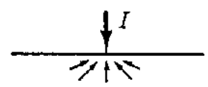
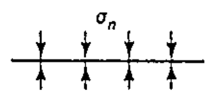
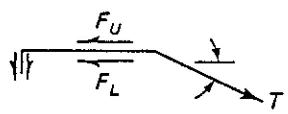
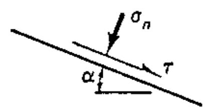
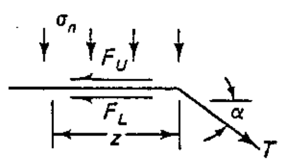
TYPICAL EARTHEN LINER SYSTEMS	**FIGURE** 2-3

[Ref 6] VARIOUS DESIGN MODELS FOR GEOMEMBRANES IN WASTE DISPOSAL SITUATIONS (REF: KOERNER AND RICHARDSON, 48)

Problem	Liner stress	Free body diagram	Required properties: Geomembrane	Required properties: Landfill	Typical factor of safety
1. liner self weight	tensile		$G, t, \sigma_{allow}, \delta_L$	β, H	10 to 100
2. weight of filling	tensile		$t, \sigma_{allow}, \delta_U, \delta_L$	β, h, γ, H	0.5 to 10
3. impact during construction	impact		I	d, w	0.1 to 5
4. weight of landfill	compression		σ_{allow}	γ, H	10 to 50
5. puncture	puncture		σ_p	γ, H, P, A_p	0.5 to 10
6. anchorage	tensile		$t, \sigma_{allow}, \delta_U, \delta_L$	β, γ, ϕ	0.7 to 5
7. settlement of landfill	shear		τ, δ_U	β, γ, H	10 to 100
8. subsidence under landfill	tensile		$t, \sigma_{allow}, \delta_U, \delta_L, \chi$	α, γ, H	0.3 to 10

Notes:

Geomembrane properties

- G = specific gravity
- t = thickness
- σ_{allow} = allowable stress (yield or break)
- τ = shear stress
- I = impact energy
- σ_p = puncture stress
- δ_U = friction with material above
- δ_L = friction with material below
- χ = mobilization distance

Landfill properties

- β = slope angle
- H = height
- γ = unit weight
- h = lift height
- α = subsidence angle
- ϕ = friction angle
- d = drop height
- W = weight
- p = puncture force
- A_p = puncture area

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ENGINEERING ANALYSIS of GEOSYNTHETICS

FIGURE 2-4

[Ref 6] VARIOUS DESIGN CONSIDERATIONS FOR DRAINAGE GEOCOMPOSITES (USUALLY GEONETS) IN WASTE DISPOSAL SITUATIONS [48]

	Problem	Reason	Approach	Required Properties: Geosynthetic	Required Properties: Landfill	Status of Problem
1.	strength of core	avoid crushing of core	$FS = \sigma_{ult}/\sigma_{max}$	σ_{ult}	γ, H	designable
2.	flow in core	first approximation	$FS = q_{allow}/q_{act}$	q_{allow}	γ, H, i, q_{act}	designable
3.	creep of core	first reduction	$FS = q'_{allow}/q_{act}$	q'_{allow}	γ, H, q_{act}	variable
4. (a)	elastic intrusion of geomembrane	second reduction	elastic plate theory	E, μ, x, y	γ, H, q_{act}	designable
(b)	elastic intrusion of geotextile	second reduction	elastic plate theory	E, μ, x, y	γ, H, q_{act}	designable
5. (a)	creep intrusion of geomembrane	third reduction	creep theory	$\dot{\varepsilon}(\sigma, t), x, y$	γ, H, t	unknown
(b)	creep intrusion of geotextile	third reduction	creep theory	$\dot{\varepsilon}(\sigma, t), x, y$	γ, H, t	unknown

Notes:

- Geocomposite properties
  - σ_{ult} = ultimate compression strength
  - q_{allow} = allowable flow rate
  - t = time
  - E = modulus of elasticity
  - μ = Poisson's ratio
  - x,y = core dimensions
  - $\dot{\varepsilon}(\sigma,t)$ = strain rate
- Landfill properties
  - γ = unit weight
  - H = height
  - i = hydraulic gradient
  - q_{act} = actual (design) flow rate
  - t = time
  - σ_{max} = maximum stress
  - σ = applied stress

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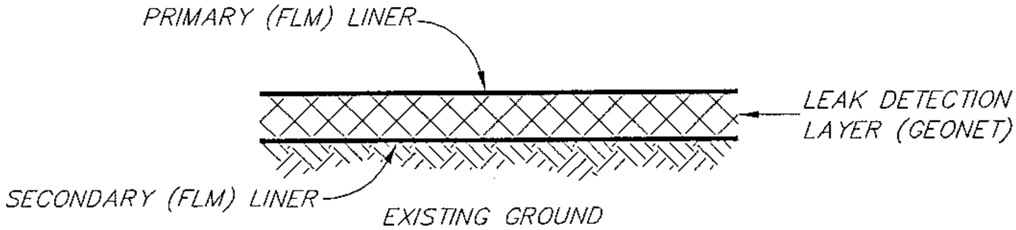
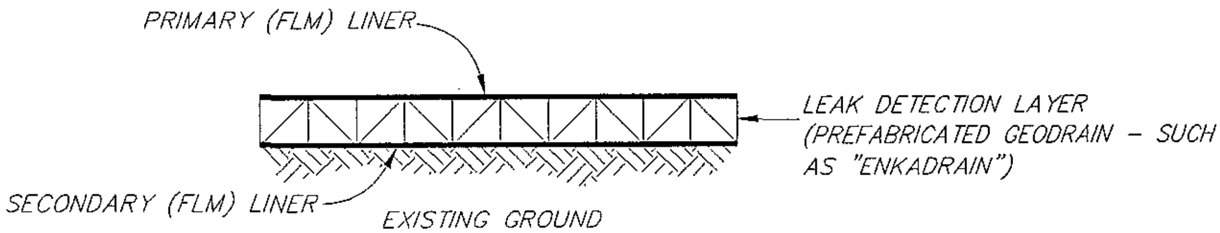
DESIGN CONSIDERATIONS

FIGURE 2-5



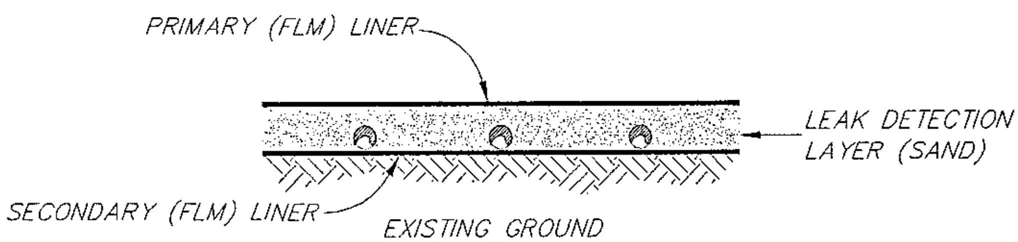
DOUBLE SYNTHETIC LINER WITH GEONET LEAK DETECTION SYSTEM

(NOT TO SCALE)



DOUBLE SYNTHETIC LINER WITH PREFABRICATED GEODRAIN LEAK DETECTION SYSTEM

(NOT TO SCALE)



DOUBLE SYNTHETIC LINER WITH SAND DRAIN LEAK DETECTION SYSTEM

(NOT TO SCALE)

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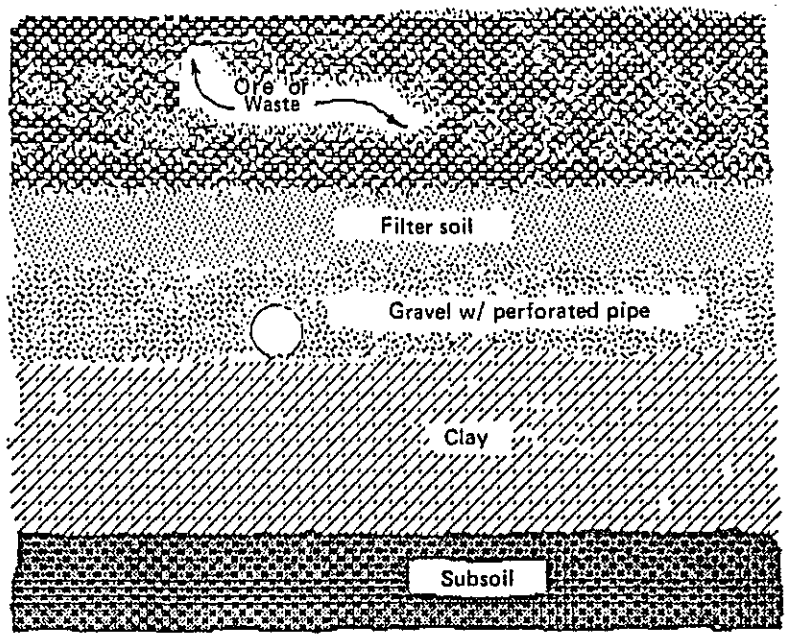
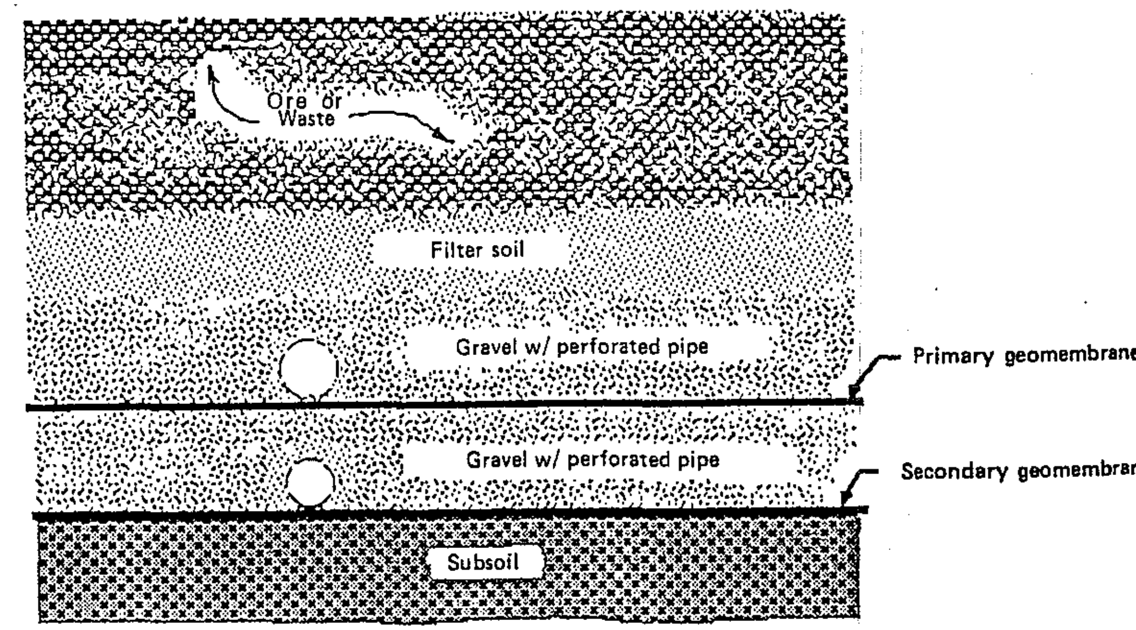
TYPICAL GEOSYNTHETIC LINER SYSTEMS

FIGURE 2-6

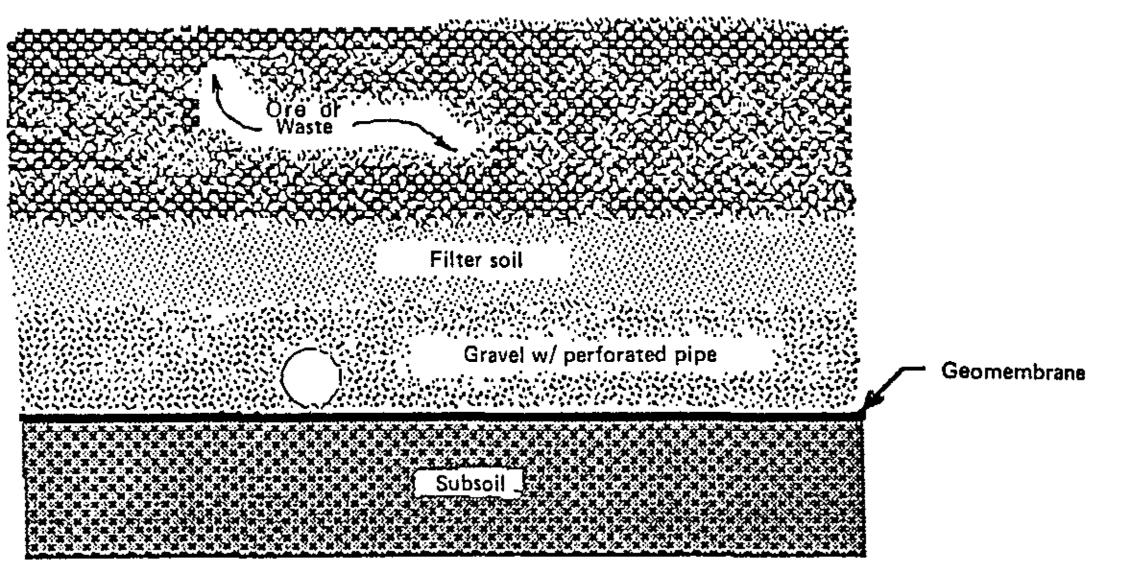
evolution of the combination liner systems over the years is illustrated in Figure 2-7 [Ref. 6]. It may be observed from these illustrations that synthetic materials were initially utilized as impermeable liner barriers in combination with conventional earthen liner systems. Since their initial use, however, the use of geosynthetic materials has evolved to include their use not only as liners, but as drainage layers (geonets), filters and protection layers (geotextiles), and for soil strengthening purposes (geogrids). In recent years, numerous variants of these basic geosynthetic components have evolved, including geodrains, composite liners and prefabricated composite liners [Ref. 18]. The utilization of composite liner systems has been proven to be effective in mitigating leakage from liner systems due to the close contact of the underlying clay subliner with the geosynthetic FML. It has been shown that leakage through a composite liner system is considerably less than the leakage resulting through an equivalent sized defect in an earthen (soil/clay) liner or a geosynthetic liner overlying permeable materials, for an equivalent head of leachate buildup over the defect [Ref. 7, 8]. It has been shown that, in general, the greatest amount of leakage will occur through the latter liner system (FML situated over permeable material). As a result, composite liner systems are generally recommended over other liner systems, with clay liners generally representing the second best alternative liner system. Geosynthetic liners used in conjunction with underlying permeable materials are considered the least desirable of all liner systems. Numerous types of geosynthetic drainage layers and leak detection systems have been developed over the years since the geotextile was primarily utilized for these functions. Geonets and other geodrain materials possessing greater cross sectional conveyance areas than geotextiles have been developed, including ENKADRAIN and others, for example [Ref. 18]. However, due to a lack of long term evidence related to their reliability, most waste facilities still utilize permeable natural materials such as aggregate and perforated leak detection piping systems for construction of the leak detection layer. In the future, as the long term reliability of synthetic drainage systems is proven, their utilization will most likely increase. This is partly due to the fact that the synthetic drainage systems possess a greater conveyance capacity as compared to permeable aggregate materials. As a result of this increased capacity, a reduction in leachate head buildup in the leak detection layer will result, minimizing the potential for seepage through the underlying liners. In addition, these systems should generally be less susceptible to clogging with fines, due to their areal extent and increased conveyance capacity, as compared to gravel drains, for example.



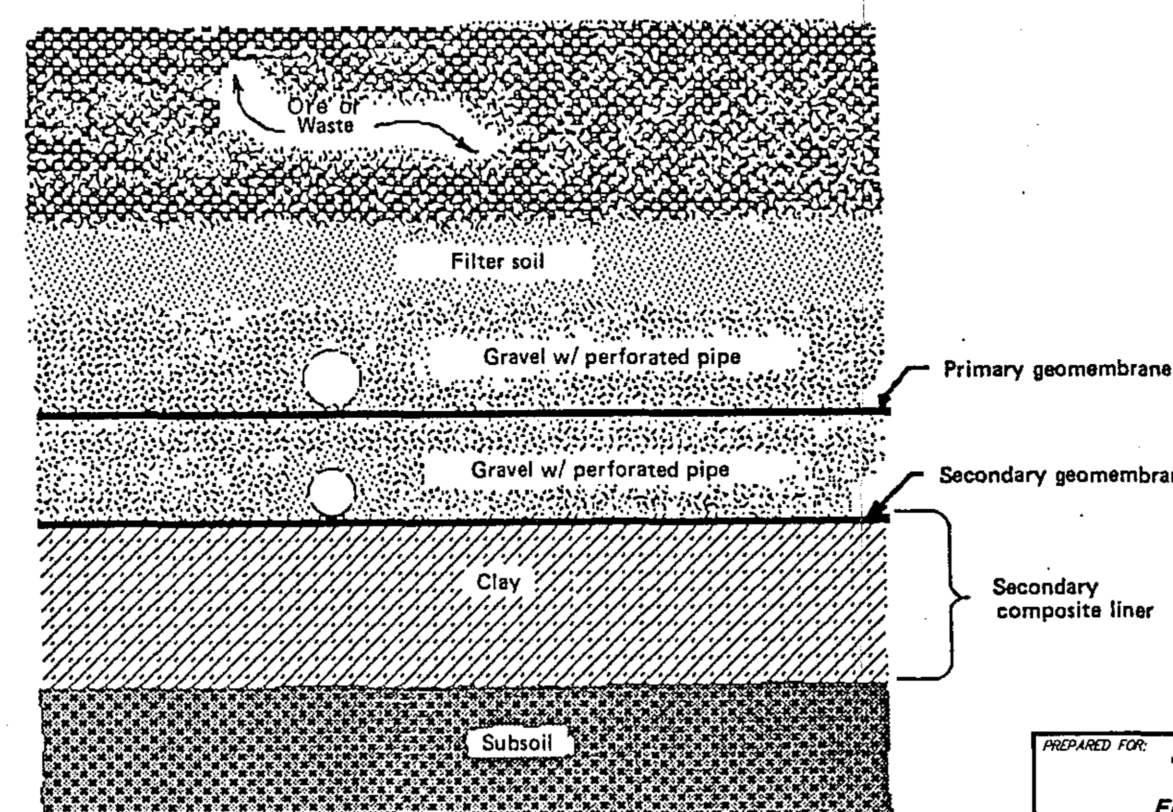
(a) Single clay liner



(c) Double geomembrane liner



(b) Single geomembrane liner



(d) Single geomembrane, single composite liner

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COMBINATION LINER SYSTEMS	FIGURE 2-7 (a)

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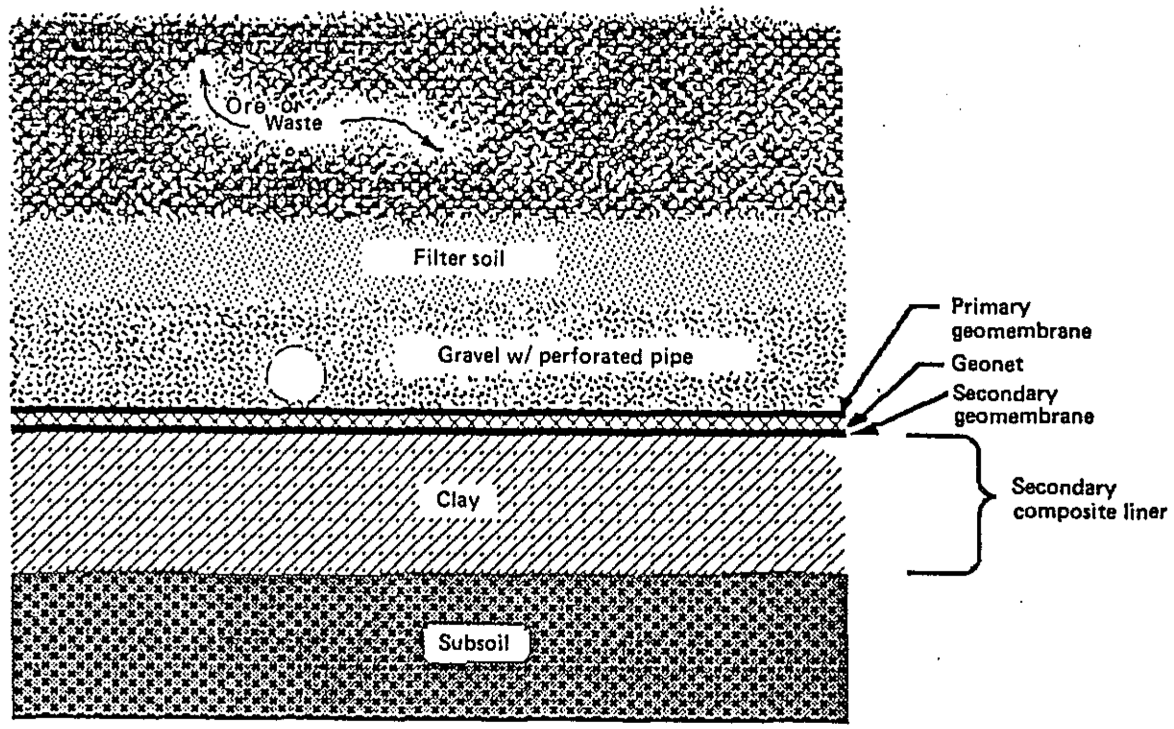
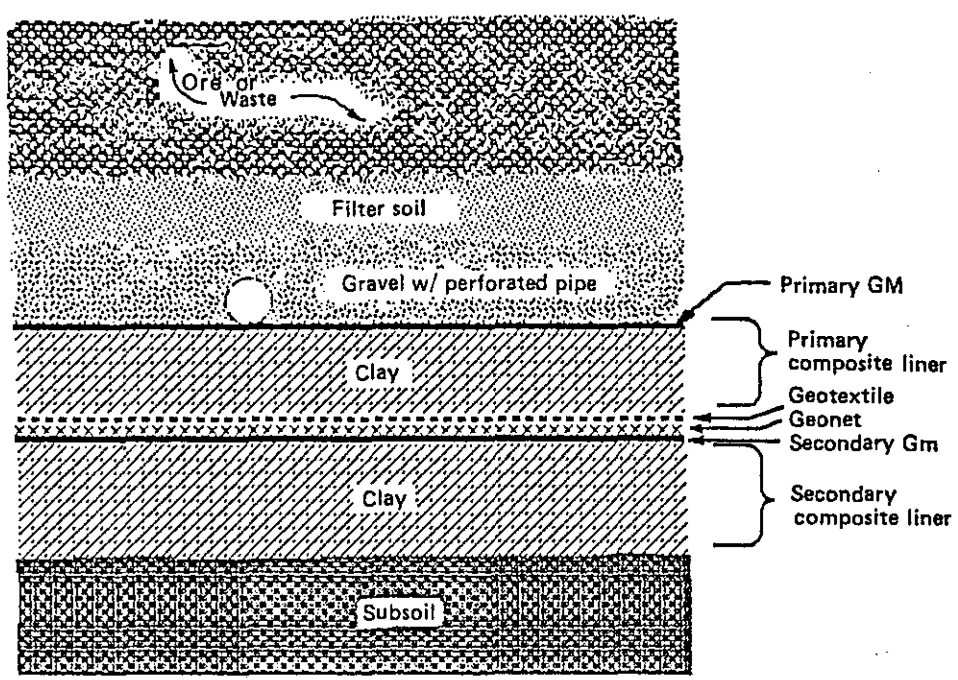
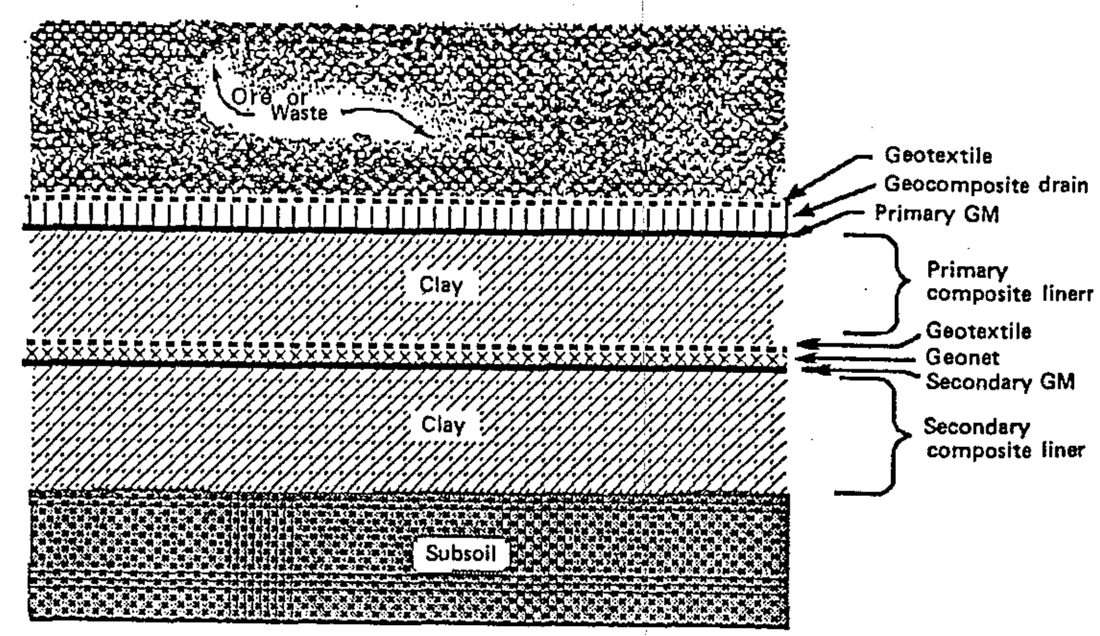


(e) Single geomembrane, single composite liner with geonet



(f) Double composite liner with geonet



(g) Double composite liner with geonet and geocomposite

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COMBINATION LINER SYSTEMS (Continued)

FIGURE 2-7 (b)

323561

2.4.3 Review of Other Jurisdictional Regulatory Requirements for Liner Systems

A multi-state review of current regulatory requirements for heap leach liner systems was conducted to identify the types of liner systems which are considered acceptable by other states and jurisdictions. A summary of these liner requirements is presented in Table 2-5.

As shown in Table 2-5, for the majority of the state regulations reviewed, a double-liner system with a leak detection system is commonly required. Only a few states require utilization of triple-lined systems or double-lined composite systems. For the majority of the state regulations reviewed, leak detection systems are commonly required to be constructed of permeable materials and require a leak detection piping system. A few states permit the use of geotextiles and/or geonets for the leak detection system. It is reported that the State of Nevada has experienced success with operations employing geotextile and geonet leak detection systems [Ref 23].

Due to the wide range of liner system components, and the number of variables inherent in the design of any system, it is not possible to provide a quantitative assessment of breakthrough times associated with each state's requirements. However, TRC has compiled Table 2-6, providing a demonstration of the relationship between various liner system design variables. For additional comparative information, TRC notes that the New York State Department of Environmental Conservation has approved the prefabricated FML/bentonite composite liner as an equivalent substitution for the upper 6-inches of an 18-inch thick primary soil liner in sanitary landfill application [Ref 48].

2.4.4 Liner Systems Capable of Meeting Commission Policy

Based on the review of the literature, product information and the regulatory guidelines or requirements of other states and jurisdictions, several alternative liner system configurations were identified as being capable of meeting the Commission's Policy requirements, as depicted in Figure 2-8. It should be noted however, that any one particular liner system may not be appropriate at all facilities and/or sites, due to various site specific physical and engineering constraints. As a result, a liner system should be selected based on numerous design considerations particular to the site, including loading projections, geotechnical and construction considerations, as well as operation and maintenance considerations. For some loading scenarios, for example, the utilization of geonets may be acceptable

TABLE 2-5
Summary of Heap Leach Pad Liner Regulations for Other States

ARIZONA

Heap leach pads are required to be constructed over a double-lined system in which one of the liners must be a synthetic liner. A leak detection and recovery system is required between the two liners. Synthetic liners shall posses a minimum 30 mil thickness. Soil liners shall have a minimum thickness of 12 inches and a maximum permeability of 10^{-6} cm/sec.

CALIFORNIA

Heap leach pads are required to be constructed over a double-lined system, comprised of a 12 inch thick primary clay liner and either a 12 inch thick clay bottom liner or 60 mil synthetic bottom liner. Clay liners shall have a maximum permeability of 10^{-6} cm/sec. The two liners are to be separated by a 12 inch thick layer of gravel containing a leak detection and recovery piping system.

COLORADO

Heap leach pads are required to be constructed over a double-lined system consisting of a synthetic primary liner and either a 12-inch thick clay bottom liner or synthetic bottom liner. Synthetic liners shall possess a minimum thickness of 40 mils. Clay liners shall have a maximum permeability of 10^{-6} cm/sec. The primary and bottom liners are separated by a 12 inch thick layer of sand, preferably, and shall possess a minimum permeability of 10^{-2} cm/sec for use as a leak detection system. The use of geonet synthetic materials is permitted for use as leak detection and recovery system if sands are not available or slopes are steep. For reusable heap pads, the primary liner consists of an asphalt layer constructed over the 12 inch thick, sand leak detection system layer. The bottom liner is comprised of a 12 inch layer of clay, soil liner, with a maximum permeability of 10^{-6} cm/sec. A composite liner system, comprised of a synthetic liner over a 12 inch thick clay layer or a clay amended soil layer, without the requirement of the leak detection system, may be used in lieu of the above liner systems, with the exception of the reusable asphalt pad facility.

IDAHO

Heap leach pads are required to be constructed over a single-lined system. The single liner must possess a maximum permeability of 10^{-6} cm/sec and may consist of either a synthetic or earthen liner. A leak detection system is not required specifically as per the liner regulations, but may be required as part of the water quality monitoring regulations.

NEVADA

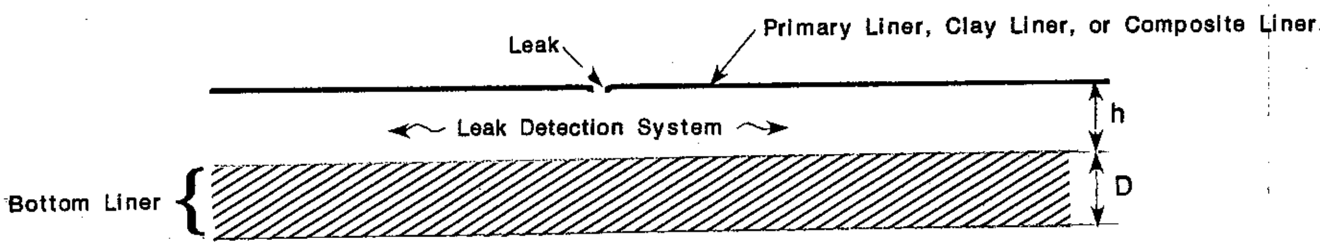
Heap leach pads are required to be constructed over a double-lined system. The primary liner must possess a maximum permeability of 10^{-7} cm/sec and may consist of either a 1 foot thick layer of clay liner or a synthetic liner. The bottom liner's specifications are dependent on whether or not a leak detection system, which is optional, is utilized in the system. If a leak detection system is utilized, then the secondary liner may be comprised of a 1 foot layer of soil liner materials possessing a maximum permeability of 10^{-5} cm/sec. If a leak detection system is not utilized, the bottom liner must be of the same thickness (1 foot) but possess a maximum permeability of 10^{-6} cm/sec. Synthetic leak detection systems such as geonets, for example, are permitted.

SOUTH DAKOTA

Heap leach pads are required to be constructed over a triple-lined system consisting of a minimum thickness, 60 mil synthetic primary liner situated over a gravel leak detection and recovery system. The gravel leak detection and recovery system is situated on top of a minimum thickness, 60 mil secondary synthetic liner. The secondary liner is situated directly on the bottom soil liner consisting of an 8 to 12 inch thick soil layer, constructed on compacted subgrade.

TABLE 2-6

Breakthrough Time Calculation for Saturated Flow Through Bottom Liner



Assume saturated flow through bottom liner:

$$Q = K\ i\ A \qquad (Darcy's\ Law\ will\ apply)$$

$$Q/A = v = K\ i\ (velocity)$$

$$v = K\ i \quad where\ i = gradient = \frac{h + D}{D} = K(\frac{h + D)}{D}$$

Now the breakthrough time is such that:

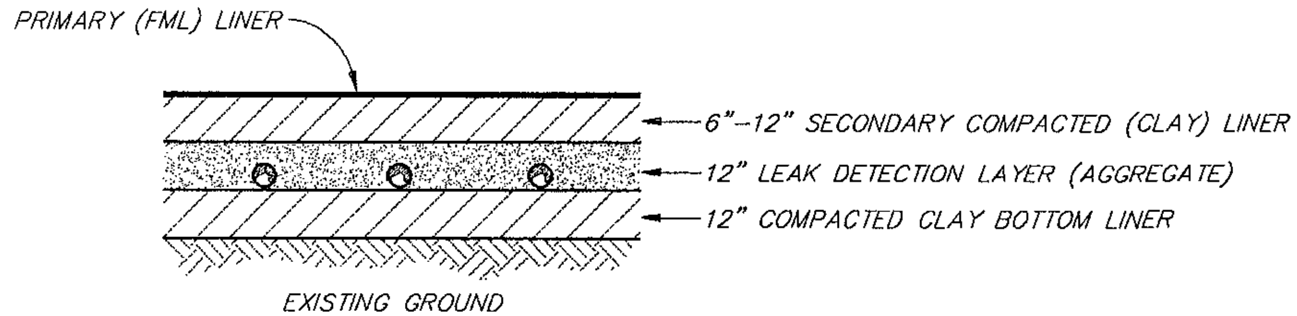
$$v\ t = D \qquad \text{(to traverse bottom liner)}$$

$$t = \frac{D}{v} = \frac{D}{K(\frac{h+D}{D})} = \frac{D^2}{K(h+D)} = \frac{D}{K(\frac{h}{D}+1)}$$

In general, it can be stated that the breakthrough time (for saturated flow through a bottom liner) is dependent on numerous variables, however, it can generally be interpreted in the following manner:

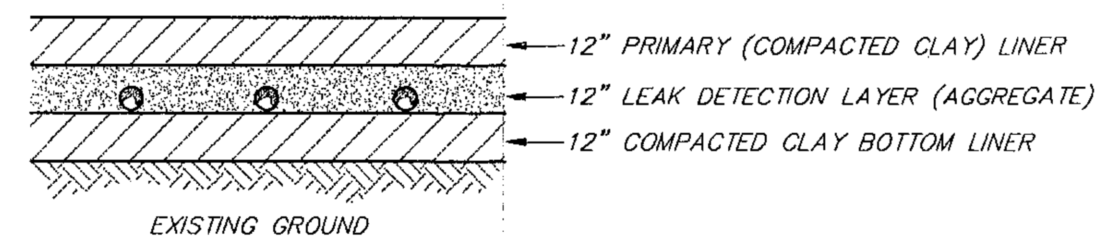
- For an increase in bottom liner thickness, there is a corresponding net increase in breakthrough time;
- For an increase in thickness (or capacity) of the leak detection and collection system, there is a corresponding net decrease in breakthrough time;
- For a decrease in hydraulic conductivity (of the liner), there is a corresponding net increase in breakthrough time.

From this it is implicit that there are a number of methods (which can be translated as design alternatives, as substantiated by the range of technical approaches discussed in Table 2-5) for achieving the design objective of prohibiting release to the environment. Many systems rely upon configurations that allow adequate response time to mitigate a leak; conversely, many systems rely upon configurations that minimize potential for a leak.



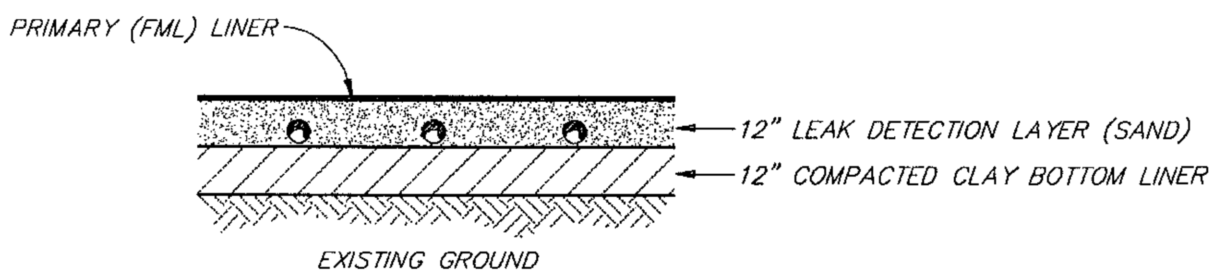
COMPOSITE/CLAY LINER SYSTEM

(NOT TO SCALE)



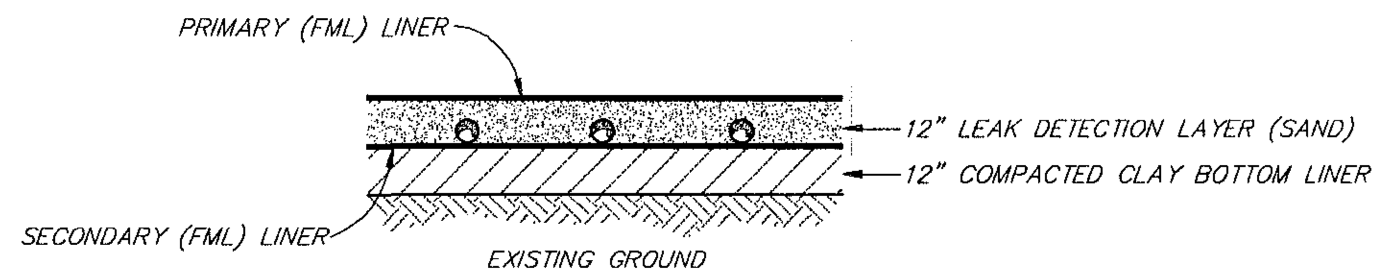
CLAY/CLAY LINER SYSTEM

(NOT TO SCALE)



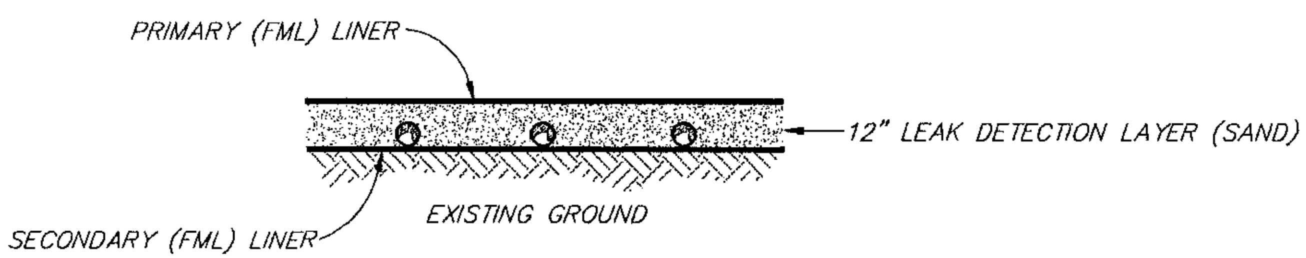
SYNTHETIC/CLAY LINER SYSTEM

(NOT TO SCALE)



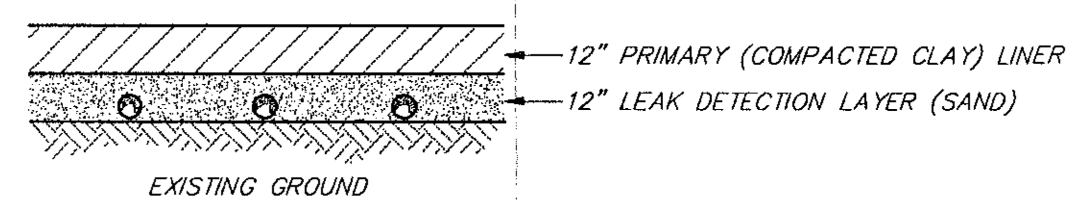
FML/COMPOSITE LINER SYSTEM

(NOT TO SCALE)



SYNTHETIC/SYNTHETIC LINER SYSTEM

(NOT TO SCALE)



CLAY/SYNTHETIC LINER SYSTEM

(NOT TO SCALE)

PREPARED FOR: **STATE OF OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY**

PREPARED BY: **TRC Environmental Consultants, Inc.**

LINER SYSTEMS POTENTIALLY CAPABLE OF MEETING EQC POLICY REQUIREMENTS

FIGURE 2-8

for use as a leak detection system, provided it can be shown that sufficient conveyance capacity will be available after the pad has been loaded and that the long term reliability of the material will be acceptable. In other cases it may be beneficial to limit the use of geosynthetic materials altogether, and utilize other materials such as earthen materials for liner construction, particularly at locations which are subjected to severe temperature fluctuations throughout the year.

Of the liner systems identified as being capable of meeting the requirements of the Commission policy, (as depicted in Figure 2-8), the liner system consisting of the composite surface liner and earthen material bottom liner was selected for further evaluation as the best "Alternative Candidate Liner System". The evaluation of this liner system has been discussed throughout the preceding sections of this report. However, this liner system should not be construed as representative of the only acceptable alternative liner system. It is imperative that each liner system be designed and selected on a site specific basis and possess the capabilities of meeting minimum prescribed performance requirements.

2.5 Estimated Liner Systems Costs

Estimated costs for the installation of each of the three liner systems (OAR 340 triple-liner system; proposed double-liner system; and alternative candidate liner system) were developed. It should be noted that these estimates are based on equivalent materials and do not include transportation costs of materials to a site (which may be substantial in certain instances and may warrant selection of an alternative system component with equivalent performance characteristics).

It should be noted that based on this cost comparison, the aggregate leak detection system material is clearly the most costly component on a per square yard basis. It may also be observed that use of geosynthetic drainage layers substantially reduces the cost of this component, with the "geotextile" drainage layer being the least expensive component, on a per square yard basis. It has been demonstrated in previous sections that utilization of geodrain leak detection systems can achieve the stated Commission policy at significant cost benefit.

As such, for comparative analysis, the alternative candidate liner system was also evaluated with respect to installation cost where (1) geodrain materials are used in lieu of aggregate drainage materials (Alternative 1); and, (2) a prefabricated composite FML/bentonite liner is used in lieu of 6-inches of compacted soil/clay in the composite upper liner (Alternative 2). The comparative cost estimates for the various liner configurations are presented in Table 2-7.

TABLE 2-7
Comparative Cost Estimates
Liner System Installation

Representative Material	*Cost/Unit*	*OAR 340 Triple Liner System*		*Proposed Double Liner System*		*Alternative Candidate Liner System*		*Alternative Option 1 (Geodrain)*		*Alternative Option 2 (HDPE/Bentonite)*	
		Units	*Ext'd*	*Units*	*Ext'd*	*Units*	*Ext'd*	*Units*	*Ext'd*	*Units*	*Ext'd*
40 mil HDPE	$31.5/sq yd	2	$6.30	1	$3.15	1	$3.15	1	$3.15	1	$3.15
10 oz. Geotextile	$1.75/sq yd	0	0	1	$1.75	0	0	0	0	0	0
6" perf. pipe	$5.50/linear foot	0.22	$1.21	0	0	0.22	$1.21	0.22	$1.21	0.22	$1.21
12" perf. PVC	$9.38/linear foot	0.02	$0.19	0.02	$0.19	0.02	$0.19	0.02	$0.19	0.02	$0.19
6" - 12" T-joint	$96.00 each	0.0028	$0.27	0	0	0.0028	$0.27	0.0028	$0.27	0.0028	$0.27
3/4" gravel	$30/ton	0.63	$18.90	0	0	0.63	$18.90	0	0	0.63	$18.90
Soil/Clay	$7.50/cubic yard	1	$7.50	0.333	$2.50	0.5	$3.75	0.5	$3.75	0.333	$2.50
HDPE w/ Bentonite	$4.95/sq yd	0	0	0	0	0	0	0	0	1	$4.95
Geodrain	$3.78/sq yd	0	0	0	0	0	0	1	$3.78	0	0
Total Cost	Square Yard	- -	$34.37	- -	$7.59	- -	$27.47	- -	$12.35	- -	$31.17

3.0 QUESTIONS ON TAILINGS TREATMENT TO REDUCE THE POTENTIAL FOR RELEASE OF TOXICS

Evaluation of Technical Issue 2 involves review of the technical basis and merit of proposed rules requiring cyanide detoxification and reuse for mill tailings generated as a result of chemical mining processes within the State of Oregon. These proposed rules deal with, in particular, the use and control of alkaline, cyanide solutions, including specific requirements set forth for removal and reuse. Cyanide removal and reuse requirements are then further coupled with detailed specifications for liners and engineered "hazardous waste" management unit cover systems to prevent migration of toxic chemical and/or metals species to the environment.

The proposed regulations would require the reduction of cyanide levels by recovery and reuse technologies through employment of physical and chemical means. Issue 2 requires a review of the proposed rule requiring tailings treatment through cyanide removal and reuse, to: ascertain technical feasibility; ascertain the probable degree of the material reduction of risk of environmental degradation that the rules may enforce; determine the level of reliability of the proposed technologies and systems; and, suggest possible alternatives, where appropriate.

The Commission has established as policy that ".. the toxicity (as measured by weak acid dissociable (WAD) cyanide content) and potential for long-term cyanide and toxic metals release from mill tailings should be reduced to the greatest degree practicable through tailings treatment." The proposed rules in OAR 340-43-070(1) state the following:

> "Mill tailings shall be treated by cyanide removal and reuse prior to disposal to reduce the amount of cyanide introduced into the tailings pond. Chemical oxidation shall be additionally used, if necessary, prior to disposal to reduce the WAD cyanide level in the liquid fraction of the tailings. The permittee shall conduct laboratory column tests on mill tailings to determine the lowest practicable concentration to which the WAD cyanide (weak acid dissociable cyanide as measured by ASTM Method D2036-82 C) can be reduced. In no event, shall the permitted WAD cyanide concentration in the liquid fraction of the tailings be greater than 30 ppm."

The rules do not require removal of potentially toxic metals from tailings prior to placement in the tailings pond. However, the rules do require measures to control acid formation in the tailings pond and specify that the tailings be covered with a suitable composite cover designed to prevent water and air infiltration.

With respect to stated Commission policy and the proposed rules regarding chemical mining, (specifically, the technical feasibility of recovering and reusing the cyanide extractant employed in the recovery of gold and silver from ores and minerals in the state of Oregon) the Commission specifically asks:

> "Do the requirements for removal and reuse of cyanide materially reduce the toxicity and long term potential for long-term cyanide and toxic metals release from mill tailings?

To answer this question, TRC has evaluated various process technologies specifically for technical potential, and to form a judgement of probable performance and demonstrated reliability in meeting the stated ODEQ intent. A summary of each technical review and evaluation is presented, including salient advantages and disadvantages. TRC then addresses specific issues of technical feasibility, toxicity reduction, reliability and level of certainty, and possible (viable) alternatives that may equally achieve the Commission policy.

The chemistry of cyanide is complex and many forms of cyanide can be present in mining solutions. TRC has elected not to provide an in depth review of cyanide chemistry due to the existence of extensive literature available [Ref 31, 32, 33, 34]. As appropriate, these literature sources are referenced throughout Section 3.0. TRC has attempted to summarize the major aspects, and to relate this material to the chemical mining rules as proposed by the State of Oregon. Discussion and supporting information is presented as part of the analysis for each aspect.

3.1 Technical Review and Evaluation

The cyanidation process for the extraction of gold has been in use for nearly one hundred years. The principal reasons for the widespread use of the process include: the simple concept; the ready availability of cyanide chemicals (which can be employed in relatively weak solutions) and, the strength and stability of the gold-cyanide complex. It is a well-established and efficient process, capable of extracting gold from otherwise very small concentrations, often with an efficiency of over 90% [Ref 30, 34]. Gold dissolves in a cyanide solution in the presence of oxygen. Typically, cyanide content, or concentration, is measured or quantified by the following designations:

- Free Cyanide: The term "free cyanide" refers to both cyanide (CN^- and hydrogen cyanide (HCN)) ions.

- Weak-Acid Dissociable Cyanide: Refers to metal cyanide complexes that may dissociate into free cyanide; also known as WAD.

- Total Cyanide: Reference to total cyanide will include all compounds that may be present in cyanidation solutions, including WAD and free cyanide, and those cyanide complexes that are not dissociated by weak acid [Ref 31].

In the absence of other metal cyanide complexes, as little as 100 ppm total cyanide (i.e. about 50 ppm free cyanide) can provide adequate gold dissolution rates. Silver is extracted in a similar manner but often requires stronger cyanide solutions and/or longer reaction times to achieve reasonable recovery efficiencies. Total cyanide solution concentrations for gold and silver extraction recovery typically range from 100 parts per million (ppm) to 2,000 ppm [Ref 32, 34].

Milling operations will generate a solid waste (tailing) that has little, if any, remaining economic mineral concentrations. The mill tailing materials typically contain only a minute fraction of the targeted economic mineral concentrations and are generally not intended to be reprocessed in the foreseeable future. Included in the mill tailing will be a certain percentage of process liquids (which may vary with technical processes employed) that remain from chemical processing operations. These liquids can be either "as received", or "diluted" (rinsed or treated to the extent necessary to meet specified end-point concentration limits such as the 30 ppm WAD standard stipulated in OAR 340-43-070(1)).

Operators must meet the specified concentration limit(s) through application of water (balance) management, in combination with treatment processes. One of the principal objectives of water management and tailings treatment is to develop the most economical process or combination of processes which will produce effluents compatible with, and protective of, the on-site environmental requirements, subsequent beneficial uses, and potentially impacted life forms associated with a receiving system. During the course of the mining operation the tailings wastewater characteristics can vary considerably due to changes in mineralization and ore geochemistry, the type(s) of metallurgical process(es) involved, the annual or daily precipitation, the size and type of mining and tailings (impoundment) disposal operations, and the concentrations of reagents required/utilized. The chosen process(es) must be reliable, yet flexible, to maintain a consistent quality of effluent throughout the life of the mine and, desirably through the closure and post closure periods.

The objectives of the design and planning of any recovery and reuse system should recognize the benefits associated with minimization of the volumes and flow rates of effluent streams. One practical approach toward achieving this is to treat the effluent stream and/or slurry waste as close to the point of origin and in as concentrated a form as possible, rather than attempting to manage a total flow of much greater volume and complexity during or after deposition.

Although similar metallurgical processes are employed over a wide range of mining operations, the resulting tailings wastewater characteristics vary widely; thus no single treatment approach is universally applicable. The selection of a treatment process or processes to achieve statutory or otherwise mandated effluent criteria is a site-specific exercise, and experience (as well as a high level of confidence) in the selected process is essential. Each treatment strategy, process, or combination of processes must also be evaluated for effectiveness in treating and removing residual solubilized metals.

3.1.1 Technical Feasibility of Removal and Reuse

TRC has interpreted the term "removal" to mean "physical isolation" from the liquid fraction of the tailings (in a form that may be reused). This is in contrast to "removal" by chemical alteration or destruction, which renders cyanide reuse as technically unachievable.

There are a limited number of physical and chemical techniques employed in the mining industry that can be considered as "removal and reuse" processes. Two of these methods (solid/liquid separation and acidification/volatization/reneutralization, respectively) have been determined as appropriate for achieving the stipulated "removal and reuse" requirement.

- PHYSICAL RECOVERY BY SOLID/LIQUID SEPARATION

Process solutions can be separated from mill tailings by thickening, clarifying or filtering the barren slurry (tailing) and returning the overflow (supernatant or filtrate liquors) directly to the milling process. The underflow (slurry or filter cake) will generally require additional treatment prior to discharge to the tailings impoundment. This additional treatment can include washing and/or chemical treatment to reduce the WAD cyanide content to specified levels. This process strategy technically conforms to the definition of "removal and reuse", and readily lends itself to follow-on treatment by "chemical oxidation" (or other means) as provided for in OAR 340-43-070(1).

There are a number of advantages realized through application of solid/liquid separation techniques. Solid/liquid separation reduces volume of solutions to be treated and stored. The physical recovery of process solutions may reduce the downstream treatment requirements and ease the management of the facility water balance. This may also allow the construction and management of a much smaller impoundment and storage facility. It also allows direct recovery of process solutions, which may reduce requirements for anti-scalants, alkalinity control and cyanide chemicals. It does not require pH adjustment for recovery. Therefore, HCN gases will not be produced, thereby improving plant safety. Added benefits include the flexibility gained through the fact that operations can be fully integrated into overall plant operations and equipment, materials and engineering expertise are readily available.

Also inherent in the process are a number of disadvantages, including that, under some site conditions, the process may be equipment and energy intensive and may require additional clarifying and filtration capacity to achieve adequate recoveries from process solutions. Also, high levels of flocculation chemicals may be required to achieve effective dewatering rates. In some instances, water balance conditions such as where there is a net inflow to the overall facility may complicate process strategies. Solid/liquid separation strategies do not directly remove WAD cyanide or heavy metals from the remaining, thickened slurries, so complexed metals cannot dissociate and precipitate. The process will generally require additional chemical treatment to achieve specified free and WAD cyanide levels. It is generally not a stand-alone process for cyanide recovery and reuse.

The solid/liquid separation process concept may be technically feasible when the slurries can be readily thickened or dewatered to yield sufficient additional process water to justify the recovery operations. However, the technical viability of this concept will require a site-specific examination of the process conditions and a determination of the physical and chemical process responses. These determinations can be made through carefully planned and executed test work. If, and when technically viable, the concept can provide the operator with considerable flexibility and be implemented with a high level of certainty.

This general concept is in practice at an operation in the Northwest and utilizes countercurrent washing and filtration in combination with what is known as the INCO SO_2 - O_2 process for cyanide destruction [Ref 35]. The concept is similar to the countercurrent decantation (CCD) processes already in use in gold mills and copper operations. It is likely that the underflow or filter cake, washed or unwashed, would require further treatment to meet the specified OAR 340-43-070(1) WAD standard and to reduce the potential for long-term cyanide and toxic metals release from the mill tailings.

The design and construction of such facilities is routine and there are several qualified companies in the United States that can provide turnkey services. These include, but should not be limited to, Fluor Daniel Wright; Bechtel; and, Davy McKee in California; Roberts and Schaefer in Salt Lake City; and Minproc, BEI, and United Engineers in Denver. There are numerous other smaller engineering houses that can provide capable design services. TRC notes that identification of the foregoing entities is intended solely to demonstrate availability of engineering and construction expertise, and in no way shall be construed as an endorsement of any specific technology or firm (entity).

Solid liquid separation equipment is readily available. The dewatering process would not require special materials of construction. Follow-on chemical treatment processes may require corrosion resistant materials, depending upon the selected treatment strategy.

- AVR PROCESSES (ACIDIFICATION/VOLATILIZATION/RENEUTRALIZATION)

Cyanide recovery by AVR chemical processing utilizes the volatility of hydrogen cyanide (HCN) (at a lowered pH) to strip free cyanide from solution or slurry and recover it in usable form. The original AVR processes were intended solely as a method of cyanide recovery from relatively clean barren solutions. Recent developments, however, have tended to focus upon the treatment of slurries [Ref 31, 36, 37].

AVR processes are affected by the concentrations of cyanide and the types of cyanide complexes that are present in the solutions. Performance is also dependent upon pH control, temperature, and slurry viscosity. The process requires high volumes of air to quickly and efficiently remove HCN from solution. Performance is also dependent upon proper equipment selection and design configurations. Designs must incorporate a means of controlling scaling and build-up of precipitated solids.

The AVR process is conducted in three stages. The first is known as acidification. This involves the lowering of process solution pH to below 8.5 with the use of concentrated mineral acid, typically sulfuric acid. Generally, a near neutral or slightly acidic solution is employed. The acidification step must be carried out in an enclosed environment to prevent escape of HCN gas. From the acidification stage, the acidified solution or slurry containing HCN is sent to the cyanide stripping or volatilization stage, which is usually conducted in packed towers. The volatilization system is sealed to prevent escape of HCN laden air and to allow efficient recovery of cyanide. HCN laden air is then withdrawn from the stripping tower and is reabsorbed into a caustic solution in a separate packed tower scrubber. The solution is recirculated within the scrubber until a specified concentration of cyanide is achieved, and is then returned to the process for reuse. Once the barren slurry or solution is free of recoverable cyanide, it is reneutralized. The pH is adjusted (for alkalinity) to precipitate the residual metals and to add buffering capacity to released solids. With the cyanide removed, the soluble metals are generally precipitated from solution as stable carbonates and hydroxides.

The advantages of the AVR process include the fact that, under favorable site conditions, the concentration of WAD cyanide in the barren or tailings impoundment water can be reduced below 30 ppm. Also, heavy metals and metal-cyanide complexes may be precipitated from solutions since the cyanide available for complexing has been removed. Also attractive is the fact that the process is applicable to barren leach solutions as well as tailings slurries, and the required reagents are readily available.

Conversely, a number of disadvantages are also associated with the AVR process, including the fact that the resulting HCN vapor is hazardous (requiring appropriate safety measures to be implemented and enforced); and additional treatment may be required to meet stringent effluent standards if there are higher levels of the more strongly bonded cyanide complexes. Higher initial levels of complexed cyanide may require adjustment of the pH to lower levels, and additional holding times to carry out the formation and removal of volatile HCN. If the cyanide solution is not re-used on-site, and reuse is mandated, transportation to another off-site user presents additional possible risk to the environment.

AVR technology is reasonably well defined, particularly for situations where it is applied to barren solutions. However, the necessary design conditions will be site specific and will depend on a thorough characterization of the anticipated quantities and qualities of process solutions. There are presently two commercial operations now using the patented CYANISORB (patent held by Cyprus Minerals Corp.) process in slurry treatment applications [Ref 36]. The first application at Cyprus' Golden Cross (Gold) Mine in New Zealand has been in operation since 1991. Nerco Mining,Inc. has recently commissioned a full scale AVR plant at their DeLamar (Silver) Mine [Ref 37] in Idaho. Each operation reports that performance is meeting design expectations. Both installations were preceded by extensive, site specific effluent and slurry laboratory and pilot plant testing.

There are several qualified companies in the United States that can design and construct AVR based process plants. However, for slurry applications these firms will generally require considerable direction from the operator (presumably functioning as licensee of the technology), and the patent holder. The process systems do not require special (other than corrosion resistant) plant equipment or materials of construction. All are readily available.

3.1.2 Toxicity Reduction Potential by Removal and Reuse of Cyanide and Cyanide Solutions

The principal reason for removing cyanide from gold mill effluents is to minimize the potential for harm to wildlife and to reduce the longer term risk of contamination of groundwater, surface water or soils through release of effluents to the environment. For this reason, the Commission has posed the question:

"Do the requirements for removal and reuse of cyanide materially reduce the toxicity and long term potential for long-term cyanide and toxic metals release from mill tailings?

A reduction in the relative concentrations of all forms of cyanide, but especially in free and WAD cyanide, will reduce the toxicity of mill tailings. The toxicity of cyanidation solutions is very complex and involves not only the toxic characteristics of the cyanide compounds but other constituents as well, including metals and degradation products [Ref 30, 31]. Other factors may aggravate toxicity conditions including insufficient dissolved oxygen, increased water temperatures, high or low pH conditions and salinity. The presence of zinc and copper in solution and dissolved ammonia may increase the toxic action of the solutions. Over the long term, once the source of the cyanide is eliminated, it can be considered to be a non-persistent chemical. Its action is reversible and living organisms have mechanisms capable of eliminating it [Ref 30].

While cyanide can eventually be toxic to all life forms, some aquatic microorganisms such as bacteria, algae and fungi can tolerate and metabolize cyanide at fairly elevated levels (up to 200 ppm) [Ref 32]. Higher aquatic organisms are less resistant. In fact, most species of fish are sensitive to levels considerably lower than the National Drinking Water Standard of 0.2 ppm. Therefore, solutions that must be released from a mining operation to the waters of the state will require additional and extensive treatment beyond the technical requirements of the ODEQ meet this standard for tailings effluents. Treatment technology to these levels cannot be achieved by recovery and reuse methods alone [Ref 30, 31, 32].

The use of WAD cyanide as a conservative control parameter provides an additional factor of safety since the control of the WAD cyanide to 30 ppm (or less) is usually representative of free cyanide levels well below 30 ppm.

Reuse of cyanide in and of itself would not reduce the immediate or long term toxicity potential of milling operation waste water system since the total cyanide in the system is not destroyed but is returned to the process. The recovery and reuse requirement would be expected to reduce the overall amount of cyanide chemical consumed over the life of the operation. Ultimately, however, whatever residual cyanide remains in the process solutions must be removed chemically prior to facility closure.

When employed to reduce cyanide levels, chemical destruction methods will tend to alter the cyanide species to less toxic nitrogen compounds (such as cyanate and ammonia) which are ultimately dissipated by natural processes. Reductions in cyanide levels in the liquids released to tailings will tend to accelerate the detoxification responses. The persistence of cyanide derived materials, therefore, will also tend to be transient [Ref 30, 31].

The selection of the optimum process or combination of processes necessary to reduce cyanide concentrations to a specified standard and to reduce the long term potential for cyanide and toxic metals release from the mill tailings must be consistent with site-specific criteria. Although there are similarities at various locations, each site is unique and evaluations must consider the chemistry of the ore and the resulting solutions, the local geological and hydrological conditions, the design and metallurgical objectives, as well as the response of the process solutions to various wastewater treatment options. The most important criterion that will provide immediate environmental benefit to the site is the removal of cyanide species from the process solutions impounded on site. It does not matter whether the cyanide is removed and reused or permanently altered to less harmful forms. There are many alternatives, and no one method is viable in all circumstances.

3.1.2.1 Technology Limitations

An assessment of the technical viability of treatment processes will generally require a site-specific test program to examine the appropriate process conditions and to determine the physical and chemical process responses. A proper assessment of the long term reliability of the selected treatment process, whether it is a recovery and reuse and/or chemical oxidation process, must consider the specific test results and the operating history of the selected process [Ref 30, 40, 41, 42].

In many cases the removal and reuse requirement may be consistent with the best and most appropriate tailings treatment process. However, when treating mill tailings slurries using the AVR process, favorable supporting test data must necessarily be weighed, at this time, without benefit of long term experience. In other instances, a chemical oxidation process may equally, or more effectively achieve the policy of the Commission. Several chemical destruction technologies, in fact, have extensively demonstrated and well documented operating histories [Ref 30, 31, 35, 42, 43]. The advantages and disadvantages of each method are well known and may often be evaluated with less site-specific testing. Chemical destruction processes are generally capable of reducing free and WAD cyanide to lower levels than those achievable through recovery and reuse processes.

Several different chemical oxidation methods are currently in use throughout the gold mining industry. Chemical methods within the plant are able to provide the operator with control over the content of WAD cyanide levels prior to impoundment as tailings or barren solutions or certainly prior to release as effluent. Chemical oxidation methods permanently alter the cyanide compounds, thus they are then unavailable for "reuse". The destruction methods described in this report are well established and provide a positive means of control.

The following methods generally have been applied as stand-alone processes. However, when appropriate, they may be used to supplement "recovery and reuse" technologies. These supplemental methods are briefly described below to enable their inclusion in the "Level of Certainty Analysis" (Section 3.1.3), and are further discussed in (Section 3.1.4) "Alternate Treatment Technologies".

- Alkaline chlorination: a process where the destruction of free and WAD cyanide is based on oxidation of the cyanide ion to cyanate (by the hypochlorite ion). Weak acid dissociable cyanide levels can be reduced to low levels in most applications and cyanate, ammonia, and thiocyanate can be further oxidized, if necessary. Iron cyanides are not usually decomposed but metal concentrations in solution can be reduced to very low levels by precipitation. Once the cyanide is oxidized the metals precipitate as insoluble hydroxides [Ref 30, 31, 32].

  The use of chlorine and hypochlorite for the treatment of barren cyanide solutions is the most highly developed of all the available cyanide destruction methods. Operations are simple, reliable and flexible, and they may be easily controlled and automated.

- Destruction by Sulfur Dioxide: can be accomplished through either of two commercial processes that are characterized by the oxidation of cyanide to cyanate using sulfur dioxide or mixtures of sulfur dioxide and air [Ref 30, 31]. The processes reportedly are able to reduce total cyanide and metals to exceptionally low levels. Free and weak acid dissociable cyanide species are chemically removed by oxidation to cyanate. Iron cyanide complexes are reduced and precipitated as insoluble ferrocyanide salts. After the metal cyanide complexes have been precipitated, a ferric sulfate solution may be added to precipitate the remaining heavy metals. The cyanide is chemically destroyed and cannot be recovered for reuse. Thiocyanate, cyanate and ammonia are not further oxidized by the process [Ref 30, 31, 32].

- Hydrogen Peroxidation: encompasses two commercial processes that utilize hydrogen peroxide to destroy free cyanide and WAD cyanide. Hydrogen peroxide, in the presence of copper oxidizes the free cyanide to cyanate. WAD cyanide is also oxidized to cyanate. The metals released during the oxidation are precipitated as hydroxides. The iron cyanide complexes are combined with free copper and precipitated as insoluble ferrocyanide salts. Heavy metals are also effectively precipitated. The resulting thiocyanate, cyanate and ammonia complexes are not readily or rapidly further oxidized in the process.

  The process has been successfully applied on a wide variety of process solutions, including slurries. Reductions in total cyanide concentrations to the limits established by the ODEQ have been demonstrated. The method is well suited as either a primary destruction method or as a supplemental method, to be employed as site conditions require.

3.1.3 Level of Certainty Analysis

The level of certainty analysis is intended to be a summary statement on the reliability of the technical assessment of the projected performance of a system or technology. The level of certainty depends greatly upon past performance (as measured by the experience of the designer, operator and the history of operating practices that utilize the specific techniques and/or technology). The level of certainty in the selection of a process is directly related to the evaluation of site specific performance data, as generated by testing parameters and results. The level of certainty is enhanced by the application of conservative design criteria, operator training/expertise, and operating and maintenance practices.

3.1.3.1 Cyanide Removal By Solid/Liquid Separation

Cyanide removal by solid/liquid separation is a positive physical removal system. Reduction in the volumes of slurry released to a tailings impoundment will have a beneficial effect on reducing avian mortality by potentially reducing the area and extent of the liquid pool in the tailings impoundment. When supported by testwork, scale-up is readily and reliably achieved. However, changes in ore characteristics, such as the generation of fines, or clays, by alteration of certain minerals, may make thickening or filtration more difficult, considerably lowering the level of confidence in this technology. Testwork, therefore, must produce a thorough understanding of the expected ore characteristics.

3.1.3.2 AVR Processes

The recovery of cyanide by AVR processes will provide a positive benefit through reduction of the concentrations of free and WAD cyanide released to the impoundments. The process will depend upon the ore characteristics and the required degree of acidification to dissociate the weakly complexed (WAD) cyanides, as well as the viscosity and temperature of the slurries and solutions. Adequately planned testwork will alleviate some degree of technical concern and raise the level of confidence. However, the experience to date with AVR systems on slurries is limited.

3.1.3.3 Alkaline Chlorination

Alkaline chlorination is a well known and well understood technology. However, process specific metallurgical testing is recommended. Scale up requirements are well understood and the technology may be implemented with a high level of confidence. In most cases, alkaline chlorination methods can be implemented to reduce free and WAD cyanide to the levels established by the ODEQ. However, high reagent consumption and the potential for toxicity due to chlorine (which requires still more residual treatment) has reduced the operator preference for this method.

3.1.3.4 Destruction by Sulfur Dioxide

Cyanide destruction by sulfur dioxide is a well demonstrated technology. Process specific metallurgical testing is necessary but scale-up requirements are well understood and the technology may be implemented with a high level of confidence. The process is less sensitive to variations in ore characteristics. The process has been successfully applied in many locations to reduce total cyanide to levels well below the ODEQ standard. Soluble metals are effectively reduced as well. The INCO process has become the most widely utilized cyanide destruction process in the gold industry.

3.1.3.5 Hydrogen Peroxide Destruction Processes

Cyanide destruction by hydrogen peroxide is a well demonstrated technology. Process specific metallurgical testing is necessary from which scale up requirements are well understood. The technology may be implemented with a high level of confidence based upon proper review and interpretation of site specific testing. The peroxide process is relatively simple to implement. H_2O_2 processes have been successful for both continuous operations and for short-term applications such as rinsing and final detoxification procedures prior to closure.

3.1.4 Alternate Treatment Technologies

There are several technologies or combinations of technologies that have the potential to achieve the requirements of the ODEQ. As stand-alone technologies, each may achieve the standards set out for cyanide reduction. Combining methods, where both have been shown as capable of meeting ODEQ standards, may in many instances create a redundancy that does not materially add to environmental protection. As discussed previously, successful universal application of any single process technology is unlikely. Likewise, the designation of a single control technology may not best meet the stated policy of the Commission. As such, flexibility to select the best option(s) to comply with specified concentration standards, irrespective of whether cyanide may be reused or destroyed, may represent a more realistic approach.

Alternate treatment technologies that may meet the requirements of the DEQ are presented below. Brief introductions to these methods were presented previously.

3.1.4.1 Alkaline Chlorination

As discussed previously, the alkaline chlorination process for the destruction of free and WAD cyanide is based on the principle of oxidation of cyanide to cyanate (by the hypochlorite ion) at pH values in the range of 10 to 11. Hypochlorite ion may be provided by the use of either liquid chlorine or solid calcium hypochlorite. Additional lime or caustic is required to maintain a high pH to prevent undesirable side reactions. Weakly complexed metal cyanides behave similarly, but are oxidized more slowly. Once oxidized, the metals precipitate as insoluble hydroxides. Ferrocyanide is not directly affected by the treatment but may precipitate by forming insoluble salts heavy metals [Ref 30, 31, 32].

A reduction in the levels of all forms of cyanide, but especially in free and WAD cyanide, will reduce the toxicity of mill tailings. The cyanates formed in this process are considerably less toxic than the corresponding cyanides. Alkaline chlorination may be considered if recovery and reuse is unable to achieve the desired WAD cyanide concentrations.

The use of chlorine or hypochlorite for the treatment of barren cyanide solutions is the most highly developed of all the available cyanide destruction methods. Operations are simple, reliable and flexible, and they may be easily controlled and automated. Advantages include the following:

- Weak acid dissociable cyanide levels can be reduced to 30 ppm in most applications;
- Cyanate, ammonia, and thiocyanate can be further oxidized if necessary;
- Toxic metal concentrations can be reduced to very low levels;
- Alkaline chlorination is a well understood process;
- Chlorination reagents are readily available; and,
- Equipment, materials, and design expertise are readily available.

Likewise, a number of disadvantages are inherent in the process, including:

- Reagent consumption may be excessive if the solid phase contains excessive amounts of reactive sulfides;
- Cyanide is not recovered, but is chemically destroyed;
- Reagent costs are also high if thiocyanate is present or if complete destruction of cyanate and thiocyanate is required;
- An additional treatment step may be necessary to dissipate residual chlorine;
- Careful control of pH is necessary to prevent the release of highly toxic cyanogen chloride gas; and,
- Iron cyanides are not usually decomposed.

The technical definition and understanding of alkaline chlorination processes is well documented [Ref 30, 31, 42]. Like all processes, the necessary design criteria will be process specific. The process removes WAD cyanide by chemical destruction, thus cyanide cannot be recovered for reuse. It is however, technically feasible to utilize the process in combination with removal and reuse technology or as a stand alone cyanide destruction process.

Alkaline chlorination has been successfully applied at numerous mining and chemical plating operations for cyanide destruction. There are a number of applications in Canada [Ref 30, 31], and Battle Mountain Gold now utilizes alkaline chlorination on slurries at the Fortitude Mine in Nevada [Ref 44]. However, the industry trend is toward other, more efficient cyanide destruction technologies [Ref 31, 35].

There are several qualified companies in the United States that can design and construct alkaline chlorination facilities, including those previously cited (Section 3.1.1). The process does not require exotic plant and equipment but will require certain materials of construction to be resistant to chlorides. However, these materials are readily available.

3.1.4.2 Destruction by Sulfur Dioxide

Also discussed previously, the two commercial sulfur dioxide destruction processes are commonly referred to as the INCO SO_2/Air process, and the Noranda process, respectively. Both are predicated upon the concept of oxidation of cyanide to cyanate (using sulfur dioxide or mixtures of sulfur dioxide and air), and are reportedly able to reduce total cyanide and metals to exceptionally low levels [Ref 30, 31, 42, 41].

The INCO SO_2/air process for total cyanide removal is based on oxidation of cyanide to cyanate using mixtures of SO_2 and O_2 as the oxidizing agents (in the presence of soluble copper) in a controlled pH range. The SO_2 can be supplied as a gas, as sulfurous acid, or as a soluble sulfite or bisulfite. The O_2 can be supplied by air. The process will require the addition of lime to maintain the proper alkalinity. The process developed by INCO now has a lengthy experience list and is comparable to AVR processes in technical and economic performance. Reductions of WAD cyanide to very low levels have been consistently demonstrated.

The Noranda process utilizes sulfur dioxide (which is fed directly into the process) to lower the pH to the prescribed range (usually between 7 and 9) and a copper sulfate solution is then added to reduce the total cyanide level. Once the metal cyanide complexes have been removed by precipitation, a ferric sulfate solution may be added to remove the remaining heavy metals.

Free and weak acid dissociable cyanide are removed by oxidation to cyanate. Iron cyanide complexes are reduced and precipitated as insoluble ferrocyanide salts. Heavy metals are also effectively removed. The process has been successfully applied on a wide variety of process solutions, including slurries. It has been demonstrated that cyanide concentrations may be consistently reduced to levels below the limits established by the ODEQ.

Treatment conditions, final effluent quality and process control strategies will vary according to the specific composition of the process liquids and the reactivity of the solids. The following advantages and disadvantages are reported [Ref 30, 31] for the sulfur dioxide based processes.

Destruction of cyanide in mill tailing effluents by sulfur dioxide offers several advantages, including the following:

- Process is proven and well understood, and technical support is available from patent holders and licensees;
- Removes total cyanide to low levels (less than 30 ppm);
- Removes metals and iron cyanides to low levels;
- Can be applied to solutions and slurries;
- Process is flexible and can be automated;
- Reagents are readily available;
- Reactions are rapid and no toxic gaseous intermediates are formed; and,
- Equipment, materials, and design expertise are readily available.

Likewise, a number of disadvantages are inherent in sulfur dioxide cyanide destruction, including:

- Reagent requirements may be high;

- Cyanide is not recovered, but is chemically destroyed;
- Thiocyanate, cyanate and ammonia are not oxidized further;
- Each effluent must be tested for site specific design and scale up criteria; and,
- Processes are patented.

Sulfur dioxide processes have been widely accepted and successfully utilized in recent years, however, the necessary design criteria are generally process and site-specific. The process(es) remove cyanide by chemical destruction and precipitation, thus the cyanide cannot be recovered for reuse. It is technically feasible to utilize the process in combination with removal and reuse technology or as a stand alone cyanide removal process.

Of note, the INCO process is the most widely utilized cyanide destruction process in the gold industry today. Successful installations include Echo Bay's Cove-McCoy and Kettle River Operations among over 30 licensed applications since 1985 [Ref 35].

There are several qualified companies in the United States that can design and construct the facilities. Plant and equipment will require corrosion protection but the necessary materials of construction are readily available.

3.1.4.3 Hydrogen Peroxide Destruction Processes

There are two commercial processes (known as the Kastone and Degussa processes, respectively) that utilize hydrogen peroxide to destroy free cyanide and WAD cyanide. The Kastone process was originally proposed and patented by duPont. The process uses a solution of hydrogen peroxide (containing a small amount of formaldehyde and copper) and was first utilized on a trial basis on gold mill effluent in 1981. The process developed by Degussa Corporation applies hydrogen peroxide with small amounts of copper but does not require formaldehyde [Ref 40].

Hydrogen peroxide, in the presence of copper, oxidizes the free cyanide to cyanate. Weak acid dissociable cyanide is also oxidized to cyanate. While metals released during the oxidation are precipitated as hydroxides, iron cyanide complexes are combined with free copper and precipitated as insoluble ferrocyanide salts. Heavy metals are also effectively removed. The process has been successfully applied on a wide variety of process solutions, including slurries. Total cyanide concentrations have been reduced in most instances to levels below the limits established by the ODEQ.

The reduction in the levels of all forms of cyanide results in a corresponding reduction of toxicity in the mill tailings. This is due to the fact that the cyanates formed in this process are considerably less toxic than the corresponding cyanides. These compounds will slowly hydrolyze and dissipate in the tailings impoundment. The process introduces no new chemicals with adverse environmental concerns. Treatment conditions, final effluent quality and process control strategies will vary according to the specific composition of the process liquids and the reactivity of the solids.

The following advantages [Ref30, 31] are reported for hydrogen peroxide destruction processes:

- The process is proven and well understood and technical support is available from patent holders and licensees;
- Removes total cyanide to low levels (generally less than 30 ppm);
- Removes metals and iron cyanides to low levels;
- Can be applied to solutions and slurries;
- Process is flexible and can be automated;
- Reagents are readily available;
- Reactions are rapid and no toxic gaseous intermediates are formed; and,
- Equipment, materials, and design expertise are readily available.

Conversely, a number of disadvantages have been identified for the hydrogen peroxide destruction processes:

- Reagent requirements may be high;
- Cyanide is not recovered, but is chemically destroyed;
- Close control of pH may be required;
- Thiocyanate, cyanate and ammonia are not oxidized further; and,
- Each tailing effluent stream must be tested for site specific design and scale up criteria.

Hydrogen peroxide processes have been successfully utilized in recent years. However, the necessary design criteria will be process specific. The process removes cyanide by chemical destruction and precipitation, thus the cyanide cannot be recovered for reuse. It is technically feasible to utilize the process either as a secondary treatment stage when employed in combination with removal and reuse technology, or, as a stand-alone cyanide destruction process.

Destruction of cyanides by oxidation with hydrogen peroxide has been demonstrated at over twenty operations in the United States, Canada and elsewhere. The Barrick Goldstrike operation has utilized peroxide to reduce free and WAD cyanide levels to 20 ppm [Ref 43].

There are several qualified companies in the United States that can design and construct hydrogen peroxidation facilities. The process does not require exotic plant and equipment.

3.1.4.4 Reduction by Ferrous Sulfate

Ferrous sulfate (or zinc ferrous sulfate) can be used to reduce the levels of free and WAD cyanide in the liquid portions of the tailings. Ferrous sulfate readiy forms complexes with free cyanide and with WAD cyanides if the pH is sufficiently lowered to allow the iron to replace other, less strongly associated cations. Although the ferrous and ferric cyanide complexes are precipitated, they can be decomposed by ultraviolet light in the shallow liquid pool areas of the tailings impoundment. The most prudent process strategy is to first reduce the free and WAD cyanide by removal and reuse or by outright destruction before introducing additional iron into the process.

Ferrous sulfate represents a potential option for emergency treatment of cyanide solutions in the event of a spill or equipment breakdown. It may also be suitable for final treatment of tailings or solutions once recovery and reuse methods have been completed.

3.1.4.5 Natural Degradation

Natural degradation occurs as a result of the interaction of several processes of cyanide decay such as volatilization, hydrolysis, photodegradation, dissociation, chemical and bacteriological oxidation and precipitation. New operations have the opportunity to develop and design impoundment systems to optimize, or capitalize upon the treatment effects offered through natural degradation processes. Physical and chemical phenomena can be used advantageously in the reduction of effluent toxicity and in the management of process solutions to optimize chemical usage and water management practices.

Volatilization, and dissociation, of the metal-cyanide complexes are the main mechanisms responsible for the natural degradation of cyanide in gold mill effluents. Volatilization causes a rapid, initial loss of cyanide, while dissociation controls the rate of degradation (particularly in the latter phases of natural degradation). Since initial concentrations are minor, and rapid dispersal occurs, air quality impacts are insignificant. If the WAD cyanide is removed prior to discharge, a shallow pooling impoundment design may optimize the ultimate detoxification of cyanidation process solutions. Research into the phenomena of natural degradation is limited, but the method is promising and the development of a clear understanding of the process will provide substantial benefit in protecting the environment from the release of toxic solutions to the environment.

Natural degradation would not be considered an effective stand-alone technology, however it can be effectively utilized as an added mechanism contributing to the long term reliability of technologies in minimizing the risk to the environment.

4.0 QUESTIONS ON THE CLOSURE OF HEAP LEACH AND TAILINGS FACILITIES

This section of the mining advice report addresses the closure of heap leach and tailings facilities, with regard to utilizing the following processes: 1) Detoxification; 2) Covering; and 3) Detoxification and Covering utilized together. Evaluations of these processes were conducted in order to address the following four closure questions with regard to both heap leach facilities and tailings impoundments:

Question 1: *Are detoxification and covering as prescribed in the EQC policy, technically feasible?*

Question 2: *Do detoxification and covering evaluated separately and together, material reduce the likelihood of a release of toxic chemicals and metals to the environment?*

Question 3: *What is the level of certainty assigned to each of the above answers Questions 2 and 3?*

Question 4: *Are there other technologies which can equally or more effectively achieve the EQC policy?*

TRC approached these questions utilizing published information and technical data available from sources including the U.S. EPA, the Society of Mining Engineers, etc. In the following report subsections, discussions of the evaluations are presented for each of the four questions.

4.1 Technical Feasibility of Detoxification and/or Cover Systems for Heap Leach Facilities

4.1.1 Detoxification of Heap Leach Facilities

Cyanide degradation and attenuation in a heap can be achieved by individual or combined application of rinsing, chemical treatment, or natural degradation reactions. The upper portions of the heap provide an oxidizing environment, due to the high permeability of the heap itself (an essential requirement for the extraction of gold and silver) ensuring a reasonable flow of air. Oxidation will contribute to pH reduction and the formation of HCN; volatilization will ensue. These reactions will be supplemented by oxidation by biological activity within the heap.

Cyanidation processes generally employ a pH of 10.5 or greater. Following decommissioning and abandonment, there will be a gradual decrease in pH within the heap as a result of rinsing, natural dilution and geochemical interactions with air, water and the various solid materials within the spent ore. Hydrolysis reactions will develop (independent of pH) and can occur under oxidizing and reducing conditions. The oxidation or chemical alteration of certain minerals will produce newly created clay surfaces that will also absorb chemical and metal ions from solution. It is technically feasible to reduce the WAD cyanide levels within the heaps to 0.5 ppm or less through rinse/rest cycles and chemical oxidation, minimizing post-closure toxicity concerns.

4.1.2 Cover/Closure of Heap Leach Facilities

The feasibility of covering heap leach facilities, at closure, was examined with regard to various considerations including those engineering related considerations and the long term closure effects. The covering of heap leach facilities may be accomplished by utilizing either earthen materials such as clay caps, or synthetic materials such as geomembrane covers. In general, covering the top of the heap with either material should be relatively straight forward, provided a QA/QC program is carried out during the construction. Covering of the side slopes of a heap, is often more difficult, due to their steepness, which are generally on the order of 2:1 (horizontal to vertical). As a result, limitations related to equipment used to place and adequately compact earthen cover materials may present difficulties. This problem may be addressed by placing the earthen cover materials at a milder slope, which could require regrading of the heap, or use of additional cover materials or fill materials to flatten the side slopes. The utilization of synthetic cover materials on the heap side slopes should be relatively uneventful, provided sufficient anchorage is provided to retard slippage of the material and that the material is relatively resistant to ultraviolet radiation and other environmental conditions. The use of cushioning materials between the liner and the ore may be indicated, if the underlying ore has the potential to puncture or otherwise damage the synthetic cover materials. Earthen cover materials should be covered with a topsoil or other material to retard the loss of moisture from the cover, thus reducing the likelihood of desiccation cracking. Synthetic cover materials may similarly be covered, to reduce the possibility of damage from site conditions, or deterioration effects resulting from environmental conditions.

The establishment of vegetative stands of growth may be expected to occur through either the earthen cover materials or synthetic cover materials. As a consequence, the amount of infiltration capable of percolating into the heap from precipitation and snowmelt events will increase. Also, the presence of burrowing animals can also increase the overall amount of infiltration into the heap. In general, the lower the permeability and the greater the compaction for earthen covers, the less the cover will be affected by these influences, provided post closure programs are subscribed to with regard to vegetation and animal control. It has been suggested that the utilization of layers of cobbles may be somewhat successful in deterring animal burrowing and root growth [Ref 1].

The stability of the heap may be enhanced to some degree by utilization of cover materials, as a result of the reduction in precipitation able to infiltrate the ore. This is particularly true where the facility is not provided with adequate drainage or the post-closure water balance indicates a net fluid buildup in excess of the evaporation potential of the undrained facility.

4.2 Technical Feasibility of Detoxification and/or Cover Systems for Tailing Facilities

4.2.1 Detoxification of Tailings Impoundment Facilities

Tailings detoxification is technically feasible and the processes are well understood. (Refer to Section 3.0 of this document.) Cyanide recovery and chemical treatment methods are intended to reduce the level of weak acid dissociable cyanide that is released to tailings impoundments. These treatment methods generally involve altering of the pH of the solutions, which may affect the solubility of certain heavy metals. Detoxification of tailings prior to disposal presents a positive and measurable control effort. In addition, the tailings impoundment(s) will function as a treatment unit (over the long term, due to natural degradation processes); as such, the levels of soluble cyanide and metals will tend to further dissipate over time.

Cyanidation processes are operated under highly alkaline conditions (at a pH greater than 10.5) to prevent the loss of HCN by volatilization and to protect the working environment of the operator. This pH would be reduced by the active application of a cyanide recovery system as well as through utilization of various oxidation methods. The solutions in tailings ponds would tend to drift toward a neutral pH range due to dilution, absorption of CO_2 from the atmosphere, and the possible generation of acids as a result of oxidation of the sulfide minerals. As the pH is lowered, some of the metal-cyanide complexes will dissociate into free cyanide. The tightly bound iron cyanide complexes will also be decomposed photochemically (naturally degraded through exposure to sunlight). This effect can be enhanced by the design of the tailings impoundment to maximize mixing and exposure to air and sunlight. Molecular HCN will dissipate (by volatilization) and the total cyanide concentration of the pond will be permanently lowered.

The nature of the solids generated during processing is important to these processes. Since rocks and soils normally contain free (or excess) cations, absorption of cyanide as metal cyanide complexes will be favored. WAD cyanide may be adsorbed on organic materials (including activated carbon), clays, feldspars and metal oxides. These surface effects have been shown to provide a significant contribution to cyanide reduction in tailings systems. As a result of these combined natural chemical processes, the total cyanide is often eventually reduced to levels below the proposed rule treatment standard (< 30 ppm) for tailings.

The levels of soluble metals are also reduced. Indications [Ref 30, 31] are that the solids' mass in tailings or heaps interacts with the solutions and that the cyanide appears to be permanently absorbed or converted (under aerobic and anaerobic conditions) to other nitrogen compounds. The proportions of free cyanide to total cyanide are dramatically decreased, indicating formation of metallic complexes and precipitation. Therefore, in the absence of acid generating sulfide minerals, cyanide mill tailings will tend toward chemical stabilization and the mobilization of heavy minerals will be arrested.

4.2.2 Cover/Closure of Tailings Facilities

As with the heap leach facility, the cover of a tailings facility may be carried out similarly with the use of either earthen or synthetic cover materials. However, it should be noted that for wet or undrained tailings dam facilities, it may not be possible to cover the facility until after it has been closed for many years. This is due to the potential for settlement of the unconsolidated tails, in addition to their lack of shear strength to support construction equipment. The evaporation of supernatant, pore fluids and air drying of the upper tailings horizon will eventually contribute to consolidation to some degree, with the deeper deposits being less prone to drying and more prone to consolidation unless provisions are made for direct drainage of these bottom deposits. The utilization of drained tailings deposition techniques may have beneficial effects on reducing the time period from closure to the initiation of cover operations but will depend largely on the physical and chemical properties of the tails and their ability to be drained, as well as the extent, effectiveness and layout of the drains, and the resulting density stratification of the tails.

Once the tails have achieved sufficient strength and their potential for consolidation settlement has been reduced, covering can generally be effectively facilitated with the use of earthen or synthetic cover materials, provided a QA/QC program is properly carried out. Covering the sideslopes of the impoundment with earthen cover materials may pose some construction difficulties and may require overfill and cut back techniques to be utilized, and/or the use of adequately anchored synthetic materials.

The use of cushioning materials between the tailings and synthetic cover materials, (when utilized) may be indicated if there is a potential for occurrence of puncture or other damage to the cover. The loss of moisture from earthen cover materials should be minimized by cover with topsoil or other materials to prevent the occurrence of desiccation cracking. Synthetic cover materials should be protected as well from damage potentially related to site conditions or deterioration effects resulting from environmental conditions.

Vegetative and animal control plans should be implemented to minimize the effects that root growth and burrowing animals will have on increasing the overall infiltration through either of the cover systems selected.

The stability of the tailings facility during the post closure period may be enhanced with the construction of a cover system, since the potential for long term buildup of precipitation water in the tails should be reduced (as should the pore pressures). This would hold particularly true in the event that there are no provisions to drain the facility after closure, and if the post closure water balance indicates a buildup of fluids in excess of the evaporation potential of the undrained facility.

4.3 Material Reduction of Likelihood of a Release to the Environment (Heap Leach Facilities)

4.3.1 Effects of Detoxification (Only) for Heap Leach Facilities

Literature reporting operating experience at two heap leach facilities [Ref] indicates that WAD cyanide can be reduced to 0.5 ppm in most instances, and lower in some instances. Similar reductions in soluble metals has also been reported. As the closed heaps "age", it is anticipated by the operators that the total and WAD cyanide levels will be stabilized at permanently low levels. In the absence of acid generating minerals, heavy metals are not expected to be mobilized [Ref 30, 31, 32] and concentrations are expected to remain at low levels.

4.3.2 Effects of Closure/Cover (Only) for Heap Leach Facilities

From a chemistry standpoint, covering of the facilities without prior detoxification would reduce the oxidation potential of the free cyanide present within the ore. As a result, the free cyanide ion would be more susceptible to hydrolysis, wherein the free cyanide ion would react with water and result in the generation of hydrogen cyanide. This reaction is very pH sensitive, but the presence of hydrogen cyanide in the heap would be less desirable than cyanide in its oxidized state (as cyanate or cyanate salts). Hydrogen cyanide has a high vapor pressure and readily volatilizes into a gaseous state, which would be undesirable unless venting through the cover was provided. Covering of the heap would also reduce the dilution of the cyanide present within the heap. The effect of covering the facility would generally be beneficial, if fluid buildup is in excess of the evaporation potential. The mobilization of metals, if anticipated to occur, would also be reduced. Accordingly, the cover would have a beneficial effect for heaps in which the ore possesses potential acid generating constituents such as sulfide minerals (e.g., pyrite). The reduced oxidation potential or reduction of the potential for additional hydrolysis of the sulfides would greatly contribute to a reduction in acid generating potential, particularly for those acids generated in the form of hydrogen sulfide.

However, the reduction in oxidation potential of the cyanide would cause the natural degradation of the free cyanide resulting from evaporation of the leachate and its subjection to ultraviolet degradation to be deterred as a result of covering the heap.

The stability of the facility may be enhanced by covering, since the potential for buildup of the fluid level in the heap would be reduced, particularly if the post closure water balance indicates a buildup of fluid in excess of the evaporation potential of the facility. In addition, the stability may also be enhanced, since the potential for erosion and sloughing of the heaped ore may be reduced with the construction of a cover system. The potential for wind-induced erosion of the heap may be reduced through covering, positively contributing to the ambient air quality of the site and surrounding environment.

4.3.3 Effects of Combined Detoxification and Closure/Cover - Heap Leach Facilities

Detoxification of a heap will ultimately reduce free and WAD cyanide to concentrations as low as 0.5 ppm in the short term, and as low as 0.2 ppm over the long term, and will tend to stabilize metal release. In such situations, an engineered cover designed to exclude air and water may provide no additional benefit and may in fact be deleterious to the detoxification attributes. However, heaps tend to be more porous and the need to exclude water and air (when acid generating materials are a concern) may require a more thorough analysis to determine when a cover is unwarranted and/or of questionable benefit.

Covering of the heap leach facilities after detoxification would have the effect of reducing the infiltration potential for precipitation into the heap as well as the availability of oxygen. In general, the chemistry of the spent ore would not be greatly affected, with or without the inclusion of cover, after successful detoxification of the spent ore, provided the spent ore does not contain metals or acid generating constituents such as sulfides. In these cases covering of the facilities may be desirable as a method of reducing the effects of acid generating potential or metals mobility within the spent ore, particularly if the post closure water balance shows fluid buildup in excess of the evaporation potential.

After detoxification has been successfully completed at heap leach facilities (with the exception of those with the potential for acid generation) the need for cover would generally not be warranted, if it can be demonstrated that the evaporation potential exceeds the anticipated fluid buildup within the facility. This would ensure that the build up of fluid levels within the heap would not occur and that the stability would not be affected. Spent ore which exhibits concerns related to erosion potential from precipitation or wind influences, could be addressed by investigating other methods to reduce this potential. These may include compaction of the surface materials, utilization of stabilization admixtures, or implementation of a vegetation plan.

4.4 Material Reduction of Likelihood of a Release to the Environment (Tailings Facilities)

4.4.1 Effects of Detoxification (Only) for Tailings Impoundment Facilities

In the absence of acid generating minerals, a tailings impoundment that has been receiving detoxified solutions will tend to stabilize. Metals that were solubilized in the milling process will precipitate, tending not to remobilize. As solutions percolate through the impoundment, natural attenuation and adsorption occurs. Ponds with surface water concentrations of 200 ppm total cyanide have been correlated [Ref 31] with solution concentrations of 2 or 3 ppm within the solids portion of the tailings, indicating efficient attenuation of the solution toxicity. With the deposition of lower concentration solutions, correspondingly lower levels within the tailings mass may be expected.

4.4.2 Effects of Closure/Cover (Only) for Tailings Impoundment Facilities

The effects of covering the tailings facilities without detoxification are essentially the same as those discussed for the heap leach facilities. However, due to the generally wetter state of the tailings (as compared to spent ore remaining in closed heap) it would be expected that the reduction of the oxidation potential of the free cyanide present within the tails would have a greater influence with regard to generating hydrogen cyanide. In addition, the reduction of the dilution potential of the cyanide (as a result of covering) would result in the presence of higher concentrations of hydrogen cyanide which could potentially be dispersed through the liner with seepage. This would be of particular concern in wet tailings facilities. The covering of larger facilities (of great surface area) would result in a loss of beneficial natural degradation processes.

On a comparative basis, covering of the tailings facilities would generally have a more beneficial effect (than would covering of heap leach facilities) on reducing the tails' erosion potential from precipitation and wind. This is due to the tails finer gradation, in comparison to the coarse spent ore typically remaining in heaps.

4.4.3 *Effects of Combined Detoxification and Closure/Cover - Tailings Facilities*

Once detoxified, and if the risk of metal release through acid generation is minimal, an engineered cover designed to exclude air and water may provide little, if any, quantifiable benefit with respect to prevention of toxicity release.

After detoxification of a tailings facility has been successfully carried out, the need to cover the facility would generally not be warranted (from the standpoint of contaminant containment), provided that the heavy metals species have been removed from the system during the cyanide neutralization process and that the tails do not possess the potential for acid generation. In some cases drainage of the facility could be implemented, particularly in net precipitation environments (where precipitation exceeds the evaporation) and where the potential for long term build up of fluids in the facility exists, particularly during a sequence of wet years. By maintaining the facility in an uncovered state, the potential for desirable attributes such as allowing the tails to dry out and densify would be enhanced over the long term as compared to the covered state, where drying and densification may never occur unless drainage provisions are implemented.

Other erosion control measures (in lieu of cover) could be implemented, including broadcast planting of a vegetative cover compatible with the tailings. Other erosion control measures, including covering, may not be able to be implemented for a substantial period of time, due to the lack of the tailing's shear strength, and consolidation potential, which will generally preclude heavy equipment operations until the tails have been able to consolidate and densify. In the event that covering of the facility is necessitated for some reason, the utilization of synthetic materials for cover may be feasible, provided that the potential for the tails settlement and the damage to the synthetic cover, is considered. Synthetic materials can generally be placed without the utilization of heavy equipment operations. In addition, floating covers may sometimes be considered as an alternative covering method [Ref 46].

4.5 Level of Certainty Evaluation

4.5.1 Detoxification on a Stand-Alone Basis

For mill tailings, in the absence of high levels of acid generating minerals, detoxification methods are expected to achieve the proposed rule requirement for reducing free and WAD cyanide to levels below 30 ppm. However, to achieve the drinking water standard of 0.2 ppm may require additional treatment prior to release of solutions from the tailings impoundment. If the liquid portions of the tailings are to be released, then additional chemical treatment will be required. Any of the chemical destruction methods described above may be applied, as appropriate, to achieve the required levels. These methods may be applied with a high level of confidence. Alkaline chlorination is extremely effective for final treatment, but may require an additional dechlorination step prior to releasing process water.

With heap leaching facilities, the rinsing, chemical treatment and natural degradation processes may be applied with a reasonably high level of confidence to achieve free and WAD cyanide levels of 0.5 ppm. In some cases, the drinking water standards can be achieved prior to release to the environment. Although, theoretically, evaporation may concentrate the cyanide complexes remaining in solution, as a practical matter, other soluble salts will begin to precipitate and will co-precipitate cyanides and toxic metals. Also, where evaporation is substantial it is unlikely that any solution will remain for discharge to the environment.

4.5.2 Closure/Cover on a Stand-Alone Basis

The level of certainty that would be expected to be achieved as a result of covering the heap leach facilities at closure (without prior detoxification) would be low. This is due to the fact that heap chemistry would not have the benefit of natural degradation processes that occur as a result of dilution and oxidation of the free cyanide and cyanide complexes. In addition, the buildup of cyanide gas would also be a concern, without provision for adequate venting. In cases where potential for acid generation or solubilization of heavy metals exists, covering of the heap may be necessary. This may also be true where containment of the contaminant by the liner system is deemed questionable, or where the post closure water balance indicates lack of sufficient capacity to contain fluid buildup. However, it should be noted that in those cases where covering is utilized, leaks through the cover will still occur due to defects introduced through growth of plant roots and actions of burrowing animals. As a result, the level of certainty for the cover scenario would still be considered low for this reason alone.

The level of certainty expected with the covering of tailings facilities (without detoxification) would be low. This would result from the fact that the beneficial natural degradation processes including dilution and oxidation of the free cyanide would be prevented from occurring. Also, the buildup of cyanide gas may also be a concern, without adequate ventilation provisions. In the cases where the potential for sulfide generation or heavy metals generation exists, covering may be indicated if the facility's containment liner system is questionable or if the post-closure water balance indicates that the facility lacks long term evaporative capacity. In addition, the ability to place cover materials on a tailings facility may be severely limited early in the closure sequence by the lack of shear strength and the consolidation settlement potential of the tails, until densification has had the opportunity to occur. Also, covering of the tails would inhibit densification by reducing the evaporation of the liquids expelled during the consolidation process.

4.5.3 Combined Detoxification and Closure/Cover Systems

The level of certainty resulting from both detoxification and covering of the heap leach facility would be expected to be only marginally greater than that expected from detoxification alone. This is due to the fact that after detoxification has been successfully completed, the cover will only serve to prevent precipitation from entering the detoxified ore. However after the ore has been detoxified, drainage of the facility should be implemented, provided there are no reasons why the facility cannot be drained and accept percolated precipitation waters. The exception would be those ores exhibiting the potential for acid or heavy metals generation. Even in these cases, if the containment capacity of the facility can be shown to be sufficient as a result of a post closure water balance analysis, and the containment liners are adequate, the need for cover still may be questionable.

The level of certainty to be expected as a result of covering tailings facilities after successful detoxification has been completed, would be only marginally greater than the level of certainty expected from the detoxification process alone. This results from the fact that the cover will prevent the percolation of precipitation rainfall into the detoxified ore and will inhibit further densification of the tails, over the long term. If the tails do not possess the potential for acid or heavy metals generation, drainage of the system should be considered. Otherwise, if it can be shown that the capacity of the facility is sufficient by conducting a post closure water balance analysis, and that the containment liners are adequate, the necessity for a cover system may be questionable.

4.6 Other Technologies to Achieve Commission Policy

TRC has evaluated several process technologies that appear to be suitable for cyanide removal and/or reuse, cyanide destruction and metal precipitation. Each of these methods has strengths and weaknesses and no one method is superior for every situation. TRC has concluded that a flexible approach to address site-specific characteristics provides the best means for achieving facility closure objectives, as stated by the Commission.

4.6.1 Detoxification Technologies

The technical evaluations (refer back to Section 3.0 for discussion) have centered upon demonstrated methods to oxidize and detoxify alkaline cyanide solutions. However, to efficiently achieve ultra low cyanide and metals concentrations in process effluents contents, other emerging techniques such as engineered biooxidation may warrant investigation.

4.6.2 Closure/Cover Technologies

The technical evaluations have centered on the prescribed cover system as described in the proposed rules. Within OAR 340-43-808(5), it is specified that construction of the cover shall generally follow the principles and practices contained in EPA/530-SW-89-047 "Technical Guidance Document - Final Covers on Hazardous Waste Landfills and Surface Impoundments". However, in view of the technological feasibility of detoxification of cyanide solutions, TRC concludes that appropriate closure and/or cover technologies may more closely relate to those methods/systems employed in containment of "non-hazardous" wastes.

Given that detoxification reduces the toxicity release potential associated with tailings or spent heap leach material, composite cover systems (as typically employed in hazardous waste management units) may represent no beneficial gain in containment of "contaminants". Where precipitation infiltration, dust generation, or aesthetic concerns are judged to be of critical importance at a given facility, sufficient mitigative containment can be gained through employing cover systems proven to be effective for such applications. These generally include options such as direct revegetation; soil or topsoil cover with revegetation; or stabilization. Each option can be modified, up to and including use of geomembrane materials, where site specific conditions warrant additional protective measures.

APPENDIX A-1

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LIST OF REFERENCES

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APPENDIX A-2

RECORD OF CONTACTS

TELEPHONE CALL LOG

PROJECT NO. 11958 PROJECT: ODEQ MINING RULES

DATE: 5/4/92 TIME: 1230 PHONE: ( )

TO: JIM BECK OF: TRC

FROM: JACK CLARK OF: WESTEC - DENVER

SUBJECT: RE: CONTRACT AWARD & LEAK DETECTION SYSTEMS

DISCUSSION:

MR. CLARK CONTACTED TRC TO CONFIRM THAT TRC REC'D AWARD OF CONTRACT. HE OFFERED TECHNICAL INFORMATION IN SUPPORT OF LEAK DETECTION CAPABILITY FOR HEAP LEACH PADS.

INFORMED MR CLARK THAT LEAK DETECTION ASSESSMENT WOULD BE LIMITED TO LINER EVALUATIONS AND WOULD NOT NECESSARILY EXPAND INTO EVALUATION OF LEAK DETECTION SYSTEMS. REQUESTED THAT IF HE FELT HE HAD INFORMATION OF VALUE TO THE STUDY THAT HE FORWARD SAME DIRECTLY TO H. SAWYER WITH A SPECIFIC REQUEST THAT IT BE FORWARDED TO TRC. CONCLUDED CONVERSATION. $\boxed{\text{END}}$

TRC

TELEPHONE CALL LOG

PROJECT NO. 11958 PROJECT: ODEQ MINING RULES

DATE: 5/4/92 TIME: 1300 PHONE: ( )

TO: JIM BECK OF: TRC

FROM: DIRK VAN ZYL OF: GOLDER ASSOC. - DENVER.

SUBJECT: RE: CONTRACT AWARD & LINER TECHNOLOGY

DISCUSSION:

MR. VAN ZYL CONTACTED TRC TO CONFIRM THAT TRC REC'D AWARD OF CONTRACT. HE OFFERED A NUMBER OF REFERENCES AND INDIVIDUALS AS POINTS OF CONTACT TO PROVIDE TECHNICAL INFORMATION ON LINER TECHNOLOGIES.

JMB REQUESTED THAT ANY INFORMATION IN THIS REGARD BE SUBMITTED DIRECTLY TO H. SAWYER (DEQ) FOR DEQ APPROVAL AND SUBSEQUENT PROVISION TO TRC. CONCLUDED CONVERSATION.

END

TRC

TELEPHONE CALL LOG

PROJECT NO. 11958 PROJECT: ODEQ

DATE: 5-7-92 TIME: 3:00 PHONE: ( ) 623-8567

TO: N.S. LYNN OF: LYNTEK

FROM: GVJ OF: TRC

SUBJECT: Cyanide Destruction

DISCUSSION:

Reviewed general process conditions for CN destruction. Nick offered loan of literature collected on subject including general info and copies of regulations in various western states.

Note: personal visit conducted on 5-10-92 at Lyntek — discussed alkaline chlorination, AVR, peroxide applications, including pad rinsing.

(

TRC

TELEPHONE CALL LOG

PROJECT NO. 11958 PROJECT: Oregon DEQ

DATE: 5-7-92 TIME: 1:00 PHONE: ( ) 303-643-5000

TO: BILL LAMPARD OF: CYRBUS –

FROM: GV JERGENSEN OF: TRC,

SUBJECT: AVR —

DISCUSSION:

REQUESTED INFO ON AVR technology as developed and patented by Cyprus. Mr. Lampard promised a contact from one of his people to find out what we (TRC) needed specifically

TRC

TELEPHONE CALL LOG

PROJECT NO. 11958 PROJECT: ODEQ

DATE: 5-7-92 TIME: 11:00 PHONE: ( ) 201-818-3715

TO: Roy Norcross OF: DEGUSSA

FROM: [signature] OF:

SUBJECT: H_2O_2 IN CYANIDE DESTRUCTION

DISCUSSION:

REQUEST FOR TECHNICAL LITERATURE ON CYANIDE DESTRUCTION USING H_2O_2

REVIEWED APPLICATION REQUIREMENTS -

NOTE: LITERATURE RECEIVED

FOLLOW-UP CALL 6-10-92 TO ACQUIRE SPECIFIC INFO ON OK TEDI AND OTHERS -

BARRICK - GOLDSTRIKE - TREATING BARRENS* TO ACHIEVE 20 PPM WAD (and free) CN

NOTE: This probably means CIP tails -

WILL REQUEST SPECIFIC APPLICATION DETAILS — IF WARRANTED FOR LATER FOLLOW-UP.

TRC

TELEPHONE CALL LOG

PROJECT NO. 11958 PROJECT: ODEQ

DATE: 5-11-92 TIME: 8:30 PHONE: ( )

TO: GVJ OF: TRC

FROM: Ross Jenkins OF: Cyprus

SUBJECT:

DISCUSSION:

CYANISORB PROCESS -

Mr. Jenkins called, as referred by Mr. Lompard of Cyprus. Discussed AVR technology — Promised Literature and agreed to meet at our convenience to present technology.

Literature to be sent. (Received 5-22)

Note: follow up meeting(s) planned. 5-28.

TRC

TELEPHONE CALL LOG

PROJECT NO. 11958-Q82 PROJECT: ODEQ MINING RULES

DATE: 5/13/92 TIME: 11:00 A.M. PHONE: (702) 687-4670

TO: BOB CARLSON OF: NEVADA NDEP

FROM: R.V. BECK OF: TRC

SUBJECT: HEAP LEACH PAD LINER SYSTEMS

DISCUSSION:

PADS: 1) 2-LINER SYSTEM
2) PRIMARY LINER MAX $K = 1 \times 10^{-7}$ CM/SEC CLAY OR FML. (CLAY LINER 1 FT. THICK)
3) SECONDARY LINER MAX $K = 1 \times 10^{-6}$ CM/SEC IF L.D.S. NOT USED OR 1×10^{-5} CM/SEC IF L.D.S. IS USED. (1 FT THICK)
4) GEOTEXTILE/GEONET ACCEPTABLE
5) FREE DRAINING MATERIAL REQUIRED ABOVE PRIMARY LINER TO RELIEVE HEAD

PONDS: 1) 2-LINER SYSTEM
2) PRIMARY LINER $K \leq 10^{-7}$ CM/SEC CLAY OR FML WITH $K \leq 10^{-12}$ CM/SEC. CLAY LINER 1 FT THICK.
3) SECONDARY LINER 1' OF 1×10^{-7} CM/SEC CLAY OR FML W/ $K \leq 10^{-12}$ CM/SEC
4) LCRS GEONET OR PERMEABLE MATERIAL

TELEPHONE CALL LOG

PROJECT NO. ______ PROJECT: ______

DATE: ______ TIME: ______ PHONE: ( ) ______

TO: ______ OF: ______

FROM: ______ OF: ______

SUBJECT: ______

DISCUSSION:

DETOX OF H.L. FACILITIES:

1) SPENT ORE TO BE STABILIZED TO CN^- LEVELS BELOW 0.2 ppm WAD AT pH BETWEEN 6 AND 9.
2) LEACHATE TO BE CHARACTERIZED FOR METALS AND SULPHIDES.
3) UPON APPROVAL RECLAMATION MAY COMMENCE.

DETOX OF TAILING PONDS:

1) SHOULD BE STABILIZED IN PLACE W/ REGARD TO SULPHIDES AND ACIDS
2) LINER OF 10^{-6} CM/SEC IS REQUIRED FOR BOTTOM OF POND
3) OPERATIONS STRESS THE EMPHASIS OF A FLUID MANAGEMENT PLAN

TRC

TELEPHONE CALL LOG

PROJECT NO. 11958-082 PROJECT: ODEQ MINING RULES

DATE: 5/13/92 TIME: 2:00 P.M. PHONE: (208) 334-5898

TO: JERRY YODER OF: DEQ - IDAHO

FROM: R.V. BECK OF: TRC

SUBJECT: HEAP LEACH PAD LINER SYSTEMS

DISCUSSION:

PADS: 1) SINGLE LINERS ACCEPTABLE FOR H.L PADS.

2) FML OR CLAY ACCEPTABLE PROVIDED $K \leq 10^{-6}$ CM/SEC.

3.) L.D.S. NOT REQUIRED PER SE BUT MAY BE NECESSARY AS PART OF W.Q. MONITORING PROGRAM

PONDS: 1) DOUBLE LINER SYSTEM

2) L.D.S. NECESSARY

TRC

TELEPHONE CALL LOG

PROJECT NO. 11958 PROJECT: ODEQ

DATE: 5-19-92 TIME: 4:00 PHONE: ( )

TO: Andre Douchane OF: Battle Mountain

FROM: GVJ OF: TRC.

SUBJECT: CN Desti

DISCUSSION:

INQUIRED ABOUT BMGC Alk Chlor. at Fortitude Mine. Referred to ART LEFLER — CONSULT.

Alk Cl_2 utilized at Fortitude to reduce Free/WAD CN to less than 50 ppm.

BMGC plans to implement (INCO) SO_2 process at San Luis if site tests support process. Plan to reduce free/WAD CN "significantly" below 30 ppm. In interim will use a waste from steel processing, [$ZnFe(SO_4)_2$] Zinc ferrous sulfate to reduce CN and heavy metals to comply with permit standards.

Note — Consider zinc ferrous sulfate to be an emergency measure. INCO process selected as candidate due to longer term reliability and efficiency.

TRC

TELEPHONE CALL LOG

PROJECT NO. 11958 PROJECT: ODEQ MINING RULES

DATE: 5/21/92 TIME: PHONE: (202) 737-1872

TO: MS. ANN NAFFIER OF: MINERAL POLICY CENTER WASH. D.C.

FROM: JIM BECK OF: TRC

SUBJECT: REQUEST FOR TECHNICAL INFORMATION

DISCUSSION:

CONTACTED MINERAL POLICY CENTER TO REQUEST TECHNICAL DOCUMENTATION RELATING TO HEAP LEACH LINER, CYANIDATION, AND CLOSURE/RECLAMATION ISSUES.

MS. NAFFIER INDICATED THAT SHE WOULD SEND ALL BACK ISSUES OF CLEMENTINE PUBLICATION; THAT THEY HAD SIGNIFICANT AMOUNT OF MATERIAL & MR. HOCKING WILL PREPARE SOME MATERIAL; AND REFERRED ME TO MR. WILL PATRICK IN BOZEMAN MT. OFFICE.

$\boxed{\text{END}}$

TRC

TELEPHONE CALL LOG

PROJECT NO. 11958 PROJECT: ODEQ MINING RULES

DATE: 5/21/92 TIME: PHONE: (406) 585-9009

TO: MR. WILL PATRICK OF: MINERAL POLICY CENTER BOZEMAN MT.

FROM: JIM BECK OF: TRC

SUBJECT: REQUEST FOR TECHNICAL INFORMATION

DISCUSSION:

CONTACTED W. PATRICK TO FOLLOW-UP ON D.C. OFFICE REFERRAL. EXPLAINED REASON FOR CALL, TRC CONTRACT, AND BASIS FOR REQUEST FOR TECHNICAL INFORMATION RE: LINER SYSTEMS, CYANIDATION, ETC. EXPLAINED THAT RECORD OF PROCEEDINGS CONTAINED PRIMARILY NEWS CLIPPINGS AND THAT TRC WAS LOOKING FOR INFO OF A DOCUMENTABLE TECHNICAL NATURE TO EVALUATE. REQUESTED THAT HE COMPILE SAME AND DELIVER TO H. SAWYER FOR FORWARDING TO TRC. HE INDICATED THAT HE WOULD DO SO.

END

TRC

TELEPHONE CALL LOG

PROJECT NO. 11958 PROJECT: ODEQ MINING RULES

DATE: 5/28/92 TIME: PHONE: ( )

TO: JIM BECK OF: TRC

FROM: WILL PATRICK OF: MINERAL POLICY CENTER

SUBJECT: TECHNICAL INFORMATION REQUEST.

DISCUSSION:

W. PATRICK CALLED TO GET CLARIFICATION AS TO MY REQUEST FOR INFO. FURTHER EXPLAINED. HE SAID HE'D BE GETTING APPROPRIATE MATERIALS TOGETHER FOR CONSIDERATION AND WOULD FORWARD TO. H. SAWYER. $\boxed{\text{END}}$

TRC

~~TELEPHONE CALL~~ LOG

PROJECT

OUTSIDE MEETINGS -

1/2

PROJECT NO. 11958 PROJECT: ODEQ

DATE: 5-28-92 TIME: PHONE: ( )

TO: OF: CYPRUS GOLD -

FROM: OF:

SUBJECT:

DISCUSSION: Meeting to REVIEW CYANISORB® TECHNOLOGY (Patented)

Mr. J. Sturgess - Director Env. Affairs Cyprus Copper Co.

Mr. A. Goldstone - Process Engineer Cyprus Gold

Mr. R. Jenkins - Bus. Dev. Engineer. / Cyprus Gold.

M. J. Beck - Project Mgr. TRC.

Mr G. Jergenson, Process Mgr. TRC

Reviewed Development of Cyprus' AVR Process called CYANISORB. Mr. Goldstone supervised testing and process development at the Golden Cross Mine. Site located in rainy climate, in a major trout fishery habitat. Process said to produce less than 30ppm free and WAD levels and project is permitted without a FML liner.

Cyprus believes that technology is now available to remove CN from slurries at high efficiency. TRC referred to papers by Goldstone and Mudder and Omofoma/Hampton.

TRC

Job: ODEQ Date:

Subject	Item Discussed	Action By	Date

Cyprus offered copies of New Zealand permit, if thought useful, to present exercise.

Other information, including process patent provided by mail.

Specific Process Information generally confidential.

Cyprus, in selling (offering) their technology truly believes that, in the CYANISORB Process, they have solved the problems that limited the use of AVR on slurries.

TELEPHONE CALL LOG

PROJECT NO. 11958 PROJECT: ODEQ Mining Rules

DATE: 6/3/92 TIME: PHONE: ( )

TO: Jim Beck OF: TRC

FROM: Dirk van Zyl OF: Golder Assoc. - Denver

SUBJECT: Project Schedule

DISCUSSION:

Mr. van Zyl called to inquire about project completion schedule, specifically draft report submittal.

Told him contract specified delivery date was 6/19. Referred him to ODEQ if additional questions. Conversation concluded. END

TRC

TELEPHONE CALL LOG

PROJECT NO. 11958 PROJECT: ODEQ

DATE: 6-9-92 TIME: 11:00 PHONE: ( ) 721-9111

TO: M. Both OF: Minproc

FROM: GWJ OF: TRC

SUBJECT:

DISCUSSION: Application history of CN destruction processes.

Mr. Both provided comment on various processes, from Minproc experience and his own personal experience.

1. Battle Mountain Gold "so called" CN Removal System at San Luis IS NOT a true AVR system — Tailings acidified prior to release to lined pond — however CN not recovered and no extra effort provided to "strip" CN from acidified tails.

2 Alk Chlorination Works Effectively to reduce CN but requires high amounts of reagents, etc. process is finding decreasing usage.

TRC

TELEPHONE CALL LOG

2/2

PROJECT NO. ______ PROJECT: ______

DATE: ______ TIME: ______ PHONE: ( ) ______

TO: Murray OF: ______

FROM: ______ OF: ______

SUBJECT: ______

DISCUSSION:

3. INCO is said to have some 70 installations. Murray promised FAX on list of Applications —

4. Minpro bidding on SO_2 system (Construction / Design-Construction of SO_2 processes in several projects -

5. H_2O_2 systems not as widely used but, when properly applied (in the right situations) are effective.

TRC

TELEPHONE CALL LOG

PROJECT NO. 11958 Q82 PROJECT: ODEQ MINING RULES

DATE: 7/15/92 TIME: 1600 PHONE: (907) 789-9114

TO: MR. RICK RICHINS OF: COUER d'ALENE MINES

FROM: JIM BECK OF: TRC

SUBJECT: RE: THUNDER MOUNTAIN MINE ENVIRONMENTAL LEADERSHIP AWARD.

DISCUSSION:

CONTACTED MR. RICHINS IN RESPONSE TO READING ARTICLE IN MINERAL POLICY CENTER PUBLICATION "CLEMENTINE"; INQUIRED ABOUT DESIGN PARAMETERS FOR LINER SYSTEM, CYANIDE DETOXIFICATION, AND COVER/CLOSURE.

LINER — NAT CLAY + AGGREG LEAK DET. SYSTEM.
+ 80 MIL HDPE + 6" SEALED ASPHALT
+ 18" LEACHATE COLLECTION ZONE.

DETOX — ALKALINE CHLORINATION WASH/RINSE TO
0.2 mg/L 2-hr/24 hr STABILIZED.
PLACED IN PIT OR TO COMP. CLAY AREA.

COVER — 6" COMP. CLAY + TOPSOIL/VEG.

NOTE - ALL CLAY NATURALLY OCCURRING ONSITE

END

TRC

APPENDIX A-3

LIST OF PREPARERS

The following alphabetical list of TRC contributors prepared the Report of Findings on Specific Technical Issues - State of Oregon Proposed Chemical Mining Rules:

1. *Beck, James M.*

   Mr. Beck is a Registered Professional Engineer with fifteen years experience in mining and environmental engineering. He holds a B.S. degree in Mining Engineering from the Michigan Technological University (1977) and has completed studies toward an M.B.A. degree at the University of Colorado. He has extensive experience in the design and evaluation of heap leach facilities; cyanide destruction; liner, cap and cover systems; and in heap leach and tailing facility closure and site reclamation. This experience has been gained through approximately five years previous employment with Anaconda Copper Company in addition to employment as a mining and environmental consultant for the past ten years. His recent experience has included technical critique and comment on a number of proposed mine waste regulatory programs.

2. *Beck, Richard V.*

   Mr. Beck is a Registered Professional Engineer with over fifteen years experience in all aspects of solid waste management facility geotechnical design and construction. He holds a B.S. degree in Physics from Elmhurst College (1975), a B.S. degree in Civil Engineering from Tri-State University (1977), and an M.S. in Civil Engineering (Geotechnical) from the University of Colorado (1983). As a geotechnical engineer, he has extensive experience in the design and construction of mining and solid waste facilities, including all aspects of liner and leachate collection systems, tailing impoundment facilities, and cap and cover systems for facility closure.

3. *Jergensen, Gerald V.*

   Mr. Jergensen holds a B.S. degree in Minerals Engineering from the Colorado School of Mines (1965), and an M.B.A. degree from the University of Colorado (1972). He serves as an adjunct professor of Metallurgy at the Colorado School of Mines. As a mineral processing engineer, Mr. Jergensen has extensive experience in process chemistry and design and evaluation of heap leaching and tailing treatment operations.

4. *Muhm, James R.*

Mr. Muhm is a Certified Professional Geologist with over forty years experience in regulatory affairs and community relations. He holds a B.S. degree in Geology from the University of Wyoming (1950). He was recently a major participant in a cooperative rulemaking effort under contract to the state of Minnesota, culminating in the 1990 publication of "The Report on the Mining Simulation Project (Non-Ferrous Mineral Project)". He was subsequently engaged in a similar regulatory development program under contract to the state of Maine, for development of a statewide non-ferrous metallic mining regulatory program.

APPENDIX B-1

ODEQ COMMENTS/RESPONSES

APPENDIX B-1: ODEQ COMMENTS/RESPONSES

TRC has assembled ODEQ comments (as contained within the July 2, 1992 letter) and provided the following responses, assembled by Section corresponding with the report format:

1) Section 1: INTRODUCTION

1-1 *<u>ODEQ.</u> Your draft report deviated from the specific technical questions in the scope of work and inappropriately presented suggestions on policy issues that have been extensively considered and debated by the Commission. As noted in our attached comments, all such policy suggestions must be eliminated from the final report. You are welcome to submit your views on policy issues to the Commission if you choose by letter or separate document. If you do so, we and the Commission will consider them as we would any other commentator – but we will not consider them a part of the work we contracted for nor a formal part of the report. This report, to be consistent with the scope of work in the contract, must present technical information and analysis in response to the questions posed, and be free of recommendations or opinions you may hold which were not a part of the contract or scope of work.*

TRC RESPONSE: TRC does not agree that the draft report deviated from the specific technical questions in the scope of work, particularly since the Request for Proposal was entitled "Technical Advice on Mining Rules". TRC examined the technical aspects of the issues and drew conclusions therefrom. Nevertheless, TRC has modified appropriate sections of the report accordingly, as discussed below, to satisfy ODEQ concerns.

1-2 *<u>ODEQ.</u> This section (1) presents significant concerns. The conclusions section (1.3) should be deleted from this report in its entirety. If TRC wishes to make policy suggestions to the Commission, it may do so by letter addressed to the Commission. The scope of work in this contract specifically asks for technical response to specific questions and specifies that the consultant is not to cross the line into policy.*

TRC RESPONSE: TRC has deleted Section 1.3 to satisfy the ODEQ directive.

While TRC agrees that the scope specifically asks for technical response to specific questions, we note that each issue response format, as prepared by ODEQ, contained a specific question pertaining to identifying alternative technologies or systems that equally or more effectively achieve the stated Commission policy. TRC presented those alternatives, with caveats pertaining to their suitability or limitations in specific applications. Likewise, TRC identified caveats pertaining to the suitability or limitations in ODEQ proposed criteria that could inhibit the ability to achieve stated Commission policy. This suggests that either (1) one or more of the identified alternatives, or (2) the proposed rule criteria may have difficulty achieving the stated Commission policy objectives at all times and in all circumstances. Implicit in such a conclusion is that site-specific, or a situational-specific application may be the only way to achieve stated Commission policy at all times. If that is perceived to be a policy suggestion, it is an erroneous perception. TRC feels rather strongly that such statements contained within the body of the draft report are technical conclusions based on professional judgement, as opposed to being unsolicited policy statements.

1-3 *<u>ODEQ.</u> The conclusion at the top of Page 7 regarding avian mortality should be deleted. It is not appropriate for the scope of work for this contract.*

TRC RESPONSE: TRC has removed Section 1.3 from the final report. This is due to the fact that there is insufficient evidence to support toxicity risk potential comparisons between 50 ppm and 30 ppm. However, we disagree that its inclusion is "not appropriate", and respond that inclusion of the avian mortality concept was introduced with extreme emphasis in the rulemaking proceedings by parties to the rulemaking. TRC was requested to review the record of the rulemaking proceedings maintained in Portland to assure that all concerned parties comments received due consideration. As a matter of record, it can be noted that an estimated ninety percent of all written documentation in those files classified as submittal from The Wilderness Society, Concerned Citizens for Responsible Mining, and related constituencies pertained to copies of newspaper articles and various state regulatory enforcement documentation citing avian mortality concerns. Of particular note, comments to the draft report from Concerned Citizens for Responsible Mining were submitted containing attachments dedicated to the sole issue of avian mortality. We note that Question 2 d.(2) on Page 5 of the RFP pertains to "toxicity"; to evaluate any material reduction would require addressing the definition of toxicity.

1-4 *<u>ODEQ.</u> DEQ would recommend that TRC consider deleting the Record of Findings (Section 1.2) and rename Section 1.0 from Executive Summary to Introduction. There is substantial information within the body of the report, and it is virtually impossible to adequately capture it in a few bullets in an executive summary. Further, an attempt to summarize has the risk of crossing the line into policy matters.*

TRC RESPONSE: TRC disagrees that summarizing technical findings intrudes into policy formulation. The summary was prepared to assist reader comprehension of an involved technical analysis. TRC reaffirms the suitability of its summary in the revised Section 1.2.

2) Section 2.0: Questions/Comments on Liner System Design

2-1 *<u>ODEQ</u> - The organization of this section requires the reader to read through a great deal of repetitive material. This makes it easy to get lost and difficult to understand the comparative differences and similarities between liner systems. It would seem easier to assimilate the material if the discussion were reorganized to take one question or evaluation criteria at a time and consider each of the three liners evaluated in a comparative sense. e.g., consider the performance characteristics of the leak detection systems of the three liners in the same section. Then summarize the total evaluation of each liner system at the end.*

TRC RESPONSE: TRC agrees that a great deal of information is presented, and that it can appear repetitive. TRC considered a number of presentation formats, including that suggested by ODEQ (i.e. consider the performance characteristics of the leak detection systems of the three liners in the same section). However, it was determined that in using such an approach a greater degree of repetition and confusion resulted.

2-2 *<u>ODEQ</u> - Figure 2-1 c) presents a graphic picture of the alternative candidate liner system. This figure identifies <u>two</u> flexible membrane liners (FML). The narrative description of the liner system in the text only identifies <u>one</u> FML. This needs to be clarified.*

TRC RESPONSE: The "alternative liner system candidate" as presented in Figure 2-1 (c) should have only one flexible membrane liner as per the text description. Figure 2-1 (c) has subsequently been corrected to agree with the text.

2-3 *<u>ODEQ</u> - Page 15 and subsequent pages in this section – The leak detection criteria is from the DEQ rule proposal – not the EQC policy statement. The Commission policy does not specify permeability requirements, the DEQ proposed rules do.*

TRC RESPONSE: It should be noted that as per the RFP, both the ODEQ and OMC proposed liners specified that they would be able to meet the 400 gpd/acre leak detection criteria and within the 10 week time period. As a result, this information was utilized by TRC for the analysis, in addition to review of the systems with regard to the EQC policy. As appropriate, TRC has modified text in the final report to properly differentiate between EQC policy and ODEQ proposed rules.

2-4 *<u>ODEQ</u> - Somewhere in the report, it would be helpful to clearly display in a comparative sense the differences between permeability levels of 10^{-7}, 10^{-11}, 10^{-6}, and 10^{-2} with respect to thickness of material and distance that fluid will move in a given period of time. Since the Commission policy statement only specifies that any leak will be detected and that correction and cleanup can occur before there is a release to the environment from the boundary of the last liner, a better understanding of how fast material will move and how far will give the Commission information needed to make the ultimate policy judgement on the specific leak detection and permeability criteria necessary in the rules.*

TRC RESPONSE: TRC has prepared an illustration (Table 2-6) which depicts the relationships between (1) the permeability of the liner components, and (2) the depths of leachate head buildup in the leak detection layer, and, (3) the thickness of the bottom liner. It is important to realize that permeability alone does not entirely influence the magnitude or rate of leachate leakage through a liner or liner defect, but that these other parameters contribute similarly. In essence, the issue should be the allowable resultant leakage rate through a liner or liner defect which is a function of all three parameters listed above.

2-5 *<u>ODEQ</u> - Definitions were provided on page 34 for various terms used for "geo" materials. It would be helpful to put the definitions in terms that a lay person would better understand and visualize. Examples of typical dimensions or use situations may be helpful.*

TRC RESPONSE: Definitions of "geo" materials as previously presented on page 34 of the report, have been moved to the beginning of Section 2.0 and placed in a "glossary" format. Some typical applications of the materials have also been included following the definitions, however TRC is uncertain as to how the definitions can be further reduced to lay terms.

2-6 *<u>ODEQ</u> - Page 25. Some additional clarification or discussion of methods for placement of materials on the top FML so as to prevent puncture would be helpful. References were made on previous pages to "sequenced ore loading" and a properly designed solution recovery system (leachate collection system) placed between the top liner and the ore. Discussion to tie the significance and importance of these items together would be helpful.*

TRC RESPONSE: Methods for placement of ore and sequenced loading schemes need to be addressed by the heap pad designer on a site specific basis depending on the site, angularity of the ore, cushioning methods used, liner type and thickness as well as equipment used to place the ore on the pad. Numerous discussions are made throughout the report referencing the leachate collection system's benefit in aiding the reduction in hydraulic head over the primary liner and enhancement of the heap stability.

2-7 *<u>ODEQ</u> - Page 29. In the third paragraph, the second sentence reads: "The leak detection system's permeable material component effectively serves as a liner system component..." This seems to need some clarification.*

TRC RESPONSE: This sentence has been revised. The leak detection system should effectively serve as a component of any liner system.

2-8 *<u>ODEQ</u> - Page 31. The report notes the importance of preventing drying of the clay liner until the secondary liner or other appropriate materials can be placed over it to retard loss of moisture. The purpose is to prevent desiccation cracking which adversely affects the overall permeability of the liner. Assuming moisture is maintained until the secondary liner is in place, what is the likelihood of drying and desiccation cracking occurring over an extended period of time? Is there any information available on this issue?*

TRC RESPONSE: The purpose of this discussion was to convey to the reader that methods should be observed to prevent, inasmuch as is possible, the occurrence of desiccation cracking in the clay liner. Desiccation cracking is very difficult to entirely prevent for liners constructed of earthen materials which are compacted to high densities in order to achieve low permeabilities. In general the higher the moisture content of the liner the more pliable it will be and will be less prone to desiccation cracking. However, as the liner becomes more moist and pliable (at water contents beyond the water content at optimum density) its density decreases while the permeability generally increases and the shear strength decreases. At higher water contents the workability of the clay becomes increasingly more difficult, as well. Therefore, the complete elimination of desiccation cracking may not be practical or reasonable to expect for earthen liners. Even the utilization of FML materials or other such low permeability materials over such clay liners will only retard the loss of moisture from the liner and will not completely eliminate it, since moisture loss from the liner in the form of water vapor will still pass through the FML. The extent of loss of moisture from a clay liner will depend on the climate, initial moisture content of the liner, overlying materials and the strength of the soil particle-water bonds in the clay, which is function of the soil mineral composition and chemistry. These are all site-specific factors. To determine the likelihood of drying and cracking occurring over time, one would have to examine the site-specific design and operational parameters. Many references are cited throughout this section to provide the reader with sources of additional information.

2-9 *ODEQ - Page 42. Reference is made in the 5th line down to ...the overlying secondary and underlying bottom liners... It seems in this situation that the "overlying secondary" is really the top or primary liner. The identification of liner components using the terms primary, secondary, top, bottom, is at times not consistent.*

TRC RESPONSE: This sentence has been revised to be more generic since the purpose of the cushioning materials would be to protect the geosynthetic liners in contact with materials which have the potential to puncture them. The terms "primary" and "top" liners are synonymous. "Secondary" liners are considered the next liner below the primary or top liner and in the case of a two-liner system, the term secondary liner would also be synonymous with the term "bottom" liner.

2-10 *ODEQ - Pages 47-49. It would be helpful to be more explicit as to how the liner systems are consistent with the EQC policy.*

TRC RESPONSE: Evaluations of the liner systems with regard to meeting the EQC policy were based on the analyses of each liner system as presented in Section 2.1. as well as what TRC believes to be good engineering judgement, since the EQC policy has no specific criteria or performance standards to compare each liner to. Therefore TRC used its best engineering judgement and the results of the investigations to determine whether or not a liner system has the potential to satisfy the EQC's very general policy requirements.

2-11 *ODEQ - Page 65 and Table 2-5. The information provided in the table regarding other state requirements for liners presents an obvious question regarding the real difference between permeabilities for liners of 10^{-3}, 10^{-4}, and 10^{-7}. Addressing the earlier comment (2-3) regarding this issue would help to put some perspective on the differences.*

TRC RESPONSE: Please see the response to comment number 2-3.

2-12 *ODEQ -Figure 2-8. This figure presents alternative liner configurations that are potentially capable of meeting the EQC policy requirements. The configurations are general, and specifications are minimal. One would assume that there are real differences between these liner configurations with regard to the risk of release, the degree of certainty that they would satisfy the Commission policy, etc. The prior analysis of liner components provides some basis for the reader to make subjective judgements of the relative performance characteristics of these liner configurations. There is insufficient information, however, to leave the reader comfortable that each liner would indeed meet the Commission policy within some limits of certainty. Some further explanation seems appropriate.*

TRC RESPONSE: The alternative liner configurations as presented in Figure 2-8 of the DRAFT report were included in the document as other potential liner candidates worthy of further consideration in meeting the EQC policy requirements if the DEQ so desires. TRC never intended to analyze more than one alternative liner system candidate under its contract with DEQ and believes that it has presented one alternative liner system and variants thereof, capable of meeting the EQC policy. TRC included this figure for the reader's information and to illustrate that many other types of liner systems are commonly utilized, and may warrant further consideration or investigation by the DEQ.

3) **Section 3.0: Questions/Comments on Tailings Treatment:**

3-1 *ODEQ - Pages 80-81. All references to avian mortality and WAD cyanide levels should be eliminated from this report. This crosses into policy discussion which is specifically outside the scope of work specified in the contract. Discussion should focus on technology for removal and reuse of cyanide, and the cyanide levels that can be achieved with such technology.*

TRC RESPONSE: The Commission asked: "Do the requirements for removal and reuse of cyanide materially reduce toxicity and potential for long-term cyanide and toxic metals release from mill tailings? Avian mortality represents an important, highly visible aspect of the toxicity question.

A limited review of available toxicity information suggests that the level of free and WAD cyanide at which bird mortalities begin to occur is about 50 ppm. The ODEQ standard of 30 ppm provides a reasonable and achievable level of safety relative to the information presently available. Additional research on the appropriate level of allowable cyanide will either support the standard or it won't. If new information suggests an even lower level, then the Commission is on very solid ground in reducing the standard as appropriate.

TRC has concluded that the 30 ppm standard can be achieved with presently available technologies, including recovery and reuse, in most foreseeable situations.

TRC has concluded that the standard is technically achievable by most chemical destruction techniques, and incorporated this finding into the text.

3-2 *ODEQ - DEQ would not agree with the conclusion that "Reuse of cyanide in and of itself would not reduce the immediate or long term toxicity potential..." Reuse would be consistent with the intent of Oregon's Toxic Use Reduction Law. Reuse would reduce the quantity of chemicals transported onto the site during the life of operations, and would therefore reduce the potential for accidental release during transport, storage, handling, etc. If cyanide is removed, but not reused, it would have to go somewhere. The options would appear to be to transport it off site to another location for use or destruction and disposal, or to chemically convert it to a less toxic form for disposal on site. Either option would not be consistent with the Commission policy to reduce the potential for release to the greatest degree practicable.*

TRC RESPONSE: If the standard of 30 ppm for free and WAD cyanide can be achieved by (1) recovery and reuse, or (2) by alternative technologies, then there is no substantial difference in the immediate or long term potential for release at that site.

Recovery and reuse (within the process) does NOT reduce the amount of cyanide within the process system. Neither does recovery and reuse reduce the amount of free or WAD cyanide that is impounded, and which constitutes the principal toxicity threat to the environment. Recovery and reuse does reduce the quantity of cyanide consumed over the life of the process. (As noted in the TRC draft report).

3-3 *<u>ODEQ</u> - Page 88. At the end of the page, the statement is made that "Heavy metals are also effectively removed." The term removed is not used consistently in the report. It would seem that removed would apply to "physically separated" and should not be used to refer to alteration of chemical form to a less soluble and less mobile form. If there is actual physical removal of heavy metals, where do they go? How are they to be handled and disposed of?*

TRC RESPONSE: Heavy metals will be precipitated from solution rather than removed from the system. Generally, once the free and WAD cyanides are reduced (by removal or destruction) below the concentrations of the metals in solution, these metals will precipitate as hydroxides, carbonates and other metal complexes. Although the metals remain in the solid portion of the tailings or heaps, they have been converted to compounds of much lower solubility and mobility, and do not constitute a realistic threat to the environment.

The term "removed" has been accordingly changed to "precipitated from solution" or simply "precipitated", as appropriate.

3-4 *<u>ODEQ</u> - Page 92 and Section 4. Natural degradation should be taken advantage of during the life of the mine, before closure of the heap and tailings pond. Natural degradation is not very controllable or manageable. TRC correctly points out that it should not be considered an effective stand-alone technology.*

TRC RESPONSE: Natural degradation is not readily controlled in the short term. TRC also notes, however, that preliminary indications from the literature review made for this study suggests that the end result of the natural degradation process may be very predictable (i.e., very low final levels of both WAD and total cyanide concentrations).

4) Questions/Comments on Closure

4-1 *<u>ODEQ</u> - Pages 99-101 and Section 4.3.*

- *4.3.1 - TRC states that a heap can be effectively detoxified.*
- *4.3.2 - TRC states that covering would generally be beneficial, reducing water infiltration into the heap, thus inhibiting mobilization of metals, reducing potential for acid formation, and enhancing stability of the heap. TRC notes that a disadvantage of cover would be to reduce the potential for further natural degradation of residual cyanide left in the heap.*
- *4.3.3. - TRC states that detoxification will virtually eliminate free and WAD cyanide and will stabilize metal release, and that covering will provide no additional benefit and may in fact be deleterious to the detoxification attributes (provided that the ore does not contain metals or acid generating constituents such as sulfides, in which cases cover may be desirable). TRC further states that cover would generally not be*

warranted since provisions for drainage of waters from the heap could be implemented to insure that water buildup and stability problems do not occur.

The conclusions in these sections appear inconsistent. If the heap can be effectively detoxified, then the identified disadvantages associated with cover (reduced further natural degradation) would be largely negated, and the positive aspects of cover (reduced infiltration, inhibited mobilization of metals, enhanced stability of the heap) would be realized.

TRC RESPONSE: TRC only indicates that a heap can be effectively detoxified to 0.5 ppm WAD based on general mining industry experience. The results of this study indicate that cyanide degradation and attenuation in a heap can be achieved by individual or combined application of rinsing, chemical treatment, and natural degradation reactions. We have noted that 0.5 ppm free and WAD levels have been attained in heap closures in the short term. However, the amount of additional treatment and rinsing that will be required to attain the federal standard is unclear. With natural degradation and/or continued rinsing, lower concentrations may be achieved.

The detoxification, rinsing and closing process may require an extended period of active management. Until the specified standard is reached, TRC suggests that covering would reduce the potential for natural degradation to result in these lower levels of residual cyanide. TRC indicates that a cover may preclude attainment of the ultimate 0.2 ppm WAD closure requirement.

Rinsing and detoxification processes have been shown to lower the pH of both the detoxification solutions and of the heap itself. If there is a potential for acid generation, heavy metal mobilization could be inadvertently initiated during the detoxification process. In this instance, covering as soon as practicable may be warranted, even though the proposed 0.2 ppm WAD cyanide levels have not been attained within the heap.

In order to assure that the heaps remain stable it may be necessary to prevent the accumulation of water within the heaps. This can be achieved either by providing adequate provisions for evaporation and transpiration from the heaps or by isolating the heaps from infiltration of water. This may be a concern if the fluid buildup potential exceeds that of evaporation. Covering or other alternative technologies may be warranted where such is the case.

For clarification purposes, the following table has been prepared.

	Heap Leach Facility Closure			Tailings Facility Closure		
	Detox	Cover	Combined	Detox	Cover	Combined
Toxic Chemical Reduction	YES	NO	MAYBE	YES	NO	NO
Toxic Metal Reduction	NO	NO	MAYBE	MAYBE	MAYBE	MAYBE

4-2 *<u>ODEQ</u> - The suggested implementation of drainage of the heap to protect against water buildup (as opposed to cover) implies a potential need for treatment of drainage water, (particularly if detoxification is not uniformly effective throughout the heap) and continued monitoring of drainage water quality after closure. This approach seems inconsistent with the general intent of closure in a manner to reduce the need for ongoing maintenance to zero as soon as practicable, and prevention of the release of potentially toxic chemicals to the environment.*

TRC RESPONSE: The provisions for drainage would be of great value during the closure period so that maximum value is derived from the natural degradation processes. Also, the drainage points provide a ready monitoring point for the operator to observe the results and progress of the closure process and to modify the efforts as necessary to assure the quality of the end result. Monitoring of heap (or tailing) drainage appears to be unavoidable, although monitoring curtailment may be more appropriately linked to stabilized achievement of standards rather than an arbitrary time period such as 30 years, which is more appropriately applied to "hazardous waste" management units.

4-3 *<u>ODEQ</u> - Pages 101-102 Section 4.4*

- *In 4.4.3, TRC states that once detoxified, a cover designed to exclude air and water may provide little, if any quantifiable benefit with respect to toxicity release. The section goes on to note qualifications that the tails do not possess the potential for acid generation, heavy metals species have been removed from the system, and drainage is implemented as necessary to prevent fluid buildup.*

- *We would note that removal of heavy metals species from the tailings is not required by the current rule draft. It would seem that a closed, uncovered tailings facility would present a long term potential for production of leachate drainage that would require maintenance and monitoring, could require treatment, and would likely be inconsistent with the Commission policy regarding release to the environment of toxic chemicals.*

TRC RESPONSE: If the potential for acid production due to sulfides is significant, then a more complex covering system may be warranted. Only site specific tailings chemistry can provide an indication of the extent of such covering that will be necessary.

4-4 *<u>ODEQ</u> - Page 104. The conclusions of section 4.5.3 again appear to be based on an assumption that drainage is provided to prevent fluid buildup in the tailings. We have the same comments and concerns as expressed above on this issue.*

TRC RESPONSE: TRC is not presenting contradictions, but is identifying potential shortcomings. TRC is stressing the necessity for flexibility to select and implement appropriate engineering alternatives to achieve maximal results. Either provisions for (1) adequate water removal through transpiration and evaporation, or (2) prevention of water infiltration may be necessary to maintain the stability of a particular tailings impoundment.

Materials within tailings impoundments tend to consolidate and may ultimately reach a density that excludes further infiltration of water. At this point, the potential for acid generation diminishes. However, if acid generation potential is high at the outset, then methods for the exclusion of air (and thereby oxidation potential) may be required. This could require a cover or other alternative measures to assure compliance.

APPENDIX B-2

ODEQ COMMENT LETTER (AS RECEIVED)

Oregon

DEPARTMENT OF ENVIRONMENTAL QUALITY

July 2, 1992

JUL 06 92

James M. Beck, P.E.
Manager Hazardous Waste Investigation and Engineering
TRC Environmental Consultants, Inc.
7002 South Revere Parkway, Suite 60
Englewood, CO 80112

Re: Draft Report on Findings on Specific Technical Issues - Proposed Chemical Mining Rules

Dear Mr. Beck:

The Department of Environmental Quality has reviewed the Draft Report and transmits its specific comments in the attachment to this letter. Pursuant to the Contract between TRC and the Department, the final report is due 15 days after receipt of these comments.

Under separate cover, we have already transmitted to you copies of the comments received from others who have reviewed the Draft Report. We urge you to read these comments from others, and to consider and respond to the comments regarding specific sections of your report as you deem appropriate in the preparation of your final report. We are aware that some of the comments deal with matters that are outside the scope of work in this contract and you should not attempt to consider or respond to such comments.

Your draft report deviated from the specific technical questions in the scope of work and inappropriately presented suggestions on policy issues that have been extensively considered and debated by the Commission. As noted in our attached comments, all such policy suggestions must be eliminated from the final report. You are welcome to submit your views on policy issues to the Commission if you choose by letter or separate document. If you do so, we and the Commission will consider them as we would any other commenter — but we will not consider them a part of the work we contracted for nor a formal part of the report. This report, to be consistent with the scope of work in the contract, must present technical information and analysis in response to the questions posed, and be free of recommendations or opinions you may hold which were not a part of the contract or scope of work.

Sincerely,

Fred Hansen

Fred Hansen
Director

811 SW Sixth Avenue
Portland, OR 97204-1390
(503) 229-5696

FH:l
Attachment

DEQ Comments on TRC Draft Report

These comments will start with Section 2 and end with comments on Section 1.

Section 2

General Comments.

The organization of this section requires the reader to read through a great deal of repetitive material. This makes it easy to get lost and difficult to understand the comparative differences and similarities between liner systems. It would seem easier to assimilate the material if the discussion were reorganized to take one question or evaluation criteria at a time and consider each of the three liners evaluated in a comparative sense. e.g., consider the performance characteristics of the leak detection systems of the three liners in the same section. Then summarize the total evaluation of each liner system at the end.

There is some confusion throughout the section on liners regarding the distinction between the Statement of Commission Policy as presented in the RFP, and the specific performance criteria that are contained in the rule language for the DEQ proposed Triple liner. In some instances, the other liners are evaluated in relation to the specifications in the DEQ proposed rule. Such comparison is helpful in understanding the differences between liners, however, the evaluation also needs to be clearly related to the elements of the EQC policy statement.

References in the text to figure numbers and the actual figures do not match up in all cases (beginning on page 59 with the reference to figure 2-5 which is actually figure 2.6).

Specific Comments

Figure 2-1 c) presents a graphic picture of the alternative candidate liner system. This figure identifies two flexible membrane liners (FML). The narrative description of the liner system in the text only identifies one FML. This needs to be clarified.

Page 15 and subsequent pages in this section -- The leak detection criteria is from the DEQ rule proposal -- not the EQC policy statement. (See general comment above.)

The Commission policy does not specify permeability requirements. The DEQ proposed rules do. (See general comment above.)

Somewhere in the report, it would be helpful to clearly display in a comparative sense the differences between permeability levels of 10^{-7}, 10^{-11}, 10^{-6}, and 10^{-2} with respect to thickness of material and distance that fluid will move in a given period of time. Since the Commission policy statement only specifies that any leak will be detected and that correction and cleanup can occur before there is a release to the environment from the boundary of the last liner, a better understanding of how fast material will move and how far will give the Commission information needed to make the ultimate policy judgment on the specific leak detection and permeability criteria necessary in the rules.

Definitions were provided on page 34 for various terms used for "geo" materials. It would be helpful if this were provided prior to the first significant discussion of these materials which begins shortly after page 15. It would also be helpful to put the definitions in terms that a lay person would better understand and visualize. Examples of typical dimensions or use situations may be helpful.

Page 25 Some additional clarification or discussion of methods for placement of materials on the top FML so as to prevent puncture would be helpful. References were made on previous pages to "sequenced ore loading" and a properly designed solution recovery system (leachate collection system) placed between the top liner and the ore. Discussion to tie the significance and importance of these items together would be helpful.

Page 29 In the third paragraph, the second sentence reads: "The leak detection system's permeable material component effectively serves as a liner system component....." This seems to need some clarification.

Page 31 The report notes the importance of preventing drying of the clay liner until the secondary liner or other appropriate materials can be placed over it to retard loss of moisture. The purpose is to prevent desiccation cracking which adversely affects the overall permeability of the liner. Assuming moisture is maintained until the secondary liner is in place, what is the likelihood of drying and desiccation cracking occurring over an extended period of time? Is there any information available on this issue?

Page 42 Reference is made in the 5th line down to ...the overlying secondary and underlying bottom liners... It seems in this situation that the "overlying secondary" is really the top or primary liner. The identification of liner components using the terms primary, secondary, top, bottom, is at times not consistent.

Pages 47-49 -- It would be helpful to be more explicit as to how the liner systems are consistent with the EQC policy. (See general comment above.)

Page 65 and Table 2-5 -- The information provided in the table regarding other state requirements for liners presents an obvious question regarding the real difference between permeabilities for liners of 10^{-5}, 10^{-6}, and 10^{-7}. Addressing the earlier comment regarding this issue would help to put some perspective on the differences.

Figure 2-8 -- This figure presents alternative liner configurations that are potentially capable of meeting the EQC policy requirements. The configurations are general, and specifications are minimal. One would assume that there are real differences between these liner configurations with regard to the risk of release, the degree of certainty that they would satisfy the Commission policy, etc. The prior analysis of liner components provides some basis for the reader to make subjective judgments of the relative performance characteristics of these liner configurations. There is insufficient information, however, to leave the reader comfortable that each liner would indeed meet the Commission policy within some limits of certainty. Some further explanation seems appropriate.

Section 3

Pages 80-81 -- All references to avian mortality and WAD cyanide levels should be eliminated from this report. This crosses into policy discussion which is specifically outside the scope of work specified in the contract. Discussion should focus on technology for removal and reuse of cyanide, and the cyanide levels that can be achieved with such technology.

Page 81 DEQ would not agree with the conclusion that "Reuse of cyanide in and of itself would not reduce the immediate or long term toxicity potential..." Reuse would be consistent with the intent of Oregon's Toxic Use Reduction Law. Reuse would reduce the quantity of chemicals transported onto the site during the life of operations, and would therefore reduce the potential for accidental release during transport, storage, handling, etc. If cyanide is removed, but not reused, it would have to go somewhere. The options would appear to be to transport it off site to another location for use or destruction and disposal, or to chemically convert it to a less toxic form for disposal on site. Either option would not be consistent with the Commission policy to reduce the potential for release to the greatest degree practicable.

Page 88 At the end of the page, the statement is made that "Heavy metals are also effectively removed." The term removed is not used consistently in the report. It would seem that removed would apply to "physically separated" and should not be used to refer to alteration of chemical form to a less soluble and less mobile form. If there is actual physical removal of heavy metals, where do they go? How are they to be handled and disposed of?

Page 92 and Section 4 -- Natural degradation should be taken advantage of during the life of the mine, before closure of the heap and tailings pond. Natural degradation is not very controllable or manageable. TRC correctly points out that it should not be considered an effective stand-alone technology.

Section 4

Pages 99-101 Section 4.3

- 4.3.1 - TRC states that a heap can be effectively detoxified.

- 4.3.2 - TRC states that covering would generally be beneficial, reducing water infiltration into the heap, thus inhibiting mobilization of metals, reducing potential for acid formation, and enhancing stability of the heap by reducing the potential for fluid buildup in the heap. TRC notes that a disadvantage of cover would be to reduce the potential for further natural degradation of residual cyanide left in the heap.

- 4.3.3 - TRC states that detoxification will virtually eliminate free and WAD cyanide and will stabilize metal release, and that covering will provide no additional benefit and may in fact be deleterious to the detoxification attributes (provided that the ore does not contain metals or acid generating constituents such as sulfides, in which cases cover may be desirable). TRC further states that cover would generally not be warranted since provisions for drainage of waters from the heap could be implemented to insure that water buildup and stability problems do not occur.

The conclusions in these sections appear inconsistent. If the heap can be effectively detoxified, then the identified disadvantages associated with cover (reduced further natural degradation) would be largely negated, and the positive aspects of cover (reduced infiltration, inhibited mobilization of metals, enhanced stability of the heap) would be realized.

The suggested implementation of drainage of the heap to protect against water buildup (as opposed to cover) implies a potential need for treatment of drainage water, (particularly if detoxification is not uniformly effective throughout the heap) and continued monitoring of drainage water quality after closure. This approach seems inconsistent with the general intent of closure in a manner to reduce the need for ongoing maintenance to zero as soon as practicable, and prevention of the release of potentially toxic chemicals to the environment.

Pages 101-102 Section 4.4

In 4.4.3, TRC states that once detoxified, a cover designed to exclude air and water may provide little, if any quantifiable benefit with respect to toxicity release. The section goes on to note qualifications that the tails do not possess the potential for acid generation, heavy metals species have been removed from the system, and drainage is implemented as necessary to prevent fluid buildup.

We would note that removal of heavy metals species from the tailings is not required by the current rule draft. It would seem that a closed, uncovered tailings facility would present a long term potential for production of leachate drainage that would require maintenance and monitoring, could require treatment, and would likely be inconsistent with the Commission policy regarding release to the environment of toxic chemicals.

Page 104 The conclusions of section 4.5.3 again appear to be based on an assumption that drainage is provided to prevent fluid buildup in the tailings. We have the same comments and concerns as expressed above on this issue.

Section 1

This section presents significant concerns. The conclusions section (1.3) should be deleted from this report in its entirety. If TRC wishes to make policy suggestions to the Commission, it may do so by letter addressed to the Commission. The scope of work in this contract specifically asks for technical response to specific questions and specifies that the consultant is not to cross the line into policy.

The conclusion at the top of page 7 regarding avian mortality should be deleted. It is not appropriate for the scope of work for this contract.

DEQ would recommend that TRC consider deleting the Record of Findings (Section 1.2) and rename Section 1.0 from Executive Summary to Introduction. There is substantial information within the body of the report, and it is virtually impossible to adequately capture it in a few bullets in an executive summary. Further, an attempt to summarize has the risk of crossing the line into policy matters.

APPENDIX C-1

ODEQ REQUEST FOR PROPOSAL

State of Oregon

DEPARTMENT OF ENVIRONMENTAL QUALITY

REQUEST FOR PROPOSALS
FOR
TECHNICAL ADVICE ON MINING RULES

February 7, 1992

TABLE OF CONTENTS

ATTACHMENTS

I. GENERAL INFORMATION

A. Introduction

The Environmental Quality Commission (Commission) is considering adoption of rules to require mining operations using cyanide or other toxic chemicals to protect soils, groundwater, surface waters, and wildlife from contamination or harm by process solutions and waste waters. The protective measures required by the proposed rules include cyanide recovery and re-use, chemical detoxification of cyanide residues, and extensive lining and engineered closure of waste disposal facilities.

During the public participation process on the proposed rules, mining companies and associations have argued that some of the requirements are unnecessarily stringent or are unproven or are unavailable. Environmental protection organizations have argued that the proposed rules may not be adequately protective in certain respects.

The Commission has studied the proposed rules and the public comments received, and has extensively debated the policy issues associated with the rule proposal. Prior to final action to adopt proposed rules, the Commission has elected to seek an evaluation and advice on specific technical questions from an independent, knowledgeable contractor.

The entire record of the rulemaking proceeding is available for inspection as background material for this proposal request. The record can be reviewed in the headquarters office of the Department of Environmental Quality (DEQ or Department or Agency). A full copy of the draft proposed rules being considered by the Environmental Quality Commission is attached as Attachment B.

B. Proposed Project Timeline

Date	Action
February 7, 1992	Mail Request for Proposal
February 28, 1992	Information Exchange (to take place only between mailing of the RFP and this date)
March 10, 1992	Written Proposals Due
March 20, 1992	Selection of Contractor (written notice of award to successful proposer)

March 30, 1992	Protest Period (protests must be filed by this date)
April 10, 1992	Execution of Standard State Personal Service Contract (target date)
Within 15 calendar days of Contract Execution:	Participate in Public Meeting.
Within 45 calendar days of Contract Execution:	Draft Written Report submitted to DEQ.
Within 15 calendar days of Receipt of Comments from DEQ:	Submit Final Report.

C. Services Requested

DEQ is requesting proposals from individuals acting as independent contractors (see attached Independent Contractor Certification Statement form), firms, joint ventures or teams for providing advice to the Commission on technical issues related to proposed rules for mining operations using chemicals to extract metals from ores. Companies interested in pooling their resources through contractor/subcontractor, joint ventures or team arrangements can do so provided that one entity is identified which ultimately will bear total contract responsibility.

D. Scope of Work

Three policies have been established by the Commission. The selected contractor shall evaluate and address specific technical questions surrounding these policies. The Commission is not asking for alternative policy recommendations or evaluation of economic issues. The task of the contractor is to answer the questions posed in the following paragraphs based on their knowledge, expertise, experience, review of current published technical data, and technical evaluation of the issues.

1. Questions on Liners, Leak Detection, and Leak Collection Systems

   a. Statement of Policy:

      The Commission establishes as policy that a liner, leak detection and leak collection system are necessary to assure that any leak will be detected before toxic materials escape from the liner system and are released to the environment. These systems must assure that if a leak is found, sufficient time is available to allow for the repair of the leak and clean up of any leaked material before there is a release to the environment. Natural

conditions, such as depth to groundwater or net rainfall, shall be considered as additional protection but not in lieu of the protection required by the required engineered protection.

NOTE: Definition of "environment" or use of defining qualifiers is central to the issue. The Commission considers that the environment begins at the bottom of the last liner.

b. Issue:

In the proposed rule contained in 340-43-065(4), the requirements for heap leach pad liners are as follows:

(4) The heap leach pad liner system shall be of triple liner construction with between liner leak detection consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;

(b) Continuous flexible membrane middle and top liners of suitable synthetic material separated by a minimum of 12 inches of permeable material (minimum permeability of 10^{-2} cm/sec);

(c) A leak detection system between the synthetic liners capable of detecting leakage of 400 gallons/day acre within ten weeks of leak initiation.

As opposed to this liner system, the Oregon Mining Council has proposed a liner characterized either as a composite liner or as a double liner and generally described as follows:

Composite Liner -- a composite liner system construction with between liner leak detection consisting of:

- An engineered, stable, low-permeability soil/clay bottom liner (maximum coefficient of permeaability of 10^{-7} cm/sec) with a minimum thickness of 12 inches;

- Continuous flexible membrane top liner of suitable synthetic material;

- A geotextile layer between the liner materials for leak detection. The leak detection and recovery system would also include collector pipes tied to the geotextile, spaced at appropriate intervals to achieve the 10-week leak initiation detection performance standard.

c. Question:

Will either or both liner systems meet the stated policy objective of the Commission?

d. Method to Answer or Address Question:

(1) Are each of the various liner systems proposed technically feasible?

(2) Will each of the various liner systems meet the stated Commission policy?

(3) For those liner systems which will meet the stated Commission policy, what level of certainty for achieving this policy do you assign to each system?

(4) Are there other liner systems which will achieve this policy and what level of certainty for achieving this policy do you assign to each?

The consultant is also asked to provide a simple comparison of typical costs for installation of the various liner configurations.

2. Questions on Tailings Treatment to Reduce the Potential for Release of Toxics

a. Statement of Policy:

The Commission establishes as policy that the toxicity and potential for long-term cyanide and toxic metals release from mill tailings should be reduced to the greatest degree practicable through tailings treatment.

b. Issue:

The proposed rules in 340-43-070(1) state the following:

(1) Mill tailings shall be treated by cyanide removal and re-use prior to disposal to reduce the amount of cyanide introduced into the tailings pond. Chemical oxidation or other means shall be additionally used, if necessary, prior to disposal to reduce the WAD cyanide level in the

liquid fraction of the tailings. The permittee shall conduct laboratory column tests on mill tailings to determine the lowest practicable concentration to which the WAD cyanide (weak-acid dissociable cyanide as measured by ASTM Method D2036-82 C) can be reduced. In no event, shall the permitted WAD cyanide concentration in the liquid fraction of the tailings be greater than 30 ppm.

The rules do not require removal of potentially toxic metals from tailings prior to placement in the tailings pond. The rules do require steps to control acid formation in the tailings pond and require covering upon closure with a composite cover designed to prevent water and air infiltration.

c. Question:

Do the requirements for **removal** and **reuse** of cyanide materially reduce toxicity and potential for long-term cyanide and toxic metals release from mill tailings?

d. Method to Answer or Address Question:

(1) Are **removal** and **reuse** technically feasible?

Potential factors for consideration include:

- Is the process technically defined and understood?
- Has the process been demonstrated in practical application, and if so, where?
- Are engineering firms available to design and oversee construction?
- Are materials and equipment available to construct?

(2). Do **removal** and **reuse** (evaluated separately) materially reduce the toxicity and potential for long-term cyanide and toxic metals release from mill tailings?

(3) What is the level of certainty you give to the answers provided above?

(4) Are there other tailings treatment technologies which will equally, or more effectively achieve the policy of the Commission?

3. Questions on Closure of the Heap Leach and Tailings Facilities

a. Statement of Policy:

The Commission establishes as policy that the closure of the heap leach and tailings disposal facilities will prevent release to the environment of toxic chemicals contained in the facility.

b. Issue:

Rule 340-43-080(4)(a), as proposed, requires that the heap shall be "... detoxified over a suitable period of time prior to closure, using rinse/rest cycles of rinsing and chemical oxidation, if necessary. The WAD cyanide concentration in the rinsate shall be no greater than 0.2 ppm."

In 340-43-080(4)(b), the proposed rules require that the closure of the heap shall be "... by covering the heap with a cover designed to prevent water and air infiltration."

In 340-43-080(5), the proposed rules state that "The tailings disposal facility shall be closed by covering with a composite cover designed to prevent water and air infiltration and be environmentally stable for an indefinite period of time."

c. Question:

Do the requirements of detoxification (cyanide removal by rinsing) of the heap and covering of the heap and tailings facility to exclude air and water materially reduce the likelihood of any release to the environment of toxic chemicals and metals contained in the heap over the long term?

d. Method to Answer or Address Question:

(1) Are detoxification and covering (as prescribed in this rule) technically feasible?

(2) Do detoxification and covering (evaluated separately and together) materially reduce the likelihood of a release of toxic chemicals and metals to the environment?

(3) What is the level of certainty you give to the answers provided above?

(4) Are there other technologies which can equally or more effectively achieve the policy of the Commission?

4. Public Meeting

In addition to answering the above questions, the selected contractor will be expected to participate in a meeting with persons who have expressed an interest in the rulemaking proceeding by presenting testimony at public hearings. The purpose of this meeting will be to:

- Inform the interested public on the contractors approach and schedule for addressing the questions posed.

- Identifying any anticipated need to contact persons who presented testimony in the proceeding for additional information to assist in addressing the questions posed. The Commission expects an open process where all interested parties will have the opportunity to attend the meeting.

This meeting will be scheduled at a time and place mutually agreeable to DEQ and the selected contractor. DEQ will arrange the meeting and provide notice to interested parties.

5. Written Report

A written report shall be submitted as the final product of this contract. The report shall state the question being answered, summarize the methodologies for evaluating and responding to the question, and clearly state the results of the evaluation and answer given.

A draft report shall be submitted to the Department for review. The Department will provide written comments to the contractor. The contractor will then complete the report and file a single master copy, ready for reproduction, with the Department. The report shall become the property of the Department. The Department may copy and distribute the report as it deems appropriate.

E. Type of Contract

DEQ anticipates awarding a fixed price contract. The State of Oregon standard personal service contract will be signed.

DEQ will, in its sole discretion, reserve the right to renew the contract.

F. Payment Procedure

Payment schedules for any contract entered into as a result of the RFP will be mutually agreed upon by DEQ and the prime contractor.

G. Managing Conflict of Interest

Proposing contractors (including subcontractors) shall disclose any potential conflicts of interest. A potential conflict of interest includes, but is not limited to, any involvement during the past five years with mining companies, mining industry groups, or environmental groups active in working on mining regulations and permitting or holding any interest in property in Oregon that may have mineral development potential. During the proposal development period and, if awarded the contract, during the contract period, the selected contractor shall maintain an arm's length relationship with all parties who are or could be interested in the rule making procedure before the Commission. The selected contractor is required to disclose all contacts, either to or by them, during the proposal process and the life of the contract.

APPENDIX C-2

ODEQ PROPOSED RULE DRAFT

RULES PROPOSAL:

OREGON ADMINISTRATIVE RULES

CHAPTER 340

DIVISION 43

CHEMICAL MINING

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS

PURPOSE

340-43-005

The purpose of these rules and guidelines is to protect the quality of the environment and public health in Oregon by requiring application of "... all available and reasonable methods...", Oregon Revised Statutes (ORS) 468.710, for control of wastes and chemicals relative to design, construction, operation, and closure of mining operations which use cyanide or other toxic chemicals to extract metals or metal-bearing minerals from the ore and which produce wastes or wastewaters containing toxic materials.

DEFINITIONS

340-43-010

Unless the context requires otherwise, as used in this Division:

(1) "Chemical process mine" means a mining and processing operation for metal-bearing ores that uses chemicals to dissolve metals from ores.

(2) "Department" means the Department of Environmental Quality.

(3) "Guidelines" means this body of rules contained in 340-43-045 through 340-43-100.

(4) "Positive exclusion of wildlife" means the use of such devices as tanks, pipes, fences, netting, covers and heap-leach drip-irrigation emitters or covered emitters.

(5) "Tailings" means the spent ore resulting from the milling and chemical extraction process.

PERMIT REQUIRED

340-43-015

(1) A person proposing to construct a new chemical mining operation, commencing to operate an existing non-permitted operation, or proposing to substantially modify or expand an existing operation shall first apply for, and receive, a permit from the Department. The permit may be an NPDES (National Pollutant Discharge Elimination System) permit if there is a point-source discharge to surface waters or a WPCF (Water Pollution Control Facility) permit if there is no discharge. Consideration may be given to site-specific conditions such as climate, proximity to water, and type of wastes to establish the final permit type and requirements for the facility.

(2) The permit application shall comply with the requirements of OAR Chapter 340, Divisions 14 and 45 and be accompanied by a report that fully addresses the requirements of this Division .

PERMIT APPLICATION

340-43-020

(1) The permit application shall fully describe the existing site and environmental conditions, with an analysis of how the proposed operation will affect the site and its environment. The Department shall, at a minimum, require the information specified for the DOGAMI consolidated application under Section 13, Chapter 735, 1991 Oregon Laws. The Department will also use the information contained in NEPA (National Environmental Policy Act), EA (Environmental Assessment), or EIS (Environmental Impact Statement) documents, if they are required by the project, as partial fulfillment of the requirements of this paragraph.

(2) The permit application shall, in addition to the information described in Paragraph (1) above, include the following information, unless the information has been otherwise submitted:

(a) Climate/meteorology characterization, with supporting data;

(b) Soils characterization, with supporting data;

(c) Surface water hydrology study, with supporting data;

(d) Characterization of surface water and groundwater quality;

(e) Inventory of surface water and groundwater beneficial uses;

(f) Hydrogeologic characterization of groundwater, with supporting data;

(g) Geologic engineering, hazards and geotechnical study, with supporting data;

(h) Characterization of mine materials and wastes which include, for example, overburden, waste rock, stockpiled ore, leached ore and tailings. Characterization of mine materials and wastes shall include, but not be limited to the following:

(A) Chemical and mineral analysis related to toxicity;

(B) Determination of the potential for acid water formation;

(C) Determination of the potential for long-term leaching of toxic materials from the wastes;

(i) Characterization of wastewater (quantity and chemical and physical quality) produced by the operation;

(j) Assessment of the potential for acid-water formation from waste disposal facilities, low-grade ore stockpiles, waste rock piles and for surface water or groundwater accumulation in open pits that will remain after mining is ended.

(3) Data submitted by the permit applicant should be based on analysis of the actual materials, when possible, or may be based on estimates from knowledge of similar operations and professional judgment.

PLANS AND SPECIFICATIONS

340-43-025

(1) A person constructing or commencing to operate a chemical process mine or substantially modifying or expanding an existing chemical process mine shall first submit plans and specifications to the Department for construction, operation and maintenance of the facilities intended for treatment, control and disposal of wastes.

(2) The Department shall approve the plans, in writing, before construction of the facilities may be started. The plans shall address all applicable requirements of this Division and shall include, but not be limited to, the following:

(a) A description of the facilities to be constructed, including tanks, pipes and other storage and conveyance means for processing chemicals and solutions and wastewaters;

(b) A management plan for control of surface water;

(c) A management plan for treatment and disposal of excess wastewater, including provisions for reuse and wastewater minimization;

(d) A facility construction plan including, as applicable, the design of low-permeability soil barriers, the type of geosynthetics to be used and a description of their installation methods, the design of wastewater treatment facilities and processes, a quality assurance plan for applicable phases of construction and a listing of construction certification reports to be provided to the Department;

(e) A preliminary closure plan;

(f) A preliminary post-closure monitoring and maintenance plan;

(g) A spill containment and control plan.

DESIGN, CONSTRUCTION, OPERATION AND CLOSURE REQUIREMENTS

340-43-030

(1) All chemical process and waste disposal facilitiesand facilities for mixing, distribution, and application of chemicals associated with on-site mining operations; ore preparation and beneficiation facilities; and processed -ore

disposal facilities shall be designed, constructed, operated and closed in accordance with the guidelines contained in this Division.

(2) A groundwater monitoring plan shall be submitted to, and be approved by the Department. Monitoring wells shall be installed for detection of groundwater contamination as required by OAR Chapter 340, Division 40, unless the hydrogeology of the site or other technical information indicates that an adverse impact on groundwater quality is not likely to occur.

(3) Alternative methods of control of wastes may be acceptable if the permit applicant can demonstrate that the alternate methods will provide fully-equivalent environmental protection. The burden of proof of fully-equivalent protection lies with the permit applicant.

(4) The Department may, in accordance with a written compliance schedule, grant reasonable time for existing facilities to comply with these rules.

EXEMPTION FROM STATE PERMIT FOR HAZARDOUS WASTE TREATMENT OR DISPOSAL FACILITIES

340-43-035

(1) The state hazardous waste program requires a permit for the "treatment", "storage" or "disposal" of any "hazardous waste" as identified or listed in OAR Chapter 340, Division 101 from the Department, prior to the treatment and disposal of wastes. Permitting requirements can be found in OAR Chapter 340, Division 105, Hazardous Waste Management.

(2) However, any operation permitted under this Division, which would otherwise require the neutralization or treatment of hazardous waste and would require a permit pursuant to OAR Chapter 340, Division 105, shall be exempt from the requirement to obtain such hazardous waste treatment permit.

(3) All mined materials disposed of under this Division shall pass Oregon's hazardous waste rule criteria or they will be considered a state hazardous waste and must be disposed of accordingly.

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS

PURPOSE

340-43-040

(1) This Division establishes criteria for the design, construction, operation and closure of chemical mining operations and supplements the provisions of OAR 340-43-005 through OAR 340-43-035.

(2) Any disapproval of submitted plans or specifications, or imposition of requirements by the Department to improve existing facilities or their operation will be referenced when appropriate, to applicable guidelines or rules.

GENERAL PROVISIONS

340-43-045

(1) Facilities permitted under either a WPCF or NPDES permit shall not discharge wastewater or process solutions to surface water, groundwater or soils, except as expressly allowed by the permit.

(2) Facilities subject to these rules shall not be sited in 100-year floodplainsor wetlands. A buffer zone (a minimum of 200 feet wide) shall be established between waste disposal facilities and surface waters.

(3) All chemical conveyances (ditches, troughs, pipes, etc.) shall be equipped with secondary containment and leak detection means for preventing and detecting release of chemicals to surface water, groundwater or soils.

(4) Acid water accumulation in open pits resulting from the mining operation must be prevented by appropriate mining practices, by measures taken in the closure process, or be treated to control pH and toxicity, for the life of the pit.

(5) Construction of surface impoundment liner systems shall conform generally to the principles and practices described in EPA/600/2-88/052, Lining of Waste Containment and Other Impoundment Facilities, September 1988.

(6) The Department may require the permittee to hire a third-party contractor to perform the functions set forth below. Selection of the contractor shall be subject to Department approval.

(a) Review and evaluate the design and construction specifications of all mined-materials disposal facilities permitted under this Division for functional adequacy and conformance with Department requirements. The Department shall not approve construction of the disposal facilities until the design and construction specifications have been evaluated.

(b) Monitor the course of construction of all mined-materials disposal facilities for compliance with the approved design and construction specifications. The third-party contractor shall regularly document the progress of construction and the Department shall require the permittee to take corrective action if construction does not satisfactorily conform to the approved design and construction specifications.

CONTROL OF SURFACE WATER RUN-ON AND RUN-OFF

340-43-050

(1) Surface water run-on and run-off shall be controlled such that it will not endanger the facility or become contaminated by contact with process materials or loaded with sediment. The control systems shall be designed to accommodate a 100-year, 24-hour storm event, or any other defined climatic event that is more appropriate to the site, and be placed so as to allow for restoration of the natural drainage network, to the maximum extent practicable, upon facility closure.

(2) All mined materials shall be properly placed and protected from surface water and precipitation so as not to be eroded and contribute sediment to site stormwater run-off or to otherwise contaminate surface water.

PHYSICAL STABILITY OF RETAINING STRUCTURES AND EMPLACED MINE MATERIALS

340-43-055

(1) Permit applicants must demonstrate to the Department that the design of chemical processing facilities and waste disposal facilities is adequate to ensure the stability of all structural components of the facilities during operation, closure and post closure.

(2) Retaining structures, foundations and mine materials emplacements shall be designed by a qualified, registered professional and be constructed for long-term stability under anticipated loading and seismic conditions.

(3) Temporary structures and materials emplacements may, with written approval from the Department, be constructed to a lesser standard if it can be shown that they pose no, or minimal, threat to public safety or the environment.

PROTECTION OF WILDLIFE

340-43-060

(1) Wildlife shall be positively excluded from contact with chemical processing solutions and wastewaters containing chemicals.

(2) The Department may waive the positive exclusion requirement if the Oregon Department of Fish and Wildlife (ODF&W) certifies to the Department that the project is designed such that it will adequately protect wildlife.

GUIDELINES FOR DESIGN, CONSTRUCTION, AND OPERATION OF HEAP-LEACH FACILITIES

340-43-065

(1) This paragraph applies to heap-leach facilities using dedicated, or expanding, pads. Heap-leach facilities using on-off, reusable pads may require variations from these rules; they shall be approved on a case-by-case basis by the Department.

(2) The heap-leach facility (pad and associated ponds, pipes and tanks) shall be sized to prevent flooding of any of its components.

(3) TABLE 1 of this Division establishes minimum capacity-sizing criteria for the leach-pad and ponds. The pad and ponds may be designed to act separately or in conjunction with each other to obtain the required storage volumes. Other design criteria may be used, with Department approval, if local conditions warrant. The best available climatic data shall be used to confirm the critical design storm event and estimate the liquid levels in the system over a full seasonal cycle. The liquid mass balance may include provision for evaporation.

(4) The heap-leach pad liner system shall be of triple liner construction with between-liner leak detection consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;

(b) Continuous flexible-membrane middle and top liners of suitable synthetic material separated by a minimum of 12 inches of permeable material (minimum permeability of 10^{-2} cm/sec);

(c) A leak-detection system between the synthetic liners capable of detecting leakage of 400 gallons/day-acre within ten weeks of leak initiation.

(5) The processing-chemical pond liners shall be of triple liner construction with between-liner leak detection consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;

(b) Continuous flexible-membrane middle and top liners of suitable synthetic material separated by a permeable material (minimum coefficient of permeability of 10^{-2} cm/sec);

(c) A leak detection system between the synthetic liners capable of detecting leakage of 400 gallons/day-acre, within ten weeks of leak initiation.

(6) Emergency ponds may be constructed as an alternative to larger pregnant and barren ponds. The emergency pond may be constructed to a lesser standard, with the limitation that it is to be used only infrequently and for short periods of time. The Department will specify reporting and use limitations for the ponds in the permit. A between-liner leak detection system is not required for the emergency pond.

(7) The emergency-pond liner shall be of composite construction consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-6} cm/sec) with a minimum thickness of 12 inches, and

(b) A single flexible-membrane synthetic top liner of suitable material.

(6) The heap-leach pad shall be provided with a process chemical collection system above the upper-most liner that will prevent an accumulation of process chemical within the heap greater than 24 inches in depth.

(7) The permittee shall prepare a written operating plan for safe temporary shut-down of the heap-leach facility and train employees in its implementation.

(8) The permittee shall respond to leakage collected by the heap-leach and processing-chemical storage pond leak-collection systems according to the process defined in TABLE 2.

(9) The permittee shall determine the acid-generating potential of the spent ore by acid\base accounting and other appropriate static and dynamic laboratory tests. If the spent ore is shown to be potentially acid generating under the conditions expected in the heap at closure, the permittee shall submit a plan for acid correction for Department approval prior to loading the heap.

GUIDELINES FOR DISPOSAL OF MILL TAILINGS

340-43-070

(1) Mill tailings shall be treated by cyanide removal and re-use prior to disposal to reduce the amount of cyanide introduced into the tailings pond. Chemical oxidation or other means shall be additionally used, if necessary, prior to disposal to reduce the WAD cyanide level in the liquid fraction of the tailings. The permittee shall conduct laboratory column tests on mill tailings to determine the lowest practicable concentration to which the WAD cyanide (weak-acid dissociable cyanide as measured by ASTM Method D2036-82 C) can be reduced. In no event, shall the permitted WAD cyanide concentration in the liquid fraction of the tailings be greater than 30 ppm.

(2) (Deleted)

(3) The permittee shall determine the potential for acid-water formation from the tailings by means of acid-base accounting and other suitable laboratory static and dynamic tests. If acid formation can occur, basic materials shall be added to the tailings in the amount of three (3) times the acid formation potential or to give a net neutralization potential of at least 20 tons of $CaCO_3$ per 1000 tons of tailings, whichever is greater, before placing tailings in the disposal facility.

(4) The disposal facility shall be lined with a composite double liner consisting of a flexible-membrane synthetic top liner in tight contact with an engineered,

stable, soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) having a minimum thickness of 36 inches.

Construction of the liner shall generally follow the principles and practices contained in EPA/600/2-88/052, "Lining of Waste Containment and Other Impoundment Facilities, September, 1988.

(5) The disposal facility shall be provided with a leachate collection system above the liner suitable for monitoring, collecting and treating potential acid drainage.

GUIDELINES FOR DISPOSAL OR STORAGE OF WASTEROCK, LOW-GRADE ORE AND OTHER MINED MATERIALS

340-43-075

The permittee shall determine the acid-producing and metals-release potential of the wasterock, low-grade ore or other mined materials by acid/base accounting and other appropriate static and dynamic laboratory tests. If the mined materials are shown to be potentially acid forming, or capable of releasing toxic metals, the permittee shall submit a plan for correction and disposal for Department approval prior to permanently placing the materials.

GUIDELINES FOR HEAP-LEACH AND TAILINGS DISPOSAL FACILITY CLOSURE

340-43-080

(1) The waste disposal facilities shall be closed under these rules in conjunction with the reclamation requirements of DOGAMI (Oregon Department of Geology and Mineral Industries).

(2) An up-dated closure plan and post-closure monitoring and maintenance plan shall be submitted to the Department by the permittee at least 180 days prior to beginning closure operations or making any substantial changes to the operation. The closure plan must be compatible with DOGAMI's reclamation plan and may be part of it.

(3) Chemical conveyances (ditches, troughs, pipes, etc.) not necessary for post-closure monitoring shall be removed. The secondary containment systems shall be checked before closure for process-chemical contamination, and contaminated soil or other materials, if any, shall be removed to an acceptable disposal facility.

(4) Closure of the heap-leach facility.

(a) The heap shall be detoxified over a suitable period of time prior to closure, using rinse/rest cycles of rinsing and chemical oxidation, if necessary. The WAD cyanide concentration in the rinsate shall be no greater than 0.2 ppm.

(b) Following detoxification as defined in (a) above, the heap shall be closed in place on the pad by covering the heap with a cover designed to prevent water and air infiltration. The cover should consist, at a minimum, of a low-permeability layer and suitable drainage and soil layers to prevent erosion and damage by animals and to sustain vegetation growth, in accordance with DOGAMI's reclamation rules.

(c) The ponds associated with the heap shall be closed by folding in the synthetic liners and filling and contouring the pits with inert material. Residual sludge may be disposed of in one of the on-site waste disposal facilities, provided it meets the criteria for such wastes in these guidelines. The process chemical collection system of the heap shall be maintained in operative condition so that it can be used to monitor the amount and quality of infiltrated water, if any, draining from the heap.

(5) The tailings disposal facility shall be closed by covering with a composite cover designed to prevent water and air infiltration and be environmentally stable for an indefinite period of time. Maximum effort shall be made to isolate the tailings from the environment. Construction of the cover shall generally follow the principles and practices contained in EPA/530-SW-89-047, Technical Guidance Document -- Final Covers on Hazardous Waste Landfills and Surface Impoundments.

POST-CLOSURE MONITORING

340-43-085

(1) The Department may continue its permit in force for thirty (30) years after closure of the operation and will include permit requirements for periodic monitoring to determine if release of pollutants is occurring.

(2) Monitoring data will be reviewed regularly by the Department to determine the effectiveness of closure of the disposal facilities. The Department will consult with DOGAMI on release of security funds that would otherwise be needed to correct problems resulting from ineffective closure.

LAND DISPOSAL OF WASTEWATER

340-43-090

(1) To qualify for land disposal of excess wastewater, the permit applicant shall demonstrate to the Department that the process has been designed to minimize the amount of excess wastewater that is produced, through use of water-efficient processes, wastewater treatment and reuse, and reduction by natural evaporation. Excess wastewater that must be released shall be treated and disposed of to land under the conditions specified in the permit.

(2) A disposal plan shall be submitted as part of the permit application that, at a minimum, includes:

(a) Wastewater quantity and quality characterization;

(b) Soils characterization and suitability analysis;

(c) Drainage and run-off characteristics of the site relative to land application of wastewater;

(d) Proximity of the disposal site to groundwater and surface water and potential impact;

(e) Wastewater application schedule and water balance;

(f) Disposal site assimilative capacity determination;

(g) Soils, surface water and groundwater monitoring plan;

(h) Potential impact on wildlife or sensitive plant species.

(3) The Department will evaluate the disposal plan and set site-specific permit conditions for the wastewater discharge.

GUIDELINES FOR OPEN-PIT CLOSURE

340-43-095

(1) Open pits that will be left as a result of the mining operation shall be assessed prior to, and following, mining operations for the potential to contaminate

water to the extent that it might not meet water-quality standards due to build-up of acid or toxic metals.

(2) If the Department finds that the potential for water accumulation in the pit(s) exists, the permit applicant shall submit a closure plan for the pit that will address contamination prevention and possible remedial treatment of the water. The closure plan shall, at a minimum, examine the following alternatives:

(a) Avoidance, during mining, of acid-generating materials that can be left in place, rather than being exposed to oxidation and weathering;

(b) Removal from the pit and disposal, during or after the mining operation, of residual acid-generating materials that would otherwise be left exposed to oxidation and weathering;

(c) Protective capping in-situ of residual acid-generating materials;

(d) Treatment methods for correcting acidity and toxicity of accumulated water;

(e) Installation of an impermeable liner under ponded water to prevent groundwater contamination;

(f) Backfilling of the pit(s) above the water table to reduce oxidation of residual acid-generating materials.

TABLE 1

Heap-Leach Liquid Storage Criteria

Component	Pregnant-Solution Pond	Barren-Solution Pond
Operating Volume	Minimum necessary to maintain recirculation	Minimum necessary to maintain recirculation
Operational Surge	Anticipated draindown and rinse volume	Anticipated draindown and rinse volume
Climatic Surge	100-yr, 24-hr storm plus 10-yr snowmelt	100-yr, 24-hr storm plus 10-yr snowmelt
Safety Factor	2-ft dry freeboard	2-ft dry freeboard

TABLE 2

Required Responses to Leakage Detected from the Leach Pad

Leakage Category	Response
Zero leakage to 200 gal/day-acre	Notify the Department; increase pumping and monitoring
Leakage from 200 gal/day-acre to 400 gal/day-acre	Change operating practices to reduce leakage
Leakage in excess of 400 gal/day-acre	Repair leaks under Department schedule.

TRC

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State of Oregon
Department of Environmental Quality **Memorandum**

Date: July 30, 1992

To: Environmental Quality Commission

From: Fred Hansen, Director

Subject: Consideration of Contractor's Report on Proposed Chemical Mining Rules, and Recommendation for Adoption of Proposed Chemical Mining Rules

Background

On December 13, 1991, the Environmental Quality Commission (Commission or EQC) considered adoption of rules to require mining operations using cyanide or other toxic chemicals to protect soils, groundwater, surface waters, and wildlife from contamination or harm by process solutions and waste waters. The protective measures required by the proposed rules included (but were not limited to) cyanide recovery and re-use, chemical detoxification of cyanide residues, and extensive lining and engineered closure of waste disposal facilities.

During the public participation process on the proposed rules, mining companies and associations argued that some of the requirements are unnecessarily stringent, unproven, or unavailable. Environmental protection organizations argued that the proposed rules may not be adequately protective in certain respects.

The Commission studied the proposed rules and public comments received, and extensively debated the policy issues associated with the rule proposal. The Commission elected to defer action on the adoption of proposed rules for chemical mining, and to seek an evaluation and advice on specific technical questions from an independent, knowledgeable contractor.

The Commission directed the Department to employ a consultant to provide technical advice on specific technical questions related to provisions of the proposed rules. The Department drafted a **Request for Proposal** (RFP) in consultation with the Commission, and issued notice of the RFP on February 7, 1992. The RFP identified DEQ's intent to issue a fixed price contract and required proposers to submit a project budget.

Notice was published in newspapers in Portland, Denver, Reno, and Vancouver, B.C. Locations outside Portland were selected because they are known centers of activity and expertise on mining.

The RFP was sent to more than 50 individuals and consulting firms, based on requests in response to ads, or other indications of potential interest. The RFP was also sent to the Advocate for Minority, Women & Emerging Small Businesses (Executive Dept., Salem). Proposals were to be submitted by March 10, 1992.

Two proposals were received. Proposals were independently reviewed by three reviewers. All three reviewers deemed one proposal unacceptable for reasons that the proposer lacked the experience and expertise desired, the proposal was not fully responsive to the RFP, and the price was too high. The selected proposal was responsive to the RFP, the proposers team displayed the experience and expertise desired and was the lowest price proposal. Selected references were checked for the responsive proposal; no negative responses were received. The selected proposal was submitted by TRC Environmental Consultants, Inc. in Englewood, Colorado.

DEQ entered into a contract with TRC Environmental Consultants, Inc. The consultant received written notice that work on the contract could commence on April 27, 1992. The Contract required submittal of a draft report to DEQ for review and comment within 45 days after notified to start work. The contract further provided that, following receipt of DEQ comments on the draft report, the Contractor would have 15 days to submit the final report. As work began on the contract, the Department and the Contractor agreed on June 19, 1992, as the reasonable target date for submittal of the draft report. The public was advised at a public meeting on May 5, 1992, that the date for submittal was approximately June 19. Since 45 days from receipt of notification of contract execution would fall on June 11, 1992, an amendment to the contract was executed to formalize June 19, 1992, as the target date for draft report submittal.

DEQ elected to make the draft report available to others for review and comment. This extra review was not originally contemplated when the RFP was drafted. The draft report was provided to persons who attended a May 5, 1992, public meeting on the matter and asked to receive a copy. People who asked to review the draft report subsequent to that meeting were also being provided a review copy. Copies of the draft report were distributed to reviewers on Monday, June 22, 1992. Reviewers were asked to submit written comments to DEQ by 5:00 p.m. on Monday, June 29, 1992.

DEQ forwarded all comments received from reviewers to the Contractor. By letter dated July 2, 1992, DEQ provided its comments to the Contractor. It also advised the Contractor that some of the comments which were forwarded from others related to matters that were outside the scope of work in the contract and the Contractor should make no attempt to consider or respond to such comments. DEQ's comments included suggestions for clarifications, format revisions, and direction to delete some conclusions that were considered to be outside the scope of work in the contract.

The Contractor advised DEQ that review of comments and preparation of revisions and responses would delay delivery of the final report from July 17, 1992 to July 22, 1992. The final report from the Contractor was received on July 22, 1992. Copies were forwarded to interested parties and the Commission on July 23 and 24, respectively.

<u>**Discussion of Issues Related to the Process**</u>

There are several issues related to the process and scope of work that warrant discussion.

1. Potential Conflict of Interest

The Department has received a letter and comments suggesting that the Contractor may be unable to render an unbiased report for a number of reasons, including that the principal consultant is on the board of directors of the Colorado Mining Association and is a member of the Northwest Mining Association. One of the other team members had also done some work with regard to two mining proposals in Oregon.

The RFP incorporated the following disclosure requirement:

> "Proposing contractors (including subcontractors) shall disclose any potential conflicts of interest. A potential conflict of interest includes, but is not limited to, any involvement during the past five years with mining companies, mining industry groups, or environmental groups active in working on mining regulations and permitting or holding any interest in property in Oregon that may have mineral development potential. During the proposal development period and, if awarded the contract, during the contract period, the selected contractor shall maintain an arm's length relationship with all parties who are or could be interested in the rule making procedure before the Commission. The selected contractor is required to disclose all contacts, either to or by them, during the proposal process and the life of the contract."

The potential conflicts of interest cited by persons during the process were disclosed by the consultant in their written proposal and orally at the May 5, 1992, public meeting. The Department evaluated the potential conflicts identified by the consultant, and concluded that they would not prevent the consultant from appropriately responding to the technical questions in the scope of work. Exhibit A attached to and part of the contract entered into with the consultant included the following language:

> "D. Managing Conflict of Interest
>
> Contractor shall disclose any potential conflicts of interest. A potential conflict of interest includes, but is not limited to, any involvement during the past five years with mining companies, mining industry groups, or environmental groups active in working on mining regulations and permitting or holding any interest in property in Oregon that may have mineral development potential. Contractor shall maintain an arm's length relationship with all parties who are or could be interested in the rule making procedure before the Commission. Contractor shall make a written record of all contacts, either to or by them, during the proposal process and the life of the contract, and shall provide a copy of the written record to the Department when the final report is presented."

A record of contacts pursuant to the contract was provided by the consultant as Appendix A-2 of their report.

The Department concludes that the Contractor fully complied with the requirements regarding "Conflict of Interest". Further, the Department concludes that although there is and has been in the past some relationship between the contractor and the mining industry, the contractor is capable of rendering unbiased judgment on the limited technical questions contained within the Scope of Work. The Department also concludes that had the contract called for policy recommendations from the Contractor, an unbiased report could not have been assured. Since this is not what was asked of the Contractor, the Department concludes that the report meets our goal of addressing the questions the Commission posed in an unbiased fashion, although we do have some technical differences of opinion with the Contractor which we note in subsequent discussion.

2. Consideration of Economics in the Evaluation

The Oregon Mining Council (OMC), in material provided for the contractor to consider, and in their comments on the Draft Contractor's Report, suggests that the Contractor's report should provide the Department and Commission with adequate information to determine the most cost effective ways of meeting the EQC's policies, and the report fails to do so. OMC appears to interpret the discussion leading to the

Commission decision to employ a contractor as intent to include a strong economic component in the study.

The Department does not share the OMC view of the Contractor's charge. The Department believes that the record of the discussions leading up to the decision to hire a contractor, when taken as a whole, clearly reflects that the Commission did not want an economic study or a cost/benefit study. Further, the Scope of Work reflected in the RFP and the contract specifically states that "[t]he Commission is <u>not</u> asking for alternative policy recommendations or evaluation of economic issues." The Commission wanted response to specific questions regarding the technical feasibility of control technology, and the environmental effects of various control technologies.

The Scope of work did ask the contractor to provide a simple comparison of typical costs for installation of the various liner configurations. The Contractor was asked to determine if there were other technologies that could meet the Commission policies. The Department believes that the record is also clear that the Commission expected that the Contractor's report would include some relative judgments regarding cost implications of any other technologies identified that would meet the specific policy objectives of the Commission.

In addition, the Department believes that the Commission intends to take economics into account as it seeks to find an appropriate balance between environmental protection goals and requirements, the pollution control technology necessary to achieve the environmental protection requirements, and the perceived costs of implementing the technology and requirements. The Department would further note that information is available in the record to make reasonable judgments regarding costs of various technologies in relation to environmental protection.

Based on these views, the Department has advised the Contractor both informally and in writing to disregard any suggestions that the report be expanded to include economic considerations.

OMC has also noted that redundancy between various rule requirements was not addressed and should be. The Department simply notes that the RFP and the contract do not ask the Contractor to provide an opinion on the issue of potential redundancy between different components of the rules.

3. Contractor's Comments not Related to the Scope of Work

The draft report submitted by the contractor contained some discussion and conclusions that the Department viewed as deviating from the charge and specific technical questions presented in the Scope of Work. The scope of work in the RFP and contract specifically stated as follows:

> "B. Scope of Work
>
> Three policies have been established by the Commission. Contractor shall evaluate and address specific technical questions surrounding these policies. The Commission is not asking for alternative policy recommendations or evaluation of economic issues. Contractor's task is to answer the questions posed in the following paragraphs based on Contractor's knowledge, expertise, experience, review of current published technical data, and technical evaluation of the issues. ......"

In its comments on the draft report, the Department advised the Contractor as follows:

> "Your draft report deviated from the specific technical questions in the scope of work and inappropriately presented suggestions on policy issues that have been extensively considered and debated by the Commission. As noted in our attached comments, all such policy suggestions must be eliminated from the final report. You are welcome to submit your views on policy issues to the Commission if you choose by letter or separate document. If you do so, we and the Commission will consider them as we would any other commenter — but we will not consider them a part of the work we contracted for nor a formal part of the report. This report, to be consistent with the scope of work in the contract, must present technical information and analysis in response to the questions posed, and be free of recommendations or opinions you may hold which were not a part of the contract or scope of work."

The Northwest Mining Association has reacted to the Department's directions to the Contractor by suggesting that the Department's action constitutes a conflict of interest and an effort to manipulate the report. The Department obviously disagrees. The Contractor was not asked or directed to modify the technical response to the questions posed in the scope of work. The Contractor was asked to clarify the response in some cases. The Contractor was asked to delete from the report some conclusions that were deemed to be beyond the scope of work of the contract and was invited to submit those or other opinions to the Commission by separate letter.

Specifically, the scope of work did not ask the Contractor to provide information on the level of cyanide that should be deemed toxic to birds. The Department asked that discussion on this issue be removed from the report. Similarly, the scope of work did not ask the Contractor to speculate on whether the regulatory framework of the proposed rules should be modified. The Department recommended that conclusions on this issue be removed from the report and invited a separate letter submittal.

The final report submitted by the Contractor contains a response to the Department's comments in Appendix B-1. This appendix describes how the report was modified to address Department comments. In the response to comments, the Contractor specifically states that they complied with the Department's directive even though they did not believe that their draft report had deviated from the scope of work of the contract.

Summary of the Evaluation and Findings of the Contractor's Report

Following is a recap of the questions posed in the Scope of Work, and the Contractor's response shown in italics, as quoted from the Record of Findings in the Introduction to the Contractor's Report. This summary will be followed by a discussion of issues for Commission consideration.

I. LINERS, LEAK DETECTION AND LEAK COLLECTION SYSTEMS

Scope of Work

1. Questions on Liners, Leak Detection, and Leak Collection Systems

   a. Statement of Policy:

      The Commission establishes as policy that a liner, leak detection and leak collection system are necessary to assure that any leak will be detected before toxic materials escape from the liner system and are released to the environment. These systems must assure that if a leak is found, sufficient time is available to allow for the repair of the leak and clean up of any leaked material before there is a release to the environment. Natural conditions, such as depth to groundwater or net rainfall, shall be considered as additional protection but not in lieu of the protection required by the required engineered protection.

NOTE: Definition of "environment" or use of defining qualifiers is central to the issue. The Commission considers that the environment begins at the bottom of the last liner.

b. Issue:

In the proposed rule contained in 340-43-065(4), the requirements for heap leach pad liners are as follows:

(4) The heap leach pad liner system shall be of triple liner construction with between liner leak detection consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;

(b) Continuous flexible membrane middle and top liners of suitable synthetic material separated by a minimum of 12 inches of permeable material (minimum permeability of 10^{-2} cm/sec);

(c) A leak detection system between the synthetic liners capable of detecting leakage of 400 gallons/day acre within ten weeks of leak initiation.

As opposed to this liner system, the Oregon Mining Council has proposed a liner characterized either as a composite liner or as a double liner and generally described as follows:

Composite Liner -- a composite liner system construction with between liner leak detection consisting of:

- An engineered, stable, low-permeability soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) with a minimum thickness of 12 inches;

- Continuous flexible membrane top liner of suitable synthetic material;

- A geotextile layer between the liner materials for leak detection. The leak detection and recovery system would also include collector pipes tied to the geotextile, spaced at appropriate intervals to achieve the 10-week leak initiation detection performance standard.

c. Question:

Will either or both liner systems meet the stated policy objective of the Commission?

d. Method to Answer or Address Question:

(1) Are each of the various liner systems proposed technically feasible?

(2) Will each of the various liner systems meet the stated Commission policy?

(3) For those liner systems which will meet the stated Commission policy, what level of certainty for achieving this policy do you assign to each system?

(4) Are there other liner systems which will achieve this policy and what level of certainty for achieving this policy do you assign to each?

The consultant is also asked to provide a simple comparison of typical costs for installation of the various liner configurations.

Summary of the Contractor's Evaluation

(1) Are each of the various liner systems proposed technically feasible?

- *The OAR 340-43-065(4) Triple Liner System is technically feasible.*
- *The OMC Double Liner System is technically feasible.*
- *The Alternative Candidate Liner System is technically feasible.*

(2) ***Will each of the various liner systems meet the stated Commission Policy?***

- *The OAR 340-43-065(4) Triple Liner System will generally meet the stated Commission Policy.*
- *The OMC Double Liner System will have difficulty meeting the stated Commission Policy.*
- *The Alternative Candidate Liner System will meet the stated Commission Policy.*

(3) ***For those liner systems which will meet the stated Commission policy, what level of certainty for achieving this policy to you assign to each system?***

- *Using assigned values (refer to Section 2.3 for discussion), mathematically generated weighted average levels of certainty (the greater the number, the higher the level of certainty) are as follows:*

Liner System	*Equal Weight on all Components*	*Emphasis on Lower Components*	*Emphasis on Upper Components*
OAR 340 Triple Liner	28.0	51.0	61.0
OMC Double Liner	19.0	41.0	35.0
Alternative Candidate Triple Liner	29.0	62.0	54.0

(4) ***Are there other liner systems which will achieve this policy and what level of certainty for achieving this policy do you assign to each?***

- *There are a number of other liner systems which will achieve this policy. TRC selected one (the Alternative Candidate Triple Liner) for additional analysis, the results of which are presented above.*
- *There are a number of variations on the permeable zone component of the Alternative Candidate Triple Liner System (as well as for the OAR 340 system permeable zone) that can also achieve this policy with equivalent levels of certainty while offering varying cost advantages (based on the simple comparison of typical costs for installation) over the proposed Alternative Candidate Liner*

System. The presented Alternative Candidate Liner System design purposefully incorporated certain components equivalent to those in the OAR 340-43-065(4) system, however, alternative engineered geodrain materials for those components have been identified and evaluated as capable of performing at an equivalent level of certainty.

II. TAILINGS TREATMENT TO REDUCE THE POTENTIAL FOR RELEASE OF TOXICS

Scope of Work

2. Questions on Tailings Treatment to Reduce the Potential for Release of Toxics

a. Statement of Policy:

The Commission establishes as policy that the toxicity and potential for long-term cyanide and toxic metals release from mill tailings should be reduced to the greatest degree practicable through tailings treatment.

b. Issue:

The proposed rules in 340-43-070(1) state the following:

(1) Mill tailings shall be treated by cyanide removal and re-use prior to disposal to reduce the amount of cyanide introduced into the tailings pond. Chemical oxidation or other means shall be additionally used, if necessary, prior to disposal to reduce the WAD cyanide level in the liquid fraction of the tailings. The permittee shall conduct laboratory column tests on mill tailings to determine the lowest practicable concentration to which the WAD cyanide (weak-acid dissociable cyanide as measured by ASTM Method D2036-82 C) can be reduced. In no event, shall the permitted WAD cyanide concentration in the liquid fraction of the tailings be greater than 30 ppm.

The rules do not require removal of potentially toxic metals from tailings prior to placement in the tailings pond. The rules do require steps to control acid formation in the tailings pond and require covering upon closure with a composite cover designed to prevent water and air infiltration.

c. Question:

Do the requirements for **removal** and **reuse** of cyanide materially reduce toxicity and potential for long-term cyanide and toxic metals release from mill tailings?

d. Method to Answer or Address Question:

(1) Are **removal** and **reuse** technically feasible?

Potential factors for consideration include:
- Is the process technically defined and understood?
- Has the process been demonstrated in practical application, and if so, where?
- Are engineering firms available to design and oversee construction?
- Are materials and equipment available to construct?

(2) Do **removal** and **reuse** (evaluated separately) materially reduce the toxicity and potential for long-term cyanide and toxic metals release from mill tailings?

(3) What is the level of certainty you give to the answers provided above?

(4) Are there other tailings treatment technologies which will equally, or more effectively achieve the policy of the Commission?

Summary of the Consultant's Evaluation

(1) Are removal and reuse technically feasible?

- *Removal and reuse are technically feasible, but limit the operator to technologies with limitations on operating efficiency.*

- *The process has been demonstrated in practical application, for example, at the Golden Cross Mine in New Zealand, operated by Cyprus Gold Company, as well as at the DeLamar (silver) Mine in Idaho, operated by NERCO Minerals.*

- *Engineering firms are available to design and oversee construction.*

- *Materials and equipment are available to construct.*

(2) Do removal and reuse (evaluated separately) materially reduce the toxicity and potential for long-term cyanide and toxic metals release from mill tailings?

- *Removal of cyanide from tailings <u>does</u> materially <u>reduce</u> the <u>cyanide toxicity</u> and potential for long-term release. Cyanide removal <u>may</u>, dependent on specific tailing chemistry, <u>contribute to a reduction</u> in toxicity and potential for release of toxic metals over the long-term.*

- *Reuse of cyanide <u>does not</u> reduce the <u>cyanide toxicity</u> or potential for long-term cyanide and toxic metals release from mill tailings. It does reduce the total quantity of cyanide reagent consumed over the life of the operation. There is a material reduction in operating efficiency when cyanide reuse is employed, in comparison to chemical destruction techniques, particularly at lower concentrations of cyanide in process solutions.*

(3) What is the level of certainty you give to the answers provided above?

- *The generic level of certainty that <u>removal and reuse</u> are technically feasible is high, however, removal and reuse limits the available technology that can be applied to either solid/liquid separation or AVR (acidification/volatilization/reneutralization) processes, which may not provide maximum removal under many tailing chemistry conditions.*

- *The level of certainty that <u>removal</u> of cyanide material reduces the toxicity and potential for long-term cyanide release from mill tailings is high.*

- *The level of certainty that <u>removal</u> of cyanide materially reduces the toxicity and potential for long-term toxic metals release from mill tailings is variable, again dependent upon the specific tailings chemistry.*

- *The level of certainty that <u>reuse</u> of cyanide materially reduces the toxicity potential for long-term cyanide release from mill tailings is nil. <u>Reuse does not in any way contribute to a reduction of "toxicity"</u> or potential for release of solutions released to tailings, as reagent concentration in process solutions ideally remains constant at all times. It simply reduces the quantity of make-up reagent required over the life of the operation.*

- *The level of certainty that <u>reuse</u> of cyanide materially reduces the toxicity and potential for long-term toxic metals release from mill tailings is nil. Reuse does not in any way impact toxicity or potential for release as regent concentration in* *process solutions ideally remains constant at all times. It simply reduces the quantity of make-up reagent required over the life of the operation.*

(4) Are there other tailings treatment technologies which will equally or more effectively achieve the policy of the Commission?

- *There are a number of tailings treatment technologies which will equally or more effectively achieve the stated policy of the Commission. In addition, these technologies are oftentimes technically more appropriate than removal and reuse under given tailings chemistry, offer significant economic advantage, greater operational flexibility, and result in more efficient utilization of resources. These technologies are discussed in Section 3.1.4.*

III. CLOSURE OF HEAP LEACH AND TAILINGS FACILITY

Scope of Work

3. Questions on Closure of the Heap Leach and Tailings Facilities

   a. Statement of Policy:

      The Commission establishes as policy that the closure of the heap leach and tailings disposal facilities will prevent release to the environment of toxic chemicals contained in the facility.

   b. Issue:

      Rule 340-43-080(4)(a), as proposed, requires that the heap shall be "... detoxified over a suitable period of time prior to closure, using rinse/rest cycles of rinsing and chemical oxidation, if necessary. The WAD cyanide concentration in the rinsate shall be no greater than 0.2 ppm."

      In 340-43-080(4)(b), the proposed rules require that the closure of the heap shall be "... by covering the heap with a cover designed to prevent water and air infiltration."

      In 340-43-080(5), the proposed rules state that "The tailings disposal facility shall be closed by covering with a composite cover designed to prevent water and air infiltration and be environmentally stable for an indefinite period of time."

c. Question:

Do the requirements of detoxification (cyanide removal by rinsing) of the heap and covering of the heap and tailings facility to exclude air and water materially reduce the likelihood of any release to the environment of toxic chemicals and metals contained in the heap over the long term?

d. Method to Answer or Address Question:

(1) Are detoxification and covering (as prescribed in this rule) technically feasible?

(2) Do detoxification and covering (evaluated separately and together) materially reduce the likelihood of a release of toxic chemicals and metals to the environment?

(3) What is the level of certainty you give to the answers provided above?

(4) Are there other technologies which can equally or more effectively achieve the policy of the Commission?

Summary of the Consultant's Evaluation

(1) Are detoxification and covering (as prescribed in this rule) technically feasible?

- *Detoxification and covering of heap leach facilities is technically feasible.*
- *Detoxification and covering of tailings facilities is technically feasible.*

(2) Do detoxification and covering (evaluated separately and together) materially reduce the likelihood of a release of toxic chemicals and metals to the environment?

Heap Leach Facilities

Toxic Chemical Release Potential

- *Detoxification of heap leach materials (spent ore) does materially reduce the likelihood of a release of toxic chemicals to the environment.*

- *Covering of heap leach materials (spent ore) without prior detoxification does not materially reduce the likelihood of a release of toxic chemicals to the environment.*

- *Covering of decommissioned heap leach facilities, following detoxification of cyanide concentrations within the spent ore, may materially reduce the likelihood of a release of toxic chemicals to the environment in some instances, but this primarily results from the contribution of detoxification. Conversely, covering in addition to detoxification, if applied inappropriately, can adversely affect control of releases of toxic chemicals to the environment.*

Toxic Metals Release Potential

- *Detoxification of heap leach materials (spent ore) does not materially reduce the likelihood of a release of toxic metals to the environment.*

- *Covering of heap leach materials (spent ore) without prior detoxification does material reduce the likelihood of a release of toxic metals to the environment.*

- *Covering of decommissioned heap leach facilities, following detoxification of cyanide concentrations within the spent ore, where spent ore chemistry dictates (due to acid-generating potential), does materially reduce the likelihood of a release of toxic metals to the environment. However, where acid-generating potential is not a concern, little, if any additional benefit is realized toward materially reducing the likelihood of a release of toxic metals to the environment by covering after detoxification.*

Tailings Facilities

Toxic Chemical Release Potential

- *Detoxification of mill tailings does materially reduce the likelihood of a release of toxic chemicals to the environment.*

- *Covering of mill tailings without prior detoxification does not materially reduce the likelihood of a release of toxic chemicals to the environment, except in the case of net precipitative buildup.*

- *Covering of decommissioned tailings facilities, following detoxification of the cyanide concentrations within the tails, in most instances does not materially reduce the likelihood of a release of toxic chemicals to the environment.*

Conversely, covering may inhibit further reduction of toxic chemicals by natural degradation.

Toxic Metal Release Potential

- *Detoxification of mill tailings may not materially reduce the likelihood of a release of toxic metals to the environment.*

- *Covering of mill tailings without prior detoxification may not materially reduce the likelihood of a release of toxic metals to the environment, except in the case of net precipitative buildup.*

- *Covering of decommissioned tailings facilities, following detoxification of the cyanide concentrations within the tails, in some instances may materially reduce the likelihood of a release of toxic metals to the environment, primarily as a result of reducing the potential for acid generation and resultant mobilization of toxic metals.*

(3) What is the level of certainty you give to the answers provided above?

- *Level of certainty of findings described above is high. Level of certainty with respect to application if findings varies with given site conditions (i.e., in many instances, prescriptive proposed rule requirements may function favorably; likewise, in many instances the prescriptive rule requirements may function with adverse consequences, resulting in non-achievement of Commission policy).*

(4) Are there other technologies which will equally, or more effectively achieve the policy of the Commission?

- *There are variants on the proposed technologies that can equally or more effectively achieve the policy of the Commission. Specific site conditions dictate where variants on detoxification and/or cover requirements are appropriate.*

- *Specifically, once heap leach or tailing materials are detoxified, typical earthen cover systems can equally or more effectively achieve the policy of the Commission at significant economic advantage over prescriptive composite liner systems designed for "hazardous waste" impoundment cover systems.*

In order to help clarify the above findings of the Contractor, the Department would summarize them as follows:

Item	Toxic Chemicals Release Potential (Cyanide)	Toxic Metals Release Potential
Heap Leach Facility		
Detoxification Only	Materially reduces	Does not materially reduce
Cover Only	Does not materially reduce	Materially reduces
Cover after Detoxification	Cover adds little if any benefit to detoxification, and may be a detriment	Materially reduces where acid generating potential exists. Little if any benefit if acid generating potential does not exist
Tailings Facility		
Detoxification Only	Materially reduces	May not materially reduce
Cover Only	Does not materially reduce, except in case of net precipitation buildup	May not materially reduce
Cover after Detoxification	Cover adds little if any benefit beyond detoxification, and may inhibit natural degradation	May materially reduce, by reducing the potential for acid generation

Discussion of Issues and Options for Modification of the December 13, 1992 Rule Draft

Review of the Contractor's report raises several issues which should be further discussed along with the potential for rule modification.

1. **Should the policy statements presented in the RFP and Scope of Work for the Contractor's evaluation be included in the proposed rules to further articulate the Commission's intent with respect to environmental protection?**

   During the discussion and formulation of the RFP, the Commission articulated three statements of policy regarding the level of environmental protection that was deemed appropriate for Oregon. Although these policies were not explicitly included in the rules, staff understood the direction of the Commission regarding content of the rules to include the elements of the policy statements.

The Department believes that it would be appropriate to include the essence of these policy statements within the rules as a further statement of the intent of the rules. The Department has proposed to edit the wording of the policy statements from the RFP and Scope of Work for the Contractor to fit the context of the rules. The proposed amendment to include the policies is shown as an addition to OAR 340-43-006 beginning on page 3 of Attachment A.

2. Should the rules be modified to clarify the intent for interpretation and application of the guidelines sections of the proposed rules?

Staff discussions with the Contractor identified some confusion in understanding how the "guideline" sections of the rules (OAR 340-43-040 to 095) should be interpreted in relation to the "requirements" sections (OAR 340-43-016 to 035). For example, 340-43-031 (renumbered from 030) provided as follows:

> "Alternative methods of control of wastes may be acceptable if the permit applicant can demonstrate that the alternate methods will provide fully-equivalent environmental protection. The burden of proof of fully-equivalent protection lies with the permit applicant."

The Department intended that this section allow for approval of fully equivalent alternatives to the criteria that are presented in subsequent guideline sections of the rules. However, the lack of specific wording relating to the guidelines leaves the matter potentially unclear. Staff believes that this lack of clarity caused the contractor to be concerned about the ability to address site specific variables and conditions in a technically sound manner.

The Department believes this concern is legitimate, and needs to be addressed. At the December 14, 1990, EQC meeting, the Commission reflected upon the previous day's work session discussion and provided direction to the staff for development of this rule package. Following are several of the specific directions as quoted from the minutes:

- "Use a blended approach involving both rules and guidelines. The rules should not be too detailed, and the guidelines ought to be dynamic but sufficiently precise to send a reasonable and sufficiently predictable message about the regulatory expectations of Oregon."

- "Direct the rules toward eliminating risk to the environment."
- "Make the rules a combination of performance-based and technology based requirements."
- "Require the best technology available anywhere as a starting point. If technology is being used anywhere else commercially, that technology will be the starting point for requirements. Make the rules technology forcing."
- "Clearly place the burden on the applicant to show why specific technology or performance standards shouldn't apply or why alternative approaches should be considered equivalent and acceptable."
- "Assure that the regulatory approach is preventative and that the need for future superfund cleanup is eliminated."
- "Consider interagency coordination to the maximum extent practicable to minimize duplication of efforts by applicants and the public."

The Department believes the rules proposed to the Commission on December 13, 1991, meet these directions. However, there is need for some clarification to make sure that others interpret the rules as intended.

To achieve this needed clarification, the Department is proposing a number of amendments to the December 13, 1991, rule draft (see Attachment A). The rule on Design, Construction, Operation and Closure Requirements (OAR 340-43-031 {renumbered from 030}) is specifically proposed to be amended to clarify the relationship between the requirements and the guidelines and to more clearly state that alternatives which will provide "..environmental protection that is fully equivalent or better than that achieved by the facilities specified in the guidelines" can be approved. Such alternatives would include other combinations of existing technology, technology adapted for site specific conditions that influence the selection and effectiveness of particular technologies, and newly evolving technology, consistent with the stated Commission desire for a program which is technology forcing.

The wording of this rule amendment may be interpreted by some to provide an unwelcomed degree of flexibility that will result in extreme pressures from permit applicants to relax requirements to reduce costs. There is also concern that Department staff may not have the technical expertise necessary to evaluate the equivalency of alternative technologies and that the increased workload on Department staff to evaluate alternatives will be too great.

The evaluation of alternative proposals is already provided for in the rules -- just not with the clarity desired. The Department routinely evaluates alternative technology with respect to the anticipated ability of that technology to meet environmental standards in individual applications. These rules also provide in OAR 340-43-045 for the permittee to hire a third party contractor, subject to Department approval, to assist the Department with review and evaluation of design and construction specifications. Assistance with evaluation of alternative technologies for equivalency could fall within the scope of work for such a third party contractor.

Finally, the purpose statement of the guidelines section, OAR 340-43-040(1), is proposed to be amended to again clarify the intended application of the guidelines and the ability and process for securing approval of equivalent alternatives.

3. **Should the provisions of the proposed rules related to liners under the heap leach pad be retained as initially proposed or modified in some manner based upon information presented in the Contractor's report?**

The Contractor presented a great deal of information regarding liner systems, factors to be considered in installation, repair, and so on. The double liner system evaluated (OMC Double Liner) was found to be questionable in its ability to meet the Commission's leak criteria. The other two liners systems evaluated would meet the Commission's policy with some difference in characteristics and strengths. The Contractor's alternative liner placed more emphasis on the uppermost liner in terms of its ability to minimize leaks. The triple liner was judged to have a greater risk of puncture due to the placement of the uppermost membrane liner directly on top of the leak detection permeable material without cushioning.

If the objective is to rapidly detect a leak, and take action to repair it, the triple liner configuration is preferred. A leak in the upper membrane would tend to enlarge rapidly, resulting in a greater volume of leakage and earlier detection. If the objective is to minimize leakage through the uppermost liner, the Contractor's alternative would be preferred. The combination of the membrane in direct contact with clay would minimize the volume of material passing through a leak (unless it was a major tear) and extend the time before it would be likely to detect a leak. The bottom liner of the triple liner configuration provides greater environmental protection (membrane in contact with 3 feet of clay) than the alternative (one foot of clay, no membrane).

The Department notes that the Contractor found that there are many possible liner configurations that could meet the Commission's policy. In short, there is no single "best" liner configuration.

As noted above, the Contractor identified the top membrane/leak detection system interface in the OAR 340 Triple Liner configuration as a weakness and suggested the need for providing a protective cushion of some sort between the membrane and the gravel of the leak detection system. The Commission could elect to modify the specification on the OAR 340 Triple Liner to require a cushioning layer to assure protection of the liner, or could leave that decision to the applicant. An applicant's decision to design and install an appropriate cushioning layer would increase the cost of the liner, but would be expected to reduce the delays, inconvenience and extra costs associated with repair of leaks. The Department has not proposed to add a requirement for a cushioning layer.

In evaluating the information in the report, staff found it helpful to look at the information in a slightly different way than presented in the Contractor's report. Rather than describing a liner as a triple liner, it seemed helpful to view liner systems in terms of the primary function of each component as follows:

- Primary Liner -- This would be the uppermost liner. Its primary purpose would be to prevent loss of the process chemical solutions -- from the heap, or pond. As such its purpose is containment. In the heap, the primary liner, together with the process chemical collection system (potentially a system consisting of leachate collection piping imbedded in two feet or more of graded crushed ore or other drainage material placed on top of the primary liner) functions to recover the cyanide solution that has leached through the heap. The primary liner would, as specified in the guidelines, be a continuous flexible membrane of suitable synthetic material. A composite liner consisting of a membrane liner in direct contact with clay could also be used.

- Leak Detection System -- This would be installed immediately below the primary liner, and on top of a secondary liner. Its purpose would be to detect any loss of process solutions by leakage through the primary liner. Upon detection of leakage, its location would have to be identified, and repairs undertaken. Repairs could be accomplished by removal of material to expose the liner for repairs, or potentially by sealing the material in the area of the leak by grouting, or by other means such as abandoning that section of a leach pad. Leak detection technology is evolving. The time-proven system specified in the guidelines relies on approximately 12 inches of graded material that will rapidly transmit leakage to a pipe collection system which will transport the leaked solutions to the edge of the heap or pond. This system can be reliably designed to support the weight of the heap. Newer leak detection systems are using manufactured materials to accomplish the same purpose. These have the advantage of being lower cost. There is less experience with their durability. Finally, electronic leak detection technology is evolving. The Department would expect to receive proposals for consideration of alternatives to the leak detection system defined in the guidelines.

- Secondary Liner -- The secondary liner is placed below the leak detection layer. It is intended to provide assurance that any process solutions that penetrate the primary liner into the leak detection system are contained and are not released into the environment. The secondary liner must reliably contain any leakage pending location of the leak, repair of the leak, and cleanup of the leaked material as required in the guidelines. The secondary liner must also reliably prevent any release of residual process materials into the environment following closure of the facility. In short, the secondary liner is the main component of both the short range and long range environmental protection system. The most reliable secondary liner, as specified in the guidelines, would be a composite liner consisting of a continuous flexible membrane in direct contact with an engineered, stable, low permeability soil/clay layer. In general, increasing thickness of the clay layer will increase the long range protection of the environment.

The proposed rules in Attachment A present two alternatives for criteria for the heap leach pad liner. The first alternative is the triple liner proposal (OAR 340 Triple Liner) presented in the December 13, 1991, rules and evaluated by the Contractor. The second alternative proposal presents the same basic liner components in terms of a primary liner, a leak detection system, and a secondary liner as discussed above. Recognizing that alternative configurations which accomplish fully equivalent or better environmental protection can be approved, the liner configuration specified under either alternative is intended to establish in tangible form the minimum equivalent performance level for the liner system.

The Department would recommend that the wording in alternative 2 (page 15 of Attachment A) be selected because it relates liner system components to their primary purpose and provides a better framework for consideration of potentially equivalent alternative proposals. We note that the liner configurations specified in the December 13, 1991, rules were nearly identical for the heap leach pad liner and the liner under process chemical storage ponds. For purposes of consistency, the Department would also propose that the processing chemical storage pond liner specification be revised in a similar manner to alternative 2 for the heap leach pad. A similar Alternative 2 is presented for the process chemical storage pond liner provision beginning on page 16 of Attachment A.

In reviewing the rules regarding correction of leaks upon detection, the Department notes that OAR 340-43-065(10) refers to Table 2 for the requirements for responding to leakage detected in the heap leach and processing chemical storage pond leak detection systems. Table 2, however, only mentions leakage detected from the leach pad. The Department proposes to amend the table to clearly indicate that it applies to both the heap leach pad and the processing chemical storage ponds.

There remains one issue. The Contractor concluded that the Commission policy could be met with a secondary or bottom liner that utilized a one foot thick low permeability clay layer. The Department is not proposing any reduction from the three foot thick layer initially proposed. The direction provided to the staff in December 1990 stressed the desire for a preventive approach which eliminated any potential need for a future superfund type cleanup. The Department views the three foot clay layer as a better long range protective feature. The Contractor presented information suggesting that the clay layer cost, while not insignificant, was relatively small in comparison to the pipe and gravel leak detection system. The Department believes that the added security of the long range protection provided justifies the incremental cost for the additional clay thickness.

4. Should the requirements of the proposed rules related to removal of cyanide from mill tailings and reuse of that cyanide be retained as initially proposed or modified in some manner based upon information presented in the Contractor's report?

The Contractor concluded that removal of cyanide from mill tailings prior to release of tailings to the disposal facility and reuse of the removed cyanide solution in the process was technically feasible, and has been demonstrated. The Contractor further concluded that removal of cyanide from the tailings prior to disposal would reduce the cyanide toxicity and potential for long term release, and may in some instances contribute to reduction in toxicity and potential for release of toxic metals over the long term. The Contractor concluded that reuse, by itself, would not affect the residual cyanide levels in the disposed tailings, and would not result in a reduction of toxicity or the potential for long term release of cyanide from the tailings facility. The Contractor did note that reuse would reduce the total quantity of cyanide reagent consumed over the life of the facility. Finally, the Contractor noted that there are a number of chemical treatment technologies that will equally or more effectively reduce cyanide concentrations in the tailings prior to their disposal, and that these chemical treatment technologies may have some advantages including lower cost, and greater flexibility. The Contractor also noted that if removal and reuse were required, it may be necessary to also utilize some chemical treatment in addition to meet target levels for residual cyanide in the disposed tailings.

The Department continues to recommend that removal of cyanide from the tailings and reuse of recovered cyanide in the process be required. The reuse of any substance, assuming that the process mixture is of a set concentration, will never lower the toxicity. The Department fully agrees. The real issue, however, is that reuse lowers the total volume of chemicals which must be transported to and handled at the facility, thereby reducing the risk of accidental release during these activities.

The removal and reuse requirement would be consistent with the legislative goals for reduction in the quantity of toxic or potentially toxic chemicals used -- both the cyanide used in the leaching process, and the chemicals that would otherwise be used for chemical destruction of cyanide. It would also be consistent with earlier Commission direction to the Department. Finally, there are two potential process that were identified as feasible for achieving the removal and reuse goal.

5. Should the requirements for detoxification and cover of the heap and tailings facility upon closure be retained as initially proposed or modified in some manner based upon information presented in the Contractor's report?

The Contractor concluded that detoxification of the heap prior to closure was technically feasible and would materially reduce the potential for release of toxic chemicals to the environment. Further, detoxification of the tailings prior to disposal to the tailings pond (by removal of cyanide and potentially by further chemical destruction as required) would materially reduce the likelihood of a release of toxic chemicals to the environment. The Contractor concluded that covering of the heap and tailings facilities, without prior detoxification, would not materially reduce the likelihood of release of toxic chemicals to the environment. Finally, the Contractor concluded that covering following detoxification would be beneficial if there is a potential for acid formation based on the chemistry of the ore, otherwise, there would be little if any benefit of covering after detoxification, providing there is no potential for net accumulation of liquid in the heap or tailings facility after closure. The Contractor noted that covering could have a negative result by impeding natural degradation of cyanide by exposure to oxygen and direct sun.

The Department has chosen to not rely on natural degradation of cyanide for meeting an acceptable level of detoxification for closure. Further degradation of residual cyanide may occur prior to covering, but the rate and extent is not predictable, and should not be relied upon. Also, the permittee could elect to delay covering to allow for some additional natural degradation if that was necessary for meeting the detoxification requirements..

The Department has not proposed to modify the December 13, 1991, rule proposal relative to detoxification and cover upon closure. Given the size of a heap leach pad, it seems reasonable to assume that detoxification efforts will not be uniformly effective throughout the entire pad volume. Differences in density of material and other factors would allow for the potential of "hot spots" that are not effectively detoxified. On average, the residual cyanide level in the rinsate may meet the target, but that does not mean that uniform detoxification has been achieved. If precipitation is allowed to percolate through the heap after closure, further leaching of chemicals could occur. The Department concludes that covering, after detoxification, affords an increased level of security and long term environmental protection for the site.

6. Should some consideration be given to the potential for redundancy that may occur as a result of the cumulative effects of the various provisions of the rules?

The Contractor, in the introduction to their summary of findings, noted that "... due to the structuring of the RFP, the cumulative result of all proposed rule components, while significant, is not portrayed." Some would argue that if the liner is sufficient to contain the material and prevent loss to the environment, it should not be necessary to go to the added cost and trouble of detoxifying. Similarly, some would argue that the liner should negate the need for a cover -- the protection of the liner proposed by the Department is sufficient.

In reviewing this issue, the Department notes that the liner system is necessary <u>during active operations</u> to assure that process solutions are not released to the environment. The liner system also can continue to function <u>during and after closure</u> to prevent loss of residual chemicals to the environment. Detoxification is intended to reduce the potential for release of potentially toxic materials to the environment <u>after closure</u>. Cover is intended to prevent precipitation from entering the heap or tailings facility <u>after closure</u> and causing instability, or continued leaching and transport of chemicals to the environment. Thus, to address concerns during the active operation phase, **a fully effective liner system is required**. Thus, any potential for redundancy would be related to the closure phase of the requirements.

The Department believes that it is all but impossible to predict all of the possible things that could occur at a site during operation and after closure that would result in an unintended environmental effect. The Contractor's findings clearly state that detoxification materially reduces the likelihood of a release of toxic chemicals (cyanide) to the environment and that the certainty of their findings is high. If acid forming condition exist, the combination of detoxification and cover may materially reduce the likelihood of toxic metals release to the environment. The Department concludes that detoxification is a high priority requirement for long term environmental protection, and is not redundant of the liner system.

It may be appropriate for the Commission to consider the potential tradeoff between covering of the heap and the thickness of the clay layer of the secondary (bottom) liner and the level of short term and long term environmental protection that is afforded by the secondary liner. The Department notes that the cover would work to prevent fluid passing through the heap where it could potentially create a problem -- either by penetration of the liner system to reach the environment, or by moving laterally along the liner system to exit via drainage to the surface drainage system. The liner system would minimize any release to the environment below the liner, but would not preclude the potential release to the ground surface adjacent to the heap. Thus the Department concludes the liner and cover work together to minimize the potential for creation of problems after closure. The question would be whether the three foot thick clay portion of the secondary liner could be reduced in relation to cover requirement. In the discussion on liners (issue 3), the Department concluded that the cost of the clay layer, although not insignificant, was small compared to the cost of other components of the liner system, and elected to recommend retaining the requirement for three feet of clay (or an equivalently protective alternative) as a long range protective feature. The Department is not persuaded to alter that recommendation in light of the above analysis.

Finally, it is noted that a decision regarding the liner requirements is necessary at the beginning of the process since liners are among the first facilities to be installed. Covers may not be installed on the first components at a project site for 5 or more years. Thus, there is an opportunity to reevaluate the desirability for cover requirements if and when new information becomes available up to the time cover installation would begin. The Department believes that prudent planning for any project at this time should include provisions for cover after detoxification to assure appropriate long range environmental protection.

7. Should the provisions of the proposed rules be modified to more clearly provide for independent on-site inspection during liner installation and loading of the leach pad?

The Contractor's report stresses the importance of using care when installing the leachate collection layer on top of the primary liner and then loading the initial ore on the heap leach pad. Care is needed to assure that the liner system is not damaged in the process. Other consultants who called staff during the period when the RFP was being circulated also stressed the critical importance of continuous on-site regulatory inspections during this process.

The existing rules provide for a third party contractor to be employed to assist in design review, and during construction of disposal facilities but did not clearly provide for any review or inspection functions during operations. Commissioner Lorenzen asked at the December 13, 1991, meeting that the scope of inspection during construction be broadened beyond "disposal" facilities. The Department proposes to modify this section of the rules (OAR 340-43-045(6)) as suggested by Commissioner Lorenzen and to clearly expand the universe of activities that would be within the scope of work for a third party contractor to include inspection of operations after construction (see page 12 of Attachment A).

An additional issue may warrant some consideration by the Commission. The Department's Contractor informally advised that one approach that is being used relative to third party contractor inspection services includes routine provisions to change contractors after about 3 years to make sure that the relationship between the contractor's field inspector and the permittee do not become too friendly. There are other possible procedures that could be explored for contractor selection, contractor hiring, and payments to the third party contractor to assure that the contractor is not perceived to be an employee of the permittee. The current rule wording was selected because of concern regarding the budget restrictions which limit the ability of the Department to accept funds from the applicant and expend them for employing the third party consultant. It may be appropriate to explore some form of escrow account for this purpose. The Department is not making a specific proposal on these issues at this time, but feels they merit some discussion, and could be the subject of additional policy direction from the Commission.

8. Miscellaneous changes to the proposed rules

There are a number of minor changes to the rules proposed in Attachment A that have not been discussed. Some rule renumbering is proposed to comply with the requirements of the Secretary of State that rule numbers that have been used in the past not be reused.

The Attorney General's office has advised the Department that the process for land use compatibility determination needs to be clarified in the rule. Additional language is proposed to be inserted into OAR 340-43-016 to achieve this purpose. The Department intends to rely on a determination coordinated by the Department of Geology and Mineral Industries pursuant to the provisions of HB 2244. This issue will likely have to be addressed in further detail when the Department's State Agency Coordination Program and related rules are updated.

Finally, some additional editorial changes have been made to improve the clarity of the rules and remove potential ambiguity.

Department Recommendation

The Department recommends that the rules last considered by the Commission on December 13, 1991, with modifications as recommended above, including approval of Alternative 2 for the heap leach pad liner requirements, and Alternative 2 for the processing chemical pond liners be adopted as presented in Attachment A.

Attachments

A. Chemical Mining Rules Proposed for Adoption

B. Procedural Documentation of Rulemaking Process

   1. Public Notice
   2. Rulemaking Statements
   3. Fiscal and Economic Impact Statement
   4. Land Use Compatibility Statement
   5. Abstract of Technical Comments Received Regarding Proposed Rules for Chemical Mining
   6. Response to Public Comment Regarding Proposed DEQ Chemical Mining Rules
   7. December 13, 1991 Rule Draft Showing Revisions to June 14, 1991 Draft
   8. Summary of Record of EQC Discussions of Mining Rules

<u>**References**</u> (Available upon request)

1. Final Consultant's Report
2. Letters of Comment on Draft Consultant's Report
3. Draft Consultant's Report
4. RFP
5. Proposal submitted by TRC Environmental Consultants
6. Contract between DEQ and TRC
7. Amendment No. 1 to Contract between DEQ and TRC
8. <u>Issue Paper on Proposed Chemical Mining Rules</u> prepared by CH_2M Hill and Stoel Rives Boley Jones & Grey, May 5, 1992.

HLS:l

July 30, 1992 Markup for
August 7, 1992 EQC Consideration

Attachment A

Note: Underlined text is proposed language to be added to the rule draft presented to the Commission on 12/13/91.

~~[Bracketed and struck through]~~ text is proposed language to be deleted from the rules presented to the Commission on 12/13/91.

RULES PROPOSAL:

OREGON ADMINISTRATIVE RULES

CHAPTER 340

DIVISION 43

CHEMICAL MINING

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS

PURPOSE and POLICIES

340-43-006~~[5]~~

Renumber to comply with Secretary of State requirement that prior numbers not be used.

(1) The purpose of these rules and guidelines is to prevent water pollution and protect the quality of the environment and public health in Oregon, consistent with the policies of ORS 468B.015 and 468B.020, by requiring application of ~~["...]~~ all available and reasonable methods~~[...", Oregon Revised Statutes (ORS) 468.710,]~~ for control of wastes and chemicals relative to design, construction, operation, and closure of mining operations which use cyanide or other toxic chemicals to extract metals or metal-bearing minerals from the ore and which produce wastes or wastewaters containing toxic materials.

Original statute citation did not match quote. Statutes renumbered following 1991 legislature. Amendments intended to more clearly state original intent.

(2) The following policies are established to provide further guidance regarding the level of environmental protection these rules are intended to achieve:

This new section is intended to codify the policies that were articulated by the Commission as part of the RFP for the Contractor's evaluation. Wording of these policy statements has been modified for clarity and to be compatible with the rule format.

(a) Liner, leak detection and leak collection systems (systems) are necessary for heap leach pads, solution ponds, and tailings facilities to assure that any leak will be detected before toxic materials escape from the liner system and are released to the environment. For purposes of these rules, the environment is considered to begin at the bottom of the last liner. These systems shall assure that a leak is found, and that sufficient time is available to allow for the repair of the leak and clean up of any leaked material before there is a release to the environment. Natural conditions, such as depth to groundwater or net rainfall, shall be considered as additional protection but not in lieu of the protection required by the engineered liner system.

(b) The toxicity of mill tailings and the potential for long-term cyanide and toxic metals release from mill tailings shall be reduced to the greatest degree practicable through removal ~~and~~ reuse ~~of~~ or destruction chemical solutions prior to placement of tailings in the tailings disposal facility.

(c) The closure of heap leach pads and tailings disposal facilities shall prevent future release to the environment of residual potentially toxic chemicals contained in the facility.

DEFINITIONS

340-43-011~~[0]~~

Renumber to comply with Secretary of State requirement that prior numbers not be used.

Unless the context requires otherwise, as used in this Division:

(1) "Chemical process mine" means a mining and processing operation for metal-bearing ores that uses chemicals to dissolve metals from ores.

(2) "Department" means the Department of Environmental Quality.

(3) "Guidelines" means this body of rules contained in 340-43-045 through 340-43-100.

(4) "Positive exclusion of wildlife" means the use of such devices as tanks, pipes, fences, netting, covers and heap-leach drip-irrigation emitters or covered emitters.

(5) "Tailings" means the spent ore resulting from the milling and chemical extraction process.

PERMIT REQUIRED

340-43-016~~[5]~~

Renumber to comply with Secretary of State requirement that prior numbers not be used.

The reference for statutory authority for requiring a permit is added for clarity.

(1) As required by ORS 468B.050, a~~[A]~~ person proposing to construct a new chemical mining operation, commencing to operate an existing non-permitted operation, or proposing to substantially modify or expand an existing operation shall first apply for, and receive, a permit from the Department. The permit may be an NPDES (National Pollutant Discharge Elimination System) permit if there is a point-source discharge to surface waters or a WPCF (Water Pollution Control

Facility) permit if there is no discharge. Consideration may be given to site-specific conditions such as climate, proximity to water, and type of wastes to establish the final permit type and requirements for the facility.

(2) The permit application shall comply with the requirements of OAR Chapter 340, Divisions 14 and 45 and be accompanied by a report that fully addresses the requirements of this Division.

(3) Prior to issuance of a permit for a chemical process mining activity under this Division, a determination of compliance with statewide planning goals and compatibility with local land use plans must be made. The Department shall determine compliance with Statewide Planning Goals and compatibility with acknowledged comprehensive plans and land use regulations in a manner consistent with its approved State Agency Coordination Program and the rules in OAR Chapter 340, Division 18. In making these determinations, the Department shall consider and may rely on the findings and recommendations made by the project coordinating committee authorized by ORS 517.965 and by the Department of Geology and Mineral Industries pursuant to their State Agency Coordination Program and OAR Chapter 632, Divisions 1 and 37.

The Attorney General advised that the process for land use compatibility determination needs to be clarified in the rule. The Department intends to rely on a determination coordinated by the Department of Geology and Mineral Industries pursuant to the provisions of HB 2244 (Chapter 735, Oregon Laws 1991).

PERMIT APPLICATION

340-43-021~~[0]~~

Renumber to comply with Secretary of State requirement that prior numbers not be used.

(1) The permit application shall fully describe the existing site and environmental conditions, with an analysis of how the proposed operation will affect the site and its environment. The application ~~[Department]~~ shall, at a minimum, contain ~~[require]~~ the information specified for the DOGAMI (Department of Geology and Mineral Industries) consolidated application under ORS 517.971 (Section 13, Chapter 735, 1991 Oregon Laws). The Department will also use the information contained in NEPA (National Environmental Policy Act), EA (Environmental Assessment), or EIS (Environmental

Amendments intended to clarify requirements, terms, and statutory reference.

Impact Statement) documents, if they are required <u>for</u> ~~[by]~~ the project, as partial fulfillment of the requirements of this paragraph.

(2) The permit application shall, in addition to the information described in Paragraph (1) above, include the following information, unless the information has been otherwise submitted:

(a) Climate/meteorology characterization, with supporting data;

(b) Soils characterization, with supporting data;

(c) Surface water hydrology study, with supporting data;

(d) Characterization of surface water and groundwater quality;

(e) Inventory of surface water and groundwater beneficial uses;

(f) Hydrogeologic characterization of groundwater, with supporting data;

(g) Geologic engineering, hazards and geotechnical study, with supporting data;

(h) Characterization of mine materials and wastes which include, for example, overburden, waste rock, stockpiled ore, leached ore and tailings. Characterization of mine materials and wastes shall include, but not be limited to the following:

(A) Chemical and mineral analysis related to toxicity;

(B) Determination of the potential for acid water formation;

(C) Determination of the potential for long-term leaching of toxic materials from the wastes;

(i) Characterization of wastewater (quantity and chemical and physical quality) produced by the operation;

(j) Assessment of the potential for acid-water formation from waste disposal facilities, low-grade ore stockpiles, waste rock piles and for surface water or groundwater accumulation in open pits that will remain after mining is ended.

(3) Data submitted by the permit applicant should be based on analysis of the actual materials, when possible, or may be based on estimates from knowledge of similar operations and professional judgment.

PLANS AND SPECIFICATIONS

340-43-026~~[5]~~

Renumber to comply with Secretary of State requirement that prior numbers not be used.

(1) A person constructing or commencing to operate a chemical process mine or substantially modifying or expanding an existing chemical process mine shall first submit plans and specifications to the Department for construction, operation and maintenance of the facilities intended for treatment, control and disposal of wastes.

(2) ~~[The Department shall approve the plans, in writing, before construction of the facilities may be started.]~~ The plans shall address all applicable requirements of this Division and shall include, but not be limited to, the following:

Deleted text is relocated to a new paragraph (3). Intent of change is to improve clarity.

(a) A description of the facilities to be constructed, including tanks, pipes and other storage and conveyance means for processing chemicals and solutions and wastewaters;

(b) A management plan for control of surface water;

(c) A management plan for treatment and disposal of excess wastewater, including provisions for reuse and wastewater minimization;

(d) A facility construction plan including, as applicable, the design of low-permeability soil barriers, the type of geosynthetics to be used and a description of their installation methods, the design of wastewater treatment facilities and processes, a quality assurance plan for applicable phases of construction and a listing of construction certification reports to be provided to the Department;

(e) A preliminary closure plan;

(f) A preliminary post-closure monitoring and maintenance plan;

(g) A spill containment and control plan.

(3) The Department shall approve the plans, in writing, before construction of the facilities may be started.

DESIGN, CONSTRUCTION, OPERATION AND CLOSURE REQUIREMENTS

340-43-031~~[0]~~

Renumber to comply with Secretary of State requirements that prior numbers not be used.

(1) All chemical process and waste disposal facilities and facilities for mixing, distribution, and application of chemicals associated with on-site mining operations; ore preparation and beneficiation facilities; and processed ore disposal facilities shall be designed, constructed, operated and closed in accordance with the guidelines contained in this Division.

(2~~[3]~~) Alternative facilities and methods of control of wastes and potential pollutants may be approved by the Department ~~[acceptable]~~ if the permit applicant can demonstrate that the alternate facilities and methods will provide ~~[fully equivalent]~~ environmental protection that is fully equivalent or better than that achieved by the facilities specified in the guidelines in Sections 43-040 to 43-095 of these rules. The burden of proof of fully equivalent protection lies with the permit applicant. Written approval of any alternative by the

Amendments are intended to clarify that equivalent technology can be substituted for that specified in the guidelines section. In addition, the wording was broadened in response to the concern of Commissioner Squier that the term waste was too narrow in

Department shall be evidence of acceptance as equivalent or better level of environmental protection.

(3~~[2]~~) A groundwater monitoring plan shall be submitted to, and be approved by the Department. Monitoring wells shall be installed for detection of groundwater contamination as required by OAR Chapter 340, Division 40, unless the Department concludes in writing that the hydrogeology of the site or other technical information indicates that an adverse impact on groundwater quality is not likely to occur.

(4) The Department may, in accordance with a written compliance schedule, grant reasonable time for existing facilities to comply with these rules.

scope. This new wording intended to allow appropriate consideration of site specific factors in the selection of appropriate technologies as well as allow for selection and use of new technologies that may be developed.

EXEMPTION FROM STATE PERMIT FOR HAZARDOUS WASTE TREATMENT OR DISPOSAL FACILITIES

340-43-035

(1) The state hazardous waste program requires a permit for the "treatment", "storage" or "disposal" of any "hazardous waste" as identified or listed in OAR Chapter 340, Division 101 from the Department, prior to the treatment and disposal of wastes. Permitting requirements can be found in OAR Chapter 340, Division 105, Hazardous Waste Management.

(2) However, any operation permitted under this Division, which would otherwise require the neutralization or treatment of hazardous waste and would require a permit pursuant to OAR Chapter 340, Division 105, shall be exempt from the requirement to obtain such hazardous waste treatment permit.

(3) All mined materials disposed of under this Division shall pass Oregon's hazardous waste rule criteria or they will be considered a state hazardous waste and must be disposed of accordingly.

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS

PURPOSE

340-43-040

(1) This Division establishes criteria for the design, construction, operation and closure of chemical mining operations and supplements the provisions of OAR 340-43-006~~[5]~~ through OAR 340-43-035. These criteria are intended to establish the minimum level of environmental protection that is necessary using a combination of performance standards and minimum design criteria. Approval of alternative facilities or methods to achieve an equivalent or better environmental result is allowed as defined in OAR 340-43-031.

This addition is intended to further clarify the intended application of the guidelines, and the ability and process for securing approval of alternatives.

(2) Any disapproval of submitted plans or specifications, or imposition of requirements by the Department to improve existing facilities or their operation will be referenced when appropriate, to applicable guidelines or rules.

GENERAL PROVISIONS

340-43-045

(1) Facilities permitted under either a WPCF or NPDES permit shall not discharge wastewater or process solutions to surface water, groundwater or soils, except as expressly allowed by the permit.

(2) Facilities subject to these rules shall not be sited in 100-year floodplains or wetlands. A buffer zone (a minimum of 200 feet wide) shall be established between waste disposal facilities and surface waters.

(3) All chemical conveyances (ditches, troughs, pipes, etc.) shall be equipped with secondary containment and

leak detection means for preventing and detecting release of chemicals to surface water, groundwater or soils.

(4) Acid water accumulation in open pits resulting from the mining operation must be prevented by appropriate mining practices, by measures taken in the closure process, or be treated to control pH and toxicity, for the life of the pit.

(5) Construction of surface impoundment liner systems shall conform generally to the principles and practices described in <u>EPA/600/2-88/052, Lining of Waste Containment and Other Impoundment Facilities, September 1988</u>.

(6) The Department may require the permittee to hire a third-party contractor to perform the functions set forth below. Selection of the contractor shall be subject to Department approval.

(a) Review and evaluate the design and construction specifications of all mined-materials disposal facilities permitted under this Division for functional adequacy and conformance with Department requirements. The Department shall not approve construction of the disposal facilities until the design and construction specifications have been evaluated.

(b) Monitor the course of construction of all mined-materials ~~[disposal]~~ facilities for compliance with the approved design and construction specifications. The third-party contractor shall regularly document the progress of construction and the Department shall require the permittee to take corrective action if construction does not satisfactorily conform to the approved design and construction specifications.

Commissioner Lorenzen expressed concern that the term "disposal facilities" is too narrow. He requested the word "disposal" be removed from this rule regarding independent review.)

<u>(c) Provide on-site inspections during ongoing operations, including but not limited to the loading of the heap, to assure protection of the integrity of</u>

This provision is added in response to the importance noted by the Contractor regarding loading of the

the liner system and other environmental protection measures.

heap so as to not damage the liner.

CONTROL OF SURFACE WATER RUN-ON AND RUN-OFF

340-43-050

(1) Surface water run-on and run-off shall be controlled such that it will not endanger the facility or become contaminated by contact with process materials or loaded with sediment. The control systems shall be designed to accommodate a 100-year, 24-hour storm event, or any other defined climatic event that is more appropriate to the site, and be placed so as to allow for restoration of the natural drainage network, to the maximum extent practicable, upon facility closure.

(2) All mined materials shall be properly placed and protected from surface water and precipitation so as not to be eroded and contribute sediment to site stormwater run-off or to otherwise contaminate surface water.

PHYSICAL STABILITY OF RETAINING STRUCTURES AND EMPLACED MINE MATERIALS

340-43-055

(1) Permit applicants must demonstrate to the Department that the design of chemical processing facilities and waste disposal facilities is adequate to ensure the stability of all structural components of the facilities during operation, closure and post closure.

(2) Retaining structures, foundations and mine materials emplacements shall be designed by a qualified, registered professional and be constructed for long-term stability under anticipated loading and seismic conditions.

(3) Temporary structures and materials emplacements may, with written approval from the Department, be con-

structed to a lesser standard if it can be shown that they pose no, or minimal, threat to public safety or the environment.

PROTECTION OF WILDLIFE

340-43-060

(1) Wildlife shall be positively excluded from contact with chemical processing solutions and wastewaters containing chemicals.

(2) The Department may waive the positive exclusion requirement if the Oregon Department of Fish and Wildlife (ODF&W) certifies to the Department that the project is designed such that it will adequately protect wildlife.

GUIDELINES FOR DESIGN, CONSTRUCTION, AND OPERATION OF HEAP-LEACH FACILITIES

340-43-065

(1) This paragraph applies to heap-leach facilities using dedicated, or expanding, pads. Heap-leach facilities using on-off, reusable pads may require variations from these rules; they shall be approved on a case-by-case basis by the Department.

(2) The heap-leach facility (pad and associated ponds, pipes and tanks) shall be sized to prevent flooding of any of its components.

(3) TABLE 1 of this Division establishes minimum capacity-sizing criteria for the leach-pad and ponds. The pad and ponds may be designed to act separately or in conjunction with each other to obtain the required storage volumes. Other design criteria may be used, with Department approval, if local conditions warrant. The best available climatic data shall be used to confirm the critical design storm event and estimate the liquid levels in the system over a full seasonal cycle.

The liquid mass balance may include provision for evaporation.

Heap Leach Pad Liner Alternative 1

(4) The heap-leach pad liner system shall be of triple liner construction with between-liner leak detection consisting of:

(As proposed in the December 13, 1991 rules.)

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;

(b) Continuous flexible-membrane middle and top liners of suitable synthetic material separated by a minimum of 12 inches of permeable material (minimum permeability of 10^{-2} cm/sec);

(c) A leak-detection system between the synthetic liners capable of detecting leakage of 400 gallons/day-acre within ten weeks of leak initiation.

Heap Leach Pad Liner Alternative 2

(4) The heap leach pad liner system shall be designed, constructed, and operated to meet the following criteria:

(a) A primary liner consisting, at a minimum, of a continuous flexible-membrane of suitable synthetic material shall be provided. This liner shall function together with the process chemical collection system installed immediately above this liner (see section (8) of this rule) to remove process chemicals from the heap.

(b) A leak detection system shall be installed immediately below the primary liner for the purpose of detecting loss of process solutions by leakage through the primary liner. The leak detection system shall be capable of detecting leakage through the primary liner of 400 gallons/day-acre within ten weeks of leak initiation. The leak

This alternative is intended to define the liner system more in terms of the intended purpose of each component in relation to operational purposes and environmental protection purposes. It is recognized that there are alternative configurations for the primary liner, the leak detection system, and the secondary liner that may achieve equivalent environmental protection and be more appropriate for an individual facility. The applicant would have the opportunity to secure approval of an alternative detection system shall consist of appropriately sized collection piping placed within a minimum thickness of 12 inches of permeable material (minimum permeability of 10^{-2} cm/sec) that is capable of withstanding the anticipated weight of the heap without loss of function.

design that would achieve equivalent or better environmental protection as provided in OAR 340-43-031.

(c) A secondary liner shall be placed below the leak detection system to provide assurance that any leakage through the primary liner during the operation of the heap and following closure of the heap is not released to the environment. The Secondary liner shall be of a composite design with a continuous flexible-membrane of suitable synthetic material in direct contact with an engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches.

Processing Chemical Pond Liner Alternative 1

(5) The processing-chemical pond liners shall be of triple liner construction with between-liner leak detection consisting of:

(Original rule language from December 13, 1991 Draft.)

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;

(b) Continuous flexible-membrane middle and top liners of suitable synthetic material separated by a permeable material (minimum coefficient of permeability of 10^{-2} cm/sec);

(c) A leak detection system between the synthetic liners capable of detecting leakage of 400 gallons/day-acre, within ten weeks of leak initiation.

Processing Chemical Pond Liner Alternative 2

(5) The processing chemical pond liner system shall be designed, constructed, and operated to meet the following criteria:

This proposed alternative is patterned after Alternative 2 for the Heap Leach Pad Liner. It is intended to

(a) A primary liner consisting, at a minimum, of a continuous flexible-membrane of suitable synthetic material shall be provided. This liner shall provide for positive containment of processing chemical solutions.

capture the liner specifications in Alternative 1 but in different words.

(b) A leak detection system shall be installed immediately below the primary liner for the purpose of detecting loss of process chemical solutions by leakage through the primary liner. The leak detection system shall be capable of detecting leakage through the primary liner of 400 gallons/day-acre within ten weeks of leak initiation. The leak detection system shall consist of appropriately sized collection piping placed within a layer of permeable material (minimum permeability of 10^{-2} cm/sec).

(c) A secondary liner shall be placed below the leak detection system to provide assurance that any leakage through the primary liner during the use of the pond is not released to the environment. The Secondary liner shall be of a composite design with a continuous flexible-membrane of suitable synthetic material in direct contact with an engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches.

(6) Emergency ponds may be constructed as an alternative to larger pregnant and barren ponds. The emergency pond may be constructed to a lesser standard, with the limitation that it is to be used only infrequently and for short periods of time. The Department will specify reporting and use limitations for the ponds in the permit. A between-liner leak detection system is not required for the emergency pond.

(7) The emergency-pond liner shall be of composite construction consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-6}

°m/sec) with a minimum thickness of 12 inches, and

(b) A single flexible-membrane synthetic top liner of suitable material.

(8~~[6]~~) The heap-leach pad shall be provided with a process chemical collection system above the upper-most liner that will prevent an accumulation of process chemical within the heap greater than 24 inches in depth.

The numbering for this and subsequent sections was incorrectly shown in the December 13, 1991 rule draft.

(9~~[7]~~) The permittee shall prepare a written operating plan for safe temporary shut-down of the heap-leach facility and train employees in its implementation.

(10~~[8]~~) The permittee shall respond to leakage collected by the heap-leach and processing-chemical storage pond leak-collection systems according to the process defined in TABLE 2.

(11~~[9]~~) The permittee shall determine the acid-generating potential of the spent ore by acid\base accounting and other appropriate static and dynamic laboratory tests. If the spent ore is shown to be potentially acid generating under the conditions expected in the heap at closure, the permittee shall submit a plan for acid correction for Department approval prior to loading the heap.

GUIDELINES FOR DISPOSAL OF MILL TAILINGS

to the lowest practicably level

340-43-070

or destruction

(1) Mill tailings shall be treated by cyanide removal ~~and~~ re-use prior to disposal to reduce the amount of cyanide introduced into the tailings pond. ~~Chemical~~ oxidation ~~or other~~ means shall be ~~additionally used, if~~ necessary, ~~prior to disposal to reduce~~ the WAD cyanide level in the liquid fraction ~~of the tailings~~. The permittee shall conduct laboratory column tests on mill tailings to determine the lowest practicable concentration to which the WAD cyanide (weak-acid dissociable cyanide as measured by ASTM Method D2036-82 C) can be reduced. In no event, shall the permitted WAD

No change is proposed in the requirements for removal and reuse of cyanide. See discussion in staff report.

cyanide concentration in the liquid fraction of the tailings be greater than 30 ppm.

(2~~[3]~~) The permittee shall determine the potential for acid-water formation from the tailings by means of acid-base accounting and other suitable laboratory static and dynamic tests. If acid formation can occur, basic materials shall be added to the tailings in the amount of three (3) times the acid formation potential or to give a net neutralization potential of at least 20 tons of $CaCO_3$ per 1000 tons of tailings, whichever is greater, before placing tailings in the disposal facility.

Section 2 was previously deleted, and the subsequent sections were not renumbered. The amended numbering corrects this error.

(3~~[4]~~) The disposal facility shall be lined with a composite double liner consisting of a flexible-membrane synthetic top liner in tight contact with an engineered, stable, soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) having a minimum thickness of 36 inches.

Construction of the liner shall generally follow the principles and practices contained in EPA/600/2-88/052, "Lining of Waste Containment and Other Impoundment Facilities, September, 1988.

(4~~[5]~~) The disposal facility shall be provided with a leachate collection system above the liner suitable for monitoring, collecting and treating potential acid drainage.

GUIDELINES FOR DISPOSAL OR STORAGE OF WASTEROCK, LOW-GRADE ORE AND OTHER MINED MATERIALS

340-43-075

The permittee shall determine the acid-producing and metals-release potential of the wasterock, low-grade ore or other mined materials by acid/base accounting and other appropriate static and dynamic laboratory tests. If the mined materials are shown to be potentially acid forming, or capable of releasing toxic metals, the permittee shall submit a plan for correction and disposal for Department approval prior to permanently placing the materials.

GUIDELINES FOR HEAP-LEACH AND TAILINGS DISPOSAL FACILITY CLOSURE

340-43-080

(1) The waste disposal facilities shall be closed under these rules in conjunction with the reclamation requirements of DOGAMI (Oregon Department of Geology and Mineral Industries).

(2) An up-dated closure plan and post-closure monitoring and maintenance plan shall be submitted to the Department by the permittee at least 180 days prior to beginning closure operations or making any substantial changes to the operation. The closure plan must be compatible with DOGAMI's reclamation plan and may be part of it.

(3) Chemical conveyances (ditches, troughs, pipes, etc.) not necessary for post-closure monitoring shall be removed. The secondary containment systems shall be checked before closure for process-chemical contamination, and contaminated soil or other materials, if any, shall be removed to an acceptable disposal facility.

(4) Closure of the heap-leach facility.

(a) The heap shall be detoxified over a suitable period of time prior to closure, using rinse/rest cycles of rinsing and chemical oxidation, if necessary. The WAD cyanide concentration in the rinsate shall be no greater than 0.2 ppm.

(b) Following detoxification as defined in (a) above, the heap shall be closed in place on the pad by covering the heap with a cover designed to prevent water and air infiltration. The cover should consist, at a minimum, of a low-permeability layer and suitable drainage and soil layers to prevent erosion and damage by animals and to sustain

No change is proposed in the cover requirement. See staff report for discussion.

vegetation growth, in accordance with DOGAMI's reclamation rules.

(c) The ponds associated with the heap shall be closed by folding in the synthetic liners and filling and contouring the pits with inert material. Residual sludge may be disposed of in one of the on-site waste disposal facilities, provided it meets the criteria for such wastes in these guidelines. The process chemical collection system of the heap shall be maintained in operative condition so that it can be used to monitor the amount and quality of infiltrated water, if any, draining from the heap.

(5) The tailings disposal facility shall be closed by covering with a composite cover designed to prevent water and air infiltration and be environmentally stable for an indefinite period of time. Maximum effort shall be made to isolate the tailings from the environment. Construction of the cover shall generally follow the principles and practices contained in EPA/530-SW-89-047, Technical Guidance Document -- Final Covers on Hazardous Waste Landfills and Surface Impoundments.

No change is proposed in the cover requirement. See staff report for discussion.

POST-CLOSURE MONITORING

340-43-085

(1) The Department may continue its permit in force for thirty (30) years after closure of the operation and will include permit requirements for periodic monitoring to determine if release of pollutants is occurring.

(2) Monitoring data will be reviewed regularly by the Department to determine the effectiveness of closure of the disposal facilities. The Department will consult with DOGAMI on release of security funds that would otherwise be needed to correct problems resulting from ineffective closure.

LAND DISPOSAL OF WASTEWATER

340-43-090

(1) To qualify for land disposal of excess wastewater, the permit applicant shall demonstrate to the Department that the process has been designed to minimize the amount of excess wastewater that is produced, through use of water-efficient processes, wastewater treatment and reuse, and reduction by natural evaporation. Excess wastewater that must be released shall be treated and disposed of to land under the conditions specified in the permit.

(2) A disposal plan shall be submitted as part of the permit application that, at a minimum, includes:

(a) Wastewater quantity and quality characterization;

(b) Soils characterization and suitability analysis;

(c) Drainage and run-off characteristics of the site relative to land application of wastewater;

(d) Proximity of the disposal site to groundwater and surface water and potential impact;

(e) Wastewater application schedule and water balance;

(f) Disposal site assimilative capacity determination;

(g) Soils, surface water and groundwater monitoring plan;

(h) Potential impact on wildlife or sensitive plant species.

(3) The Department will evaluate the disposal plan and set site-specific permit conditions for the wastewater discharge.

GUIDELINES FOR OPEN-PIT CLOSURE

340-43-095

(1) Open pits that will be left as a result of the mining operation shall be assessed prior to, and following, mining operations for the potential to contaminate water to the extent that it might not meet water-quality standards due to build-up of acid or toxic metals.

(2) If the Department finds that the potential for water accumulation in the pit(s) exists, the permit applicant shall submit a closure plan for the pit that will address contamination prevention and possible remedial treatment of the water. The closure plan shall, at a minimum, examine the following alternatives:

(a) Avoidance, during mining, of acid-generating materials that can be left in place, rather than being exposed to oxidation and weathering;

(b) Removal from the pit and disposal, during or after the mining operation, of residual acid-generating materials that would otherwise be left exposed to oxidation and weathering;

(c) Protective capping in-situ of residual acid-generating materials;

(d) Treatment methods for correcting acidity and toxicity of accumulated water;

(e) Installation of an impermeable liner under ponded water to prevent groundwater contamination;

(f) Backfilling of the pit(s) above the water table to reduce oxidation of residual acid-generating materials.

TABLE 1

Heap-Leach Liquid Storage Criteria

Component	Pregnant-Solution Pond	Barren-Solution Pond
Operating Volume	Minimum necessary to maintain recirculation	Minimum necessary to maintain recirculation
Operational Surge	Anticipated draindown and rinse volume	Anticipated draindown and rinse volume
Climatic Surge	100-yr, 24-hr storm plus 10-yr snowmelt	100-yr, 24-hr storm plus 10-yr snowmelt
Safety Factor	2-ft dry freeboard	2-ft dry freeboard

TABLE 2

Required Responses to Leakage Detected from the Leach Pad and Processing Chemical Storage Ponds

Leakage Category	Response
Zero leakage to 200 gal/day-acre	Notify the Department; increase pumping and monitoring
Leakage from 200 gal/day-acre to 400 gal/day-acre	Change operating practices to reduce leakage
Leakage in excess of 400 gal/day-acre	Repair leaks under Department schedule.

Oregon Department of Environmental Quality

A CHANCE TO COMMENT ON...

OAR Chapter 340, Division 43--Proposed Rules For MINING OPERATIONS WHICH USE CYANIDE OR OTHER TOXIC CHEMICALS TO EXTRACT METALS OR METAL-BEARING MINERALS FROM ORES

Notice Issued: 4-12-91
Comments Due : 5-20-91

WHO IS AFFECTED:

Mining and ore-processing operations which use chemicals to extract metals or metal-bearing minerals from the ore and Oregonians who could be affected by or have an interest in these types of mining operations.

WHAT IS PROPOSED:

The Department of Environmental Quality is proposing to adopt rules to regulate affected mining and ore-processing operations. The rules would apply to heap-leaching, a process that uses cyanide compounds or other chemicals to extract gold and silver from ore as well as vat-leaching and milling. The rules would constitute a separate division in Oregon's water-quality control rules (OAR Chapter 340).

WHAT ARE THE ENVIRONMENTAL CONCERNS:

The primary environmental concern about heap-leaching, vat-leaching and milling is the potential to contaminate the environment. Chemicals that spill or escape devices designed to contain them may reach nearby surface water or may filter through soils to reach groundwater.

If people use water near a leaching or milling operation for irrigation, recreation or drinking, health concerns may become an issue. Wildlife or livestock may drink from water that could be contaminated by chemicals. Mine processing ponds that hold cyanide solution may attract birds and other wildlife in areas where water is scarce.

Spent ore, from which gold and silver have been extracted, must be treated and disposed of properly to protect people and wildlife from contact with toxic metals, cyanide or other chemicals.

811 S.W. 6th Avenue
Portland, OR 97204

11/1/86

FOR FURTHER INFORMATION:

Contact the person or division identified in the public notice by calling 229-5696 in the Portland area. To avoid long distance charges from other parts of the state, call 1-800-452-4011.

Other issues that are not unique to leaching and milling operations may also be of concern. Land disturbance destroys vegetation and the general environment of the mined area. When a mine closes down, contaminated soils may remain at the mining site.

WHAT ARE THE HIGHLIGHTS:

The proposed rules require affected mining and ore-processing operations to:

- o Reduce heap-leach residual cyanide toxicity by rinsing and through hydrogen peroxide oxidation before the mine can close
- o Reduce levels of cyanide and toxic metals in discharged mill tailings by chemical and physical treatment
- o Reduce long-term risk of acid water and toxic metals releases by preventing acid water formation from mill tailings disposal facilities
- o Provide composite liners and leak detection under processing-solution ponds, leach heaps and tailings disposal facilities
- o Isolate and repair leaks in processing-solution ponds and leach heaps, if they occur
- o Provide positive protection such as covers, nets or fences to exclude wildlife from contact with chemical processing solutions
- o Install monitoring wells, when necessary, to detect possible contamination of groundwater
- o Provide long-term monitoring to determine effectiveness of leach heaps and tailings disposal facilities, after the mine is closed

HOW DOES DEQ REGULATE MINING?

DEQ has drafted these proposed mining operation rules to address the leaching process. Any company that wants to operate a mine using leaching or milling processes must go through a separate permit process. Applications for a water quality permit are reviewed using DEQ's rules to determine if the proposed mine will meet environmental regulations. DEQ's permit process includes the opportunity for public input on every proposed permit. Every permit must be accompanied by:

- o A statement from the local land use planning agency
- o Site characterization and design plans and specifications of the equipment and devices that may control pollution
- o Estimates of the amount of contaminants that will be created and how they will be treated
- o An analysis of how the environment will be affected.

The permit applicant must prove that the proposed mine will meet environmental standards and regulations that apply to the activity. If DEQ finds that an applicant has met the technical requirement, DEQ will mail out a public notice, inviting the public to comment on the proposed permit during a 30-day comment period. A hearing is held when DEQ anticipates significant public interest or at the request of interested citizens.

HOW TO COMMENT:

DEQ invites your review and comment of the proposed rules. If a permit application is received, DEQ will review that separately and will invite the public to comment on conditions of the proposed permit.

Hearings are scheduled for:

Date:	Time:	Location:
May 15, 1991	9:30 am	DEQ Headquarters, Room 3A 811 S.W. Sixth Avenue Portland, Oregon
May 16, 1991	7:00 pm	Nyssa High School Auditorium 820 Adrian Boulevard Nyssa, Oregon
May 20, 1991	7:00 pm	City Council Chambers 101 NW "A" Street (Corner of 6th & "A") Grants Pass, Oregon

Written comments will be received by the Department until 5:00 pm May 20, 1991, and should be sent to the Department at the following address:

Attn: Mary Lynn
Department of Environmental Quality
Water Quality Division
811 S.W. Sixth Avenue
Portland, OR 97204
Telephone (503) 229-5425

Copies of the proposed rules are available from the Department at the above address, and at DEQ's regional offices in Pendleton, Bend, Medford and Salem. Copies are also available at the Malheur County Library in Ontario, the Nyssa Library, the Lakeview Library, the Baker City Library and the Josephine County Library in Grants Pass.

WHAT IS THE NEXT STEP:

Following the public comment period, DEQ makes changes in the draft rules and submits the revised rules to the Environmental Quality Commission for approval. The Commission may adopt the proposed rule, adopt a modified rule on the same subject matter, or decline to act. The Commission's deliberation may come in June, 1991, at its regularly scheduled meeting.

A Statement of Need, Fiscal and Economic Impact Statement and Land Use Consistency Statement are attached to this notice.

IW\WC8\WC8131
JET 4/9/91

RULEMAKING STATEMENTS
for

OAR 340, Chapter 43--Proposed Rules for MINING OPERATIONS WHICH USE CYANIDE OR OTHER TOXIC CHEMICALS TO EXTRACT METALS OR METAL-BEARING MINERALS FROM ORES

STATEMENT OF NEED:

Pursuant to ORS 183.335(7), this statement provides information on the Environmental Quality Commission's intended action to adopt a rule.

1. Legal Authority

   These proposed rules were prepared for adoption by the Environmental Quality Commission under its general rule-making authority as expressed in ORS 468.020; "...the commission shall adopt such rules and standards as it considers necessary and proper in performing the functions vested by law in the commission.

2. Need for the Rule

   Oregon presently has no rules which specifically regulate mining activities that utilize chemicals to extract metals or metal-bearing minerals from the ore. The Department has concluded that it needs to develop rules specific to such mining operations to effectively regulate the potentially large-scale impact they may have on the environment.

3. Principal Documents Relied Upon in this Rulemaking

   These documents are available from the sources indicated or may be reviewed at the Department's Water Quality Division offices at 811 S.W. Sixth Avenue, Portland, Oregon 97204, Fifth Floor. (503) 229-5425

   <u>Cyanide Destruction--The INCO SO_2-Air Process</u>, 1990, a compilation of literature published by INCO TECH, Mississauga, Ontario, (416) 822-3323

   <u>State-of-the-Art of Processes for the Treatment of Gold Mill Effluents</u>, Ingles, J. and J.S. Scott, Mining, Mineral and Metallurgical Processes Division, Environmental Protection Programs Directorate, Environment Canada, Ottawa, Ontario, K1A 0E7, 1987

   <u>Proceedings of the Nevada Wildlife/Mining Workshop</u>, Reno, Nevada, 1990, Sponsored by the Nevada Mining Association, Reno, Nevada, (702) 829-2121

EPA/530-SW-89-047 Final Covers on Hazardous Waste Landfills and Surface Impoundments, July, 1989, Office of Solid Waste and Emergency Response, EPA, Washington, DC 20460

Draft Acid Rock Drainage Technical Guide, Vol. 1, British Columbia Acid Mine Drainage Task Force Report, August, 1989, Prepared by Steffen Robertson and Kirsten (B.C.) Inc., Vancouver, B.C., V6E 2N7

Discharges of Waste to Land, California Code of Regulations Title 23, Chapter 3, Subchapter 15, Department of General Services, P.O. Box 1015, North Highland, CA 95660

Heap Leach Technology Workshop, Pegasus Gold Corporation, July 1990, Presented by EIC Corporation, Denver, Colorado, (303) 692-0272

Proceedings, Gold Mining Effluent Treatment Seminars, Conference, Vancouver, B.C., February 15-16, 1989, Environment Canada, West Vancouver, British Columbia, V7T 1A2

Strawman II Recommendations for a Regulatory Program For Mining Waste and Materials Under Subtitle D of RCRA, EPA and The Western Governors' Assn., (303) 534-7309, 1990

Introduction to Evaluation, Design and Operation of Precious Metal Heap Leaching Projects, Soc. Of Mining Engineers, Inc., Littleton, Colorado, 1988, van Zyl, Hutchison and Kiel, editors

FISCAL AND ECONOMIC IMPACT STATEMENT:

1. Other State Agencies

These proposed rules are not expected to have any added fiscal impact on other state agencies because the rules will be administered and enforced entirely by the Department.

2. Municipalities

These proposed rules are not expected to have any added fiscal impact on municipalities and counties. They may save time and effort for those municipalities and counties that evaluate the environmental impact of proposed mining projects by defining the environmental control measures that the Department will employ in its permits.

3. Overall Economic Impact on Business

These proposed rules are expected to add operating and capital costs to all subject mining operations, above what they might currently experience in other states. It is the Department's intent to require preventive environmentally-protective measures that may cost more during the life of the mine but which should minimize the potential future cost of remediation due to toxic pollution.

Increased costs could be incurred under these rules by the mining companies, particularly in regard to the following waste-treatment processes.

a. Cyanide detoxification of mill tailings

Using cost estimates from INCO TECH as an example, the capital costs of cyanide destruction by the SO_2-Air process for a 1,000 metric-ton per day CIP (carbon-in-pulp) operation would be $248,000 (Can.) and the operating cost would be $1.61 (Can.) per metric ton of ore.

b. Cyanide recovery and re-use

Costs associated with cyanide recovery and re-use may vary considerably with the particular process used and the nature of the ore being treated. Economic studies have been done by CANMET (Energy, Mines and Resources, Canada) and Steffan, Robertson and Kirsten. Both studies estimate, under the assumptions that were used, that cyanide recovery and re-use could pay for itself and return the capital cost required to install the process.

c. Composite liners with leak detection for disposal facilities

The added cost of a triple liner over a double liner could be expected to be at least $0.50 per square foot of liner. The added cost of a plastic-pipe-based between-liner leak detection system would consist primarily of labor costs and would be dependent upon the size and complexity of the system; no cost estimate has been made.

4. The Small Business Impact

Small businesses are not anticipated to be engaged in full-scale mining operations because of their capital-intensive nature. Small businesses might, however, be engaged in secondary mining/ore processing operations such as chemical processing of tailings or low-grade ore from earlier mining.

Small businesses may propose alternatives to the environmental control requirements of these rules. The Department can accept the alternatives if the operator can demonstrate that they will be equally protective. The Director may also grant a variance from these rules on a case-by-case basis.

LAND-USE COMPATIBILITY STATEMENT:

The proposed rules may affect land use and appear to be consistent with the Statewide Planning Goals.

The rules are designed to preserve water quality in the areas affected by mining and are considered consistent with Goal Six (air, water and land resources quality). The proposed rules, after adoption, will be implemented through the Department's current land-use compatibility procedures for WPCF (Water Pollution Control Facility) and NPDES (National Pollutant Discharge Elimination System) permits.

Public comment on any land use issue involved is welcome and may be submitted in the same fashion as indicated for testimony in this notice.

The Department requests that local, state and federal agencies review the proposed action and comment on possible conflicts with their programs which affect land use and with statewide planning goals within their expertise and jurisdiction.

The Department will request that the Department of Land Conservation and Development mediate any apparent rule conflicts brought to its attention by local, state or federal authorities.

Jerry Turnbaugh
(503) 229-5374
April 10, 1991

ABSTRACT OF TECHNICAL COMMENTS RECEIVED REGARDING PROPOSED RULES FOR CHEMICAL MINING (OAR Chapter 340, Division 43)

Foreword

Extensive written and oral comment was received before, during, and after the thirty-day period that the rules were open for public comment. The following is the author's attempt to abstract the significant technical comments that were received and to note at least one source for the comment. Much of the comment was duplicative but no attempt was made to tally the number of commentators since the comment process focusses on the content of issues rather than their popularity.

The comment abstracts are the author's paraphrasing of the comments and are intended to be essentially correct but it should be understood that they may not exactly portray what the commentator intended.

The number(s) following each comment abstract refer to a commentator listed in the attached List of Referenced Commentators. The list does not identify all the commentators; it is intended only to refer to at least one commentator who raised a particular issue.

General Comments

ORS 468.710, under which DEQ is authorized, establishes a policy for water pollution control. While water law is appropriate for waste waters, it does not appear to provide sufficient basis for regulating mine processing and mine wastes beyond a potential to release contaminants to the environment. These DEQ rules are not supported by the Oregon water pollution control laws (which focus on point-source control). 10

DEQ should require further bonding for environmental damage, beyond DOGAMI's reclamation bonding. 1

Use the rules of other states, instead of trying to reinvent the rules. 28

Add a section prohibiting liquid cyanide transport to the site. 26

Add a section on fees--all fees should come from the miners for DEQ to monitor the sites. 26

Add a section on disposal of operational garbage. Burying on site should not be allowed. 26

Add a provision to require DEQ to check the past compliance record of the company requesting the permit. Companies with unresolved or ongoing problems in other states should not be allowed to operate in Oregon. 26

Add a section regulating transportation of chemicals. 1

DEQ should devise a strict air quality control program to protect against the hazards of dust and toxics raised by hauling and blasting. 6

Safe Drinking Water Act provisions which allow aquifers to be exempt from Safe Drinking Water standards should not apply to chemical process mines. 6

Facility construction should be monitored, inspected and approved by DEQ or a third party contractor. 6

340-43-005

Define "reasonable" as found in ORS 468.715

In order to exercise its authority under ORS 468.715(b), the department must show that (1) the technology required is necessary for the prevention of the new pollution and the abatement of existing pollution and (2) that the technology is both available and reasonable. The department has failed to meet these standards with its proposed regulations of mining activities. The rule-making process should follow the policies in ORS 468.710 and .715. The standard should be developed under 468.735(3) and .694. Rules should allow for site specific conditions. 12

The rules do not seem to recognize the regulations and standards enforced by federal land management agencies, which is not in keeping with 468.710(5) which calls for cooperation with federal agencies. 12

The department is charged with fostering the cooperation of people, industry, cities and counties in order to prevent, control and reduce pollution of the waters of the state. (ORS 468.715(a). 12

ORS 183.335 (2)(b)(D) imposes on the DEQ a requirement that it prepare a statement of fiscal impact and economic effect of the proposed action on the local government and the public and project any significant economic effect of the regulations on industry. 12

ORS 183.545 requires an agency to periodically review its rules to minimize economic effect on businesses. 12

ORS 468.735(h) requires the DEQ to consider the impact of its regulations on the development of industry when setting standards of quality and purity. The DEQ must show that the methods described by the rules are reasonable. 12

ORS 183.335 (2)(b)(D) A determination of reasonableness involves not only a determination that the method is effective but that it does not have any unreasonable negative economic impact on the regulated industry. 12

DEQ has decided to regulate mining wastes as a solid waste under subtitle D of RCRA rather than as hazardous waste under subtitle C, without clearly stating the policies or scientific evidence which justifies this more stringent treatment of mining waste. 12

340-43-010

Define "small...operations" as those with a production level of (less than) 1000 tons per day. 12

Clarify reference to the exclusion of small-scale froth-flotation operations. 37

Define "small" mineral extraction operations or establish a procedure for excluding small operations. 17

Limit scope to toxic chemicals and wastewaters containing toxic materials. 10

340-43-015

Does not correspond to the purpose section because it appears to apply to all operations using chemicals. Also, define "small" for the froth-flotation exemption. 39

Define "acid mine drainage" as "low pH water which contains high levels of sulphate and dissolved solids and which may also contain various levels of heavy metals". 25

Define "toxic chemicals" as those substances so listed by EPA (40 CFR Part 261). 10, 24

Define "toxic" (includes chlorine, bromine, lime, acids, etc.?)--rules should address only cyanide. 39

340-43-020

Consideration should be given to special areas of concern; e.g., State Parks, Research Natural Areas, BLM areas of Critical Environmental Concern, Endangered Species habitat, State Natural Heritage Conservation Areas, etc. 37

Should specify time frame for DEQ to respond to permittee and the fees to be charged. 35

Streamline the amount of redundant information required of permittees by committing to accepting the information submitted to other agencies. 27

340-43-025

(2) Soils characterization not necessary unless agency is prepared to consider soil attenuation capacities, otherwise soil information bears no relationship to water quality. 10

(2) Need a process for verifying submitted data to prevent falsification. 16

(2h) Specify what will be an adequate characterization of hydrogeology. 8

(2)(l) Delete because there should be no open pits; they should be refilled and reclaimed. 16

(3) This section is too weak; would allow applicant to falsify data under the guise of error. 16

(3) Add, "Site map <u>including floodplain information, if appropriate;</u> 14

(3) Add, "Data submitted...and professional judgement. <u>All data submitted shall be according to collection methodologies approved by department staff, and shall be reviewed for adequacy by department staff before the permit application is processed.</u> 14

(3) add after "...professional judgement <u>on the part of an engineer or geologist registered with the State of Oregon.</u> 8

Require information on special areas of concern and relationship to land use plans and, in coastal zones, consistency with Oregon Coastal Zone Management Plan. 37

Proposed rule gives little incentive for consideration of site-specific conditions. 10

Permit application info should be reviewed by a reputable qualified firm with appropriate quality assurance included in the report. 1

Require applicant to identify "areas of special concern" in the application that are critical to the existence of endangered or threatened animal or plant species. Areas should include Areas of Critical Environmental Concern (ACEC), Research Natural Areas (RNA), Outstanding Areas (ONA) and areas designated by the Oregon Natural Heritage Plan. There should be protection for these areas from adjacent mining. 4

All baseline data and plans should be approved by DEQ or a third party contractor hired by DEQ, with no input from the applicant. 6

Registrations of professionals should be verified and stamps required. 8

Specify what is an adequate characterization of the hydrogeology. 8

340-43-030

(1) define "substantial" 37

(1) leaves "toxic" open to subjective judgement by DEQ. 18

(1) Define "toxic wastes" 8

(2) Should include requirements for a preliminary clean up, detoxification and restoration plan, with evidence of adequate financial ability to carry out the plan. 16

(2) Should specify time frame for DEQ response. 35
Water quality monitoring should begin <u>before</u> construction in order to establish baseline water quality data. 13

(2c) Add ...of excess wastewater, <u>control of acid mine drainage,</u>...8

(2d) Scope of DEQs review of construction plans should be limited to assessing whether or not the design will adequately protect the waters of the state. The guidelines essentially design the facility. ORS 468.735 (3) specifically assigns the design opportunity to the project proponent, not the DEQ and requires DEQ to review those designs for compliance with established water standards. 10

Allow preliminary design plans to be sufficient to start the application process. Allow applicants to prepare final plans during permitting. 39

Add provision to allow applicant to meet with Department to determine the scope of information the applicant must submit. "This would provide an excellent opportunity to obtain confidentially agreements on certain portions of the operation or flowsheet which may be proprietary or patentable."12

340-43-035

(1) Include a "grandfathering" provision for existing facilities which may be successfully operating with a lesser degree of design containment. 10

(2) List what the groundwater monitoring plan should include. 8

(2) Specify that wells must meet construction, use, maintenance and abandonment standards of Water Resources Department. 8

(2) Specify what happens if the monitoring program finds something. 8

(2) eliminate "unless hydrogeology ..."--do not allow this loophole. 26, 33

(2) define phrase "is not likely to occur"--too vague. 23

(2) eliminate "unless the...likely to occur" This is a possible loophole. 20, 31

(2) Paragraph should end at line 5, following "40"; paragraph as-is invites falsification of data. 16

(3) doesn't make sense. 17, 8

(3) Change wording in "...indicates that [an] <u>no</u> adverse impact on groundwater quality [is not likely to] <u>will</u> occur." 14

(3) Should include text to the effect: "The Department may approve protective means <u>other than those required by parts (1) and (2) of this section</u> if the permit applicant can demonstrate..." 10

(3) Missing text. 8

Local site characteristics may provide protection without the added requirement of redundant lining systems. Operator who will use best available technology should not have to prove that he will not affect the environment outside the isolated system. 18

340-43-040

(1) Clarify criteria DEQ will use to grant variations from the rules. 9

(1) Provide for state-wide public input on proposed variances to the rules. 29

(1) Rule does not clearly provide for a variance procedure based on a case-by-case evaluation. 22

(1) Delete entire section--should be no waivers for these types of operations. 16, 23, 26, 33

(1) Add at end; <u>Any variances requested by the applicant must provide equivalent protection for human health and the environment.</u> 14

(1) Should specify which rule requirements are subject to granting of variance. Should not grant variances for -070 for protection of wildlife. 9

(2) Should grandfather existing facilities which have a history of non-degradation of surface and groundwaters. Changes to such facilities should require consideration under existing rules on a case-by-case basis. 10

(2) "reasonable time" is too vague; should be a maximum of 90 days for minor matters, 180 days for major compliance issues. Operation of mine should be halted until compliance occurs. 16

340-43-045

(1) Should require HW permits only when wastes exceed hazardous criteria. The hazardous waste criteria for cyanide are expected to be much higher than 0.2 mg/l. 39

(1) Proposed program is contemplated under the Oregon Water Pollution Control Laws - there is an erroneous correlation between water pollution control and solid/hazardous waste regulation. Solid wastes from the beneficiation of ores has been expressly excluded rom Oregon hazardous waste management rules. The proposed rules go far beyond the scope of the Oregon Water Pollution Control Laws to include mining wastes in their purview. 10

(1) OAR 340-101-004 expressly deletes the Bevill Exclusion by references and replaces it with the exclusion of "residues

from the extraction and beneficiation of ores and minerals...", thus being more restrictive than the federal requirement by the elimination of processing in the state exclusion. Regardless, the term beneficiation is still included, which is presumed to retain the definition provided in 40 CFR 261..4(b)(7) for lack of a state proposed definition. In nearly all applications of this definition, mining wastes will fail to meet the criteria for being characterized as hazardous under OAR 340-101-100 and 340-101-033. 10

(1) If intent is to allow an exemption to the criteria in the rules for processing wastes provided that a state hazardous waste permit is obtained, the criteria should be specified under which the DEQ would grant the exemption. 9

(3) Define "processing waste". 17

Intent is confusing. Rules should state that the Department retains authority to permit such operations under either OAR 340-105 or these rules. 14

340-43-050

(2) Use "applicant"., rather than "permit applicant". 8

(2) Is an unconstitutional statement; the applicant should be presumed innocent until proven not to be in compliance. 18

(2) The procedure for getting approval of alternative techniques needs to be clearly spelled out. 17

(2) DEQ has not offered any relationship between the prescriptive standards suggested in these guidelines and an improvement in environmental protection. Reference to full-equivalent protection is meaningless absent some method of measuring environmental improvement. Liner redundancy does not equate to environmental improvement. "One effective liner system is equivalent to any number of [in?]effective liner systems in terms to [of?] environmental protection". 10

(2) Some cost-benefit justification should be considered when prescriptively requiring liner systems in excess of what is normally considered adequate minimum design redundancy. 10

(2) Allowing alternative control methods invites legal challenge to agency decisions. DEQ should accept suggestions, however the agency should be under no obligation to make a determination on these suggestions as they relate to a particular permit application. 6

(2) Use "applicant" for "permit applicant". 8

340-43-055

(1) Clarify "inadequately treated". 9

(2) Define "flood plain, wetlands and seismic instability". 39

(2) Define "surface waters" 35

(2) Should delete since leak detection and waste treatment are required. 12

(2) Increase to one mile because dams may break. 26, 33

(2) 200 feet seems arbitrary--dam failure a danger and should be on the order of a mile. 23

(2) Should have a buffer zone of at least 1,000 feet. 34

(2) Requirements in (2) may conflict with (3) 34, 37

(2) 200 feet should read, "one mile"--too many dams break at these operations" 20, 31

(2) 200 foot buffer is inadequate. A minimum 6000 foot buffer should be required, with a greater buffer if drainage configuration merits. 16

(2) A 100 foot buffer would be much more practical than 200 feet. 15

(2) Use "perennial surface waters" as the scientific term for waters that the regulations appear to refer to. 15, 39

(2) Clarify that a buffer is required for both sides of a river or stream, if necessary. and that each shall meet a minimum of 1250 feet. 14

(2) Minimum buffer zone between any chemical process water containment structure or conduit, any ore processing site or any chemical storage site and surface waters should be 500 feet. 6

(3) Contradiction between (2) and (3) needs clarification. 37

(3) Change the text to "...or otherwise geologically unstable areas are <u>structurally adequate to protect the waters of the State</u> during operation, closure and post-closure. 10

(3) Define "seismic impact zones". 8

(2,3) Clarify siting requirements in seismic areas; (2) and (3) seem at odds. 4

(3) Is an unreasonable demand by not being specific about post closure requirements. "Post closure" implies forever, which is longer than these sites will pose a true threat to the environment if measures toward long-term mitigation of toxics are taken. 18

(4) Requirement for secondary containment for all chemical conveyances is too broad--should be limited to cyanide solutions only. 39

(4) Secondary containment for pipes is beyond any industry standard. 7

(5) Should require appropriate bonding for perpetuity. 23

(5) Should require "lifetime bond" since it uses "lifetime of pit" term. 20, 31

(5) The need for a 200 foot buffer between surface water and a facility is questionable. Placement within 200 feet of a stream could be advantageous for other engineering design reasons. 17

(5) Define "acid" by an acceptable pH range related to adjacent springs, wells and groundwater. 15

(5) Add provisions for dealing with acid water accumulation in filled-in pits. 8

340-43-060

(1) Run-off from the site should be regulated under DEQ stormwater criteria. 10

(1) 100 year, 24 hour storm should be the minimum standard. Any other allowed event should be more stringent. 16

(1) Use "excessively or abnormally ladened with sediment". 15

(2) Clarify this requirement. 35

(2) Define "temporary" or delete; too much chance for abuse of this requirement. 16

(2) Use "the mine material be sloped to minimize erosion".

340-43-065

(1) Specify who bears clean-up responsibility if a containment fails. 35

(1) Should be able to use mine or other local professionals. 18

(1) Verify registrations and stamps of registered professionals. 8

(1) Requirement for an <u>independent</u> professional seems overly restrictive. The QA/QC should be independent. Perhaps another section should address a comprehensive QA/QC procedure with independent sign-off. 17

(1) Inappropriate for DEQ to require engineering designs by independent contractors. ORS 469.735(3) expressly states that "any person responsible for complying...shall determine the means, methods, processes....". The requirement for independent contractors is unwarranted and clearly inconsistent with the ORS. 10

(1) Define "registered professional". 7

(1) Option to "independent" professional would be to let the work be done by the mining company and then checked by the independent professional. 8

(2) Define "temporary structures and "materials emplacements". 14

340-43-070

(1) Define wildlife to include "non-game" animals. 37

(1) Provide alternate off-site source of clean water for wildlife, in addition to positive exclusion. 36

(1) Require positive exclusion from chemical sprayers on top of the heap. 34

(1) Allow fine-spray sprinklers which allow for evaporation of excess solution and do not necessarily create ponding. 27

(1) Do not allow netting--require "totally enclosed tanks and ponds" 26
Must use totally-enclosed tanks and ponds to protect wildlife. 20, 31, 33

(1) All tanks and ponds should be enclosed; the heap should be double netted. Fences should be adequate to keep out burrowing wildlife. 16

(1) add "closed containment" to positive exclusion devices 37

(1) Define "wildlife"; use "vertebrate wildlife". 15

(1) Rewrite this section to define positive exclusion more narrowly. The only positive exclusion is complete containment. Fences will not deter small mammals, reptiles or amphibians. Netting is more a deterrent than a positive exclusion, and drip-irrigation emitters do not necessarily eliminate puddling. 14

(1) Require pregnant and barren ponds be in tanks, that pipes replace open ditches, that drip emitters on the top of heaps be covered with loose gravel and that all tailings from milling operations be dewatered and buried in special lined landfill areas. 14

(1) Need complete description of "wildlife". ALL wildlife species must be protected. 13

(1) Wildlife protection is irrelevant with regards to Oregon Water Pollution Control Laws. It may be more appropriate for DEQ rules to include a requirement such as: "Permits issued pursuant to these rules do not release an operator from his obligations under the jurisdiction of applicable agencies, including but not limited to, the Oregon Department of Fish and Wildlife and U.S. Fish and Wildlife Service." 10

(1) Establish priority ranking for protective measures with impenetrable barriers as highest. Allow netting only upon demonstration that impenetrable barriers are impracticable. 9

(1) Move standards in 70 to 005, General Provisions. 9

(1) Plans and construction specifications for positive exclusion methods proposed by an applicant should be reviewed by a reputable, qualified individual or group. 1

(1) Exclusion devices should be monitored regularly for effectiveness. 1

(1) Clarify that non-game species are included in the wildlife definition. 4

(1) Make positive protection means more explicit; require that all process chemicals be totally enclosed in tanks or with synthetic covers. 6

(1) If netting is used, the ponds should be rectangular (3:1 aspect ratio) so they can be netted more easily. 6

(1) Netting should be polypropylene, solid strand and uv-resistant. 6

(1) Drip irrigation should be used instead of spraying and the emitters covered with gravel to prevent ponding. 6

(1) All chemical ponds and conveyances should be enclosed with an 8-foot high cyclone fence with hardware cloth extending two feet below and two feet above the surface. 6

(1) All tailings should be totally detoxified to remove processing chemicals, heavy metals and sulfide. 6

340-43-075

(1) Should specifically refer to type of professional as "engineer, hydrogeologist, etc.". 34, 35

(1) Do not need to require "independent"--company engineers have more in-depth experience and are equally qualified. 12, 39

(4) Requiring tank tightness testing before covering or enclosing is not appropriate because some tanks can be tested by pressurizing. 39
Specify third-part quality assurance in -035 since installation of each process component requires it. 27

Requirements are inappropriate unless they are required for all industries using chemicals in their processes. This section should be limited to exterior tanks where the tank bottoms directly contact soils. 39

340-43-080

(1) Secondary containment needed only for toxic chemicals--change "all". 12

(3)(a) Define "failure" or delete (thickness has no realistic correlation to liner performance. 11

(3c) Require electronic sensors for "immediate leak detection". 26

(3c) 24 hours too long--use electronic means to detect as soon as leak occurs. 23

(3)(c) Need detection sooner than 24 hours--use electronic rather than mechanical detection system. 20, 31, 33

(3)(c) 24 hours is too long for detection of leaks. BAT should be specified and a minimum time should be set; perhaps 8 hours. Applicant should show why 8 hours can't be met. 16

(3)(c) This implies a third containment system in order to be able to detect leaks in the secondary containment system. 11

(3)(d) Delete after "24 hours" in line 6. Operator may be allowed to prove it was not possible to act or complete removal within 24 hours, but 24 hours should be standard. 16

(4a) Should read "liner". 11

(5a) Should require 110% of capacity, plus estimated amount of run-on from 25 year storm. 16

(5c) 24 hours too long--use electronic sensors. 26

(5c) Eliminate this section (see 3c). 23

(5c) Change section because 24 hours too long. 20, 31

(5c) 24 hours is too long for detection of leaks; require same as my comment in (3)(c). 16

(6) Use "inspected on a daily basis when in use. 15

Should be provisions for bringing existing mining operations into compliance with regard to secondary containment. 16

340-43-085

(3) Change wording "...of this section, <u>and shall provide monthly summary reports to the department.</u> 14

Require periodic inspections of structures, tanks and other facilities by an independent, registered consultant who makes written findings. 16

Inspection timing should be determined by the type of system rather than by regulation. 7

340-43-090

(1) Must specify requirements for on-off pads. 26

(1) "variations" is too open-ended and potentially useful to companies determined to bypass the rules. 23

(1) Should identify the possible "variations". 20, 31, 33

(1) Define "variations". 16

(2), (6) Do not allow lesser standards for temporary, overflow or emergency structures. 16

(2) Should not allow lesser requirements for cyanide containing structures. 26

(2) Should eliminate lesser requirements for emergency ponds. 20, 31, 33

(3) Table I--operating volume may be low since solution concentrations and slime precipitation must be considered. 12

(3) clarify Table I--to remove ambiguity that both ponds should have the required capacity. 38

(3) Impractical and unnecessary to design process water ponds for containment of rinse volumes. Process waters contained in solution ponds can be detoxified and recirculated as rinse water should it be necessary to rinse a heap prematurely. 10

(3) Should require containment volume for the anticipated operating volume, the design storm (100 year, 24 hour) and two feet of freeboard. Require excess capacity for drain-down, depending upon availability of back-up power sources. The rain on snow event should be required only when there is increased risk to human health or the environment. 10

(3) Delete rinse volume--assume it will be the operating volume. 39

(3) The projected draindown volume and the climatic surge volume should be determined by the applicant and only the largest volume required. 39

(4) Triple liner and 36" of clay are unnecessary--double liner and 12" works well. 28

(4) Change design requirements for pads to more closely reflect current standards and practice in neighboring states. 24

(4) Include provision for more flexibility in pad design if site conditions so warrant. 24

(4) Add a figure to describe the liner system. 8

(4) Prudent minimum design criteria should be a synthetic primary liner overlying an effective leak detection and removal system. The secondary liner should be equivalent to 12 inches of compacted soil with a maximum permeability of 10-6 cm/sec. 10

(4) The minimum synthetic liner thickness should be specified. 11

(4) Define "free flow", specify the head on the liner. 11

(4) Define the basis for the one-week requirement. 11

(4) The liner designs are too restrictive--should allow triple liner with 36" base <u>or</u> LDS as described <u>or</u> monitoring wells. 38

(4) Triple liner is unnecessary and excessive. NRC doesn't require this degree of caution. Double liner is more than adequate. 15

(4) "Maximum permeability" should read "coefficient of permeability". 11

(4) Leak detection system performance requirement appears to be unrealistically conservative. DEQ should provide the reasoning behind establishing this prescriptive requirement. 10

(4) 36 inches is excessive; 12 inches is protective. 14

(4) A 36" clay liner is excessive and probably unworkable. 7

(4) Triple liners are overkill--should allow soil attenuation of cyanide. 32

(4b) Minimum permeability of synthetic liners should be 10E-7 cm/sec. 26

(4)(b) drainage nets or other alternates to the specified 12 inches should be considered. 11

(4c) "one week" too long for detection of leaks. 23

(4c) Specify the head. 8

(4)(c) The intention of this regulation is to require a standard (single) composite liner. The work "double" should be deleted to prevent confusion with the term "double composite liner". 11

(4)(c) Specify the head. 8

(4) Triple liner is excessive--fails to take natural degradation processes in surrounding soil. 22

(5) Leak detection requirements excessively stringent and fails to set realistic points of compliance at a reasonable distance from the facility. 22

(5)(b) and (c) List the minimum thickness as is done in (4)(b). 8

(4)(c) & (5)(c) Should use two leak detection systems operating independently and simultaneously between the three pad liners. Electronic moisture sensors are far superior to mechanical devices. 19, 20, 26, 31, 33

(4,5) Leak detection sensors should be placed between both sets of liners, not just between middle and top liners. 16

(5a) 36" of 10D-7 clay is overkill 35

(5b) Specify the minimum thickness. 8

(4,5,7) Rules require more protection from puncture and leakage from the pad than the pond and the head is limited to 2 feet on the pad. Should be some trade-off in liner construction. 17

(5c) Specify the head. 8

(6) Do not allow emergency ponds--they would be used too often. 26, 33

(6) Time limit should be stated for allowable use of emergency ponds. 1

(6) Make "infrequently and for short periods of time" more specific. The ponds should be used only in emergency situations. 9

(6) Define "infrequently" and "short periods of time". 11

(6) Change wording; "...may be constructed as an [alternative] <u>back-up</u> to larger pregnant and barren ponds. The emergency pond may be constructed to a lesser standard <u>which still ensures protection of human health and the environment,</u>....and for <u>time periods not to exceed 48 hours</u> [short periods of time]. Add, <u>All uses of the emergency pond shall be reported to the department immediately.</u> 14

(7) Leak detection is just as important for emergency ponds. 14

(8) Should not limit depth to 24 inches since pond liners are the same and depth is not limited. 15

(9) Operator should conduct quarterly emergency drills which are observed by an independent observer making a written analysis of the drill; operators who fail to train should be shut down until they demonstrate capability to respond to emergencies. 16

(9) This rule needs more definitive standards regarding protection of human health and the environment during temporary closure and should define a limit so a permittee cannot walk away from a site for years.. Require prior notice of temporary closure and require ongoing maintenance, monitoring and reporting during closure. 14

(10) Requirement for leak repair "at first opportunity" too vague. Operation should immediately cease when leak is detected and the fix should be inspected by DEQ prior to resumption of operations. 6

(10) Change wording; "...actual liquid depth shall [either be repaired at the first opportunity] <u>be reported to the department immediately and repaired under department supervision and</u> [or] ...below the specified rate <u>until repair is certified by the department to be complete.</u> [The Department shall set a time schedule for repair with the permittee, if necessary.] 14

(10) Use EPA guideline for acceptable leakage (<u>Background Document on Proposed Liner & Leak Detection Rule)</u> of 2500 gallons per day per acre which requires closure or repair. 39

(10) Operation of pad should be shut down while leak is being repaired. 16

(10) Should suspend operations at once until repairs are made. 23, 26

(10) Replace entire section with "Operations shall be discontinued while the pad is unloaded and the detectable leak is repaired" 20, 31, 33

(11) Clarify intent of last sentence. Suggest "If the spent ore is shown to be potentially acid generating, the permittee shall submit a plan to prevent acid generation after heap abandonment and reclamation." 17

(11) Should not be left to operator to determine if spent ore will be acid generating. Should be a timeline for submitting and implementing plan to deal with acid generating spent ore. 16

Coefficient of permeability and thickness are equivalent trade-offs with soil/clay liners. 11

No basis for the prescriptive liner system requirement, nor any relief from the prescriptive requirement based on site-specific conditions. 10

Allow lower design standards for smaller leach operations; e.g., a pad with 15′ of ore does not need the same depth of underlayment as one with an ore height of 90′. Set requirements on tonnage/area basis. 24

A figure would be helpful to describe the liner system. 8

Level of containment is unreasonably high; the minimum prescriptive standard and evaluation of acid generating waste is inadequately addressed. 30

340-43-095

(1) Liners not needed if chemicals and metals are removed. 10

(1) Delete "second consideration". The process indicated by "first consideration" is the only acceptable process for detoxification. 16

(1) Unnecessary and excessive to detoxify since pond is lined. 15

(1) Should spell out why prefer removal over detoxification. 37

(1) Eliminate "second consideration"--should be no second consideration 20, 27, 31, 33

(2) Values for ANP/AGP should serve as "trigger values" to initiate kinetic testing. The results of the kinetic tests should determine whether or not acid generation is likely to occur. 10

(3) A test is needed to demonstrate that non-acid-generating tailings also are not toxic metal producers. Use TCLP 1311. 17

(3) EPA Method 1312 (Synthetic Precipitation Leaching Procedure more nearly simulates processes expected to occur with mine wastes and tailings than TCLP 1311. 10

(3) Should require 36 inches, not 12 inches. 16

(3) Specify the criteria DEQ will use to determine whether disposal of tailings in slurry form will be allowed. Allow only upon demonstration that disposal in de-watered form is impracticable. Amend (3) to require criteria of Table 2 <u>and</u> of 070 -- both must be met. 9

(3) Tables 2 and 3 are generic values. The limits should be determined on a site-specific basis. 7

(3) All values in Tables 2 and 3 correspond to the EPA recommended levels using either method except copper and zinc. The maximum EPA values for these two elements are 20 and 100 times higher that the values in Tables 2 and 3. There is no apparent basis for this selective discrimination on copper and zinc. 10

(3b) The criteria in Tables 2 and 3 will not prevent wildlife deaths with exposure to the slurry or dewatered solids. (data was provided) 14

(3b4b) Should use EPA Method 1312 instead of 1311. 12

(3b4b) Should use a multiplier of 100 for cyanide also--allow 20 mg/kg for WAD cyanide and 1000 mg/kg total cyanide. 12

(3b4b) Allow material passing 1311 (or 1312) to be placed in an unlined pond or a pond with a minimal 12 inch impervious clay liner. 12

(3b4b) Criteria for tailings impossible--because they are below the average crustal abundance for many of the metals. 22

(3)(c) Should read "minimum thickness of 36 inches" 20, 23, 26, 31

(3)(c) Liner not required under non-toxic, dewatered (or even wet) tailing structure. Should allow drainage; specify whether the collection system is a surface or subsurface structure. 17

(4) Soils in the area contain "trace elements" at levels greater than those proposed for tailings (e.g. arsenic at 100-500 ppm, background is 10-12 ppm) 21

(4) Clarify objective of this section. Alternative is to screen the tailings for sulfide and heavy metals. If neither are present, allow disposal under DOGAMI regulations with attention to long-term stability, re-vegetation, etc. 17

(4) If toxic metals were present in the liquid, must address protection of wildlife. The standards should address more than cyanide concentration in the tailings water and should be worked out with ODF&W. 17

(4) If the solid portion exceeds the TCLP limits or if acid generation is possible, a lined impoundment with long-term stability would be the appropriate control technology. 17

(4) The present draft implies that any rock with metal levels exceeding the TCLP criteria would fall under Oregon's hazardous waste rules. This should be very clearly stated if this is the intent. 17

(4) The screening method for acid and toxics needs careful evaluation. Total sulfur determinations should be done with LECO furnace methods; other methods fail to detect low levels of pyrite that can readily oxidize. 17

(4) For low levels of pyrite, a specific amount of $CaCO_3$ should be specified rather than the ratio; suggest somewhere between five and 20 tons of $CaCO_3$. 17

(4) Should use kinetic testing, especially for low levels of pyrite. 17

(4) Total sulfur (sulfide) of 1 g/kg is too low and doesn't measure the susceptibility of rocks to contribute acid; use another method. 15

(4) Sulfide or pyritic sulfur appropriate indicator of acid generating potential--determine by ASTM Method 02493 or difference between total and sulfate sulfur. 10

(4) Define "separate facility"--Arlington or on-site? 8

(4) Dry tailings are emphasized; good argument can be made for permanent storage of saturated tailings. 17, 22

(4a) Define "separate facility" (on-site or off-site?). 8

(4b) Zinc requirement is too low--secondary drinking-water standard is 5 mg/l. Operations using Merrill-Crowe zinc-dust precipitation may have 200 mg/l or higher zinc in the tailings. Delete zinc from Tables 2 and 3. 39

(4b) Tailings detoxification levels of Tables 2 & 3 are not technically or economically possible--Nevada considers 20-50 mg/l WAD as being detoxified. 39

(4b) This section seems to allow (a) to be violated--is that the intent? 8

(4b) Cyanide removal is a new and unproven technology compared with INCO SO_2/air. SCN^- and CNO^- should be removed from Table 2 because there is no basis for regulating them and they are produced by the process. 40

(4b) Only known technology for removing SCN^- and CNO^- is chlorine which is discouraged in the rules. By products of chlorine are ammonia and possible chlorinated compounds, both of which can be more toxic than SCN- or CNO-. 40

340-43-100

(2) Change wording to: The closure plan must be compatible with the reclamation plan on file with DOGAMI. 8

(4) Allow pond liners to be buried in place rather than removing them to another disposal site. 28

(4) Should regulate mining under RCRA-D

(4)(b) Specify type of cover and that it will withstand seismic events and penetration by large roots. 20, 26, 31

(4)(b) Heap cover will prevent natural degradation of cyanide. Heaps also contain minerals, water and fertilizer that help sustain vegetation better than an impermeable cover. 18

(4b) If spent ore is detoxified to the rule requirements, should not have to cover. Soil cover will deplete thin-soil areas of Oregon. 38, 39

(4)(b) and (4) should include the word "native" to specify vegetation to ensure that the species are adapted to the site. 34

(4)(c) Sludges should be left in heap ponds as an appropriate means of disposal. 18

(4)(b) Should allow some spent and detoxified ore to be pushed off the edge of the pad to facilitate re-contouring for reclamation. Clarify last sentence. 17

(4) Low-permeability and soil layers will not provide any erosion protection for the coarse material on the pad. 17

(4) The cover to prevent water infiltration should be specified. Should be designed to withstand penetration by roots, seismic events and other likely intrusive events. 16

(4) After a heap is detoxified to the criteria of Table 4, it should be considered to meet closure requirements. Unnecessary to require a low-permeability layer over the material unless there is a toxic-metal issue. The environment is not well served by "encapsulating" residual low-levels of cyanides unless such measures are necessary to contain other materials deleterious to the environment. 10

(4) Should the heap need a cover if it has been detoxified? 4

(4) Requirements are too vague; the heaps and mining waste products should be totally detoxified and backfilled, otherwise should require strict containment. 6

(4) How will water infiltration be monitored? 4

(4) Table 4 is generic values. The limits should be determined on a site-specific basis. 7

(4)(c) Why remove the liner and bury it someplace else? 7

(4c) Define "inert material". 8

(5) Tailings should not be covered for same reasons given in (4). 18

(5) Define the "low permeability layer" 20, 26, 31

(5) Requiring low-permeability covers on non-toxic materials could, in some locations, be counter productive. Letting water drain through could be preferable to having it flow over the edges. 17

(4)(a), (5) Should require analysis for heavy metals, not just for residual cyanides. 14

(6) Should require a "lifetime" bond. 20, 26, 31

(6) Should require a bond to make repairs if containment fails. 16

(4)(b), (5) and (6) Terminology is too vague. Requirement that the closed facility should be environmentally stable for "an indefinite period of time" is too broad to be able to develop a post-closure plan and to determine financial assurance requirements for post-closure monitoring. 11

340-43-110

30 years too long, given the other protective provisions of the rule. 38

Require monitoring for 30 years; if leakage occurs, monitor for 30 years from the date of last pollutant release. 34

Monitoring for 30 years is out of the question-unnecessarily expensive; why not 2 years? 28

Replace "may" with <u>must</u>. 23, 26

In line 1 should read permit <u>must</u> be continued. 20, 31

In line 1, delete "may" and insert "must"; all costs of monitoring should be borne by operator and guaranteed by an adequate bond. 16

Change wording: "...permit [may] <u>shall</u> be continued ...for a [nominal] period of <u>at least</u> thirty...and [would] <u>shall</u> include...monitoring <u>by the permittee</u> ..." 14

Define "periodic" monitoring. 13

If mining companies are allowed to monitor their own operations, DEQ should have the authority to conduct unannounced quality control reviews of monitoring methods and results. 13

A 30 year post-closure monitoring period is inconsistent with the non-hazardous nature of most mining waste. Require post-closure monitoring for a pre-determined period following demonstrated site stabilization, perhaps consistent with a permit renewal term of five years. 10

Monitoring period should be based on the system and technology (rather than an arbitrary 30 years). 7

340-43-115

Limit "toxic" only to chemicals, materials and wastes identified as "hazardous" under 40 CFR Parts 260 and 261. 12

(1) Change wording; "...the permit <u>and in a manner that will not adversely impact human health and the environment.</u> 14

(2h) Add after word wildlife, <u>including non-game species</u>. 37

(2) Disposal plan should include analysis of potential impacts to Areas of Special Concern and to Fisheries, as well as to wildlife and sensitive plants. 13

(2) Require demonstration that disposal of wastewater will not adversely affect wildlife, sensitive plant species or aquatic life. 9

340-43-120

(1) Change to "pits must be backfilled". 23

(1) Eliminate present wording. Add requirement that pit must be refilled and aquifers must be restructured. 20, 31, 33

(1) Mining sites, aquifers and pits must be fully restored. 19

(1) Add requirement that pond be fenced for wildlife protection. 34

(1) Delete. This section must require the restoration of pits by filling in with detoxified wastes, reclamation of aquifers and surface areas. 16

(2e) Requirement of liner under the pond seems conditional and doesn't address site conditions. 18

(2)(b) This would leave even greater scar and would place more acid-generating material in a disposal facility. 14

(2c) Has potential for failure of the cap, especially on steep slopes. 14

(2d) Requires perpetual treatment with related costs and potential for failure. 14

(2e) Has potential for failure that requires perpetual monitoring and remedial action, as well as exclusion from wildlife access. 14

(2) Only (a) and (f) should be allowed. 14

(2f) Change wording; "...of the pit(s) [above the water table] <u>to the level necessary to </u>[reduce] <u>prevent</u> oxidation of residual acid-generating materials. 14

(2e) Omit possibility of a liner under the pond in a pit; it may prevent groundwater contamination but a toxic pond could endanger wildlife. 1

(2f) State criteria used to decide what materials will be suitable for backfill material. 4

(2f) Pit backfilling is necessary in all cases to protect wildlife and water quality and should be a condition of mining. 6

(2f) Requirements for backfilling should be spelled out with strict guidelines which will also help DEQ avert legal challenge for arbitrariness. 6

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9/18/91

LIST OF REFERENCED COMMENTATORS

1. U.S. Dept. of the Interior
   Fish and Wildlife Service
2. Bob Powne
3. Malheur Mining
4. Native Plant Society of Oregon
5. Cornelia DuBois
6. National Wildlife Federation
7. E. L. Hunsaker III
8. Oregon Water Resource Department
9. Oregon Department of Fish and Wildlife
10. Knight Piesold and Co.
11. Jim Coskey
12. Simplot Resources
13. The Wildlife Society
14. Oregon Environmental Council
15. Chris Broili, Marvin Niccum
16. David M. Johns
17. Oregon Department of Geology and Mineral Industries
18. Loren A. Lovejoy
19. Thea Weiss Tarbet
20. Fred Farrand, Pat Thomassen
21. Phelps Dodge Mining Company
22. Ernest K. Lehman & Associates
23. Michael A. Sequeira
24. John H. Cogswell
25. Teck Corporation

26. Concerned Citizens for Responsible Mining
27. U.S. Department of the Interior, Bureau of Mines
28. City of Nyssa
29. Orval R. Layton
30. Sunshine Mining Company
31. Ralph Steils
32. Horizon Gold Corporation
33. Willamette University
34. Valerie R. Elliot
35. Dan Maws
36. Grant County Conservationists
37. Sierra Club
38. Glenbrook Nickel Company
39. Merco Minerals Company
40. INCO Exploration and Technical Services, Inc.

RESPONSE TO PUBLIC COMMENT REGARDING PROPOSED DEQ CHEMICAL MINING RULES (OAR CHAPTER 340, DIVISION 43)

Comment: Public Policy Issues

Considerable testimony was received on issues that are essentially "public policy" issues; e.g. whether Oregon should allow chemical mining at all, what should be the trade-offs between the possible adverse environmental impacts of chemical mining or open-pit mines and economic development, etc.

Response: The Department has not made recommendations on these public policy issues. The following comments and responses are directed primarily toward the technical issues raised by the proposed rules.

Comment: Department's Regulatory Authority

Commentators questioned the Department's authority to regulate chemical mining under its water-quality rules, rather than its solid-waste rules. It was suggested that the Department wait until EPA (the US Environmental Protection Agency) promulgates rules to govern chemical mining. It was also suggested that DOGAMI (Oregon Department of Geology and Mineral Industries) or the federal agencies should regulate mining, rather than the Department.

Response: The EQC (Environmental Quality Commission) has reviewed its regulatory responsibilities relative to mining and environmental protection and has concluded that the potential for adverse environmental impact resulting from large-scale chemical mining, especially mining of the open-pit type, is great enough that the Department should be regulating such mining.

The EQC requested that the Department propose rules to regulate chemical mining. The Department believes it is inappropriate to wait for EPA to promulgate rules, since it is not certain when, or if, EPA will do so. Further, the Department considers that the greatest potential adverse environmental impact from chemical mining is to waters of the state and has, therefore, chosen to propose regulation of mining under its water quality protection authority.

The proposed rules exempt chemical mining operations that would otherwise need one, from obtaining a state hazardous waste treatment or disposal permit if process wastes are treated to the criteria contained in the proposed rules.

The Department understands that it has environmental protection responsibility on federal lands as well as state and private lands and recommends the exercise of that responsibility in the case of mining rather than relying on the federal agencies involved to provide the necessary environmental protection regulation.

Comment: Recognition of Environmentally-Sensitive Special Areas

Some commentators felt that the proposed rules should give consideration to special areas of concern; e.g., State Parks, Research Natural Areas, BLM areas of Critical Environmental Concern, Endangered Species habitat, State Natural Heritage Conservation Areas, etc.

Response: The proposed rules do not single out any one type of environmental situation. The proposed rules attempt to adequately address all environmental concerns, regardless of their particular setting.

Comment: Permit Application Information and Baseline Data Collection

Some commentators were concerned that the requirements for baseline data and environmental characterization were too extensive and duplicated the data required by DOGAMI and the federal EA (Environmental Assessment), EIS (Environmental Impact Statement) process.

Other commentators recommended that all environmental data be collected and verified by the Department or a third-party contractor to ensure the validity of the data.

Response: The proposed rules are not intended to require unnecessary duplication of data and other information required in its permitting process. The rules provide that the Department will accept applicable data that permit applicants have gathered to fulfill their other permitting requirements.

The Department will review the baseline data applicable to its permit and may further verify, using internal or external resources, critical portions of the data.

Comment: Plans Review by the Department

There was some comment regarding the purpose, scope, and timing of the Departmental plan review process referred to in the proposed rules.

Response: The Department believes that its plan review process and responsibilities are effective and adequately described elsewhere in its rules and has not proposed to change them in this set of rules.

Comment: Grandfathering Provision

It was suggested that the rules include a "grandfathering" provision for existing facilities which may be successfully operating with a lesser degree of design containment.

Response: The proposed rules provide that the Department may, in accordance with a written compliance schedule, grant reasonable time for existing facilities to comply with the proposed rules.

Comment: Site-Specific Flexibility and Formal Variance from the Proposed Rules

A significant part of the comment related to the desirability on the part of potential permit applicants for site-specific flexibility in applying general performance-based rules and the desirability on the part of others in rigidly applying very prescriptive rules.

Response: The Department has attempted to strike a compromise in its proposed rules between rules that are performance-based and those that specification-based. The rules contain design, operation and closure guidelines that provide a relatively high degree of specificity. On the other hand, the Department recognizes that each site can differ significantly from the next and has acknowledged this in the proposed rules by allowing alternate environmental protective means if the permit applicant can demonstrate that they provide equivalent protection.

The Department has deleted the variance provision in this version of the proposed rules because it feels there is sufficient flexibility in the rules to allow it to fit the requirements of the rules to the situation. The Department is regularly called upon to make decisions regarding permits that are based on its best professional judgment since it is impossible to write rules that are sufficiently complete and explicit to address every situation.

Comment: Siting Prohibitions

Considerable comment was made on the prohibitions against siting mine-waste facilities in areas of seismic instability and on the appropriate width of the buffer zone between facilities and surface waters. Suggestions on the appropriate buffer zone width ranged from the proposed 200 feet up to a mile or more.

Response: The Department has deleted prohibitions against siting mine-waste disposal facilities in areas of seismic instability in the present proposed rules because such areas are hard to define and because dams and other retaining structures must be designed to accommodate anticipated seismic loadings anyway. The general prohibitions against siting facilities within 200 feet of surface water and in wetlands are retained.

The Department has retained the 200-foot minimum width as being sufficient to provide at least some margin of safety from readily-identifiable spills or leaks.

Comment: Requirement for Design by Independent Professionals

Considerable comment was directed at whether an "independent" professional person should be required for designing retaining structures, foundations, and materials emplacements. Some mining companies regard their registered professionals as being competent and qualified by experience to perform such design work. On the other hand, considerable comment urged the added "safety factor" of a qualified professional who is independent of the permittee.

Response: The Department recommendation proposes to delete the "independent" requirement so that mining companies are not precluded from using their own design expertise.

However, the Department has added a provision which allows it to require the permittee to hire a third-party consultant subject to approval by the Department, to review the facility plans and specifications and to monitor the course of construction.

Comment: Wildlife Protection

Appropriate means of protecting wildlife against the toxic effects of chemical processing solutions was a topic of major comment. The proposed rules required positive exclusion of wildlife from chemical processing solutions and wastewaters as the only sure means of preventing wildlife mortality. Commentators asked for a definition of wildlife, and variously objected to or approved the positive exclusion requirement.

Response: The Department has not proposed to define "wildlife" but to continue to use the word in its broadest sense. The Department has modified its positive exclusion provision by requiring exclusion only from those solutions and wastewaters that pose a threat to wildlife, as determined by ODF&W (Oregon Department of Fish and Wildlife). Passage of HB 2244 by the 1991 Oregon Legislature required ODF&W to establish standards by rule for wildlife protection.
The Department has defined "positive exclusion" in the present proposed rules as the use of pipes, fences, netting covers and heap-leach drip-irrigation emitters or covered emitters.

Reference to hazing has been deleted since positive exclusion is required and hazing is felt to be, at best, a non-positive exclusion means.

The Department will waive the positive exclusion requirement if ODF&W certifies to the Department that the project is designed such that it will adequately protect wildlife.

Comment: Requirements for Containment Tanks

The earlier proposed rules contained a section on requirements for tanks used for containment of chemicals. Little comment was received regarding tanks except that tanks were generally regarded as being more protective than lined ponds.

Response: The Department has deleted the entire section on tanks from the present proposed rules. The Department feels it has adequate authority through its design and specification review process to ensure the proper installation and operations of tanks containing chemicals. It was also felt that inclusion of the rather extensive section on tanks tended to confuse the proposed rules and make them more difficult to understand.

Comment: Lesser Design Standards for Emergency Ponds

A number of commentators were concerned that emergency overflow ponds should not be allowed or should be designed to as strict a standard as the working ponds.

Response: The Department has retained provision for emergency ponds to be used in a temporary fashion and designed to a lesser liner standard than the working ponds. Emergency ponds provide an important margin of safety against accidental flooding and the Department is confident that it can prevent abuse of the intended temporary use of the ponds by means of permit conditions.

Comment: Heap-Leach Facility Liner Requirements

Extensive comment was received on the proposed design criteria for heap-leach pad liners. Comments ranged from the position that the proposed "triple liner" configuration consisting of a low-permeability soil/clay bottom liner and two flexible-membrane synthetic liners with a leak detection system in between was barely adequate, to the position that it was grossly overprotective.

Response: The Department has retained the triple liner configuration with a "between-liner" leak detection system. It was decided that the value of the between-liner leak detection system outweighed any disadvantage of the third liner.

Comment: Repair of Heap-Leach Leaks

Considerable comment was received on the difficulty of determining the acceptable leak rate that the Department specified.

Response: The Department has continued the repair requirement and has included in the proposed rules the graduated response program suggested by the Oregon Mining Council.

Comment: End-of-Pipe Treatment of Mill Tailings

The proposed detoxification requirement and accompanying numeric detoxification criteria for mill tailings caused extensive comment. Comment ranged from rejection of the requirement as being impractical and unnecessary to full approval.

Response: The Department has specified cyanide recovery and re-use as the required detoxification technology. The permittee is required under the present proposed rules to conduct tests on their tailings to determine the lowest practicable concentration of WAD (weak-acid dissociable) cyanide attainable. The Department has, however, proposed a maximum allowable concentration of WAD cyanide of 30 ppm (parts per million) as a technology-based criterion.

The 30 ppm WAD cyanide criterion is not intended to be protective of wildlife. The Department will rely on ODF&W to determine the appropriate wildlife protection criteria for chemical mining processing solutions and wastes.

The proposed rules specify that mill tailings shall pass the EPA TCLP (toxicity characteristic leach procedure) Method 1311 test or else they will be considered a state hazardous waste and must be regulated under the state hazardous waste program.

Comment: Mill Tailings Pond Liner Requirement

Some commentators objected to the proposed liner requirements on the basis that they were over-protective and expensive. Other commentators supported the liners as being appropriate for protection against leakage.

Response: The Department has retained the proposed double liner system for tailings, with no distinction as to whether the tailings are potentially acid-generating or are deposited as a slurry or as dewatered solids.

Comment: Heap-Leach Facility Closure

Some commentators objected to the separate detoxification criteria for spent ore on the heap and the rinsate. The criteria were considered to be too stringent and too difficult to measure since generally-accepted standard analytical methods are not available. Other commentators supported the requirements as being appropriate.

Other objections related to the requirement for cover layers on the heap. The argument was made that cyanide detoxification could better take place if the heap were left open to the elements.

Response: The Department has simplified the heap detoxification requirement by specifying only a maximum allowable WAD cyanide rinsate concentration of 0.2 ppm. It is assumed that once the rinsate reaches 0.2 ppm, only the relatively stable cyanide compounds will be left in the heap.

The spent ore is required to pass the EPA TCLP Method 1311 test or it will be considered a state hazardous waste.

The Department has also retained the cover requirement as an appropriate means of preventing possible long-term acid-water generation and release of cyanide and toxic metals by water and oxygen infiltration.

Comment: Mill Tailings Disposal Facility Closure

Comments regarding closure requirements for the tailings facility were generally the same as those for closure of the leach heap.

Response: The Department continues to assume that the best means of preventing long-term release of toxic materials from a closed tailings facility is end-of-pipe detoxification prior to disposal, addition of acid-neutralizing materials to the tailings, if necessary, and installation of a composite cap that will exclude infiltration of water and oxygen. These requirements have been continued in the present proposed rules.

Comment: Post-Closure Monitoring

Comments on the period for post-closure monitoring of potential releases from the disposal facilities ranged from nothing to 30 years and more.

Response: The Department will require post-closure monitoring in its permit with regular review of the data to determine the effectiveness closure. If toxic leakage problems arise, the Department has the authority to modify the permit to include remedial action to solve the problem. The present proposed rules specify that the Department may continue its permit in effect for up to 30 years.

The Department will also coordinate closure monitoring with DOGAMI and consult with them on retention of security funds that may be needed for remedial action to correct problems from ineffective closure.

Once closure is considered to be effective, the permit may be terminated.

Comment: Open-Pit Closure Requirements

Considerable interest was shown by commentators on the guidelines for closure of the open pit. Most of the comment was directed at additional requirements, especially backfilling of the pits and restructuring of affected aquifers.

Response: The Department has generally addressed the potential problems of acid-water formation and collection in residual open pits in the draft rules by requiring the permittee to estimate from the site data what the potential for problems is and to address several specific strategies for possible alleviation of the problem.

Complete backfilling of open pits is not necessarily a water-pollution prevention method and thus the Department has not included backfilling as a requirement per se. Other protective regulations exist (DEQ groundwater protection rules) and WRD's (Oregon Water Resources Department rules) that also relate to potential water pollution problems arising from residual mining pits.

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Key for revisions to June 14, 1991 Draft: Attachment B-7
Added Text
~~Deleted Text~~

RULES PROPOSAL:

OREGON ADMINISTRATIVE RULES

CHAPTER 340

DIVISION 43

CHEMICAL MINING

~~MINING OPERATIONS WHICH USE CYANIDE OR OTHER TOXIC CHEMICALS TO EXTRACT METALS OR METAL-BEARING MINERALS FROM ORES~~

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GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS ~~SUBJECT TO THESE RULES~~

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PURPOSE

340-43-005

The purpose of these rules and guidelines is to protect the quality of the environment and public health in Oregon by requiring application of "... all available and reasonable methods...", Oregon Revised Statutes (ORS) 468.710, for control of wastes and chemicals relative to design, construction, operation, and closure of mining operations which use cyanide or other toxic chemicals to extract metals or metal-bearing minerals from the ore ~~or~~ and which produce wastes or wastewaters containing toxic materials.

~~**SCOPE**~~

~~**340-43-010**~~

~~These rules and guidelines apply to mining operations which use chemicals to extract metals or metal-bearing minerals from the ore except for small mineral-extraction operations using froth flotation.~~

~~The rules do not apply to mining and mineral extraction operations which do not use chemical extraction methods. Examples of mining activities to which the rules do not apply are aggregate mines and those placer mines which use only gravity separation methods. Any mining operation, however, that produces waste rock or spent ore that has the potential for forming acidic leachate may be covered by one or more of the provisions of these rules.~~
~~Non-mining operations, such as smelters, are not covered by these rules.~~

DEFINITIONS

340-43-01~~5~~0

Unless the context requires otherwise, as used in ~~these rules~~ this Division:

(1) "Chemical process mine" means a mining and processing operation for metal-bearing ores that uses chemicals to dissolve metals from ores.

(2) ~~(1)~~ "Department" means the Department of Environmental Quality.

(3) ~~(2)~~ "Guidelines" means this body of rules contained in 340-43-045~~0~~ through 340-43-1~~2~~00.

(4) "Positive exclusion of wildlife" means the use of such devices as tanks, pipes, fences, netting, covers and heap-leach drip-irrigation emitters or covered emitters.

~~(3) "Slurry" means a suspension of ore or waste materials in water.~~

(5) ~~(4)~~ "Tailings" means the spent ore resulting from the milling and chemical extraction process.

PERMIT REQUIRED

340-43-0~~20~~15

(1) A person proposing to construct a new chemical mining operation, commencing to operate an existing non-permitted operation, or proposing to substantially modify or expand an existing operation shall first apply for, and receive, a permit from the Department. The permit may be an NPDES (National Pollutant Discharge Elimination System) permit if there is a point-source discharge to surface waters or a WPCF (Water Pollution Control Facility) permit if there is no discharge. Consideration may be given to site-specific conditions such as climate, proximity to water, and type of wastes to establish the final permit type and requirements for the facility.

(2) The permit application shall comply with the requirements of OAR Chapter 340, Divisions 14 and 45 and be accompanied by a report that fully addresses the requirements of this Division ~~OAR 340, Division 43~~.

PERMIT APPLICATION ~~INFORMATION~~

340-43-02~~5~~0

(1) The permit application shall fully describe the existing site and environmental conditions, with an analysis of how the proposed operation will affect the site and its environment. The Department shall, at a minimum, require the information specified for the DOGAMI consolidated application under Section 13, Chapter 735, 1991 Oregon Laws. The Department will also use the information contained in NEPA (National Environmental Policy Act), EA (Environmental Assessment), or EIS (Environmental Impact Statement) documents, if they are required by the project, as partial fulfillment of the requirements of this paragraph. ~~The Department may accept the information and operating plan required by DOGAMI (Department of Geology and Mineral Industries) under OAR 632, Division 35, or the information contained in a NEPA (National Environmental Protection Act), EA (Environmental Assessment), or EIS (Environmental Impact Study) document as partial fulfillment of the requirements of this paragraph.~~

(2) The permit application shall, in addition to the information ~~required by the application forms,~~ described in Paragraph (1) above, include the following information, unless the information has been otherwise submitted:

~~(a) Site description;~~

~~(b) Site map;~~

(a) ~~(c)~~ Climate/meteorology characterization, with supporting data;

(b) ~~(d)~~ Soils characterization, with supporting data;

(c) ~~(e)~~ Surface water hydrology study, with supporting data;

(d) ~~(f)~~ ~~Surface~~ Characterization of surface water and groundwater quality;

(e) ~~(g)~~ Inventory of surface water and groundwater beneficial uses;

(f) ~~(h)~~ Hydrogeologic characterization of groundwater, with supporting data;

(g) ~~(i)~~ Geologic engineering, hazards and geotechnical study, with supporting data;

(h) ~~(j)~~ Characterization of mine materials and wastes which include, for example, overburden, waste rock, stockpiled ore, leached ore and tailings. Characterization of mine materials and wastes shall include, but not be limited to the following:

(A) Chemical and mineral analysis related to toxicity;

(B) Determination of the potential for acid water ~~generation~~ formation;

(C) Determination of the potential for long-term leaching of toxic materials from the wastes;

(i) ~~(k)~~ Characterization of wastewater (quantity and chemical and physical quality) produced by the operation;

(j) ~~(1)~~ Assessment of the potential for ~~residual~~ acid-water formation from waste disposal facilities, low-grade ore stockpiles, waste rock piles and for surface water or groundwater accumulation in open pits that will remain after mining is ended. ~~and accumulation in open pits remaining after mining;~~

~~(m) Any other relevant baseline data.~~

(3) Data submitted by the permit applicant should be based on analysis of the actual materials, when possible, or may be based on estimates from knowledge of similar operations~~,~~ and professional judgment.

PLANS AND SPECIFICATIONS

340-43-0~~30~~25

(1) A person constructing or commencing to operate a chemical process mine or substantially modifying or expanding an existing chemical process mine ~~mining operation which will use cyanide or other toxic chemicals to extract metals or metal-bearing minerals from the ore or which will produce wastes or wastewaters containing toxic materials or substantially modifying or expanding an existing such operation~~ shall first submit plans and specifications to the Department for construction, operation and maintenance of the facilities intended for treatment, control and disposal of ~~potentially toxic~~ wastes.

(2) The Department shall approve the plans, in writing, before construction of the facilities may be started. The plans shall address all applicable requirements of this Division ~~these rules~~ and shall include, but not be limited to, the following:

(a) A description of the facilities to be constructed~~;~~, including tanks, pipes and other storage and conveyance means for processing chemicals and solutions and wastewaters;

(b) A ~~surface water~~ management plan for control of surface water;

(c) A ~~wastewater~~ management plan for treatment and disposal of excess wastewater, including provisions for reuse and wastewater minimization;

(d) A facility construction plan including, as applicable, the design of low-permeability soil barriers, ~~the installation method for geosynthetics,~~ the type of geosynthetics to be used and a description of their installation methods, the design of wastewater treatment facilities and processes, a quality assurance plan for applicable phases of construction and a listing of construction certification reports to be provided to the Department;

(e) A preliminary closure plan;

(f) A preliminary post-closure monitoring and maintenance plan;

(g) A spill containment and control plan.

DESIGN, CONSTRUCTION, OPERATION AND CLOSURE REQUIREMENTS

340-43-03~~5~~0

(1) All chemical process and waste disposal facilities~~,~~ ~~including~~ and facilities for mixing, distribution, and application of chemicals associated with on-site mining operations; ore preparation and beneficiation facilities; and processed ~~waste~~ -ore disposal facilities~~; and tailings disposal facilities~~ shall be designed, constructed, operated and closed in accordance with the guidelines contained in ~~these rules~~ this Division.

(2) A groundwater monitoring plan shall be submitted to, and be approved by the Department. Monitoring wells shall be installed for detection of groundwater contamination as required by ~~OAR 340-40~~ OAR Chapter 340, Division 40, unless the hydrogeology of the site or other technical information indicates that an adverse impact on groundwater quality is not likely to occur.

~~(3) The Department may approve other protective means if the permit applicant can demonstrate that they provide equivalent protection, or the Department may grant a variance from the requirement as provided in OAR 340-43-040.~~

(3) Alternative methods of control of wastes may be acceptable if the permit applicant can demonstrate that the alternate methods will provide fully-equivalent environmental protection. The burden of proof of fully-equivalent protection lies with the permit applicant.

(4) The Department may, in accordance with a written compliance schedule, grant reasonable time for existing facilities to comply with these rules.

~~GRANTING OF VARIANCES FROM SPECIFIED REQUIREMENTS~~

~~340-32-040~~

~~(1) The Department may, by written variance, waive certain requirements of these rules when size of operation, location, topography, operational procedures, or other site specific conditions indicate that the purpose of these rules can be achieved without strict adherence to the requirements.~~

~~(2) The Department may, in accordance with a written compliance schedule, grant reasonable time for existing facilities to comply with these rules.~~

EXEMPTION FROM STATE PERMIT~~S~~ FOR HAZARDOUS WASTE TREATMENT OR DISPOSAL FACILITIES

340-43-0~~4~~35

(1) The state hazardous waste program requires a permit for the "treatment", "storage" or "disposal" of any "hazardous waste" as identified or listed in OAR Chapter 340, Division 101 from the Department, prior to the treatment and disposal of wastes. Permitting requirements can be found in OAR Chapter 340, Division 105, Hazardous Waste Management. ~~The Department may, by written variance, waive certain requirements of these rules when size of operation, location, topography, operational procedures, or other site specific conditions indicate that the purpose of these rules can be achieved without strict adherence to the requirements.~~

(2) However, any operation permitted under ~~these rules~~ this Division, which would otherwise require the neutralization or treatment of hazardous waste and

would require a permit pursuant to OAR ~~340-105~~ Chapter 340, Division 105, shall be exempt from the requirement to obtain such hazardous waste treatment permit.

~~(3) If processing wastes are not treated to the criteria contained in these rules, the permit applicant shall obtain a state hazardous waste treatment and disposal permit.~~

(3) All mined materials disposed of under this Division shall pass Oregon's hazardous waste rule criteria or they will be considered a state hazardous waste and must be disposed of accordingly.

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS ~~SUBJECT TO THESE RULES~~

PURPOSE

340-43-040~~5~~

(1) ~~The guidelines contained in these rules~~ This Division establishes criteria for the design, construction, operation and closure of ~~facilities subject to these rules~~ chemical mining operations and supplements the provisions of ~~paragraphs~~ OAR 340-43-005 through OAR 340-43-~~045~~035.

~~(2) Alternative methods of control of wastes may be acceptable if the permit applicant can demonstrate that the alternate methods will provide fully-equivalent environmental protection. The burden of proof of fully-equivalent protection lies with the permit applicant.~~

~~(3)~~ (2) Any disapproval of submitted plans or specifications, or imposition of requirements by the Department to improve existing facilities or their operation will be referenced when appropriate, to applicable guidelines or ~~appropriate sections of these~~ rules.

GENERAL PROVISIONS

340-43-0~~5~~45

(1) Facilities permitted under either a WPCF or NPDES permit shall not discharge ~~inadequately treated~~ wastewater or process solutions to surface water,

groundwater or soils, except as expressly allowed by the permit.

(2) Facilities subject to these rules shall not be sited in 100-year floodplains~~, in~~ or wetlands~~, or on geological features of demonstrated seismic instability~~. A buffer zone (a minimum of 200 feet wide ~~at a minimum~~) shall be established between waste disposal facilities and surface waters.

~~(3) Permit applicants must demonstrate to the Department that the design of ore treatment facilities or waste disposal facilities sited in seismic impact zones or otherwise geologically unstable areas is adequate to ensure the integrity of all structural components of the facilities during operation, closure and post closure.~~

~~(4)~~ (3) All chemical conveyances (ditches, troughs, pipes, etc.) shall be equipped with secondary containment and leak detection means for preventing and detecting release of chemicals to surface water, groundwater or soils.

(~~5)~~ (4) Acid water accumulation in open pits resulting from the mining operation must be prevented by appropriate mining practices, by measures taken in the closure process, or be treated to control pH and toxicity, for the life of the pit.

~~(6)~~ (5) Construction of surface impoundment liner systems shall conform generally to the principles and practices described in EPA/600/2-88/052, Lining of Waste Containment and Other Impoundment Facilities, September 1988.

(6) The Department may require the permittee to hire a third-party contractor to perform the functions set forth below. Selection of the contractor shall be subject to Department approval.

(a) Review and evaluate the design and construction specifications of all mined-materials disposal facilities permitted under this Division for functional adequacy and conformance with Department requirements. The Department shall not approve construction of the disposal facilities until the design and construction specifications have been evaluated.

(b) Monitor the course of construction of all mined-materials disposal facilities for compliance with the approved design and construction specifications. The third-party contractor shall regularly document the progress of construction and the Department shall require the permittee to take corrective action if construction does not satisfactorily conform to the approved design and construction specifications.

CONTROL OF SURFACE WATER RUN-ON AND RUN-OFF

340-43-0~~6~~50

(1) Surface water run-on and run-off shall be controlled such that it will not endanger the facility or become contaminated by contact with process ~~toxic~~ materials or loaded with sediment. The control systems shall be designed to accommodate a 100-year, 24-hour storm event, or any other defined climatic event that is more appropriate to the site, and be placed so as to allow for restoration of the natural drainage network, to the maximum extent practicable, upon facility closure.

(2) All mined materials shall be properly placed and protected from surface water and precipitation so as not to be eroded and contribute sediment to site stormwater run-off or to otherwise contaminate surface water.

PHYSICAL STABILITY OF RETAINING STRUCTURES AND EMPLACED MINE MATERIALS

340-43-0~~6~~55

(1) Permit applicants must demonstrate to the Department that the design of chemical processing facilities and waste disposal facilities is adequate to ensure the stability of all structural components of the facilities during operation, closure and post closure.

~~(1)~~ (2) Retaining structures, foundations and mine materials emplacements shall be designed by a~~n independent,~~ qualified, registered professional and be constructed for long-term stability under anticipated loading and seismic conditions.

~~(2)~~ (3) Temporary structures and materials emplacements may, with written approval from the Department, be constructed to a lesser standard if it can be shown that they pose no, or minimal, threat to public safety or the environment.

PROTECTION OF WILDLIFE

340-43-0~~7~~60

(1) Wildlife shall be positively excluded from contact with chemical processing solutions and wastewaters containing chemicals.

(2) The Department may waive the positive exclusion requirement if the Oregon Department of Fish and Wildlife (ODF&W) certifies to the Department that the project is designed such that it will adequately protect wildlife.

~~(1) Provision shall be made for positive exclusion of wildlife from contact with processing chemicals, contaminated surface waters or wastewaters which are toxic to wildlife. Positive exclusion requires the use of such devices as pipes, fences, netting, covers and heap-leach drip-irrigation emitters.~~

~~(2) Hazing or other non positive protective measures are not acceptable.~~

~~GUIDELINES FOR DESIGN AND INSTALLATION OF VAT-LEACH TANKS, VESSELS AND SECONDARY CONTAINMENT SYSTEMS~~

~~340-43-070~~

~~(1) Owners or operators of new tank, vessel and secondary containment systems or components must ensure that the foundation, structural support, seams, connections, and pressure controls (if applicable) are adequately designed and that the system has sufficient structural strength, compatibility with the materials to be stored or treated, and corrosion protection so that it will not collapse, rupture, or fail. The owner or operator must obtain a written assessment reviewed and certified by an independent, qualified, registered professional attesting that the system has sufficient structural integrity and is acceptable for the storing and treating of materials.~~

~~This assessment shall include, at a minimum, the following information:~~

~~(a) Design standard(s) according to which the tank(s), vessel(s) and ancillary equipment is or will be constructed;~~

~~(b) Hazardous characteristics of the materials to be handled;~~

~~(c) For new tank systems or components in which the external shell of a metal tank or any external metal component of the tank system is or will be in contact with the soil or with water, a determination by a corrosion expert of:~~

~~(A) Factors affecting the potential for corrosion, including but not limited to:~~

~~(i) Soil moisture content;~~

~~(ii) Soil pH;~~

~~(iii) Soil sulfides level;~~

~~(iv) Soil resistivity;~~

~~(v) Structure to soil potential;~~

~~(vi) Influence of nearby underground metal structures (e.g., piping);~~

~~(vii) Stray electric current;~~

~~(viii) Existing corrosion-protection measures (e.g., coating, cathodic protection);~~

~~(B) The type and degree of external corrosion protection that is needed to ensure the integrity of the tank or vessel system during the use of the system or component, consisting of one or more of the following:~~

~~(i) Corrosion-resistant materials of construction such as special alloys or fiberglass-reinforced plastic;~~

~~(ii) Corrosion-resistant coating (such as epoxy or fiberglass) with cathodic protection (e.g., impressed current or sacrificial anodes);~~

~~(iii) Electrical isolation devices such as insulating joints and flanges.~~

~~(d) For underground tank system components that are likely to be affected by vehicular traffic, a determination of design or operational measures that will protect the tank system against potential damage;~~

~~(e) Design consideration to ensure that:~~

~~(A) Tank and vessel foundations will maintain the load of a full tank or vessel;~~

~~(B) Tank and vessel systems will be anchored to prevent flotation or dislodgement where the system is placed in a saturated zone, or is located within a seismic fault zone;~~

~~(C) Tank and vessel systems will withstand the effect of frost heave.~~

~~(2) The owner or operator of a new tank or vessel system must ensure that proper handling procedures are adhered to in order to prevent damage to the system during installation. Prior to covering, enclosing, or placing a new tank or vessel system or component in use, an independent, qualified professional who is trained and experienced in the proper installation of such systems, shall inspect the system or component for the presence of any of the following items:~~

~~(a) Weld breaks;~~

~~(b) Punctures;~~

~~(c) Scrapes of protective coatings;~~

~~(d) Cracks;~~

~~(e) Corrosion;~~

~~(f) Other structural damage or inadequate construction or installation.~~

~~All discrepancies shall be remedied before the system is covered, enclosed or placed in use.~~

~~(3) New tank or vessel systems or components and piping that are placed underground and backfilled shall be provided with a backfill material that is a noncorrosive, porous, homogenous substance and is carefully installed so that the backfill is placed completely around the system and compacted to ensure that the tank and piping are fully and uniformly supported.~~

~~(4) All new tanks, vessels and ancillary equipment shall be tested for tightness prior to being covered, enclosed or placed in use. If a tank or vessel system is found not to be tight, all repairs necessary to remedy the leak(s) in the system shall be performed prior to the tank or vessel system being covered, enclosed or placed in use.~~

~~(5) Ancillary equipment shall be supported and protected against physical damage and excessive stress due to settlement, vibration, expansion or contraction.~~

~~(6) The owner or operator shall provide the type and degree of corrosion protection necessary, to ensure the integrity of the tank or vessel system during use of the system. The installation of a corrosion protection system that is field fabricated shall be supervised by an independent corrosion expert to ensure proper installation.~~

~~(7) The owner or operator shall obtain and keep on file at the facility written statements by those persons required to certify the design of the tank or vessel system and supervise the installation of the system to attest that the system was properly designed and installed and that repairs, if necessary, were properly performed.~~

~~GUIDELINES FOR CONTAINMENT AND DETECTION OF RELEASES FROM VAT-LEACH TANKS, VESSELS AND SECONDARY CONTAINMENT SYSTEMS~~

~~340-43-080~~

~~(1) In order to prevent the release of toxic materials or wastes to the environment, secondary containment that meets the requirements of this section shall be provided for all new tank or vessel systems or components, prior to their being put into service.~~

~~(2) Secondary containment systems shall be:~~

~~(a) Designed, installed, and operated to prevent any migration of toxic materials or accumulated liquid out of the system to the soil, groundwater, or surface water at any time during the use of the system;~~

~~(b) Capable of detecting and collecting releases and accumulated liquids until the collected material is removed.~~

~~(3) Secondary containment systems shall be at a minimum:~~

~~(a) Constructed or lined with materials that are compatible with the materials to be placed in the system and of sufficient thickness to prevent failure due to pressure gradients (including static head and external hydrological forces), physical contact with the materials to which they are exposed, climatic conditions, the stress of installation, and the stress of daily operation (including stresses from nearby vehicular traffic);~~

~~(b) Placed on a foundation or base capable of providing support to the secondary containment system and resistance to pressure gradients above and below the system and capable of preventing failure due to settlement, compression, or uplift;~~

~~(c) Provided with a leak detection system that is designed and operated so that it will detect the failure of either the primary and secondary containment structure or any release of hazardous materials or accumulated liquid in the secondary containment system within 24 hours, or at the earliest practicable time if the existing detection technology or site conditions will not allow detection of a release within 24 hours;~~

~~(d) Sloped or otherwise designed or operated to drain and remove liquids resulting from leaks, spills, or precipitation. Spilled or leaked materials and accumulated precipitation shall be removed from the secondary containment system within 24 hours, or in as timely a manner as is possible to prevent harm to human health or the environment, if removal of the released waste or~~

~~accumulated precipitation cannot be accomplished within 24 hours.~~

~~(4) Secondary containment for tanks or vessels shall include one or more of the following:~~

~~(a) A line (external to the tank);~~

~~(b) A vault;~~

~~(c) A double-walled tank; or~~

~~(d) An equivalent device as approved by the Department.~~

~~(5) In addition to the requirements of paragraphs (2), (3), and (4) of this section, secondary containment systems shall satisfy the following requirements:~~

~~(a) External liner systems shall be:~~

~~(A) Designed or operated to contain 100 percent of the capacity of the largest tank within its boundary;~~

~~(B) Designed or operated to prevent run-on or infiltration of precipitation into the secondary containment system unless the collection system has sufficient excess capacity to contain run-on or infiltration. Such additional capacity shall be sufficient to contain precipitation from a 25-year, 24-hour rainfall event;~~

~~(C) Free of cracks or gaps; and~~

~~(D) Designed and installed to completely surround the tank or vessel and to cover all surrounding earth likely to come into contact with the waste if released from the tank(s) (i.e., capable of preventing lateral as well as vertical migration of the waste).~~

~~(b) Vault systems shall be:~~

~~(A) Designed or operated to contain 100 percent of the capacity of the largest tank or vessel within its boundary;~~

~~(B) Designed or operated to prevent run-on or infiltration of precipitation into the secondary containment system unless the collection system has sufficient excess capacity to contain run-on or infiltration. Such additional capacity shall be sufficient to contain precipitation from a 25-year, 24-hour rainfall event;~~

~~(C) Constructed with chemical-resistant water stops in place at all joints (if any);~~

~~(D) Provided with an impermeable interior coating or lining that is compatible with the stored materials and that will prevent migration of material into the concrete;~~

~~(E) Provided with an exterior moisture barrier or be otherwise designed or operated to prevent migration of moisture into the vault if the vault is subject to hydraulic pressure.~~

~~(c) Double-walled tanks shall be:~~

~~(A) Designed as an integral structure (i.e., an inner tank within an outer shell) so that any release from the inner tank is contained by the outer shell;~~

~~(B) Protected, if constructed of metal, from both corrosion of the primary tank interior and the external surface of the outer shell; and~~

~~(C) Provided with a built-in continuous leak detection system capable of detecting a release within 24 hours or at the earliest practicable time, if the owner or operator can demonstrate to the Department and the Department concurs, that the existing leak detection technology or site conditions will not allow detection of a release within 24 hours.~~

~~(6) Ancillary equipment shall be provided with full secondary containment (e.g., trench, jacketing, double-walled piping) except for:~~

~~(a) Above ground piping (exclusive of flanges, joints, valves, and connections) that are visually inspected for leaks on a daily basis;~~

~~(b) Welded flanges, welded joints, and welded connections that are visually inspected for leaks on a daily basis;~~

~~(c) Sealless or magnetic coupling pumps and sealless valves, that are visually inspected for leaks on a daily basis; and~~

~~(d) Pressurized above ground piping systems with automatic shut-off devices (e.g., excess flow check valves, flow metering shutdown devices, loss of pressure actuated shut-off devices) that are visually inspected for leaks on a daily basis.~~

~~GUIDELINES FOR INSPECTION OF VAT-LEACH TANKS, VESSELS AND SECONDARY CONTAINMENT SYSTEMS~~

~~340-43-085~~

~~(1) The owner or operator shall inspect, at least once each operating day:~~

~~(A) Overfill/spill control equipment (e.g., waste-feed cutoff systems, bypass systems, and drainage systems) to ensure that it is in good working order;~~

~~(B) The above-ground portions of the tank or vessel system, if any, to detect corrosion or releases of waste;~~

~~(C) Data gathered from monitoring equipment and leak-detection equipment (e.g., pressure and temperature gauges, monitoring wells) to ensure that the tank or vessel system is being operated according to its design; and~~

~~(D) The construction materials and the area immediately surrounding the externally accessible portion of the tank system including secondary containment structures (e.g., dikes) to detect erosion or signs of releases of materials (e.g., wet spots, dead vegetation).~~

~~(2) The owner or operator shall inspect cathodic protection systems, if present, according to, at a minimum, the following schedule to ensure that they are functioning properly:~~

~~(a) The proper operation of the cathodic protection system shall be confirmed within six months after initial installation, and annually thereafter;~~

~~(b) All sources of impressed current shall be inspected and/or tested, as appropriate, at least bimonthly (i.e., every other month).~~

~~(3) The owner or operator shall document in the operating record of the facility an inspection of those items in paragraphs (1) and (2) of this section.~~

GUIDELINES FOR DESIGN, CONSTRUCTION, AND OPERATION OF HEAP-LEACH FACILITIES

340-43-<u>065</u>~~090~~

(1) ~~These guidelines apply~~ This paragraph applies ~~generally~~ to heap-leach facilities using dedicated, or expanding, pads. Heap-leach facilities using on-off, reusable pads may require variations from these rules<u>; they</u> ~~that~~ shall be approved <u>on a case-by-case basis</u> by the Department.

(2) The heap-leach facility (pad and associated ponds, pipes and tanks) shall be sized to prevent flooding of any of its components. ~~A limited-use, emergency overflow pond (or tank) constructed to lesser requirements as described in this paragraph may be used in addition to the pregnant-solution pond (or tank) to reduce the required design capacity of the pregnant-solution pond(or tank).~~

(3) TABLE 1 of this Division establishes minimum capacity-sizing criteria <u>for the leach-pad and ponds</u>. The pad <u>and ponds</u>~~, pond and tank components~~ may be designed to act separately or in conjunction with each other to obtain the required storage volumes. <u>Other design criteria may be used, with Department approval, if local conditions warrant.</u> The best available climatic data shall be used to confirm the ~~most appropriate~~ <u>critical</u> design storm event and estimate the liquid levels in the system over a full

seasonal cycle. The liquid mass balance may include provision for evaporation.

(4) The heap-leach pad liner system shall be of triple liner construction with between-liner leak detection consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;

(b) Continuous ~~full~~ <u>flexible</u>-membrane middle and top liners of suitable synthetic material separated by a minimum of 12 inches of permeable material (minimum permeability of 10^{-2} cm/sec);

(c) A leak-detection system between the synthetic liners capable of detecting leakage ~~equivalent to free flow from a total hole area of 0.05 square inches per acre of liner~~ of 400 gallons/day-acre within <u>ten</u> ~~one~~ weeks of leak initiation.

(5) The processing-chemical pond liners shall be of triple liner construction with between-liner leak detection consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;

(b) Continuous ~~full~~ <u>flexible</u>-membrane middle and top liners of suitable synthetic material separated by a ~~suitable~~ permeable material (minimum <u>coefficient of</u> permeability of 10^{-2} cm/sec);

(c) A leak detection system between the synthetic liners capable of detecting leakage ~~equivalent to free flow from a total hole area of 0.05 square inches per acre of liner~~ <u>of 400 gallons/day-acre</u>, within ~~one~~ <u>ten</u> week<u>s</u> of leak initiation.

(6) Emergency ponds may be constructed as an alternative to larger pregnant and barren ponds. The emergency pond may be constructed to a lesser standard, with the limitation that it is to be used only infrequently and for short periods of time. The Department will specify reporting and use limitations

for the ponds in the permit. A between-liner leak detection system is not required for the emergency pond.

(7) The emergency-pond liner shall be of composite construction consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-6}~~-7~~ °m/sec) with a minimum thickness of 12 inches, and

(b) A single ~~full~~ flexible-membrane synthetic top liner of suitable material.

~~(8)~~ (6) The heap-leach pad shall be provided with a process chemical collection system above the upper-most liner that will prevent an accumulation of process chemical within the heap greater than 24 inches in depth.

~~(9)~~ (7) The permittee shall prepare a written operating plan for safe temporary shut-down of the heap-leach facility and train employees in its implementation.

~~(10)~~ (8) The permittee shall respond to leakage collected by the heap-leach and processing-chemical storage pond leak-collection systems according to the process defined in TABLE 2.

~~(10) Leaks detected by the heap-leach and processing-chemical pond leak-detection systems with leak rates in excess of the rate for free flow through 0.05 square inches of hole per acre of liner at the actual liquid depth shall either be repaired at the first opportunity or operations shall be modified such that the leakage is reduced below the specified rate. The Department will set a time schedule for repair with the permittee, if necessary.~~

~~(11)~~ (9) The ~~permit applicant~~ permittee shall determine the acid-generating potential of the spent ore by acid\base accounting and other appropriate static and dynamic laboratory tests. If the spent ore is shown to be potentially acid generating under the conditions expected in the heap at closure, the permittee shall submit a plan for acid correction for Department approval prior to loading the heap.

GUIDELINES FOR DISPOSAL OF MILL TAILINGS

340-43-09~~5~~70

(1) Mill tailings shall be treated by cyanide removal and re-use prior to disposal to reduce the amount of cyanide introduced into the tailings pond. Chemical oxidation or other means shall be additionally used, if necessary, prior to disposal to reduce the WAD cyanide level in the liquid fraction of the tailings. The permittee shall conduct laboratory column tests on mill tailings to determine the lowest practicable concentration to which the WAD cyanide (weak-acid dissociable cyanide as measured by ASTM Method D2036-82 C) can be reduced. In no event, shall the permitted WAD cyanide concentration in the liquid fraction of the tailings be greater than 30 ppm. ~~Mill tailings shall be treated prior to disposal to remove or detoxify process chemicals and available toxic metals, and minimize potential formation of acid leachate in the waste disposal facility. The Department places first consideration on use of treatment technologies which will remove toxic metals, cyanide or other process chemicals and acid-generating minerals from the wastestream and use them in a beneficial manner. Second consideration will be given to cyanide oxidation or other "detoxification" treatments which will convert or remove toxic metals and cyanide complexes to reduce overall toxicity.~~

~~(2) The liquid-retention capacity of tailings disposal facilities which receive tailings as a slurry shall be designed to the (applicable) criteria of TABLE 1 to prevent overflow.~~

(3) The permittee shall determine the potential for acid-water formation from the tailings by means of acid-base accounting and other suitable laboratory static and dynamic tests. If acid formation can occur, basic materials shall be added to the tailings in the amount of three (3) times the acid formation potential or to give a net neutralization potential of at least 20 tons of $CaCO_3$ per 1000 tons of tailings, whichever is greater, before placing tailings in the disposal facility.

~~Disposal of non-acid-generating tailings.~~

~~(a) Non-acid-generating tailings should be disposed of as de-watered solids and the disposal area progressively covered, but disposal as a slurry will be considered.~~

~~(b) Tailings disposed of either as a slurry or as de-watered solids, shall meet the criteria of TABLE 2 or 3 of this Division, respectively.~~

~~(c) The disposal facility shall be lined with an engineered, stable, soil/clay liner with a maximum permeability of 10^{-6} cm/sec, having a minimum thickness of 12 inches and shall be provided with a collection system to remove stormwater.~~

(4) The disposal facility shall be lined with a composite double liner consisting of a flexible-membrane synthetic top liner in tight contact with an engineered, stable, soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) having a minimum thickness of 36 inches.

Construction of the liner shall generally follow the principles and practices contained in EPA/600/2-88/052, "Lining of Waste Containment and Other Impoundment Facilities, September, 1988.

~~Disposal of acid-generating tailings.~~

~~(a) Tailings, or waste materials that have been separated from tailings, which contain more than 1.0 g/kg of total sulfide sulfur and are acid generating, shall be disposed of in a separate disposal facility.~~

~~(b) Tailings or waste materials disposed of as a slurry or as de-watered solids shall meet the treatment criteria of TABLE 2 or 3, respectively, except that the sulfur criterion may be exceeded.~~

~~(c) The disposal facility shall be lined with a composite double liner consisting of a full-membrane synthetic top liner in tight contact with an engineered, stable, soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) having a minimum thickness of 36 inches.~~

~~Construction of the liner shall follow the principles and practices contained in EPA/600/2-88/052, "Lining of Waste Containment and Other Impoundment Facilities, September, 1988.~~

~~(d) The disposal facility shall be provided with a leachate collection system above the liner~~

~~suitable for monitoring, collection and treatment of potential acid drainage.~~

~~(e) The permittee shall segregate and place acid-generating and acid-neutralizing tailings in such a manner as to minimize acid water generation~~ formation ~~by maximizing neutralization and exclusion of water and oxygen, according to a Department-approved plan.~~

(5) The disposal facility shall be provided with a leachate collection system above the liner suitable for monitoring, collecting and treating potential acid drainage.

GUIDELINES FOR DISPOSAL OR STORAGE OF WASTEROCK, LOW-GRADE ORE AND OTHER MINED MATERIALS

340-43-075

The permittee shall determine the acid-producing and metals- release potential of the wasterock, low-grade ore or other mined materials by acid/base accounting and other appropriate static and dynamic laboratory tests. If the mined materials are shown to be potentially acid forming, or capable of releasing toxic metals, the permittee shall submit a plan for correction and disposal for Department approval prior to permanently placing the materials.

GUIDELINES FOR HEAP-LEACH AND TAILINGS DISPOSAL FACILITY CLOSURE

340-43-~~1~~080

(1) The waste disposal facilities shall be closed under these rules in conjunction with the reclamation requirements of DOGAMI (Oregon Department of Geology and Mineral Industries).

(2) An up-dated closure plan and post-closure monitoring and maintenance plan shall be submitted to the Department by the permittee at least 180 days prior to beginning closure operations or making any substantial changes to the operation. The closure plan must be compatible with DOGAMI's reclamation plan and may be part of it.

(3) Chemical conveyances (ditches, troughs, pipes, etc.) not necessary for post-closure monitoring shall be

removed. The secondary containment systems shall be checked before closure for process-chemical contamination, and contaminated soil or other materials, if any, shall be removed to an acceptable disposal facility.

(4) Closure of the heap-leach facility.

(a) The heap shall be detoxified over a suitable period of time prior to closure, using rinse/rest cycles of rinsing and chemical oxidation, if necessary. The WAD cyanide concentration in the rinsate shall be no greater than 0.2 ppm.~~, prior to closure by a combination of rinsing and chemical treatment as, for example, with hydrogen peroxide. Chlorine compounds shall not be used. Statistically-representative samples of the spent ore and the rinse water shall be taken and analyzed for the parameters listed in TABLE 4 of this Division. Residual cyanide levels shall meet the criteria of TABLE 4.~~

(b) Following detoxification as defined in (a) above, the heap shall be closed in place on the pad by covering the heap with a cover designed to prevent water and air infiltration. ~~Following detoxification and correction for acid-generation formation potential, if any, the heap shall be closed in place on the pad by covering the heap with a cover designed to prevent water infiltration.~~ The cover should consist, at a minimum, of a low-permeability layer ~~to prevent water infiltration~~ and suitable drainage and soil layers to prevent erosion and damage by animals and to sustain vegetation growth, in accordance with DOGAMI's reclamation rules.

(c) The ponds associated with the heap shall be closed by folding in the synthetic liners and filling and contouring the pits with inert material. Residual sludge may be disposed of in one of the on-site waste disposal facilities, provided it meets the criteria for such wastes in these guidelines. ~~removing the residual solid sludge and the synthetic liners and filling in and contouring the pits with inert material. The sludge may be disposed of in one of the on-site waste disposal facilities, with Department approval.~~ The process chemical collection system of the heap shall be maintained in operative condition so that it can be used to monitor the amount and quality of infiltrated water, if any, draining from the heap.

(5) The tailings disposal facility shall be closed by covering with a composite cover designed to prevent water and air infiltration and be environmentally stable for an indefinite period of time. ~~Closure of the non-acid-generating tailings disposal facility. The facility shall be closed in place by covering the tailings with a composite cover consisting, at a minimum, of a low-permeability layer to minimize water infiltration and suitable soil layers to prevent erosion and damage by animals and to sustain vegetation growth, in accordance with DOGAMI's reclamation rules.~~

~~(6) Closure of the acid-generating tailings disposal facility. The acid-generating tailings disposal facility shall be closed by covering with a composite cover designed to prevent water infiltration and be environmentally stable for an indefinite period of time.~~ Maximum effort shall be made to isolate the tailings from the environment. Construction of the cover shall generally follow the principles and practices contained in EPA/530-SW-89-047, Technical Guidance Document -- Final Covers on Hazardous Waste Landfills and Surface Impoundments.

POST-CLOSURE MONITORING

340-43-085~~110~~

(1) The Department may continue its permit in force for thirty (30) years after closure of the operation and will include permit requirements for periodic monitoring to determine if release of pollutants is occurring.

(2) ~~The facility water-quality permit may be continued in force for a nominal period of thirty years after closure of the operation and would include appropriate requirements for periodic monitoring to determine if release of pollutants is occurring.~~ Monitoring data will ~~would~~ be reviewed regularly by the Department ~~with DOGAMI regularly~~ to determine the effectiveness of closure of the disposal facilities. The Department will consult with DOGAMI on release of

security funds ~~before DOGAMI releases bond funds~~ that would otherwise be needed to correct problems resulting from ineffective closure.

LAND DISPOSAL OF WASTEWATER

340-43-090~~115~~

(1) To qualify for land disposal of excess wastewater, the permit applicant shall demonstrate to the Department that the process has been designed to minimize the amount of excess wastewater that is produced, through use of water-efficient processes, wastewater treatment and reuse, and reduction by natural evaporation. Excess wastewater that must be released shall be treated and disposed of to land under the conditions specified in the permit.

(2) A disposal plan shall be submitted as part of the permit application that, at a minimum, includes:

(a) Wastewater quantity and quality characterization;

(b) Soils characterization and suitability analysis;

(c) Drainage and run-off characteristics of the site relative to land application of wastewater;

(d) Proximity of the disposal site to groundwater and surface water and potential impact;

(e) Wastewater application schedule and water balance;

(f) Disposal site assimilative capacity determination;

(g) Soils, surface water and groundwater monitoring plan;

(h) Potential impact on wildlife or sensitive plant species.

(3) The Department will evaluate the disposal plan and set site-specific permit conditions for the wastewater discharge.

GUIDELINES FOR OPEN-PIT CLOSURE

340-43-<u>095</u>~~120~~

(1) Open pits that will be left as a result of the mining operation shall be assessed prior to, and following, mining operations for the potential <u>to contaminate</u> ~~accumulation of~~ water <u>to the extent</u> that <u>it</u> might not meet water-quality standards due to build-up of acid or toxic metals.

(2) If the Department <u>finds</u> ~~judges~~ that the potential for water accumulation in the pit(s) exists, the permit applicant shall submit a closure plan for the pit that will address contamination prevention and possible remedial treatment of the water. The closure plan shall, at a minimum, examine the following alternatives:

(a) Avoidance, during mining, of acid-generating materials that can be left in place, rather than being exposed to oxidation and weathering;

(b) Removal <u>from the pit</u> and disposal, during or after the mining operation, of residual acid-generating materials that would otherwise be left exposed to oxidation and weathering;

(c) Protective capping in-situ of residual acid-generating materials;

(d) Treatment methods for <u>correcting acidity and toxicity of</u> accumulated water ~~for correcting acidity and toxicity~~;

(e) Installation of an impermeable liner under ponded water to prevent groundwater contamination;

(f) Backfilling of the pit(s) above the water table to reduce oxidation of residual acid-generating materials.

TABLE 1

Heap-Leach Liquid Storage Criteria

Component	Pregnant-Solution Pond	Barren-Solution Pond
Operating Volume	Minimum necessary to maintain recirculation	Minimum necessary to maintain recirculation
Operational Surge	Anticipated draindown and rinse volume	Anticipated draindown and rinse volume
Climatic Surge	100-yr, 24-hr storm plus 10-yr snowmelt	100-yr, 24-hr storm plus 10-yr snowmelt
Safety Factor	2-ft dry freeboard	2-ft dry freeboard

TABLE 2

Required Responses to Leakage Detected from the Leach Pad

Leakage Category	Response
Zero leakage to 200 gal/day-acre	Notify the Department; increase pumping and monitoring
Leakage from 200 gal/day-acre to 400 gal/day-acre	Change operating practices to reduce leakage
Leakage in excess of 400 gal/day-acre	Repair leaks under Department schedule.

~~Tailings Slurry Treatment Criteria~~

~~Parameter~~	~~Allowable Concentration~~
~~Filtered Liquid Fraction:~~	
~~Cyanide (Total)~~	~~10 mg/l~~
~~Cyanide (Wad)~~	~~0.2 mg/l~~
~~Thiocyanate ion~~	~~75 mg/l~~
~~Cyanate ion~~	~~50 mg/l~~
~~Filtered Solid Fraction:~~	
~~Total Sulfur (Sulfide)~~	~~1.0 g/kg~~
~~ANP > 3 APP~~	~~(See Notes)~~
~~Both Liquid and Solid Fractions By EPA TCLP Method 1311:~~	
~~Arsenic~~	~~5 mg/l~~
~~Barium~~	~~100 mg/l~~
~~Cadmium~~	~~1 mg/l~~
~~Chromium~~	~~5 mg/l~~
~~Copper~~	~~1 mg/l~~
~~Lead~~	~~5 mg/l~~
~~Mercury~~	~~0.2 mg/l~~
~~Selenium~~	~~1 mg/l~~
~~Silver~~	~~5 mg/l~~
~~Zinc~~	~~1 mg/l~~

~~**Notes:**~~

~~1. Liquid fraction defined as filtered slurry liquid combined with distilled-water rinsate of solid fraction; concentrations calculated on original liquid-fraction volume.~~

~~2. Cyanide (Total) and (Wad) to be determined by ASTM D2036-82 A and C.~~

~~3. ANP = Acid neutralization potential in terms of the mass of equivalent $CaCO_3$ available, expressed in mass units per thousand mass units.~~

~~APP = Acid-producing potential in terms of the mass of equivalent $CaCO_3$ required for neutralization, expressed in mass units per thousand mass units.~~

~~TABLE 3~~

~~De-Watered Tailings-Solids Treatment Criteria~~

~~Parameter~~	~~Allowable Concentration~~
~~Soluble Cyanide (Wad)~~	~~0.5 mg/kg~~
~~Soluble Cyanide (Total)~~	~~2.5 mg/kg~~
~~Cyanide (Total) after extraction of Soluble (Wad) and Soluble (Total) Cyanide~~	~~10.0 mg/kg~~
~~Total Sulfur (Sulfide)~~	~~1.0 g/kg~~
~~ANP > 3 APP~~	~~(See notes)~~
~~By EPA TCLP Method 1311:~~	
~~Arsenic~~	~~5 mg/l~~
~~Barium~~	~~100 mg/l~~
~~Cadmium~~	~~1 mg/l~~
~~Chromium~~	~~5 mg/l~~
~~Copper~~	~~1 mg/l~~
~~Lead~~	~~5 mg/l~~
~~Mercury~~	~~0.2 mg/l~~
~~Selenium~~	~~1 mg/l~~
~~Silver~~	~~5 mg/l~~
~~Zinc~~	~~1 mg/l~~

~~Notes:~~

1. ~~See Appendix A for cyanide analysis method.~~

2. ~~"De-watered" means no free liquid.~~

3. ~~ANP = Acid neutralization potential in terms of the mass of equivalent $CaCO_3$ available, expressed in mass units per thousand mass units.~~

   ~~APP = Acid-producing potential in terms of the mass of equivalent $CaCO_3$ required for neutralization, expressed in mass units per thousand mass units.~~

~~TABLE 4~~

~~Heap-Leach Closure Criteria for Cyanide~~

~~Waste Fraction~~	~~Parameter~~	~~Concentration~~
~~Heap Rinsate (Liquid)~~	~~Cyanide (Wad)~~	~~0.2 mg/l~~
	~~Cyanide (Total)~~	~~10.0 mg/l~~
~~Spent Ore (Solids)~~	~~Soluble Cyanide (Wad)~~	~~0.2 mg/kg~~
	~~Soluble Cyanide (Total)~~	~~2.5 mg/kg~~
	~~Cyanide (Total) after extraction of Soluble (Wad) and Soluble (Total) Cyanide~~	~~10.0 mg/kg~~

~~**Note:**~~

~~See Appendix A for the cyanide analysis method applicable to the spent ore.~~

~~APPENDIX A~~

~~ANALYSES OF SPENT ORE AND TAILINGS~~

~~Analysis of the spent ore and tailings shall be performed with the following procedure:~~

~~1. For extraction of Soluble Cyanide (Wad):~~

~~a. Place 500 grams of dry spent ore or tailings in 2.5 liters of de-ionized water at neutral pH in an air-tight, capped container. Select the container size to minimize head space.~~

~~b. Stir mildly for 24 hours at room temperature.~~

~~c. Filter entire slurry from Step (1.b) through No. 42 Whatman paper and immediately analyze an aliquot for Wad cyanide.~~

~~d. Calculate Soluble Cyanide (Wad) as in Step (2.d).~~

~~2. For extraction of Soluble Cyanide (Total):~~

~~a. Place 500 grams of dry spent ore or tailings in 2.5 liters of distilled water; adjust to pH 5 with~~ $\cancel{H_2SO_4}$~~.~~

~~b. Stir mildly for 24 hours at room temperature in an air-tight, capped container with no head space.~~

~~c. Filter the entire slurry from Step (2.b) through a No. 42 Whatman filter paper and analyze an aliquot of filtrate for Soluble Cyanide (Total). Use the remaining solid fraction of the slurry for Cyanide (Total) in Step (3.).~~

~~d. Calculate Soluble Cyanide (Total) as mg CN/Kg of solids:~~

$$\cancel{\text{mg CN/Kg} = \frac{(\text{mg/L CNT in filtrate}) \times 2.5}{0.5}}$$

~~3. For determination of Soluble Cyanide (Wad), use ASTM D2036-82 C.~~

~~4. For determination of Cyanide (Total) after extraction of Soluble Cyanide (Wad) and Soluble Cyanide (Total) in the solid fraction, use ASTM D2036-82 A, with a minimum of 5 grams of the solid fraction remaining from Step (2.).~~

Summary of Record of EQC Discussions of Mining Rules

December 13, 1990

At a work session on December 13, 1990, the Commission and Department discussed a variety of options for regulation of the environmental aspects of large scale gold mining operations in Oregon.

This item was intended to provide an interchange of information between the staff and the Commission and provide a common basis for the development of a regulatory approach for large scale gold mining operations in Oregon. Commissioner Lorenzen expressed his desire that the Commission give the staff clear guidance on the approach to be developed. Commissioner Wessinger noted the need to listen to staff recommendations.

Jerry Turnbaugh, of the Water Quality Division, presented background information to the Commission on mining operation, and the particular issues where decisions will have to be made in the development of the regulatory approach. Commissioner Lorenzen asked about the Department's authority on federal lands and the Department's hazardous waste authority. Michael Huston stated that the State has clear environmental authority on federal lands. Brett McKnight, of the Hazardous and Solid Waste Division, cited the hazardous waste cleanup project at the Umatilla Army Depot as an example of the Department's authority. He also noted that under the federal Resource Conservation and Recovery Act (RCRA), the owner of a facility and the operator are both subject to regulation.

In response to Commission questions on regulatory framework, Director Hansen noted that design and performance standards can be incorporated either in rule or as conditions in permits. Chairman Hutchison asked about preferences for rules as opposed to leaving requirements to be determined by professional judgement of the staff. Dave Barrows, representing the mining industry, indicated that his organization was split on that issue. Jean Cameron, representing Oregon Environmental Council, stated that they always preferred standards in rules along with flexibility for the permit writers to incorporate more stringent requirements where needed. Director Hansen stated that the approaches can be combined -- rules that incorporate design and performance standards, and permits that contain conditions based on the rules, guidelines, and best professional judgement. He also noted that mining wastes are not hazardous waste under the federal definitions, but rules adopted by the Commission change that and regulate processing operations as hazardous waste generators. Brett McKnight indicated that mine tailings may or may not be hazardous wastes. If they are, then the Department would have to site a hazardous waste storage facility at the site.

John Beaulieu and Gary Lynch, representing the Department of Geology and Mineral Industries, discussed the interagency approach to review of mining proposals, and indicated that their legislative package seeks to require applicants to present both an environmental analysis and a socio-economic analysis as part of their applications.

Chairman Hutchison then asked the Commission for an expression of their thinking. Commissioners Lorenzen and Wessinger expressed a preference for moving forward with something as rapidly as possible so that industry knows what is expected. They expressed a preference for rules that are general and not too lengthy or specific. Dave Barrows suggested that something be drafted by the Department and taken to public hearing as soon as possible rather than trying to use an advisory committee to develop a proposal. Jean Cameron urged the Commission to not rush too fast because the issue is too important to do it wrong. Representative Bob Pickard encouraged the Commission to move with purpose. He stated that an advisory committee with a long schedule won't serve the Department well in the budget process.

The Commission discussed concepts of regulating to do away with environmental risk, of requiring use of the best technology being employed on a commercial scale anywhere, and of using a combination of rules and guidelines. The Commission indicated it would provide guidance to the Department during the regular agenda at the Friday meeting.

December 14, 1990

During the regular meeting on December 14, 1990, the Commission reflected on the Work Session discussion of the previous day and expressed the following views:

- Proceed to rulemaking hearings as soon as possible on rules to address open pit large scale mining in which chemicals are used for ore processing. (Placer mining will be treated separately.)
- Use an open process including public information meetings in the development of proposed rules (in place of an advisory committee process).
- Develop draft rules sufficient to proceed to hearing by the end of February. Proceed to a rulemaking hearing and complete the rulemaking process within six months.
- Report on progress at the February 1, 1991, meeting and provide an outline of proposed rules.
- Circulate drafts to the Commission for their information as they are developed in order to provide an opportunity for input.
- Use a blended approach involving both rules and guidelines. The rules should not be too detailed, and the guidelines ought to be

dynamic but sufficiently precise to send a reasonable and sufficiently predictable message about the regulatory expectations of Oregon.

- Direct the rules toward eliminating risk to the environment.

- Make the rules a combination of performance-based and technology based requirements.

- Require the best technology available anywhere as the starting point. If technology is being used anywhere else commercially, that technology will be the starting point for requirements. Make the rules technology forcing.

- Clearly place the burden on the applicant to show why specific technology or performance standards shouldn't apply or why alternative approaches should be considered equivalent and acceptable.

- Evaluate and consider the relationship to RCRA requirements.

- Assure that the regulatory approach is preventative and that the need for future superfund cleanup is eliminated.

- Consider interagency coordination to the maximum extent practicable to minimize duplication of efforts by applicants and the public.

It was MOVED by Commissioner Wessinger that the Department proceed with development of rules based on the above guidance. The Motion was seconded by Commissioner Lorenzen and unanimously approved.

January 31, 1991

At the work session on January 31, Jerry Turnbaugh reported that the Department was proceeding in accordance with a schedule that called for completing a second draft of proposed rules for gold recovery operations by the end of February. That second draft was already complete. The target is to have a third draft which will be sufficient for distribution for public comment available by March 1. An informal group is being assembled to assist in a focused technical review of the rules on February 21. This group includes people from DEQ's water quality and solid waste programs, the Department of Fish and Wildlife, the Department of Geology and Mineral Industries, and several private sector individuals associated with and knowledgeable in mining processes and activities.

Commissioner Lorenzen complimented Mr. Turnbaugh on his efforts to develop rules to address Commission concerns. Commissioner Wessinger asked for an indication of the future problem areas with regard to the proposed rules. Mr. Turnbaugh responded that the cost of technology that is not typically practiced would be the issue. Examples would be technology to added processing steps to remove and reuse cyanide rather than discharging it with wastewater, and steps to remove acid generating materials to prevent generation of acids in the process.

Chair Hutchison asked what the draft rules would say about open mine pits. Mr. Turnbaugh indicated that these rules do not yet address water quality issues associated with the pit. Reclamation of pit areas is a responsibility of the Dept. of Geology and Mineral Industries. The groundwater section will be looking at groundwater impacts in more detail. The Department will also be looking at the relationship to solid waste and hazardous waste rules. Mr. Turnbaugh also indicated that an effort was being made to mesh closure requirements with the reclamation requirements of the Department of Geology and Mineral Industries.

Commissioner Lorenzen noted that the rules as drafted appropriately apply equally to operations on federal lands as well as operations on private lands.

__July 25, 1991__

At a work session on July 25, 1991, the Department reported on the status of the rule development process. Public hearings were held on the proposed rules as follows:

May 15, 1991 in Portland
May 17, 1991 in Nyssa
May 20, 1991 in Grants Pass.

The Department reported that comments were received from the following and that testimony was still being summarized and evaluated:

<u>State and Federal Agencies</u>

U.S. Fish and Wildlife Service
Oregon Department of Fish and Wildlife
Oregon Water Resources Department
Department of Geology and Mineral Industries

<u>Mining Interests</u>

Simplot
Horizon Gold
Atlas
Sunshine Mining
Phelps Dodge
Northwest Mining Association
Oregon Mining Council

<u>Environmental Advocacy Groups</u>

Oregon Environmental Council
Wilderness Society
National Wildlife Federation
Northwest Environmental Defense Center
Audubon Society
Native Plants Society
Sierra Club

<u>Economic Development Interests</u>

Mayors and Citizens of Nyssa, Ontario, Jordan Valley, Vale and Adrian

The Department summarized what appeared to be the most significant differences of opinion between the Department and the mining industry as represented by the Oregon Mining Council (OMC) as follows:

1. **End-of-pipe tailings cyanide treatment vs. no treatment or "natural" treatment**

The rules are based on end-of-pipe treatment as a basic pollution prevention method.

OMC comments deleted end-of-pipe treatment in favor of graduated containment of tailings wastes.

2. **Use of technology-based waste treatment criteria vs. application of water quality standards for heaps and tailings**

The rules require treatment of tailings and heaps to "technology-based" criteria, regardless of whether groundwater or surface is likely to be affected.

OMC comments would apply present water-quality standards or prevention of aquatic beneficial uses (only when water is affected) as appropriate regulatory criteria.

3. **Leak-detection and compliance at the heap liner vs. an allowable perimeter of soil contamination**

The rules require a "triple" liner configuration that provides for leak detection in the uppermost liner, with a requirement for repair if leakage exceeds an allowable "de-minimis" rate.

OMC proposes, at maximum, a "double" liner system with a lek detection system and repair if the leak exceeds the gravity flow capacity of the leak detection system.

4. **Positive wildlife exclusion vs. "safe" cyanide level**

The rules require "positive" exclusion (netting, fences, etc.) of wildlife (undefined) from all cyanide-containing waters, on the basis that no appropriate standard for "safety" exists.

OMC proposes that a known safe cyanide level exists (perhaps 50 parts per million) and should be used instead of exclusion.

5. **Long-term vs. short-term post-closure monitoring**

The rules state that the permit may be continued in force for a "nominal" period of 30 years for monitoring purposes.

OMC proposes that the permit be continued up to a maximum of five years after closure.

6. **Remedial actions relative to open pits**

The rules require a closure plan to define remedial/protective measures for the pit, if there is a potential for accumulation of contaminated water.

OMC proposes essentially the same thing but removes references to some items to be considered, such as pit-filling or mining avoidance in certain areas.

The Commission asked questions to clarify points of difference between the Department and OMC. Considerable discussion centered on the applicability of technology-based, BPJ (best professional judgment) criteria for mine waste detoxification versus water-quality-based criteria.
The Commission concluded the work session discussion by requesting staff to:

a. Complete a summary write-up of the hearings comments.

b. Complete a final draft of the proposed rules, based on the comments received and circulate the draft for review prior to the next Commission discussion of the issue.

c. Arrange for an advisory panel consisting of key representatives of the mining industry, environmental groups and the Department to meet with the full Commission during a Work Session to discuss the proposed rules.

The Commission indicated it would then follow the Work Session with specific direction to the Department on the next steps to be taken.

October 10, 1991

At this meeting, the Commission was provided with a package of materials which included the following items:

- Proposed Rules on Chemical Mining (October 10, 1991 Draft).

- Abstract of Technical Comments received during the public comment process.

- Response to Public Comment (significant issues).

- Markup of the rule proposal originally presented for comment at public hearings to show proposed changes.

At the meeting, Lydia Taylor, Administrator of the Water Quality Division, introduced the discussion on the chemical mining rules. She noted that two representatives of the mining industry and two representatives of the environmental community had been asked to make a presentation to the Commission on their views of the proposed chemical mining rules. Each group was advised to limit their presentation to 30 minutes. She also noted that Kent Ashbaker and Jerry Turnbaugh of the Water Quality staff were available to answer questions. She provided the Commission a table summarizing issues as addressed in the original draft of the rules and as addressed in the current draft. Director Hansen noted that representative of the Department of Geology and Mineral Industries and Department of Fish and Wildlife were also present to respond to questions.

Debra Struhsaker, an independent consultant on environmental and regulatory issues for the mining industry and for the Oregon Mining Council, began the presentation to the Commission on behalf of the mining industry. She noted that they would address their concerns with the technical aspects of the proposed regulations. She acknowledged the substantial efforts that had gone into the development of the rules to date. She noted that her experience is quite diverse in terms of the issues she has addressed and the states she has worked in, thus leading to a broad perspective on the issues. She handed out copies of overhead slides that she was using in her presentation.

Ms. Struhsaker made the following points in her presentation:

1. The rules should be performance standards rather than design or "universal" criteria. Regulations must apply to both eastern and western Oregon where climate, terrain, habitat, and hydrologic conditions are different. Universally prescribed design and closure criteria cannot satisfy the needs of Oregon's diverse natural environment. The current rules contain design criteria that are extremely stringent and may be good in some settings but not in others. Clarification of "alternative environmental protective means" is required. Clear guidelines need to be established for evaluating site specific criteria.

2. Hazardous Waste philosophy was used to write the rules and that is not necessary to protect the environment. The rules are inconsistent regarding whether mine waste is hazardous. A technically incorrect approach has been specified on waste classification.

3. Closure requirements are too prescriptive and should be based on site specific conditions. Compliance with environmental performance standards is achievable without requiring low permeability covers in many cases.

4. Proposed wildlife protection measures are redundant. Both detoxification and positive exclusion are required when either will suffice on tailings. The requirements need to mesh with Fish and Wildlife rules. The mortality problems at mining sites has been solved.

5. The wetlands restrictions should be removed.

Bill Schafer, representing the Oregon Mining Council, continued the presentation:

6. Thirty year post closure monitoring is not necessary. The duration of monitoring should be determined on a site specific basis.

7. The limitation of 24 inch hydraulic head in the heap effectively bans valley leach systems.

8. The approach to classification of mine wastes is flawed. EPA says method 1311 is incorrect for mine waste classification; 1312 should be used instead.

9. The proposed acid-potential evaluation provisions are inconsistent with

established practice. Mitigation measures should not be prescriptive.

Ms. Struhsaker closed by reiterating their desire to resolve the outstanding issues prior to rule adoption.

Larry Tuttle, representing Wilderness Society and other conservation organizations, summarized their involvement and concerns regarding mining wastes. He noted that they liked the first draft of the rules that were submitted to public hearing. Those rules were consistent with the governor's directive. He stated they were less happy with the second draft. They support development of the best standards to give certainty to the industry and to drive technology. He recommended that the Commission direct the Department to reopen the record and potentially hold added hearings. He suggested that the hearings be before the EQC.

Gary Brown, representing Citizens for Responsible Mining in Ontario, suggested that there will be many large scale mining operations in Oregon, not just a few. He provided a package of information for the record which recorded examples of problem mining operations. With respect to the present draft rules, he disagreed with the proposal to drop the triple liner requirement (one clay plus two synthetic) in favor of a double liner system (one clay and one synthetic in contact). He noted that the effects of leaks into the ground after closure was not known. He also noted that the heap retains large quantities of solution, and something is needed under the heaps to protect groundwater in the future. He also noted the need for long term protection through detoxification, that acid mine drainage is still a problem, and that problems should be prevented now and into the future rather than counting on the potential ability to correct them later.

Chair Wessinger then asked for questions from the Commission.

Commissioner Lorenzen asked for identification of a western state that was considered a model of environmental protection for mining wastes. Ms. Struhsaker indicated that Nevada and California were considered to be models. Commissioner Lorenzen asked to be provided with the names of contacts later. He then asked why mining waste should not be treated as hazardous waste. Ms. Struhsaker indicated that the large volumes of low hazard materials makes it difficult. She stated that if a waste tests as hazardous under the 1312 test, then it is treated as hazardous waste.

Chair Wessinger noted that when things get tough economically, environmental costs are easy to cut. He asked if the proposed rules were adequate for monitoring. Larry Tuttle responded that the legislature required third party monitoring to be paid for by the mining operation. In addition, a bond is required for all costs.

Chair Wessinger thanked the panel and asked the Department to come forward and summarize the major changes to the rules and the reasons for the changes. Jerry Turnbaugh summarized as follows:

(1) Mill Tailings/End of Pipe Treatment -- The proposed rules do not set wildlife protection levels, but a 30 ppm WAD maximum technology based limit is specified.

(2) Liners/Leak Detection/Closure -- The original proposal specified a triple liner system and the current draft proposes a double liner system. In response to a question about the reason for the change, Mr. Turnbaugh characterized the double liner system as low leakage and indicated that technical difficulties in effectively engineering and installing the triple liner system caused him to move to the double liner recommendation. In response to questions about leak detection, Mr. Turnbaugh stated that there is not a good leak detection system for use with the double liner system.

(3) A variance provision that was included in the initial draft was removed from the current draft. The Department now believed that variance type situations could be handled in permit drafting without adding the variance provision to the rules.

(4) Guidelines for tanks and vessels in the original draft were eliminated in the current draft. Such facilities were not expected to be extensively used, and could be handled adequately in the plan review process.

Chair Wessinger asked for suggestions on the next steps. Director Hansen suggested that the Commission could go step by step through the rules or it could give some direction to the Department and ask the Department to return. Among other issue that guidance would be welcomed on were whether the Commission wanted redundancy to be required in the level of protection provided, and whether the Department should defer to the Department of Fish and Wildlife on wildlife protection or make its own judgements.

Commissioner Lorenzen indicated that he wanted time to review the matter in light of the discussion before he voiced his reactions and recommendations. Commissioner Squier indicated that before she could form any judgments, she needed additional technical information on the state of the art in monitoring to detect leaks, and the ability to rapidly fix a leak once detected. This was necessary before she could form any judgments regarding the difference between double and triple liners and the need for redundancy.

Chair Wessinger stated that the Commission has expressed the desire for a very stringent rule. He noted that when they are done, they don't want an "Exxon". He suggested that the Department go back and evaluate the discussion and comments and return at the November meeting with a specific recommendation on the issues. At that time, the Commission would provide specific direction for developing the final rule draft. Commissioner Whipple noted that the Commission was not looking for a change in the approach.

November 7, 1991

The Commission convened a work session in Medford to continue the earlier Work Session Discussion of Proposed Rules for Mining Operations using Chemicals to Extract Metals from Ores. No public comment was taken at this work session. Discussion was between the Commission and Department staff.

Director Hansen asked the Commission to give advise that would allow the Department to complete a final draft of the mining rules. He suggested that major issues included other agency roles, extent of monitoring during operations, and the extent of engineered protection including how close proposed rule requirements should be to the Hazardous Waste program requirements.

Lydia Taylor, Administrator of the Water Quality Division, handed out a three column table summarizing the provisions of the rules sent out to public hearing (labeled the 6/14 draft), the rules as presented for discussion at the October 10 work session (the 10/10 draft), and the recommendation of the Department (Recommended).

Jerry Turnbaugh of the Water Quality staff summarized the recommendation on liners as a return to the original 6/14 draft which called for a triple liner system. In response to questions from Commissioner Lorenzen, Mr. Turnbaugh noted that the three liner system is better able to detect leaks, but requires more care to keep from puncturing the liner. He noted that some believe the two liner system is not as likely to leak. He also noted that a leak in the two liner system is not as likely to be detected. Commission members stated that this was one of the key issues to be determined. Director Hansen indicated that this is a judgment call. The question is whether an extra level of opportunity to detect and correct a problem is provided before the environment is affected, or whether one relies more heavily on a cap. The Commission discussed the potential for monitoring and the potential for preventing and detecting leaks.

Commissioner Lorenzen recommended that the rules be drafted to require triple liners, unless another way is proposed to assure an equivalent level of monitoring (leak detection) below the liner system. The Commission members concurred with this suggestion.

The next issue discussed was wildlife protection. The Department recommendation was the same as the 10/10 draft which proposed to rely on the Department of Fish and Wildlife. Mr. Turnbaugh noted that HB 2244 requires the Department of Fish and Wildlife to address wildlife protection measures for mining operations. Commissioner Lorenzen asked what happens if Fish and Wildlife doesn't act. Lydia Taylor responded that the proposed rules require elimination of exposure or positive exclusion.

The Commission agreed that the proposed rules should defer to Fish and Wildlife on the issue of wildlife protection measures.

Commissioner Lorenzen then raised the issue of review of design, construction and operation and indicated he would like to have the rules specify third party review. The Commission discussed options for such review including the reviewer hired by DEQ, the reviewer hired by the mining company subject to approval of DEQ, or the ability of DEQ to remove the reviewer or levy penalties. Director Hansen noted that RCRA requires that an independent engineer oversee construction. Mr. Turnbaugh indicated that the Department had considered third party review of design, but not construction or operation. Commissioner Lorenzen stated that it adds comfort to have an independent professional stake their reputation on the plan.

The Commission agreed that the proposed rules should provide for independent review of design, construction, and operation.

Lydia Taylor indicated that the Department was recommending that the requirements for mill tailings be tightened up. The original draft proposed a performance standard. Now the Department is proposing both a performance standard and two technologies -- removal/recycling of cyanide, and oxidation for greater stability.

The Commission agreed with the Department recommendation on tailings.

On the issue of testing, the Commission agreed with the recommendation to tie to the Hazardous waste requirements for testing to determine if the waste is hazardous, and managing the waste accordingly.

The Commission discussed the issue of seismic instability. Director Hansen noted that the proposal opts for some criteria for siting and assumes that facilities can generally be engineered to meet the site criteria. Lydia Taylor noted that existing groundwater criteria will have to be met. The Commission agreed with the Department recommendation.

On the issue of a variance provision, Lydia Taylor indicated that the variance provision in the original draft was eliminated in favor of an approach that will look at equivalent results in the plan review process. The Commission agreed with the proposal.

With respect to requirements for emergency ponds, Lydia Taylor advised that the requirements for emergency ponds were made less restrictive, and that if the ponds are planned to be used, they must be designed to the same standards as regular process facilities.

The next issue discussed was the monitoring after closure. Chair Wessinger asked how monitoring would be conducted after a mine was closed and the company gone. Mr. Turnbaugh indicated that requirements administered by DOGAMI include a bond to cover chemical processing and reclamation. He believed that monitoring could be covered under the bond. Commissioner Lorenzen indicated his desire to have parent corporations or the majority interest holder in the permittee to sign on to the permit to assure greater protection. Commissioner Whipple suggested the issue may be greater than just DEQ. Lydia Taylor indicated that the

intent of the new legislation was to cover the broader picture. Commissioner Lorenzen said his interest was to have any parent corporations guarantee the post closure obligation.
The consensus of the Commission was sympathy with the desire of greater security from the parent company or companies to the permittee and that this option should be looked into further.

The final issue discussed was the open pit itself. Mr. Turnbaugh indicated that the rules call for assessment and have not been modified. There was no suggestion for modification.

<u>December 13, 1991</u>

At this regular meeting, the Commission considered the Department recommendation to adopt proposed mining rules as presented in Attachment A of the staff report (rule draft dated 12/13/91). The proposed rules require mining operations using cyanide or other toxic chemicals to protect soils, groundwater, surface waters and wildlife from contamination or harm by process solutions and waste waters. The protective measures required by the proposed rules include cyanide recovery and re-use, chemical detoxification of cyanide residues and extensive lining and engineered closure of waste disposal facilities.

The department provided the Commission with a background summary of the proposed rules. Commissioner Lorenzen questioned the use of the term **disposal facility** on page A-10 of the proposed rules and asked that the wording be removed. Lydia Taylor, Administrator, Water Quality Division, responded that the term **disposal facility** would be removed from the proposed rules. Commissioner Lorenzen asked how reporting requirements listed in the rules would be handled. Ms. Taylor replied that reporting requirements would be dealt with on a permit-by-permit basis.

Ivan Urnovitz, Northwest Mining Association, **Mike Filio**, Tek Corporation, Vancouver, B. C., and **John Parks**, Atlas Precious Metals, represented the mining industry in a consolidated presentation.

Mr. Urnovitz expressed concerns regarding the following items:

- The mandatory requirement of a 36-inch clay liner.

- The tailings must be handled as hazardous waste.

- The controls were overly redundant and more requirements were in the rules than needed by the state of Oregon.

- The tests required were inappropriate. Mining wastes should be tested differently than municipal wastes.

- The wetlands requirements were arbitrary.

- The AVR system in regard to the liquid storage criteria was arbitrary and over redundant.

Mr. Filio stated that the rules were overly stringent and had caused the suspension of a negotiation with Atlas

Precious Metals on the Grassy Mountain project. His concerns were as follows:

- The method of reusing and recycling cyanide was not proven.

- That determining the potential of acid-water formation from the tailings added little benefit to the environment and was costly.

- That environmental benefits must justify added costs.

Mr. Parks complimented the staff on their efforts. He stated that he supported 80% of the rule proposals, but indicated that the 20% where disagreement exists cannot be quickly resolved. He stated that the "one size fits all" approach of the rules is not appropriate and results in unnecessary costs. He urged the Commission to take additional time to resolve the issues.

Mr. Urnovitz concluded that the rules would create a rigid, inflexible program with added costs to the mining industry. He said that added expense had not been considered, and that industry proposals met state requirements. Mr. Urnovitz suggested that an impartial review panel be established which would include the Commission chair, mining experts from Nevada or California and DEQ staff.

Larry Tuttle, The Wilderness Society, told the Commission that liner systems for tailings and heaps had been used in other states for a long time. He said that the rules would provide the mining industry the ability to prove that other approaches would provide equal protection. Mr. Tuttle added that early detection systems with triple liners would prevent cyanide from entering the soil. He said what was missing from the rules was a third-party verification of baseline data and that removing heavy metals should be a part of cyanide removal. Mr. Tuttle added that wetlands should not be risked and should not be considered at this meeting. He indicated that hazardous waste rules should apply to the tailings, and that EPA is looking at mining with that approach. He further added that the state would learn if the rules are too strict as mining activities occur. Mr. Tuttle concluded by stating that the rules should be adopted and that although the rules were not perfect, changes could evolve over time; the rules would protect the state and give the mining industry a chance to prove the rules were unnecessary.

Commissioner Squier stated that the term **waste** on page A-7 of the proposed rules was too narrow and needed to be clarified. Commissioner Whipple said that when the rules were being developed, the Commission was pushing the edge in terms of environmental protection. However, she stated, that she had concerns that more responsibility had been placed on the Commission to assure technical feasibility. She suggested that the department research the implications of mining activities and try to use the universities in this endeavor. Commissioner Whipple further added that the department should take the time to make sure the rules are technically feasible and correct. She also noted the risk of finding that the rules aren't stringent enough.

Commissioner Lorenzen expressed his general preference for performance standards rather than design standards but noted that there was no perfect performance measuring system. He expressed a desire for a third party review to examine the following issues to determine whether the proposed rules meet Commission goals:

- The requirements for liners under the heap.

- The recycling of cyanide.

- The treatment and long-term stability of tailing ponds.

He added that an independent opinion was needed on the question of whether the proposed rules were overly protective.

Commissioner Squier asked the department about the reuse of cyanide. Staff responded that reuse minimizes the use of cyanide and reduces the amount used; however, it is cheaper to buy cyanide and dispose of it. Staff further stated that by recycling cyanide the toxicity of the tailings can be reduced. Commissioner Lorenzen asked if there was another methodology in place other than the AVR system. Staff replied that the rules do not require AVR but do support removal and reuse.

Commissioner Castle said that the perception of the process was mostly economic. However, he stated, that this was not the purpose of their review. Commissioner Castle supported the idea of a third-party review but stated that the review should be confined to the technical issues relating to environmental protection. Chairman Wessinger expressed his desire not to use an industry committee but rather to find an individual or company with no ties to either side to evaluate the proposed rules. He further requested that the Department get back to the Commission as soon as possible regarding the steps for an independent review.

Director Hansen questioned the Commission about whether they wanted the third-party evaluation to be in the form of addressing applicable policy questions. He suggested that a review could focus on a review of technical issues in relation to the policy including assessment of the level of certainty that the technical requirements would meet the policy, and the technical feasibility of the requirements.

He further stated that the intent of House Bill 2244 was that rules be developed that were necessary and practical. He stated that the term "necessary" was in relation to protecting the environment and was without regard to cost. The term "practicable" applies to selection of alternatives, were available, to meet the "necessary" requirements.

Commissioner Squier noted that a third-party review would be expensive and would require time. She voiced her opinion that the **alternate methods** wording in the proposed rules allowed the department enough flexibility and favored adopting rules now.

Commissioner Lorenzen suggested that the review focus on narrow technical issues and then questioned if the department had the necessary funds to conduct the review. Commissioner Castle noted that the Department should spend whatever is necessary. Commissioner Lorenzen suggested that the third-party review should address the technical means of achieving the Commission's policies.

Commissioner Whipple, after some discussion and questioning of staff, moved that the Commission direct, with a high degree of specificity, that a third-party review be conducted on the issues of liner systems, removal and reuse of cyanide, and reduction of toxicity of the waste to the greatest degree possible. Commissioner Lorenzen seconded the motion with the understanding that closure of the various ponds, heap leach and tailings facility as well as the possible redundancy of the clay liner thickness was included within the context of the motion.

Director Hansen then summarized the issues to be addressed in relation to the policies: technical feasibility, level of certainty, other technologies.

He then noted that contracting with a third party would be a complex process, and suggested that the matter be further discussed by the Commission through a conference call within the next week.

Commissioner Squier made it clear that she wanted detection and repair of leaks before chemicals escaped into the environment to be reviewed. Chairman Wessinger, Commissioners Castle, Whipple and Lorenzen voted yes; Commissioner Squier voted no.

Water Quality Division Administrator Lydia Taylor then asked if it would be appropriate to defer action on any mining permit applications received pending completion of the third-party review and adoption of rules. The Commission agreed, and Commissioner Lorenzen noted that the Commission could very quickly adopt rules if a permit application was filed.

December 20, 1991

A special meeting by a conference call of the Environmental Quality Commission was held on Friday, December 20, 1991, at the Oregon Department of Environmental Quality, Conference Room 3A, 811 S. W. Sixth Avenue, Portland, Oregon. The purpose of the special meeting call was to discuss the Department's draft Request for Proposal (RFP) for technical advice on mining rules.

Commission members present by telephone were Vice Chair Castle, Commissioners Squier, Whipple and Lorenzen. Chair Wessinger, Director Hansen and Larry Knudsen, Assistant Attorney General, and Department staff were present in Conference Room 3A. The conference call began at 9:30 a.m.

At the December 13, 1991, EQC meeting, the Commission asked the Department to initiate a third-party review of liner systems, the removal and reuse of cyanide and the reduction of toxicity of the waste. Additionally, the Department was asked to review the technical means of achieving the Commission's policies. Draft portions of the RFP were forwarded to the Commission prior to the meeting.

Director Hansen indicated the draft RFP addressed the questions asked by the Commission and how those questions could be answered by an independent third party. Director Hansen summarized the pre-bid qualifications, procedures and processes related to the bidding and bidders. He requested that the Commission go through policy statements, issues and methods of answering.

Chair Wessinger asked Director Hansen to go through each issue of the draft RFP paragraph by paragraph. Each issue is discussed below.

Dr. Castle asked the staff for reactions to FAXed material the Commission had received. Director Hansen indicated that the memorandum had just been handed to him. The memorandum, from Mr. Richard Bach of Stoel, Rives, Boley, Jones & Grey, to John Parks, expressed concern with the proposed DEQ policy statements.

Lydia Taylor, Administrator, Water Quality Division, responded to Mr. Bach's preference to the wording "threat of harm" versus "release to the environment." Ms. Taylor said that the term "threat of harm" was too open ended and added that the purpose of the liner is to prevent a release. Commissioner Lorenzen agreed that the purpose of a liner is to keep liquid contained; if the liquid does escape from the liner, then that protective barrier is not working. Additionally, Chair Wessinger agreed with Commissioner Lorenzen's interpretation and stated that environment is the important term.

Commissioner Castle further agreed. He said Department staff correctly interpreted the direction with regard to economics; that is, a technical analysis rather than an economic analysis. Commissioner Castle stated he did not agree that risk had been excluded and that the wording asks for statements of the reviewer on the level of certainty in achieving goals.

Director Hansen said that in regard to Mr. Bach's comments about what was described in the Department's memorandum as a note at the bottom of page 1 and top of page 2 and the definition of a double liner at bottom of page 2, the Department did not object to substitute Oregon Mining Council (OMC) wording if the Commission agreed with the OMC proposed language. Director Hansen indicated that the Department was trying to describe the OMC proposal, not editorialize on it. Further, **Jerry Turnbaugh**, Water Quality Division, indicated that he had no objection to OMC's characterization of the double liner, and that it was a fair statement of what the Department believes the liner will accomplish.

Director Hansen told the Commission that OMC had suggested two additional questions be included under **Method to Answer Question--Address**. He said that the answer to their suggested Question No. 5 was implicit; Question No. 6 was the about the issue of economics which the Commission had rejected.

Commissioner Lorenzen commented on the framing of the question itself. He suggested "Will either or both liner systems meet the stated objective of the

Commission?" Commission Squier agreed with Commissioner Lorenzen. Commissioner Lorenzen stated that an additional question could be answered as a part of Issue No. 4(a): "Is 36 inches as required by Issue 4(a) the appropriate thickness to assure a high probability of achieving the Commission's objective?" He further stated that the requirement of 36 inches would be a high-cost item in some areas and expressed concern about this requirement if it was unnecessary; however, if this requirement was necessary, he had no reservations. Director Hansen indicated that **Method to Answer**, Question No. 4, addressed this issue.

Commissioner Lorenzen agreed as long as that is what Answer No. 4 meant. He further indicated concern about implementing costly regulations that do not provide further benefits; therefore, economics must be implicitly considered.

Commissioner Whipple also expressed concern about economics and redundancies. She said that it should not be difficult to obtain from the answers to the technical questions about a sense of the relative costs involved.

Commissioner Castle stated that the Commission did not want an economic analysis. He added that it was appropriate that the consultant address the issue of redundancy. From that, Commissioner Castle stated, the Commission can make judgments about whether the rules require additional measures that incur added cost but does not further protect the environment. He said that the Commission will not ignore economics when a decision is made.

Director Hansen said that the question as phrased uses the words "materially reduce." He indicated that the intent was to provide a basis for determining if there are environmental benefits to the requirements. Director Hansen referred to letter from Martha Pagel to Representative Schroeder about the idea that the rules were contrary to legislative intent. Ms. Pagel stated in her letter that two terms must be considered when meeting environmental standards: necessary and practicable. She said "necessary" is defined as that which is necessary to meet the standard and protect the environment. In further clarifying Ms. Pagel's letter, Director Hansen said that the policy statement reflects what the Commission believes is necessary to protect the environment. He stated that the question then becomes whether there are alternatives for meeting the standard and that "practicable" is considered when determining the alternative to meet the standard.

Commissioner Castle asked about the procedures to be followed in developing the final RFP. He asked if the Commission was putting the RFP in final form or if they were giving the staff advice to guide development of the final RFP. Director Hansen responded that it was the Commission's choice but the closer the Commission would come to final wording on the policy statements and questions the better. He asked the Commission to clarify that the question on the first policy issue will read: "Will either or both liner systems meet the stated policy objective of the Commission?"

Chair Wessinger asked Commissioner Lorenzen if that wording contained the difference he sought. Commissioner Lorenzen replied that perhaps one liner would meet the stated policy better than the other; maybe both liners would meet the stated policy adequately but that one will meet the policy better. Director Hansen indicated that the **Method to Answer**, Question No. 3, provides for more detail and level of certainty.

The Commission agreed that the question wording for the first policy would read as follows:

> Will either or both liner system meet the stated policy objective of the Commission?

In regard to the second policy issue, Commissioner Whipple said that she believed Mr. Bach's two additional questions (proposed questions 5 and 6) would be answered within the context of how the questions were phrased. Commissioner Squier said she believed industry intended that a difference exist because the term "management practices" was used rather than technology which would allow a broader interpretation. Commissioner Whipple asked if there were other ways to meet the policy and indicated she would not like to delay over the definition of technology. Chair Wessinger asked Department staff about technology as compared with management practices.

Mr. Turnbaugh told the Commission that the rules state that cyanide recovery and reuse are an end-of-pipe treatment technology applied before tailings are released to the impoundment. He said that industry would argue that the tailings pond is a treatment system since some natural degradation occurs and solutions can be recirculated from the tailings pond. He concluded he believed the mining industry was broadening the scope of definition beyond end of pipe and beyond what was intended in the Department's proposed rules.

Director Hansen said the issue to be addressed was whether treatment of the tailings would be required before being released to the tailings pond or whether the tailings pond would be part of the treatment system.

Commissioner Whipple said the policy is aimed at reducing toxicity in the releases to greatest degree practicable through treatment. Director Hansen stated that the Department believes that once the material is in the tailings pond, a greater risk of release to the environment exists; therefore, the Department wanted to reduce the toxicity to the greatest degree practicable before discharging the material to the tailings pond.

Commissioner Whipple asked if the policy addressed long-term impacts of treatment. Director Hansen replied that once the material is discharged to tailings pond, it is difficult to control. Commissioner Lorenzen commented that this issue should be examined by the consultant.

Commissioner Lorenzen asked if a process was discovered in the future to reprocess the tailings pond, would the Department allow material to be discharged to the pond with assurance of containment rather than treatment first. He suggested a possible revision to the policy:

> The Commission establishes as policy that the closure of the heap leach and tailings disposal facilities shall be accomplished by a means that ~~to the greatest extent possible~~ <u>a high degree of probability</u> over the long term will prevent release to the environment of any chemicals contained in the facility.

Commissioner Lorenzen also stated that he would not want the tailings spread over a large area without there being a substantial effort to reduce toxicity. He said that dealing with the tailings was a long-term effort, not just 20 years.

Director Hansen added that the liner system required by the draft rules for a tailing pond is different than under a heap leach pad because of the assumption of lower toxicity due to pretreatment. He added that the Department would look at treatment requirements differently if the liner under the tailings pond was the similar to the liner under the heap leach pad.

Commissioner Squier asked Mr. Turnbaugh about 30 parts per million (ppm) cited under **Issue** in Policy No 3. Mr. Turnbaugh replied that 30 ppm is the "best professional judgment" estimate of achievable level of detoxification that can be achieved with a variety of treatment technologies. Commissioner Squier asked how the Department would respond to a business in Portland that was discharging 35 ppm. She further clarified her question by asking how the Department would view 30 ppm of cyanide in other industrial settings: would that discharge be considered a hazardous waste and require barrelling and labeling?

Mr. Turnbaugh replied that he was uncertain of the answer. He said the Department had intended to require end-of-pipe treatment to reduce the toxicity, which is the purpose of the rules. Consequently, he continued, the Department must decide how much technology should be applied. Mr. Turnbaugh said the Department examined potential technologies and concluded that 30 ppm can be achieved. However, he said, 30 ppm is not intended to be a wildlife protective measure and does not relate to liner design. Cyanide that has been discharged to a pond can be released to the air, and this type of release necessitates modeling to determine human health risk.

Commissioner Whipple indicated her inclination to not expand the policy to include management practices. Director Hansen replied that an additional question could be considered: would a liner system be adequate or would the liner system need to be upgraded to achieve the Commission's policy regarding the release of toxics from the tailings pond. Chair Wessinger replied that he was inclined to agree with current staff recommendation.
Commissioner Squier had two questions regarding end-of-pipe treatment:

1. Is 30 ppm achievable with current technology?

2. Does the Department want to have a policy that allows discharges to the pond and confinement of the pond to protect the environment rather than promotes best achievable technology at the end of pipe?

She indicated that the draft proposal addresses the first question but she did not want to open the second question up for debate; therefore, she agreed with Chair Wessinger. Commissioner Whipple also agreed with the draft proposal. Commissioner Castle stated he had no problem with staff formulation and said that these issues will be addressed if Question Nos. 2 and 4 are adequately answered. Commissioner Lorenzen agreed.

Director Hansen summarized that the suggested Question No. 5 in Mr. Bach's letter would not be included. Mr. Turnbaugh said that he had no problem with Mr. Bach's Question No. 5 but would note that non-use may be a matter of choice rather than technical feasibility.

At this point in the meeting, Commissioner Lorenzen excused himself from the conference call. However, he added that he did have a comment about the policy on page 4, second line, about the reference "...to the greatest extent possible." He suggested the wording <u>to a high degree of probability</u>. Director Hansen replied that the Department was attempting to reflect the Commission's intent. He said that **Method to Answer Question--Address**, No. 3, would partially address this issue. Commissioner Castle said that if Commissioner Lorenzen's questions were adequately answered, would he have concern. Commissioner Lorenzen replied no but believed there may be a problem relating this question to policy. Commissioner Castle suggested the following wording to help meet Commissioner Lorenzen's concerns:

> The Commission establishes as policy that the closure of the heap leach and tailing disposal facilities will prevent release to the environment of toxic chemicals contained in the facility.

He suggested this wording be substituted as policy and the questions would not be changed. Commissioner Lorenzen agreed with Commissioner Castle's suggested wording; Commissioner Squier also agreed.

Commissioner Lorenzen then left the conference call.

Director Hansen Fred suggested that **Method to Answer Question--Address**, No. 2, be changed to read as follows:

2. Do detoxification and covering <u>(evaluated and together separately)</u> materially reduce the likelihood of a release of toxic chemicals to the environment?

Commissioners Castle and Squier agreed.

Director Hansen them presented the proposal requirements. He said a concern had surfaced about one item from discussion with the person Commissioner Castle had suggested. In regard to Proposal Requirement No. 2., if followed, the Department would end up with consultants not in touch with the technologies the Commission wanted evaluated. He said that the idea of independence was important.

Commissioner Castle suggested a change to Proposal Requirement No. 2:

2. Noninvolvement for a minimum of ~~the past~~ five years ~~with the mining industry in general, and specifically~~ with mining companies, mining industry groups, or environmental groups active in working on mining regulations and permitting.

Director Hansen suggested a proposed change made by Larry Tuttle, The Wilderness Society, as follows:

2. A substantial portion of income for a minimum of ~~the past~~ five years ~~with the mining industry in general, and specifically~~ with mining companies, mining industry groups, or environmental groups active in working on mining regulations and permitting.

Chair Wessinger indicated that he was apprehensive that consultants who could perform the job would be disqualified. Director Hansen suggested the following wording:

2. Preference will be given to entities who have had no involvement within the five (5) years. As a bid requirement, one must disclose all contacts or contracts they have had over the past five (5) years for evaluation.

Commissioner Squier indicated that she agreed with that wording, and Commissioner Castle also agreed to the proposed wording.

Ms. Taylor indicated that the Department wanted to allow judgment and that conflict of interest with anyone hired was an important consideration. She said that disclosure was important, and that the Department would ask the applicant to disclose any potential conflict of interest and whether a substantial part of their income over the past five (5) years was derived from the mining industry.

Chair Wessinger, Commissioners Castle, Squier and Whipple agreed.

Director Hansen indicated if the Commission had nothing else to add to the memorandum, the Department will proceed. He added that although this memorandum was not the proposal and that more information must be added to meet requirements, it did contain the essential elements and no formal action was needed.

Commissioner Squier stated that she would like to hear back from staff after proposals are in about the time schedule and cost range. Ms. Taylor replied that she will keep the Commission informed. Chair Wessinger asked that the Commission be sent reports about the progress of the proposal. Director Hansen indicated that he will include the status of the proposal in the Director's Report and keep them advised in interim if anything significant occurs.

Subsequent Actions

On January 7, the Department forwarded a draft to the Commission, labeled a "second draft" of the elements to be included in the RFP for consultant services. A draft of the full RFP (including all of the legally required language, etc.) was prepared. On February 3, 1992, a final draft of the RFP was forwarded to Commission members for review and comment. The transmittal memo noted that there had been numerous contacts from representatives of the mining industry while the Department was developing the final wording of the RFP. The RFP was issued on February 7, 1992.

Following the December 20, 1991, Conference Call meeting, the Department has reported to the Commission at each meeting on the current status of the consultant review process.

Note: This summary is for the most part a reproduction of the Commission approved minutes of the respective meetings. Some additions have been made to enhance readability and clarity.

HLS:l

IDAHO DEPARTMENT
OF HEALTH AND WELFARE
DIVISION OF
ENVIRONMENTAL QUALITY

1420 North Hilton, Boise, Idaho 83706-1260, (208) 334-0550

Cecil D. Andrus, Governor Richard P. Donovan, Director

July 22, 1992

Ms. Jane Wurster
Krassel Ranger District
Payette National Forest
P.O. Box 1026
McCall, Idaho 83638

RE: Investigation of underground diesel leak at Stibnite Mining Inc. ore processing by cyanidation facility.

Dear Ms. Wurster:

As you know, last week we became involved in an investigation of a diesel leak at Stibnite Mining Inc. (SMI) Stibnite Mine on the East Fork of the South Fork of the Salmon River (EFSFSR). SMI has been operating under several consent orders, one of which involves another diesel leak. Both diesel leaks are considered very significant and pose an imminent threat to surface waters of the state and in particular an anadromous fishery. In addition, a water sample has been taken which tested positive for low level cyanide contamination (0.053 mg/l). The preliminary investigation report is attached. Additional information and recommendations have been forwarded for action by our Permits and Enforcement Division. The case referral information is confidential, but we shall keep you informed of progress made during the enforcement action.

I would urge you to complete any investigation requirements the Forest deems necessary. At a minimum, we feel it is necessary for SMI to develop a formal plan to define the extent of ground water contamination surrounding their processing facility. With that in mind, I am also recommending that lead agencies require:

1) SMI to contain within underlined and bermed areas all fuels, lubricants, antifreeze, reagents, or explosives. Containment should not be exclusive to the Stibnite Mine but all lands held under title or lease by SMI or MinVen. These areas should have sumping capability and should not be allowed to contaminate any soils. Soil should not be used as an absorbent material, and continuation of land farming will not, except in emergencies, be a permissible routine practice. All road use permits should be suspended until these facilities are properly constructed;

2) As-Built Drawings for all maintenance and service facilities should be submitted to the lead agencies for reference;

3) The pilot plant facility should be decommissioned and reclaimed immediately with all asphalt and other solid waste including liners, removed and disposed of in an approved county landfill;

4) All operations should be suspended until the water management plan has been completed and BMPs are in place to prevent major sediment discharges to the EFSFSR and it's major tributaries. In particular, special attention should be given to requirements for shutting down hauling when the roads are saturated with precipitation; and

5) All operations should be suspended pending the final closure of the solid waste dump.

The recent letter from SMI (attached) may indicate that they do not understand the seriousness of these issues.

Thank you for your assistance with this case.

Regards,

Bruce A. Schuld

Bruce A. Schuld
Water Quality Compliance Officer

cc: Larry Koenig - DEQ SWIRO
Craig Shepard - DEQ SWIRO
Scott Nichols - IDL Boise
Earl Dodds - IDL McCall
Don Anderson - IDF&G McCall
Scott Grunder - IDF&G Nampa
Erv Ballou - IDWR Boise
Joe Wallace - USEPA Boise
Aliceson Beck Haas - USF&WS

IDAHO DEPARTMENT
OF HEALTH AND WELFARE

DIVISION OF
ENVIRONMENTAL QUALITY

1420 North Hilton, Boise, Idaho 83706-1260, (208) 334-0550

Cecil D. Andrus, Governor   Richard P. Donovan, Director

July 23, 1992

Mr. Kevin Walsh
Environmental Coordinator
Stibnite Mines Inc.
921 South Orchard
Suite O
Boise, Idaho 83705

RE: Diesel leak and cleanup at the Stibnite Mine ore processing facility.

Dear Mr. Walsh:

Thank you for your letter of July 17, 1992. Although Bruce Schuld has agreed with the steps you have taken to begin cleanup, we have not approved such actions as performance of a formal cleanup plan. "Minor changes", as you have referred to in your letter, to previous cleanup plans will not be sufficient. The consequences of the leak and subsequent contamination are unknown, and you should consider major modifications in defining the contamination zone, clean up effort and modification of the ore processing facility.

In addition to verifying the presence of diesel, benzene, toluene, ethyl benzene and xylene, laboratory analysis verified the presence of WAD cyanide in the saturation zone between the pregnant pond and the plant. With this in mind, a case referral package has been prepared and forwarded to our Permits and Enforcement Division for enforcement. You will be contacted by them to discuss the issues.

Laboratory results and photographs have also been provided to the U.S. Environmental Protection Agency.

Sincerely,

Craig Shepard

Craig Shepard
Monitoring & Technical Support Supervisor

cc: Larry Koenig - DEQ SWIRO
Bruce Schuld - DEQ SWIRO
Dave Pisarski - DEQ P&E
Dan Heiser - DEQ P&E
Ruth Monahan - Payette National Forest
Warren McFall - EPA IOO
Aliceson Beck Haas - USF&WS
Sy Whitman - Nez Perce Tribe
Scott Nichols - IDL Boise
Earl Dodds - IDL McCall
Don Anderson - IDF&G McCall
file

Around the

STATE

SOUTHWEST IDAHO

State officials contain leak of cyanide solution from tank

Several hundred thousand gallons of cyanide solution leaked from a ruptured tank at the DeLamar mine near the Oregon border in southwestern Idaho, state officials said Wednesday.

The leak, which occurred about 2 a.m. Wednesday, was contained in lined holding ponds at the mining site, said Larry Koenig, of the state Division of Environmental Quality.

Koenig said the cyanide sloution was being neutralized and pumped into a storage pond. One employee sustained minor injuries and is being held for observation at St. Alphonsus Regional Medical Center, a DeLamar official said.

Idaho Statesman
Boise, Idaho
August 27, 1992

Hal

OREGON MINING COUNCIL
200 Century Tower, 1201 S.W. 12th Avenue
Portland, Oregon 97205
(503) 227-5591

State of Oregon
DEPARTMENT OF ENVIRONMENTAL QUALITY
RECEIVED
AUG 24 1992
OFFICE OF THE DIRECTOR

August 21, 1992

Mr. William Wessinger, Chair
Environmental Quality Commission
121 SW Salmon, Suite 1100
Portland, Oregon 97204

Re: Chemical Mining Rules

Dear Mr. Wessinger:

The Oregon Mining Council ("OMC") thanks the Environmental Quality Commission and the Department of Environmental Quality for the opportunity to comment on the proposed chemical process mining rules, which are now in near-final form. The improvements in those rules made as a result of the day-long hearing on August 7, though limited, are of great importance to the mining industry. However, OMC feels that the rules are still needlessly rigid and unjustifiably redundant. We hope that further drastic improvements will be made as DEQ gains experience with chemical process mines.

OMC welcomed the Commission's decision to delete the requirement to reuse cyanide because it was well founded and necessary. In its response to the TRC report, DEQ staff "fully agrees" that reuse will <u>not</u> lower the toxicity of mine tailings and spent ore in comparison to chemical destruction of the sodium cyanide compounds. DEQ contradicted itself by testifying on August 7 that tailings with destroyed cyanide could be more toxic than tailings with removed cyanide. Those testifying (including a mineral economist and an engineer) cautioned that they were not experts in tailings chemistry, yet their hunches were given great weight by the Commission. The DEQ's testimony conflicted directly with the opinion of TRC, Inc., the Commission's contract expert, and with the opinion of experts contributing to OMC's testimony. OMC urges the Commission to stick with its decision based on scientific analysis.

The revision that the Commission has requested to allow more flexibility in the design of alternate liner systems is also important to OMC members. Given the high cost of liner systems, mining companies will be motivated to design liner systems that can be implemented at lower cost than the liners specified in the proposed rules while still satisfying Commission policies. However, the flexibility in the liner system rules will be illusory unless alternative liners researched and designed by qualified experts are ultimately approved by DEQ staff.

OMC remains very concerned that the TRC liner proposal may not be adopted as an approved alternative. The TRC liner is as fully researched and described as the triple liner proposed by staff. TRC found that its alternative liner fully satisfied Commission policies. If DEQ staff will not accept the thoughtful recommendations of its own expert consultants, OMC members are justifiably concerned that the considerable efforts they may spend designing better liner systems will be spent in vain. OMC urges the Commission to closely monitor the implementation of the liner rules to assure that the intended flexibility becomes a reality.

OMC members are extremely disappointed with Commission's approval of the requirement to enclose all heap leach pads and tailings facilities as hazardous waste even if the spent ore and tailings are not hazardous. It was remarkable that the experts hired by DEQ to analyze these issues were not invited to the hearing to defend their recommendations! Instead, individuals who admitted their lack of expertise in chemistry were invited to speculate on the long-term chemical behavior of mine tailings. Not surprisingly, these witnesses expressed uncertainty about the long-term chemistry of the tailings. On the basis of that uncertainty, the Commission concluded that hazardous waste-type enclosures were warranted. In OMC's view, this is an illogical approach to rulemaking, leading to unreasonable and unnecessary regulatory requirements.

Cautious regulation based on scientific uncertainty is an acknowledged technique to prevent environmental harm. That is not the same as cautious regulation based on uncertainty which stems from lack of expertise. Recognized experts have testified and are prepared to defend the proposition that spent ore and tailings chemistry can be predicted with certainty. Rocks that contain no acid-forming components will not form acid. After careful consideration, TRC concluded with a high degree of certainty that hazardous waste enclosures are not necessary for non-toxic and non-acid-forming rock materials. In the face of such testimony by experts, it is shocking that public policy was based instead on the speculations of non-experts.

If any OMC members still believe they have economically viable projects in Oregon, they will likely seek approval of alternative closure systems under proposed OAR 340-43-031(2), which allows DEQ to approve alternative facilities that provide environmental protection equivalent to that provided by the other rule requirements. Approval will be sought based upon a detailed factual record on the chemistry of the spent ore and tailings for each project. If an applicant can demonstrate with certainty that its mine tailings will be non-toxic and non-acid-forming, OMC expects that the DEQ will approve alternative closure designs. Again, OMC urges the Commission to monitor such proceedings closely to assure that apparent flexibility in the rules is not arbitrarily ignored.

Finally, OMC urges the Commission to steer clear of land use regulations in the guise of water quality rules. The Commission has been urged by environmental groups to require back-filling of open pits. Many of those environmental groups have openly announced that their true desire is to ban chemical process mining in Oregon, not merely to regulate the effects of mining. The current rules already allow the DEQ to consider backfilling as necessary to control water quality in the pit. Backfilling should receive no greater weight for that purpose than any other technological remedy. In passing the new Oregon chemical process mining statute in 1991 (HB 2244), the Oregon legislature specifically considered and rejected the proposition that backfilling of open pits should be required, except where "reclamation objectives *** cannot be achieved through other mitigation activities." ORS 517.956(3)(d). The Commission should not exceed this statutory standard, which was based on months of negotiation between the Governor's office, industry representatives, environmental groups and legislators.

In summary, though OMC appreciates the modest improvements made in the chemical process mining rules to date, OMC regrets that the rules remain unnecessarily redundant and rigid. OMC only asked for fair consideration of the technical merits of the rules. In its conference call establishing the goals for review of the proposed rules by an independent consultant, the Commission expressed concern that the rules might require expensive facilities or procedures that produce no material improvement in the protection of the environment from pollution. After careful consideration, DEQ's consultant, TRC, reached firm conclusions that several of the requirements of the proposed rules provided no material improvement in environmental protection. DEQ staff urged the Commission to ignore the consultant's conclusions, despite the absence of any scientific testimony to the contrary and despite the loss of Mr. Turnbaugh, the only staff member to have studied the technical aspects of chemical mining. OMC feels that valuable professional input has been wasted without explanation and that the resulting rules are unnecessarily rigid as a result.

TRC was obviously outraged at the treatment of its work by DEQ staff, as evidenced by TRC's letter to Commissioner Lorenzen dated August 5, 1992. TRC concluded that the proposed regulations were based on DEQ's desire to ban chemical process mining in Oregon, rather than to regulate its environmental effects. TRC's conclusion is consistent with the position taken by DEQ staff in the initial workshop with the Commission on April 17, 1990. There Director Hansen asked "Do we want this type of a process in Oregon?" and later answered his own question by saying "You do understand our bias, which is we'd just as soon see these [chemical process mines] all knocked in the head." Unfortunately, it appears that staff's hostility to chemical process mining has resulted in rules that may have the effect of precluding any further exploration efforts in Oregon.

We must acknowledge that our cities and all so-called "clean" industries are built primarily from minerals that come from open pit mines. OMC members would happily concentrate on large high-grade metal deposits that could be mined by selective underground methods. But such deposits are extremely rare and would not support the mineral demands of our society. OMC feels the environmentally responsible route for our society, which uses more minerals per capita than any other, is to mine the minerals we use "in our own back yards," where we can control the environmental effects. Otherwise we will be obtaining such minerals from third-world countries where they may be mined by state-owned or indigenous mining companies that lack the capital or the technology to mine with modern and environmentally sound methods. The atrocious environmental record of the former Soviet Union, which was more technologically advanced than most foreign mineral suppliers, should cause us to question the wisdom of prohibiting mining in our own state. Unfortunately for world ecology, foreign countries currently supply the vast majority of metals used in U.S. industry.

Think globally, permit mining locally.

Sincerely,

John Parks 9/4

John Parks, Chair
Oregon Mining Council

cc: Dr. Emery Castle
Mr. Henry Lorenzen
Ms. Carol Whipple
Ms. Linda R. McMahan
Mr. Frederic J. Hansen
Mr. Harold L. Sawyer

Concerned Citizens For Responsible Mining

• P.O. Box 957 • Ontario, Oregon 97914 •

August 3, 1992

Mr. Fred Hansen
Department of Environmental Quality
811 SW 6th Ave.
Portland, OR 97204

Dear Mr. Hansen,

Concerned Citizens for Responsible Mining (CCRM) supports the comments regarding Chemical Process Mining as submitted by Larry Tuttle, Oregon Regional Director of The Wilderness Society. CCRM believes that strict chemical process mining regulation will be required to ensure a safe environment for present and future generations. Thank you.

Sincerely,

Gary W. Brown
Chairman, CCRM

Oregon

OCT 02 1992

DEPARTMENT OF
ENVIRONMENTAL
QUALITY

September 23, 1992

Mr. John Parks, Chair
Oregon Mining Council
200 Century Tower
1201 S. W. 12th Avenue
Portland, Oregon 97205

Dear Mr. Parks:

Your letter to me dated August 21, 1992, selectively extracts from the record of the rulemaking proceeding for chemical mining rules and puts an interpretation on it which is inaccurate. The purpose of this letter is to explain what the situation actually is and was. As you probably know, the Commission met on September 1 via a telephone conference call about the remaining mining rule issues.

In your letter you question the motivation of the staff regarding the proposed rules and cite information that you believe confirms your view that Department staff is committed to preventing mining in Oregon. As a result, you suggest that the Commission closely monitor the staff to make sure the Commission's intent in the rules is carried out. This assertion is offensive.

The fact is that the Commission directed the Department to develop rules on chemical mining that would, to the best of our ability, assure that any operations permitted today would not become "superfund" type sites for future generations to clean up. We wanted regulations that emphasized protection of the environment. Where uncertainty exists, we wanted assured protection.

Each Commission member, each staff member and every interested citizen participant brings their own background knowledge and experiences to the process of developing rules. As it relates to mining, the record of the industry is a very ugly one. The mining industry has left environmental disaster in its wake. Untold hours and dollars are being spent today in an effort to reduce the adverse environmental effects from abandoned mining operations all over the country. The mining industry cannot escape this record. The fact that technology and knowledge have improved is not sufficient to convince people that the industry should be trusted to do what is environmentally correct. In short, it is not surprising that many Oregonians would have preferred to see the legislature prohibit mining in the state.

STATE OF OREGON 1859

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However, each member of this Commission and the Department staff have worked within the framework of state law and without regard to their personal opinions in the development of these rules for environmental protection for chemical mining operations. State law recognizes mining and provides for the activity to take place as long as the standards and conditions are met. In our case, state law requires that we discharge our standard setting, review and permitting activities in a manner which assures that public policies regarding environmental quality protection are achieved.

In this process, we expected the Department to propose regulations which required use of the best environmental protective technology being used anywhere on a commercial scale today. The Department did as we asked. We expected and demanded recommendations that emphasized short- and long-range environmental protection. The Department did as we asked. We have considered the Department's recommendations, the input of the industry and public, and the technical input from our consultant's study. We have balanced this against our own judgments regarding the potential unknowns and legislative direction and policy. We have made the public policy judgments that we are called upon to make in the rulemaking process. Where there is doubt, we have opted to come down on the side of preventing the potential for future environmental problems.

We also expect, and experience convinces us that our expectations are properly founded, that regardless of the recommendations the Department made during the course of this rule making process, the Department will do its best to implement the rules adopted by the Commission. We have no question about the dedication of the Department to carrying out the rules and policies of the Commission.

Your letter commented on specific topics in the rules. Following are reactions to your comments:

Reuse

> The Department recommended that the rules retain the requirement for removal of cyanide from tailings prior to disposal to the tailings pond (rather than addition of different chemicals to destroy cyanide) and the requirement for reuse of the removed cyanide. The Department acknowledged that reuse of the "removed" cyanide would not affect the level of toxicity remaining in the disposed tailings.

However, the Department expressed concern about the potential of creating other toxic compounds when additional and different chemicals, such as chlorine, are applied to destroy cyanide. Their expressed concern, based on general knowledge of chemistry and experience in dealing with the clean up of the unexpected and unintended environmentally polluting side effects of chemical usage, was not contradictory and was entirely appropriate. We do not find any specific scientific information in the record that addresses potentially toxic compounds other than cyanide.

As the Commission deliberated on the reuse issue, however, we concluded that there were uncertain potential environmental effects associated with the cyanide removal/reuse technology and with the cyanide destruction technology. Our conclusion was to modify the rules to allow use of either technology at the choice of the applicant. However, we continue to have unanswered concerns about the potential for release of toxic or harmful constituents from the tailings over the long term.

Liners and Covers

The Commission continues to be very concerned about the potential for future unintended release of potentially toxic or harmful chemical constituents from leached ore heaps, tailings ponds and other remnants of the mining operation. We took particular note of the fact that the large-scale heap leach technology that is now being used is relatively new, and we do not have the benefit of looking at an operation that was conducted and closed out 50 years ago using today's technology. We know that past mining operations and closure practices have left a record of substantial problems. While we have greatly improved technical knowledge today, we are not willing to assume that we know everything or that we can accurately and with absolute precision predict every event.

This Commission directed the Department to develop a set of rules that would <u>prevent</u> future environmental problems to the extent of our current ability. We wanted to ensure environmental protection to the best of our ability.

With respect to liners, the consultant's report helped the thinking of the Commission and Department to evolve. The policy statement that guided the consultant's evaluation on liners emphasized a purpose of facilitating rapid detection of a liner leak, and the ability to correct the leak before there was a release to the environment. In hindsight, the policy statement did not fully articulate our concerns for long-term environmental protection. TRC concluded that their proposed alternative liner configuration met our policy--as they understood our policy position. However, our final determination on the rules reflects the evolution of our policy position. Thus, the Commission and Department accepted the technical information provided by TRC on liner systems. But our final conclusion was different than theirs because of our difference in policy emphasis.

To be more specific, the TRC evaluation assumes that there is little reason for concern about post-closure release from a heap. They assume that detoxification of the heap is completely effective and that neither cover nor a liner are necessary to protect the environment. Therefore, their proposed alternative liner emphasized environmental protection during the operational phase. This Commission does not share the assumptions that TRC makes. Detoxification of the spent heap is required and necessary to "minimize" the potential for release of cyanide after closure. But we find nothing to convince us that cyanide detoxification will be 100 percent effective--and certainly nothing to convince us that other chemical constituents will not migrate from the heap over time. Certainly, if water is allowed to percolate through the heap after closure, the risk of migration of chemical constituents to produce unintended environmental damage is greatly increased. We are concerned about the long-term potential for release to groundwater and surface water.

We do not share the mining industry's conclusion that future conditions and chemical changes can be predicted with certainty. The Commission concluded that a secure liner system under heap leach pads and ponds that will provide short- and long-term protection of groundwater was essential. We also concluded that a cover over the heap and tailings pond was appropriate to minimize the potential for water to enter the heap and tailings and facilitate mobility of potential pollutants. We do not view these requirements as redundant--rather they complement each other to increase the chances that the desired degree of environmental protection is actually achieved over the long run.

Pits

The Commission continues to be concerned about the potential for pits to cause massive pollution of groundwater over time. We remain uncomfortable about the level of technical knowledge on this issue and are by no means comfortable that our rules adequately address this issue. We will continue to evaluate new information in hopes of gaining a greater level of comfort and assurance that pits, upon closure, will not prove to be perpetual sources of water pollution.

In closing, please be assured that this Commission is committed to protection of the environment of Oregon for current and future generations. We have thoughtfully weighed the argument on all sides of the issues regarding these rules. What we came up with is the best that we can with the current state of knowledge. We remain concerned that we have not done enough. We will revise these rules as new experience and data convinces us that revision is warranted.

Sincerely,

William W. Wessinger
Chair

Emery N. Castle
Vice Chair

Henry Lorenzen
Member

Carol A. Whipple
Member

Linda R. McMahan
Member

WWW/HLS/ko

Policy Options for EQC Deliberations on Mining Rules

Issue	Policy Options	Recommendation/Summary Rationale	Report Location	Rule Location
1. Add RFP Policy Statements to Rules to better articulate intent?	a. Include policy statements with editing to fit context of rules. b. Include policy statements without editing. c. Do not include policy statements in the rules.	Option a. Addition of policies will provide further clarification of the intent of the Commission and will be useful in the future during review of applications, plans, and potential proposals for alternative technologies that achieve equivalent or better environmental protection. Editing is appropriate to fit the policy statements to the format and context of the rules.	Pages 18-19	Attachment A, Pages 3-4 [OAR 340-43-006(2)]
2. Clarify intended interpretation of Guidelines sections, and ability to seek approval of equivalent or better alternatives?	a. Amend the 12/13/91 rules to clarify the intended interpretation of the guidelines section of the rules. b. Do not change the 12/13/91 rules.	Option a. Amendments clarify that: • The rules (requirements and guidelines) establish the minimum level of environmental protection using a combination of performance standards and minimum design criteria. • Alternatives that achieve an equivalent or better environmental result may be approved. • Approval of alternatives must be in writing.	Pages 19-21	Attachment A, Pages 8-9, 10 [OAR 340-43-031(2)] [OAR 340-43-040(1)]

Issue	Policy Options	Recommendation/Summary Rationale	Report Location	Rule Location
3a. Modify **description** of liner requirements for Heap Leach Pads and Process Chemical Storage Ponds?	a. Reword the liner description in the guidelines (without changing actual liner component specifications) in relation to the purpose of each liner component (primary liner, leak detection, secondary liner) for: 1) heap leach pad 2) process chemical storage ponds 3) both b. Retain 12/13/91 rule description for liners (triple liner).	Option a. 3) (Including Alternative 2 for the heap leach pad liner as displayed in rules and Alternative 2 for the process chemical storage pond liner as displayed in alternative 2.) Rewording of liner description in terms of purpose of components will facilitate potential future evaluation of alternatives that will achieve equivalent or better environmental protection.	Pages 21-24	Attachment A, Pages 14-15 for heap leach pad liner wording. Attachment A, Pages 15-16 for processing chemical pond liner wording.
3b. Modify the actual **technical specification** for the uppermost component of the liner system **(the primary liner)**?	c. Retain 12/13/91 specification (continuous flexible membrane liner of suitable synthetic material) d. Revise the specification to require a composite liner (membrane plus clay layer in direct contract) as suggested in contractor's alternative.	Option c. The option of going to a composite liner for the primary is left to the applicant. Potential tradeoff for applicant is greater need (and cost) to repair leaks vs. additional cost for primary liner installation. Department is placing greater emphasis on the Secondary liner for environmental protection.	Pages 21-24	Attachment A, Pages 14-15 for heap leach pad liner wording. Attachment A, Pages 15-16 for processing chemical pond liner wording.
3c. Modify the **technical specification** for the liner components below the leak detection system **(the secondary liner)**?	e. Retain 12/13/91 specification ("composite liner" -- continuous flexible membrane liner in direct contract with 3 feet of low permeability clay). f. Revise the specification to require a minimum of 12 inches of low permeability clay as suggested in contractor's alternative. g. Retain "composite liner" as in 12/13/91 rules but reduce the clay layer thickness from 3 feet to 12 inches (or some other thickness)	Option e. Proposed secondary liner provides both short and long range environmental protection. Three feet of clay in the composite liner affords better long range protection. Contractor supplied cost information suggesting that incremental costs of additional clay is relatively small compared to the total cost of the liner system.	Pages 21-24	Attachment A, Pages 14-15 for heap leach pad liner wording. Attachment A, Pages 15-16 for processing chemical pond liner wording.

Issue	Policy Options	Recommendation/Summary Rationale	Report Location	Rule Location
4. Maintain requirement for **removal** of cyanide from tailings before disposal, and **reuse** of recovered cyanide?	a. Retain 12/13/91 requirement for <u>removal</u> and <u>reuse</u> (with treatment of residual cyanide if necessary to achieve target for residual levels). b. Require removal (to achieve detoxification objective), but do not require reuse. c. Allow chemical treatment to destroy cyanide rather than requiring removal and reuse. d. Allow tailings to be disposed of without cyanide removal or treatment to destroy cyanide (rely on liner and natural degradation).	<u>Option a.</u> Removal and Reuse are technically feasible and technology has been demonstrated. Removal is a basic mechanism for detoxification and reduces the potential for long term releases. Removal and Reuse requirement is consistent with goal of Toxic Use Reduction program. Reducing the quantity of chemicals transported to and used at the site (both cyanide and chemicals used to destroy cyanide) reduces the potential for spills and accidental releases. Reliance on liner and natural degradation for total environmental protection is not appropriate. Long term reliability of liners has not been demonstrated. Natural degradation is neither controllable or predictable, and should not be relied upon.	Pages 24-25	No change in rules. See Attachment A, pages 17-18 for requirements. [OAR 340-43-070]

Issue	Policy Options	Recommendation/Summary Rationale	Report Location	Rule Location
5a. Maintain requirements for **detoxification** of heap prior to closure?	a. Retain the 12/13/91 rule requirement for detoxification of the **heap** prior to closure. (Rules assume that Detoxification of the tailings prior to placement in the tailings facility is already required in connection with the removal and reuse question.) b. Allow closure of heap without detoxification.	<u>Option a.</u> Detoxification of the heap (and tailings prior to placement in the tailings facility) is technically feasible and materially reduces the potential for release of toxic chemicals to the environment. Long term experience and information on stability and reliability of liners is lacking. Natural degradation is neither controllable or predictable and should not be relied upon.	Pages 25-26	No change in rules. See Attachment A, pages 19-20 for requirements. [OAR 340-43-080]
5b. Maintain the requirements of the 12/13/91 rules for **cover** of the **heap** as part of the closure requirements?	c. Retain the 12/13/91 rule requirement for cover of the heap. d. Eliminate the requirements for cover of the heap (assume liner and detoxification requirements are maintained and provide sufficient protection). e. Retain the requirement for covering of the heap, and reduce the thickness of the clay layer of the secondary liner. f. Require cover without detoxification.	<u>Option c.</u> Cover of heap will be beneficial if acid formation potential exists. Cover reduces infiltration of water into the heap, and results in reduced risk of creating instability in the heap, reduced long term potential for escape of leachate to surface water or to groundwater. Timing for installation of cover could be adjusted if necessary to take advantage of potential for "natural" degradation of residual cyanide if needed. Cover by itself would not materially reduce the likelihood of release of potentially toxic chemicals.	Pages 25-26	No change in rules. See Attachment A, pages 19-20 for requirements. [OAR 340-43-080]
5c. Maintain the requirements of the 12/13/91 rules for **cover** of the **tailings facility** as part of the closure requirements?	g. Retain the 12/13/91 rule requirement for cover of the tailings facility. h. Eliminate the requirements for cover of the tailings facility (assume liner and detoxification requirements are maintained and provide sufficient protection).	<u>Option g.</u> Cover of tailings facility will be beneficial if acid formation potential exists. Cover reduces infiltration of water into the tailings, and results in reduced risk of creating instability in the tailings, reduced long term potential for escape of leachate to surface water or to groundwater. Timing for installation of covers could be adjusted if necessary to take advantage of potential for "natural" degradation of residual cyanide if needed.	Pages 25-26	No change in rules. See Attachment A, pages 19-20 for requirements. [OAR 340-43-080]

Issue	Policy Options	Recommendation/Summary Rationale	Report Location	Rule Location
6. Modify requirements to eliminate potential redundancy resulting from cumulative effects of the various provisions of the rules?	a. Retain all requirements of the rules at this time (cover requirement could be reevaluated later if new information supports a change). b. Require cover only where acid formation potential exists. c. Require Cover of the heap with a reduction in the thickness of the secondary liner clay layer.	<u>Option a.</u> Liners, Removal and Reuse, Detoxification, and Cover all serve different primary purposes which justifies the requirements for each. There is no single component which can be eliminated while having all of its benefits provided by other components. Liner is required during operations. Long term stability and reliability of the liner is not demonstrated. Detoxification prior to closure materially reduces the likelihood of a release of toxic chemicals to the environment. Cover prevents water infiltration into heap or tailings, thereby minimizing stability concerns, potential for leachate moving laterally to surface drainage, and longer term potential for leachate penetrating the liner and moving to groundwater.	(Refer to discussion for issues 3, 4, 5 above.)	
7. Expand provisions for independent third party contractor to provide inspections services during operations?	a. Amend the rules to specifically allow for operational inspections as part of third party contractor scope of work. b. Retain rule as proposed 12/13/91. c. Amend the rules to provide clearer separation between the permittee and the third party contractor. d. Direct the Department to develop proposed rules for future consideration to provide a clearer separation between the permittee and the third party contractor.	<u>Options a, and d.</u> Commissioner Lorenzen asked for broadening of potential scope of work for third party contractor beyond just waste facilities. Assurance of careful operation during loading of the heap is necessary to protect integrity of the liner. Options for greater separation between permittee and third party contractor require further exploration. Existing laws may require budget approval and/or new legislative authority to handle this issue differently than proposed in the 12/13/91 rule draft.	Page 28	Attachment A, Pages 11-12 [OAR 340-43-045(6)(c)]

Issue	Policy Options	Recommendation/Summary Rationale	Report Location	Rule Location
8a. Add clarification regarding land use compatibility determination?	a. Amend the rules to clarify the requirement for a land use compatibility determination prior to permit issuance. b. Leave these rules silent on the issue of land use compatibility (rely on application of existing rules). c. Update the DEQ State Agency Coordination Program and associated rules to more adequately describe land use compatibility determination process.	<u>Option a.</u> Clarification is appropriate, particularly in light of interagency coordination process of HB 2244. It may also be necessary to pursue option c following adoption of these rules.	Page 28-29	Attachment A, Page 5 [OAR 340-43-016(3)]
8b. Make housekeeping changes to correct errors, references, numbering, and improve clarity?	a. Amend the rules as otherwise shown in Attachment A for reasons shown adjacent to the amendments.	<u>Option a.</u> Correct numbering of rules. Correct and add statutory references. Edit as noted in the comments column of attachment A to clarify intent. Correct title of table 2 to clarify its intended application.	Page 28-29	Attachment A, multiple pages, as noted in comments column.

OREGON MINING COUNCIL
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State of Oregon
DEPARTMENT OF ENVIRONMENTAL QUALITY
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August 27, 1992

Mr. William Wessinger, Chair
Environmental Quality Commission
121 SW Salmon, Suite 1100
Portland, Oregon 97204

Dear Mr. Wessinger:

I feel it is important to respond to recent references related to cyanide impacts at the Landusky Mine in Montana and the Summitville Mine in Colorado. Both of these operations utilize "valley-fill" heap leach designs. As you are aware, the proposed Chemical Mining Rules require the operator, ". . . prevent an accumulation of process chemical within the heap greater than 24 inches in depth.", OAR 340-43-065 (8). Neither of these operations could be permitted in Oregon as solutions typically accumulate in a valley-fill heap in the order of tens of feet.

The long term fate of residual cyanide in the heaps of potential operations in Oregon has also repeatedly been raised as a concern. The reference identified to support this concern has been the Environmental Assessment (EA) for the Landusky Mine Expansion in Montana (May 11, 1990). Subsequent to the release of this EA, a research project was commissioned which included a study of the fate of cyanide at this facility. A final report titled "Cyanide Degradation and Decommissioning of Spent Heap-Leach Ore at the Landusky Mine" was issued on December 28, 1990. Its authors concluded that natural degradation of residual cyanide will bring the facility into compliance with regulatory standards for cyanide within 6 to 10 years.

Again, I must caution that these comparisons of valley-fill heaps and potential Oregon operations are largely misleading and inappropriate.

Sincerely,

John C. Parks

John C. Parks-Chair
Oregon Mining Council

cc: Dr. Emery Castle
Mr. Henry Lorenzen
Ms. Carol Whipple
Ms. Linda R. McMahan
Mr. Frederic Hansen
Mr. Harold L. Sawyer

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THE WILDERNESS SOCIETY · FOUNDED IN 1935 ·

THE WILDERNESS SOCIETY

OREGON REGION

STATEMENT OF LAURENCE TUTTLE, OREGON REGIONAL DIRECTOR, THE WILDERNESS SOCIETY, REGARDING THE ADOPTION OF CHEMICAL MINING RULES, BEFORE THE ENVIRONMENTAL QUALITY COMMISSION OF THE STATE OF OREGON, AUGUST 7, 1992.

We urge the Environmental Quality Commission to adopt the "Rules Proposal: Oregon Administrative Rules, Chapter 340, Division 43, Chemical Mining," dated December 13, 1991.

The December 13, 1991, Rules Proposal (Rules Proposal) clearly carries out the chemical mining policies established by the Environmental Quality Commission (EQC) and Oregon Statutes. In addition, the findings of the Final Report of TRC Environmental Consultants, Inc. (TRC) generally support adoption of the Rules Proposal with modifications suggested by the July 30, 1992, staff report.

The Oregon Mining Council (OMC) and other mining industry representatives continue to suggest that the EQC rewrite its chemical mining policies and draft rules. This objective seems to be based on the premise that there is no flexibility in the Rules Proposal. Because of this alleged lack of flexibility, the mining industry argues that the specific design standards contained in the Rules Proposal should be replaced with performance standards and allowance for site-specific design.

This is a hollow argument, as illustrated by the excerpts from the Rules Proposal listed below. In addition, the Department of Environmental Quality (DEQ) staff is suggesting language that would clarify and expand this flexibility.

> <u>Page 3, Permit Required, Section 340-43-015 (1)</u>. ..... "Consideration may be given to site-specific conditions such as climate, proximity to water, and type of wastes to establish the final permit type and requirements for the facility." (See Staff Report page 4, Section 340-43-016 (1)).
>
> <u>Page 6, Design, Construction, Operation and Closure Requirements, Section 340-43-030 (3)</u>. "Alternative methods

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of control of wastes may be acceptable if the permit applicant can demonstrate that the alternative methods will provide fully-equivalent environmental protection. The burden of proof of fully-equivalent protection lies with the permit applicant." (See Staff Report page 8, Section 340-43-031(2)).

The type of flexibility included in the Rules Proposal is common to many other design activities which also involve a regulatory framework. For example, thousands of variations are possible when constructing a house with three-bedrooms, two-baths, and a double-car garage. The design can be changed to fit topography, individual taste, surrounding vegetation, and access -- to name only a few possibilities. However, as a public policy, the house might be required to have double-pane windows to meet energy conservation objectives; specific window height and size standards to provide for emergency escape in case of fire; and, a water heater release valve to prevent the appliance from becoming a missile.

In this example, while the house design remains flexible, no compromise is made on life, health, and safety standards. The Rules Proposal contains the same kind flexibility while attempting to minimize risks to humans and the environment. There should be no argument that if life, health, and safety standards are compromised at a chemical mining operation, the consequences can be catastrophic.

We have only to look at the record of spills, leaks, wildlife mortality, and unanticipated levels of toxicity at existing mines to know the results at mine operations without specific, well-defined standards. At a previous hearing before this Commission, I said that we cannot risk chemical mining operations in Oregon becoming the equivalent of the Exxon Valdez. Modifying the Rules Proposal -- or as the mining industry suggests, scrapping the Rules Proposal altogether -- will insure that there will be dozens of Exxon Valdez's in Oregon's future.

The OMC and other mining industry representatives also continue to complain that the DEQ's proposed rules are overly redundant regarding protective requirements. The rules can undoubtedly always be weakened, if it can be demonstrated that they are truly unworkable. However, if the rulemaking process is anything like the legislative process, the industry will cry "onerous" prior to passage and afterward smilingly say the guidelines are "workable."

Prior to passage of HB 2244, industry representatives claimed that many provisions of the bill would put the industry out of business in Oregon. In June 1991, following passage of the bill and in the midst of the DEQ's chemical mining rulemaking process, Atlas Precious Metals Inc. submitted to the Vale District Bureau of Land Management a revised plan of operations for its Grassy Mountain project in Malheur County, Oregon.

The original scoping document for the Grassy Mountain project, dated October 1990, showed one open pit, heap leach pad, processing facilities, tailings disposal, storage and stockpile areas. The revised proposal includes the same, plus an additional three open pits. The plan also details the addition of an underground mining operation, which alone is expected to produce 150,000 to 250,000 tons of ore. Although Atlas does not at this time plan to use chemicals to extract gold from the underground ore, it is anyone's guess what their next revision might include. If the industry finds the DEQ's rules to be so potentially onerous, why then is Atlas at the same time planning to so drastically expand its operations?

When addressing chemical mining, there is no way the DEQ could be overly redundant in its protective requirements. One need only look at this industry's past and very recent history to see that redundancy is essential. Even when implemented, such redundancy has in many cases failed to protect human health and the environment.

To cite just one example, on November 12, 1991, an estimated 144,000 gallons a day of cyanide-laden water spilled from Galactic Resource's Summitville mine in Alamosa, Colorado. The Santa Fe New Mexican quoted state and federal officials as saying that water carrying cyanide from the Summitville mine killed all aquatic life in a 17-mile stretch of the Alamosa River and the Terrace Reservoir. To date, this incident is the largest cyanide spill attributed to the Summitville mine. It is, however, one in a series of reported spills that have occurred since the mine began operations in 1986. Several of the spills have killed fish.

We will not list additional examples, since we have cited many instances in previous testimony. In the past several weeks, DEQ staff and EQC members should have received a thick notebook citing recent cases of cyanide (and other chemical) spills, leaks and animal deaths due to cyanide intake at chemical mining operations.

Commissioners, please do not allow the mining industry to bully you or the rulemaking process. We urge you to stand up to them -- for the sake of Oregon's environment and its citizens.

Attached are both summary and detailed comments on the TRC report. We are confident that you will share our conclusions and will move to adopt the December 13, 1991, Rules Proposal as drafted. The DEQ staff has recommended adoption of the December 13, 1991, Rules Proposal and has suggested clarifying language, which should be incorporated into the final rules. Although we would suggest further strengthening of the proposed rules, we support the staff recommendations.

COMMENTS SUMMARY -- TRC ENVIRONMENTAL CONSULTANTS, INC. REPORT

Question 1 - Liner Systems

The TRC alternative liner proposal places unacceptable reliance on the primary liner to provide safety and protection.

TRC acknowledges that all primary liners leak.

The TRC proposed liner alternative fails to meet the EQC policy guidelines.

- The entire emphasis is on the primary liner.
- There is no acceptable protection below the leak detection system.
  - Twelve inches of clay is the only backup.
  - TRC readily admits the protective limitations of clay due to the high potential for cracking.
  - The thinner the clay liner, the greater the chance of cracking. (TRC's liner alternative provides for a clay liner which is only 12 inches thick.)
  - TRC acknowledges that desiccation cracking in its liner alternative will allow discharge directly to the environment.

TRC's weighting of liner proposals is flawed.

- Since TRC's alternative secondary liner does not meet the EQC test, the alternative should be assigned a 0 score (failure).
- If the primary liner is the weakest component of OAR liner proposal, TRC acknowledges that low-cost corrections could be made.
  - TRC fails to evaluate corrective alternatives. The score for the OAR liner should be 34 of 36, which clearly exceeds the TRC alternative and OMC liner proposals.
- By mistakenly reversing the tabulations in the Table on page 6 of the final report, TRC substantially understates the value of the OAR triple liner lower components, the most important component of a liner system meeting EQC guidelines.

Question 2 - Tailings Treatment

TRC concludes that removal and reuse is technically feasible.

TRC concludes that reuse is unimportant. However, TRC has substantiated that removal and reuse does reduce the total quantity of cyanide consumed over the life of the operation.

- Removal and reuse reduces the opportunities for related risks such as transportation and handling mishaps.

TRC evades answering the question by converting the question from one of use/reuse to one of "offering significant economic advantage, greater operational flexibility, and . . . more efficient utilization of resources."

- None of these responses is within the scope of the question asked.
- It could be equally argued that the mining industry would enjoy all of these advantages if there were no EQC policies at all.

Question 3 - Closure of Heap and Tailings Facilities

TRC is unreasonably optimistic regarding chemical treatment processes.

- Regardless of the reagent used, chemical oxidation processes are not reliable.
- Chemical oxidation allows too much variation regarding toxins in the effluent.
- Detoxification is insufficient as a means of long-term environmental protection and should be accompanied by covering of the heap.

TRC makes only limited attempts to analyze their proposals in regard to perpetual protections or failures.

- Numerous current and past examples illustrate that overly optimistic projections have consistently been wrong.

TRC centers its discussion and evaluation of detoxification of tailings on cyanide and underemphasizes the potential presence heavy metals.

- Since heavy metal protection is not proposed by DEQ rules, a cover is the only long-term protective device following closure.
    - It is well known that gold and silver are associated with other heavy metals such as lead, mercury, and arsenic.
- TRC concludes that covering the tailings following detoxification would be beneficial if there is a potential for acid mine drainage.

Coverings for the heap and tailings facilities must be composed of highly impenetrable synthetic material.

- Years of experience with clay coverings and vegetative covers have invariably resulted in leaks.
- Vegetative covers penetrate the clay covers causing leaks.
- If not covered with vegetation, clay covers erode.

CHEMICAL PROCESS MINING RULES

LINER SYSTEMS

Many environmental problems have occurred as a result of ineffective liner systems at chemical process mines. Since Oregon's future environment depends on EQC's choice of liner systems, the effectiveness of the chosen liner system is critical. This liner system will be required to protect not only our present environment but also our future environment for hundreds of years. In choosing a liner system, consideration must be given to the following:

1. "Puncturing of the primary liner is the most prevalent problem that occurs on heap leach pads", *TRC Final Report*, page 32.

2. "damage may also result from overstressing the liner with excessive heights of ore", *TRC Final Report*, Page 32.

3. "All liners leak. There's no way you can avoid it. That's why you have a leak detection system." Bruce Humphries, Supervisor, Colorado Mined Land Reclamation Division, *Chronicle* (Omak, WA), June 3, 1992

4. "You cannot build something that will not leak", Andre Duchane, Vice President, Battle Mountain's North American Operation, *Chronicle* (Omak, WA), June 3, 1992

5. "Even a quality installation of a geosynthetic liner will in almost every case result in some occurrence of defects, however minor." *TRC Final Draft*, Page 35.

A review of the preceding comments from industry experts reveals that the OAR 340 Triple-Liner System is the only proposal which will meet EQC's policy objective "that a liner, leak detection and collection system are necessary to assure that any leak will be detected before toxic materials escape from the liner system and are released to the environment." If experts agree that the primary liner will leak, then the secondary protection system must incorporate all forms of safety redundancy in order to back up any failures the primary liner may possess. We should anticipate and build for every eventuality. Protection devices always should be stronger than the entity they are designed to protect.

Since OMC's Proposed Double Liner System obviously fails to meet EQC's policy (emphasized by TRC), it will likely not be discussed as a viable system. However, TRC's Proposed Alternate Candidate Liner System potentially will be discussed regarding the reasons it will not meet EQC's policy statement.

TRC's Proposed Alternate Candidate Liner System places its entire emphasis on the upper system components...namely the primary liner. There is essentially no protection provided for the environment below the leak detection system. Therefore, if a leak is detected, there will only be 12 inches of clay for safety. (It should be noted that the clay base should not be considered a liner, but classified as to the degree of safety it provides...the thicker the clay, the greater the degree of protection). Since "all liners leak", it is essential that the clay safety factor be maximized. In fact, TRC, when discussing the OAR Triple-Liner System, states "The bottom clay liner also provides a safety factor with regard to post-closure operations, in the event that the primary and secondary synthetic liners would be adversely affected due to environmental conditions over the duration of the post closure period." *TRC Final Report*, Page 34.

TRC's lower system component (12 inch clay) will fail to meet EQC's policy statement. Consider:

1. "The occurrence of dessication cracking could result in the clay liner's permeability being in excess of the prescribed, 10^{-7} cm/sec permeability value." *TRC Final Report*, Page 26.

2. "There is no guarantee that dessication cracking can be prevented from occurring in clay liners." *TRC Final Report*, Page 26.

3. "the potential for moisture loss is generally reduced as the liner becomes thicker in depth, since drying of the outer liner surface does not affect the deeper clay particles as much, particularly the further away from the liner's surface and drying influences the deeper clay particles are." *TRC Final Report*, Page 26.

4. "If dessication cracking has been found to occur, and extends through the full profile of the liner, leachate escape (provided the secondary liner (FML) is defective) into the environment may immediately occur."*TRC Final Report*, Page 27.

TRC's Alternate Candidate Liner System provides very little protection because of the lack of a secondary liner system and the existence of a minimal thickness of clay base. Therefore, once a leak is detected, there are no assurances that the leachate will not reach the environment. In other words, the TRC Alternate Candidate Liner System will fail to meet EQC's policy statement.

Additionally, TRC's Level of Certainty Evaluation of the three proposed liner systems is based on value judgments which are too subjective...it allows for industry biased interpretations. For example: TRC gives the Alternate Liner's secondary liner system an average score of 2.00 for performance characteristics. In reality, the score should have been 0 (a failure) since the system does not provide secondary liner which will meet EQC's policy. (It should be noted that the numerals included in the table on page 6 of TRC's Final Report do not correspond to numerals included in Table 2-2, 2-3, 2-4 on page 56.)

Furthermore, TRC's Level of Certainty Evaluation of the OAR Triple-Liner System assigned an average score of 2.00 for the primary liner because the primary liner was considered its weakest component. Should the weakness of the primary liner be of concern, the OAR Triple-Liner System should be adapted accordingly as has been suggested by DEQ staff in their recommendation. Protection ABOVE the primary liner, to strengthen the lining system, should be added. It would be sensible to require installation of a deep sand or finely crushed ore "transition course" between the heaped ore and the primary liner to protect against punctures from accident and vandalism. (Ore should not be heaped directly on the primary HDPE liner!) To limit puncturing from ore slippage, a further increase in the protective stability of the lining system could be achieved through employment of liners with rough textured surfaces.

Another alternative would be to develop a composite primary liner (FML with a variable depth clay layer) to replace the FML primary liner. For an extremely small increase in cost (3%), this alternative would provide the highest level of certainty according to the TRC evaluation method. The OAR Triple-Liner System would overwhelmingly out-score other systems by compiling a total score of 34.00 out of a possible score of 36.00 (Equal Weighting). ***(A word of caution, however:*** one theory postulates that it is reasonable to have a **thin** "sand" cushion between the HDPE and the clay liner. This is because clay in direct contact with HDPE tends to pull the fluid through the HDPE rupture. If you have a void between the two, the surface tension limits flow through the hole. This theory warrants further study should an HDPE/clay composite liner be considered.)

Protection of Oregon's environment must be considered paramount to all other issues. Oregonian's do not want situations similar to Kennecott's Bingham Canyon operation where "Assistant Utah Attorney General Fred Nelson said nature was cleaning up the damaged groundwater on its own and the water should reach safe drinking levels during the next 100 to 200 years." (*Pay Dirt*, April, 1992)

TAILINGS TREATMENT

"Question: Do the requirements for removal and reuse of cyanide materially reduce toxicity and potential for long-term cyanide and toxic metals release from mill tailings?" *Request for Proposals for Technical Advice on Mining Rules*, Feb 7, 1992, Page 5.

"Method to Answer or Address Question: (1) Are removal and reuse technically feasible? (2) Do removal and reuse (evaluated separately) materially reduce the toxicity and potential for long-term cyanide and toxic metals release from the mill tailings? (3) What is the level of certainty you give to the answers provided above? (4) Are there other tailings treatment technologies which will equally, or more effectively achieve the policy of the Commission? *Request for Proposals for Technical Advice on Mining Rules*, Feb 7, 1992, Page 5.

In response to the Feb 7, 1992, directives, TRC states that

1. "Removal and reuse are technically feasible" and has been demonstrated to function. *TRC Final Report*, Page 7

2. "**Removal of cyanide from tailings does materially reduce the cyanide toxicity and potential for long-term release**...Reuse of cyanide does not reduce the cyanide toxicity or potential for long-term cyanide and toxic metals release from mill tailings. **It does reduce the total quantity of cyanide reagent consumed over the life of the operation.**" (Emphasis added) *TRC Final Report*, Page 8.

TRC concludes that "Reuse" is unimportant. However, it was on February 8, 1990, that a truck hauling hydrochloric acid to a mining operation in Nevada, spilled its contents into the John Day River, sterilizing the river and killing 100,000 fish. Contrary to TRC's opinion regarding the reuse of cyanide, "reuse" reduces the number of opportunities for transportation and handling mishaps.

3. "The level of certainty that removal of cyanide materially reduces the toxicity and potential for long-term cyanide release from mill tailings is high." *TRC Final Report*, Page 9.

However, TRC's discussion of tailings treatment has emphasized that chemical oxidation treatments are more appropriate than "remove and reuse" systems because they "offer significant economic advantage, greater operational flexibility, and result in more efficient utilization of resources." *TRC Final Report*, Page 9. ***None of the above "advantages" are within the scope of the questions.***

Additionally, TRC is incorrect regarding their optimism about chemical oxidation treatment processes. Systems which do not provide for cyanide removal **will not** meet EQC's standards. In discussing chemical oxidation systems, TRC failed to comment on the system's Level of Certainty. These systems, no matter what reagent is used, are not technically reliable. Chemical oxidation allows too much variation regarding toxins in the effluent. Examples include:

1. Atlas Precious Metals Gold Bar Mine in Nevada - a bird kill forced Atlas to institute a cyanide neutralization (not removal) process. Their "ferrous sulfate treatment system went on line at 3:30 p.m. on August 29, 1990." (8/31/92 Atlas letter to Nevada Department of Wildlife)

However, Atlas reported an additional 15 avian mortalities during the fourth quarter of 1990. (Mining Operations Wildlife Mortality Form, 4th Qtr 1990 Report)

Additionally, in an EPA document discussing ferrous sulfate treatment of cyanide ponds, Claire Elliot (Environmental Engineer) states "According to Tom DeMull the tailings pond was responsible for the death of 1400 birds in 1987 when they came to rest on the cyanide tainted pond. Since then the facility began to add ferrous sulfate, which forms a less toxic ferro-cyanide complex, and only one bird was killed in 1988. **Although converting free cyanide to a ferro-cyanide complex reduces the toxicity considerably, there is apparent recent research showing that iron complexes with cyanide may be more toxic than previously thought. The solubility, persistence and mobility of iron-cyanide complexes varies as a function of dissolved oxygen concentration, ultraviolet radiation and the presence of other complexing agents."** (emphasis added) *NPDES Compliance Evaluation Inspection Report, Alligator Ridge Mine, Sep 30, 1989*

2. Battle Mountain Fortitude Mine in Nevada - This mine uses the alkaline chlorination process. Reports indicate that the operation is having an extremely difficult time controlling the residual chlorine. For more information, contact Doug Zimmerman, Nevada DEP, (702)-687-4670.

CLOSURE OF HEAP LEACH FACILITIES

Proper closure of mining sites is of extreme importance to the future environmental well-being of the area being impacted. Therefore, it is important that DEQ analyze these proposals relative to their benefits into perpetuity. In discussing detoxification of heap leach facilities, TRC is overly optimistic and probably incorrect when they state:

> "Cyanide degradation and attenuation in a heap can be achieved by individual or combined application of rinsing, chemical treatment, or natural degradation reactions...It is technically feasible to reduce the WAD cyanide levels within the heaps to 0.5 ppm or less through rinse/rest cycles and chemical oxidation, minimizing post-closure toxicity concerns." *TRC Final Report*, Pg 97, 98.

In May, 1990, the Bureau of Land Management and the Montana Department of State Lands prepared an Environmental Assessment (EA) for an expansion proposal at the Pegasus Landusky Mine. This EA contains a section which discusses long-term seepage of cyanidated solutions. The following is an excerpt from this section:

> "After rinsing, not all of the solution within the decommissioned heaps would dewater by gravity drainage. The volume of irrecoverable solution in the heaps would be a function of the degree of saturation within blind-offs, and the specific retention of the material. If the irrecoverable solution in the heaps could be optimistically assumed to be equivalent to the natural moisture content of the pit-run material (4%), the dewatered and the expanded Montana Gulch heap would be expected to retain a minimum of 500 million gallons of cyanidated solution at unknown concentration. The ultimate tonnage for all Landusky heaps would retain more than a billion gallons of solution at unknown concentrations. If the overall concentration of retained solution in the heaped tonnage could be assumed to be diluted by rinsing to 5 percent of the original concentration, or approximately 25 ppm, approximately 240,000 pounds of cyanide would be present in the spent ore heaps at the Landusky Mine. Eventual discharge by long-term seepage through a cyclic succession of precipitation recharge, equilibrium by diffusion, and contaminated discharge could occur. The long-term fate and concentrations of this discharged solution is not definitely established." (May, 1990, *Landusky Mine Environmental Assessment*, Pg 36)

The discussion continues by stating:

> "The retained solution would have the potential to contaminate clean water that infiltrates the heaps...Precipitation infiltration and recharge of the heaps' moisture content would result in eventual discharge of contaminated effluent, as the heaps dewater to specific retention." (May, 1990, *Landusky Mine Environmental Assessment*, Pg 37)

Considering the above documentation, it is obvious that detoxification is insufficient as a means of long term-term protection for the environment and should be accompanied by covering the heap.

CLOSURE OF TAILINGS FACILITIES

When discussing closure of tailing facilities, TRC bases the majority of their evaluation on the detoxification of the cyanide in the tailings impoundment. Discussion concerning the presence of heavy metals in the tailings is generally underemphasized. It is not proposed in the current set of rules to remove the heavy metals; therefore, the urgency to cover the tailings is enhanced.

TRC determined that covering of tailings after detoxification would provide the necessary protection if there is potential for acid mine drainage. It is a known fact that gold and silver are associated with other heavy metals such as lead, mercury, and arsenic. For example, the Atlas Grassy Mountain Project site has high arsenic levels and Horizon's Hope Butte Project site is an old mercury mine. Enclosure of these toxins will be necessary to prevent their further release by natural erosion processes such as wind and rain.

Additionally, coverings over heap and tailings facilities must be composed of highly impenetrable synthetic material. Clay coverings with a vegetative cover have been used for years to reclaim municipal and hazardous waste landfills. The older coverings have invariably leaked. The general reason cited is penetration of the clay covering by roots of the vegetative cover. If the vegetative cover is not provided, the cover erodes away.

Similarly, if the vegetative cover penetrates the cover, there is the chance of heavy metal uptake by the vegetation:

> "Reclamation research has not yet satisfactorily dealt with the problem of root penetration into tailing or other potentially hazardous media. It has been demonstrated that many plant species can accumulate potentially toxic (to animals or humans) concentrations of trace metals with no apparent harmful effects to the plants. The potential concern for physical or biological migration of hazardous substances through soil covers from waste materials to reclaimed surfaces and to the environment at large cannot be generalized....In cases of significant concern, increased cover thickness and/or the use of impermeable barriers can be warranted." (*National Park Service, Environmental Handbook for Cyanide Leaching Projects*, Page 45; June 1986)

Additionally, according to an EPA document on the California

Gulch (Colorado) mine site, "Contaminants have degraded vegetation in pastures downstream, and plant tissues in some cases contained levels of metals toxic to livestock and wildlife." *EPA National Superfund Priorities Sites: Colorado, Dec, 1991.*

'All liners leak,' says Colorado official

SAN LUIS, Colo. – All liners which hold toxic chemicals will eventually leak at some time, those in the know say.

The collections pond liner at Battle Mountain's San Luis mine is no exception.

"All liners leak. There's no way you can avoid it. It's why you have a leak detection system," said Bruce Humphries, supervisor of mineral programs for the Colorado Mined Land Reclamation Division.

"You cannot build something that will not leak," said André Douchane, vice president of Battle Mountain's North American Operations, Denver.

A clay liner probably is the best material to use, because clay is self-bonding and becomes rather impermeable, Douchane said.

The tailings pond at San Luis has a heavy duty plastic liner over 12 inches of clay to contain the tailings, which is an after-product of the process used to separate gold from ore. It contains cyanide.

The plastic liner makes sure if the solution leaks, "it goes through in very, very tiny amounts that it does not oversaturate the clay," Douchane explained.

The solution goes into the tailings pond where some of the water evaporates; what doesn't drains off into a collection pond which recycles the water to be used again in the mining process.

The collections pond is double lined with plastic, with a foot of gravel and drain pipes in between.

The first liner is leaking now, Battle Mountain officials admit.

But none of the water is escaping outside the pond; it is being contained and pumped up a hill to the recycled water tank, company officials said.

Douchane said the company didn't expect the liner to leak, but "nothing in this world is perfect."

The leak isn't considered a very big one by Ron Zumwalt, safety supervisor at San Luis.

He called it "a pinhole leak," and said only about 50 gallons of water a week is leaking through it. The pond collects water from the 120-acre tailings pond.

Leaks do not have to be reported to regulatory agencies until they reach four and a half gallons a minute, Zumwalt said.

If a major leak should crop up down the road after Battle Mountain closes up shop at San Luis, the state would be responsible for clean-up, Humphries said.

"In Colorado law, once we release the operation, they're home free," he said.

But he said Battle Mountain probably would be liable for damages under federal laws. "It can go into a superfund site. That would cost Battle Mountain Gold a lot of money."

A bill which would require a mine to have a post-closure plan for up to 30 years is pending in Congress, Humphries said.

Things may be different in Washington.

If a problem cropped up at Chesaw after mining operations ceased, "I think we would be liable in perpetuity," Douchane said.

Chronicle (Omak, Washington)
Wednesday, June 3, 1992

Parties argue over Bingham Canyon water suit settlement

SALT LAKE CITY, March 23rd (AP) — State attorneys say $12 million offered by Kennecott as compensation for damanging groundwater is a fair settlement, but water district officials contend the amount should be much higher.

During a hearing in federal court Monday, the Salt Lake County Water Conservancy District asked Judge J. Thomas Greene to block the proposed settlement, saying a plume of contaminated water from Kennecott's Bingham Canyon operation caused $200 million damage.

Greene will hear evidence from Kennecott, the state and the water district later this week. Monday's hearing focused mostly on whether the $12 million offer was fair to the public.

Assistant Utah Attorney General Fred Nelson said nature was cleaning up the damaged groundwater on its own and the water should reach safe drinking levels during the next 100 to 200 years.

Pumping the water out of the ground and trying to clean it would leave waste material that would have to be treated and disposed of, he said. Even then, hundreds of years would pass before the water would be completely safe.

Kennecott and the state cut off several sources of the contamination in an effort to solve the groundwater contamination problem, Nelson said.

Kennecott has stopped using evaporation ponds in the Bingham Canyon area known to leach hazardous metals and sulphates into the ground. The company also relined a small Bingham reservoir to prevent leaching the lower level of a large reservoir.

An investigation into groundwater contamination began in 1983 after flood waters washed out evaporation ponds near the mining operation. State engineers worked until 1988 to assess damage to the groundwater, and in 1986 the state sued. The settlement has been under negotiation ever since.

Seventy new wells were drilled and water samples were taken from 200 wells to determine the extent of the groundwater damage.

Nelson acknowledged Monday that the problem is severe, with the water containing minerals at levels hazardous to human health.

Evidence suggests that the properties in the area's soil are neutralizing the contaminated water as years pass, allowing metals to precipitate out of the soil. However, the sulphate level in the water still remains above safe levels for drinking.

The water district maintains the $12 million will not come close to covering the costs of replacing water supplies that are or will be contaminated by the spreading plume.

Is Coeur d'Alene River residue old processing tailings?

From The Wallace Miner
Wallace, Idaho—March 26th

Mineral residue in the Coeur d'Alene River believed to be mine tailings should not be considered hazardous waste, state and federal officials said on March 18th

But to exempt the heavy minerals from protective environmental regulations, it must be proved the residue originated at a mine where ore was extracted, said Mark Masarik of the Environmental Protection Agency.

A mining industry spokesman said tailings are excluded from being labeled a hazardous waste under an amendment to the federal Resource Conservation Recovery Act.

Masarik, hazardous waste section chief with the EPA, said that is true.

"At this point, if the tailings came from extraction, I would agree they are excluded from RCRA," Masarik said.

Millions of dollars in taxpayer money and the completion of major improvement projects along the Coeur d'Alene River are at stake, said Gordon Crow of Council for Mineral Information.

At least 3 projects along the river were scrapped or put on hold in recent weeks after officials learned they may have to treat the residue as hazardous waste.

Such action would dramatically increase project costs, officials said, because the material would have to be hauled to a federally approved dump.

Randy Steger, manager of the RCRA section with the Department of Environmental Quality, agreed mine tailings are exempt under what is known as the Bevill Amendment.

"If it is mine tailings, they are excluded under the Bevill Amendment — I agree wholeheartedly. But whether the sole source (of the residue) is from mine tailings has yet to be determined," Steger said.

But just because the tailings are exempt, Steger said, does not mean the residue does not have to be disposed of carefully.

"From a health risk standpoint, we (DEQ) would still have some concerns," he said.

In Idaho, the DEQ has authority to administer RCRA rules. The state has adopted its own environmental rules, patternd after the federal regulations, related to the treatment of what it considers hazardous waste.

Crow said a management plan is needed to address how the heavy-metal residue extracted from the river bed is dealt with.

"Once the EPA and DEQ draft preliminary guidelines for the handling of mine tailings, the local mining industry, health and environmental representatives will meet to hammer out a local management plant," Crow said.

Core samples taken from below a timework bridge near Rose Lake show lead concentrations of between 40-50 parts per million, said Dave Fields, district design engineer with the Idaho Transporation Department.

The ITD had planned to replace the bridge, but has since put the project on hold due to expenses related to removal of the residue.

The EPA and DEQ set limits at 5 parts per million, Fields said. However, those tests may have shown falsely high concentrations due to the way the samples were tested.

Samples were sent to Boise where further tests are being conducted, Fields said. Results are expected later this week.

Crow applauded Al Murrey of the Coeur d'Alene Basin Project, who is coordinating meetings between local, state and federal officials.

"Al Murrey went right to work and did a terrific job that will eventually benefit all the taxpayers of Idaho," Crow said.

"The process is far from over, but a major understanding has been reached between all groups involved."

Aside from the Rose Lake bridge, Coeur d'Alene River projects impacted by the environmental regulations include boat launch across from the mouth of Anderson Lake and improvements at the Rainy Hill campground.

Of Mines And Men

Nevada researcher wins rock mechanics award

Dr. Amitava Ghosh, who is performing post-doctorate research in the Department of Mining Engineering at the University of Nevada-Reno, has been awarded the prestigious Rocha Award by the International Society for Rock Mechanics for the best rock mechanics dissertation.

Ghosh's paper is entitled "Fractal and Numerical Models of Explosive Rock Fragmentation." The work explores ways to more accurately predict how rock breaks when it is blasted.

Ghosh received his PhD in mining engineering from the University of Arizona and hopes to secure a teaching position after completing his post-doctorate research. Dr. Jack Daemen, chairman of the department at the Reno school, served as Ghosh's major professor and nominated him for the award.

Thursday, July 18, 1991 Ontario Argus
Ontario, Oregon

State, feds want money

PORTLAND (AP) — The state and the federal government are trying to collect $840,000 in damages from a Utah trucking company responsible for the largest chemical spill into a river in Oregon history.

The claim was filed in late May against the Thatcher Transportation Co. for a hydrochloric acid spill Feb. 8, 1990, that killed 100,000 fish in the John Day River.

A Thatcher truck spilled 3,500 gallons of the acid, killing fish for at least 12 miles downstream. The truck was bound for a mining operation in Nevada when it slid off U.S. 395 in snowy conditions and rolled into the John Day's north fork.

Contamination from the spill gradually dissipated but was never cleaned up. It killed juvenile chinook salmon and bull trout in the John Day, a river noted for its wild salmon and trout.

The Oregon Department of Environmental Quality also levied a $6,000 fine against Thatcher. The Oregon Department of Fish and Wildlife and the U.S. Department of Interior intend to use the $840,000 in damages to restore the fisheries damaged by the spill.

"They were not wiped out, but some serious work needs to be done to restore their populations," said Greg Robart of the Department of Fish and Wildlife.

Richard Doty, a spokesman for Thatcher, said the company's insurance carrier is handling the claim.

He said Thatcher acknowledged responsibility for the incident "right at the very beginning — as soon as we determined the truck was ours."

The largest chemical spill previously was in 1983, when a truck under contract to the U.S. Forest Service overturned and dumped about 1,900 gallons of the herbicide Sevin was dumped into Willow Creek near Heppner. The spill also killed about 100,000 fish.

Fish have died in two smaller spills in the past two years in Salem's Mill Creek.

In April 1991, about 2,000 fish died when ammonia-tainted water was allowed to enter a storm drain for about three hours at Deluxe Quality Chekd Ice Cream Co.

Dead fish were found that day along a 2.1-mile stretch of Mill Creek from the discharge site to the stream's confluence with the Willamette River. The state is seeking damages of $1,197.

ENVIRONMENTAL ASSESSMENT

for

Zortman Mining Inc.

Application for Amendment No. 010 to

State Operating Permit No. 00095 and

Federal Plan of Operations M-77779

Landusky Mine Expansion

Sullivan Park Heap Leach Pad

Operating and Reclamation Plan

prepared by

Montana Department of State Lands
and
U.S. Department of the Interior
Bureau of Land Management

Pursuant to the

Montana Environmental Policy Act
and the
National Environmental Policy Act

May 11, 1990

c. Long-Term Seepage of Cyanidated Solution

After rinsing, not all of the solution within the decommissioned heaps would dewater by gravity drainage. The volume of irrecoverable solution in the heaps would be a function of the degree of saturation within blind-offs, and the specific retention of the material. If the irrecoverable solution in the heaps could be optimistically assumed to be equivalent to the natural moisture content of the pit-run material (4 percent), the dewatered Sullivan Park and the expanded Montana Gulch heap would be expected to retain a minimum of 500 million gallons of cyanidated solution at unknown concentration. The ultimate tonnage for all Landusky heaps would retain more than a billion gallons of solution at unknown concentration. If the overall concentration of retained solution in the heaped tonnage could be assumed to be diluted by rinsing to 5 percent of the original concentration, or approximately 25 ppm, approximately 240,000 pounds of cyanide would be present in the spent ore heaps at the Landusky Mine. Eventual discharge by long-term seepage through a cyclic succession of precipitation recharge, equilibration by diffusion, and contaminated discharge could occur. The long-term fate and concentrations of this discharged solution is not definitely established.

It is proposed that all leach pad liners would be punctured to provide drainage of the spent ore heaps after reclamation. A portion of the precipitation that infiltrates the reclaimed heaps would drain through the punctured liners. Successful reclamation and revegetation of spent ore heaps would significantly reduce the amount of water which infiltrates and percolates through the heaps.

Heap infiltration amounts can be estimated using climatological data in Klohn Leonhoff's geotechnical report (May 1989). Annual precipitation in the Zortman/Landusky area is 17.9 inches and evaporation is 40.5 inches (Klohn Leonhoff, May 1989). Net precipitation (precipitation minus evaporation) for each month was calculated based on measured precipitation and evaporation assuming a pan coefficient of 0.72. For months in which evaporation is greater than precipitation, a net precipitation of zero is assumed. Assuming all net precipitation seeps through the reclaimed heaps and no surface runoff occurs, annual seepage would be equal to net precipitation. Because some runoff would occur, actual seepages through the heap would be less than net precipitation. During periods when excess precipitation occurs (evaporation less than precipitation) some portion of the precipitation would infiltrate through the revegetated soil cover and would percolate through the heap. Annual net precipitation volume and average precipitation rates infiltrating through the heap for the existing leach pads, and the proposed Sullivan Park leach pad, in the Landusky mine complex area (Hydrometrics 1990) would be:

Pad	Annual Net Precip. (million gallons)	Average Precipitation Rate (gpm)
Mill Gulch	5.4	10.3
Montana Gulch	7.1	13.7
Sullivan Park	5.5	10.5
TOTAL	18.1	34.5

The retained solution would have the potential to contaminate clean water that infiltrates the heaps. Cyanidated solution in retention and infiltrated water would tend to reach chemical equilibrium by diffusion. This process could take up to six months or longer to reach equilibrium depending on diffusion rates and cyanide concentrations. When fresh water from precipitation or sprinkling flushes the heap, the process of chemical diffusion would begin again until all the cyanide migrates out of the more impermeable zones. Precipitation infiltration and recharge of the heaps' moisture content would result in eventual discharge of contaminated effluent, as the heaps dewater to specific retention. An estimated 5.5 million gallons of precipitation may infiltrate the Rock Creek heap and 2.0 million gallons could recharge the expanded Montana Gulch heap yearly. This would equal an estimated 15 gpm of seepage through these proposed heaps. The majority of this water would flow through the underdrain and exit as surface flow, with a smaller amount entering the groundwater system. Cumulative precipitation through all the Landusky heaps is expected to be 18.1 million gallons annually, resulting in an average seepage rate of 34.5 gpm. Cyanide concentrations in this long-term seepage effluent is dependent on the effectiveness of heap rinsing and degradation of retained solution. Chemical diffusion may be greater during natural infiltration than during heap neutralization because retention times may be longer. Accordingly, discharge concentrations would be higher than concentrations monitored during rinsing.

The impact of long-term cyanide solution seepage from the spent ore heaps is unknown. However, factors which could contribute to significance include: failure of surface reclamation to limit infiltration of precipitation, the concentration of residual cyanide left after a 30-day rinse cycle, and possible plugging of the post-reclamation drain holes.

d. Water Rights

Most water rights for Rock Creek, including adit water, are held by the Square Butte Grazing Association, (SBGA) and Zortman Mining, Inc. (ZMI).

There is a concern that increasing water use for various mining purposes would adversely affect water rights of the area. Water rights disputes are resolved through the Department of Natural Resources and Conservation. A dispute does exist over water rights between ZMI and SBGA that to the best of current knowledge is unresolved. Until resolved, impacts to water rights and resultant water uses can not be quantified. Resolution of water rights disputes is beyond the scope of this EA and the authorities of DSL and BLM.

e. Floodplains

Construction of the Sullivan Park heap would cover about 2,000 linear feet of the Upper Rock Creek drainage, but there are only a few small narrow deposits in this area which may be considered floodplains. Due to the size and quality, their loss is not considered significant.

STATE OF NEVADA
DEPARTMENT OF WILDLIFE
1100 Valley Road
P.O. Box 10678
Reno, Nevada 89520-0022
(702) 688-1500

BOB MILLER
Acting Governor

WILLIAM A. MOLINI
Director

August 27, 1990

Andrew Scrymgeour
Manager
Gold Bar Mine
P.O. Box 282
Eureka, NV 89316

Dear Mr. Scrymgeour,

This letter is notification that the Gold Bar Mine is not in compliance with the Nevada Department of Wildlife's Industrial Artificial Pond Permit #1866 for the mill tailings pond. During a routine inspection on August 24, 1990, Rory Lamp from our Elko office observed four dead birds (one American avocet and three sandpipers) on Cell #3 of the Gold Bar tailings pond.

During the discussion that followed with yourself, Bill Reich and Dennis Appelhans, it was determined that the free cyanide levels being discharged into the tailings pond were above what the Nevada Department of Wildlife considers lethal for wildlife. You also pointed out the Gold Bar Mine was in the process of installing a ferrous sulfate neutralization circuit to the mill facility. In your estimation, the start up date for the neutralization system would be in approximately two to three weeks. At that time Mr. Lamp indicated that the Gold Bar Mine would be required to come into compliance within 30 days.

Subsequent to that discussion, eight additional mortalities (two mallards, five sandpipers, and one merganser) were reported to Rory Lamp by Bill Reich on August 27, 1990. In light of these additional mortalities, the Nevada Department of Wildlife will require the Gold Bar Mine to take steps to neutralize the cyanide concentrations in the tailings discharge to below lethal levels within two weeks upon receipt of this letter.

On a related matter, during the pond inspection, the netting over the pregnant pond was observed to be in a state of disrepair. Bill Reich indicated that a wind storm the previous week had done the damage and that repairs were being done at that time. He indicated that the repairs would be finished as soon as possible. The Nevada Department of Wildlife would like written notification when the repairs to the netting covers on the pregnant pond have been completed.

I hope the Gold Bar Mine will resolve both of these issues quickly so that legal actions will not be required. If you have any questions, please contact me.

Sincerely,

Duane Erickson

Duane Erickson
Supervising Habitat Biologist
1375 Mountain City Highway
Elko, NV 89801
(702) 738-5332

RL
cc: Habitat Division
Bill Schaffer, Eureka County District Attorney
Richard Branzell, Sr., U.S. Fish & Wildlife Service
Wayne King, District Manager, Shoshone-Eureka Resource Area, BLM
Dale Elliot

Atlas Gold Mining Inc.
GOLD BAR MINE
P.O. BOX 282
EUREKA, NEVADA 89316-0282
(702) 237-5621

RW
9/4/90

August 31, 1990

Rory Lamp
Nevada Department of Wildlife
1375 Mountain City Highway
Elko, NV 89801

RE: Repairs to Wildlife Netting, Atlas Gold Bar Mine Leach Pad.

Dear Mr. Lamp:

This letter is to inform you that repairs to the Gold Bar Mine pregnant pond netting were completed on August 27, 1990.

The ferrous sulfate treatment system went on line at 3:30 p.m. on August 29, 1990. Results of cyanide analyses are pending. I will keep you posted as to these results and how the system is functioning.

If you require additional information, please contact me at the earliest opportunity.

Sincerely,

William J. Reich

William J. Reich
Environmental Coordinator

cc: R.E. Blubaugh
A.H. Scrymgeour
D.J. Appelhans

United States Department of the Interior

TAKE PRIDE IN AMERICA

BUREAU OF LAND MANAGEMENT
Shoshone-Eureka Resource Area
P.O. Box 1420
Battle Mountain, NV 89820

IN REPLY REFER TO:
3809
N64-85-001P
(NV-064.2)

SEP 10 1990

CERTIFIED MAIL: P 468 373 273
Returned Receipt Requested

DECISION

Richard Blubaugh, Vice President	:	Gold Bar Mine
Atlas Corporation	:	Eureka County
370 17 th Street, Suite 3150	:	Nevada
Denver, Colorado 80202		

NOTICE OF NONCOMPLIANCE

The Nevada Department of Wildlife has advised us that Atlas Corporation is in noncompliance with the State of Nevada Industrial Artificial Pond Permit as a result of recent bird mortalities, during the month of August, 1990, associated with Atlas Gold Bar Mine cyanide tailings pond. At least 14 birds were reported to have died in the pond.

As a result of the bird mortalities your operations are in violation of the requirements described in 43 Code of Federal Regulations, Subpart 3809 Surface Management Regulations. Listed below are the violations of the regulations:

1. 43 CFR 3809.1-8 (c) which states, " Upon approval of a plan by the authorized officer, operations shall be conducted in accordance with the approved plan."

2. 43 CFR 3809.3-1(a) states, " Nothing in this subpart (3809) shall be construed to effect a preemption of State laws and regulations relating to the conduct of operations."

3. The subject mortality of waterfowl is a violation of the Migratory Bird Treaty Act. As the permitting agency, the Bureau of Land Management policy is to eliminate mine-related wildlife mortality and therefore can not allow the violation to continue as it constitutes failure to follow the approved plan of operations.

Listed below are necessary actions for Atlas to come into compliance with the submitted Plan of Operations:

1. Reduce immediately the concentrations of cyanide discharged into the Gold Bar Mine open solution ponds to non toxic levels as required by State permit and eliminate toxicity to birds either by free cyanide, WAD cyanide or other industrial pond toxicity problems.

2. Within 10 days from date of receipt of this Notice, Atlas Corporation must submit an amendment to the plan of operations detailing what measures Atlas plans to implement to eliminate bird mortalities. The plan is to specify what measures, time frames, monitoring and notification schedules are to be implemented to eliminate bird mortalities associated with open solution ponds at the Gold Bar Mine.

3. Notify this office immediately of any future bird mortalities at the Gold Bar Mine and submit to this office a weekly bird mortality monitoring report indicating both the number of birds killed and the concentration level of cyanide discharged into open solution ponds at the Gold Bar Mine.

The Bureau will approve or disapprove the amended plan based in part on consultation with other affected agencies. Be advised that detoxification has been proven to be the most effective method in complying with the regulations as compared to other methods such as hazing and netting.

Lack of compliance within the 10 working days period will require the Bureau to take appropriate actions.

You have the right to appeal this decision to the Nevada State Director, Bureau of Land Management, in accordance with 43 CFR 3809.4. If you exercise this right, your appeal must be filed in writing, accompanied by a statement of reasons and any arguments you wish to present, which would justify reversal or modification of this decision. Your appeal must be filed at the Bureau of Land Management, Battle Mountain District, Battle Mountain, Nevada 89820, within 30 days after the date of this decision. This decision will remain in effect during appeal unless a written request for a stay is granted.

W King

Wayne King
For the District Manager

cc:
NV920
Rory Lamp, NDOW
Richard Navarre, USFWS
Paul Lependorfer, NDEP

SEP 27 1990
SHOSHONE-EUREKA RESOURCE AREA

ATLAS CORPORATION

Republic Plaza, 370 Seventeenth Street, Suite 3150
Denver, CO 80202
Telephone: (303) 825-1200 Fax: (303) 892-8808

September 21, 1990

Mr. Wayne King, Manager
Shoshone - Eureka Resource Area
Bureau of Land Management
P.O. Box 1420
Battle Mountain, NV 89820

Re: Gold Bar Mine, Eureka County, NV
3809, N64-85-001P (NV-064.2)

Dear Mr. King:

This is in reply to your letter and Notice of Noncompliance dated September 10, 1990 concerning bird mortalities associated with the Gold Bar Mine tailings pond. As you noted in your letter, the Nevada Department of Wildlife (NDOW) sent a notice to Atlas August 27, 1990 concerning this matter (copy enclosed).

Atlas has been working closely with the NDOW and keeping them, as well as your staff, advised of our progress towards rectifying this situation. A copy of our August 31, 1990 letter to the NDOW is enclosed. As stated in the enclosed correspondence, Atlas had installed a ferrous sulfate treatment component as a part of the refractory circuit addition to the mill process, which is located on patented claims.

Cyanide analysis results from September 4, 1990 indicate the barren slurry discharging into the tailings disposal area contains 7.2 ppm WAD cyanide (Sierra Environmental Monitoring Lab, Sparks, Nevada). Concentrations of free cyanide measured by Gold Bar personnel since September 4, 1990 indicates that concentrations have been below 50 ppm, the guide limit set by the NDOW. Additional WAD analyses are pending.

Atlas maintains a full time hazer to keep waterfowl off of the tailings disposal area. The hazing is accomplished through the use of "banger shells" and a hover-craft. Atlas feels that the combination of the ferrous sulfate system and hazing program will eliminate waterfowl mortalities at the Gold Bar Mine.

Monitoring is accomplished on a full time basis by the hazer during the day shift. Periodic monitoring is accomplished by Gold Bar Mill personnel during the evening and night shifts.

Both the Nevada Department of Wildlife and the BLM will be notified by the end of the next working day of waterfowl mortalities occurring at the Gold Bar Mine. This notification is consistent with State of Nevada Regulations. Atlas will include a waterfowl mortality report as part of its weekly self-monitoring report.

Atlas will conduct WAD cyanide analysis of the tails discharge solution every two weeks. The Gold Bar lab is not equipped to analyze for WAD cyanide. These samples must be sent to an outside laboratory. As such, it is very time consuming to get these samples to the lab and obtain the results.

Atlas sincerely regrets the unanticipated impact on avian wildlife as it relates to the operation of the Gold Bar Mine. Preventive actions were in progress prior to the letter from NDOW. Atlas will continue to work towards the goal of preventing avian wildlife mortalities at the Gold Bar Mine. We believe we can achieve this goal through the procedures outlined in the amended plan.

Please contact me or Bill Reich if you require any additional information concerning this matter.

Sincerely,

Richard E. Blubaugh

Richard E. Blubaugh
Vice President Regulatory
And Environmental Affairs

REB/jlb

cc: R. R. Weaver
M. B. Richings
A. M. Scrymgeour
W. J. Reich

NEVADA DEPARTMENT OF WILDLIFE HABITAT DIVISION (E) FORM 25b

MINING OPERATIONS WILDLIFE MORTALITY FORM

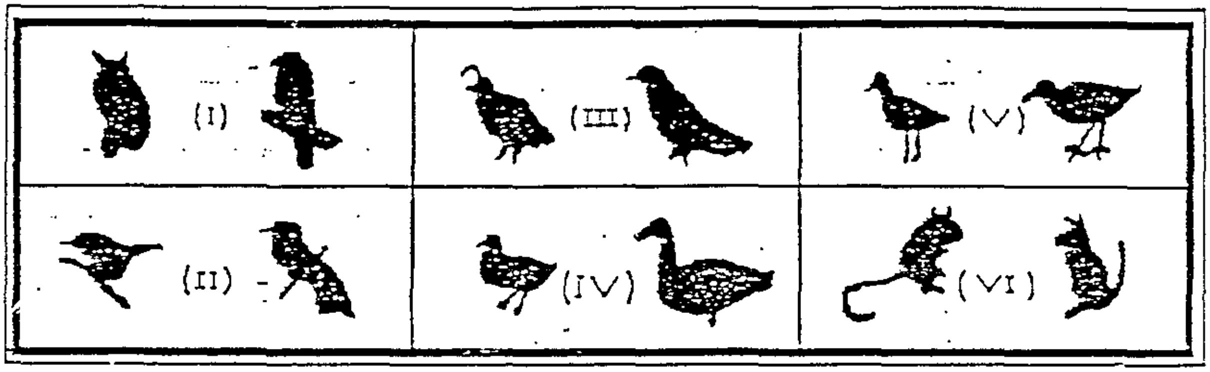
PROJECT TITLE: Atlas Gold Bar mine Permit # 1866

ADDRESS: Box 282 Eureka NV 89316 COUNTY: Eu

REPORT YEAR: 1990 QUARTER: (Check one)

(JAN-MAR)	(APR-JUNE)	(JULY-SEPT)	(OCT-DEC)
			X

WILDLIFE MORTALITY IDENTIFICATION



Please list number and species under category:

EXAMPLE:
RAPTOR. 0
SONGBIRD. . . . 1 sparrow, 2 wren
UPLAND. . . . . 1 quail
WATERFOWL . . . 3 mallard, 1 bufflehead, 4 gadwall
SHOREBIRD . . . 0
MAMMAL. . . . . 4 mice, 2 skunk, 2 chipmunk

CYANIDE-RELATED MORTALITIES
NUMBER AND SPECIFIC IDENTIFICATION

RAPTOR (I) . . . . ____

SONGBIRD (II) . . . ____

UPLAND (III) . . . ____

WATERFOWL (IV) . . 6 grebes 3 Ducks

SHOREBIRD (V) . . . 6 Gulls

MAMMAL (VI) . . . . ____

OTHER . . . . ____

(Non-Cyanide Mortalities and other remarks on back of form.)

REPORTER: L Groll DATE 1-3-91
(Name and Address)

PHONE 237-5621

PLEASE MAIL TO: NEVADA DEPARTMENT OF WILDLIFE
HABITAT SUPERVISOR
REGION II
1375 MT. CITY HIGHWAY
ELKO, NV 89801

The National Park Service

Environmental Handbook for Cyanide Leaching Projects

by Michael D. Stanton
Thomas A. Colbert
Richard B. Trenholme *of* Intermountain Soils, Inc.
Denver, Colorado

under contract to
Radian Corporation
Sacramento, California

for the
Energy, Mining and Minerals Division
National Park Service
United States Department of the Interior

June 1986

distribution of sufficient quantities (depths) of material suitable for a rooting zone for plants. In most instances salvaged native topsoil is the best source of plant growth medium, but there are projects for which the volume of available topsoil is too small to be adequate for reclamation. This is often the situation at older operations where no topsoil was salvaged prior to site development. In some areas the quality of topsoil may not justify its salvage for reclamation. Adequate soil survey information is necessary to assess topsoil quality and availability.

The importance of surface and slope stability in revegetation work cannot be overemphasized. While vegetation cover can be very effective in reducing soil erosion rates, especially due to sheet and wind erosion, it is no less true that the ability to establish any vegetation cover at all can be significantly compromised on unstable or erodible slopes. Susceptibility to erosion of a reclaimed surface is the result of a complex interaction of a number of factors. Some of these factors, notably soil texture, may not be controllable. Other factors can be influenced, most significant of which are length and steepness of slopes. For critical areas and harsh sites, the expense of additional site grading to reduce slope length and steepness is often justified, and can mean the difference between successful vegetation establishment or revegetation failure.

Vegetation cover is generally not as effective in controlling gully erosion. In reclaiming areas where susceptibility to rilling, piping or gullying is a problem, final configuration of surface drainage patterns should be given due attention. These problems tend to occur on certain types of soils, on larger reclaimed areas, in high precipitation or snowmelt areas, and especially on areas having steep slopes. Effective erosion control is critical for reclaimed embankments and tailing ponds where long term integrity of structures must be assured. A thorough discussion on slope stabilization and erosion control is given in Gray and Leiser (1982).

In addition to a stable surface, successful revegetation also depends on the availability of a suitable medium for revegetation. There exist numerous and varied regulatory approaches to this issue.

Decommissioned cyanide heaps and tailing impoundments may require from little or no soil cover to several feet of cover to be sucessfully reclaimed, depending on site conditions. Less than two feet of cover may be of tenuous effectiveness with respect to the long term isolation of waste materials, in cases where such long term isolation is an important concern. In cases where acid formation or toxic trace metals are of concern, increased cover thickness may be warranted. Many ore processing waste materials contain potentially hazardous concentrations of such trace metals as lead, arsenic, cadmium, silver, and others.

Reclamation research has not yet satisfactorily dealt with the problem of root penetration into tailing or other potentially hazardous media. It has been demonstrated that many plant species can accumulate potentially toxic (to animals or humans) concentrations of trace metals with no apparent harmful effects to the plants. The potential concern for physical or biological migration of hazardous substances through soil covers from waste materials to reclaimed surfaces and to the environment at large cannot be generalized, and must be evaluated on a case-by-case basis. In cases of significant concern, increased cover thickness and/or the use of impermeable barriers can be warranted.

Salvaged topsoil is commonly used as a final top layer for reclamation. Research has shown that in many cases as little as six inches of topsoil can significantly enhance revegetation results. The potential benefits of topsoil seem to be diminished to some extent for projects requiring that salvaged topsoil be stockpiled for many years. Research is still being done in this area. Topsoil in reclamation is discussed more thoroughly in Hargis and Redente (1984), Jurinak (1982), McKell (1982), DePuit and Schuman (1983), and U.S. Forest Service (1979).

Prior to reclamation seeding, a suitable seedbed must be prepared. Where slopes are not too

RECEIVED 2 3 JUL 1990

ENVIRONMENTAL PROTECTION AGENCY

REGION 9

Water Management Division

NPDES Compliance Evaluation Inspection Report

Name of Facility:	Alligator Ridge Mine
Owner:	B.P. Minerals America
Location:	Approximately 40 miles Northwest of Ely, Nevada
NPDES Permit No:	None
Inspection Date:	May 23, 1989

Inspection Participants:

EPA:	Claire Elliott Environmental Engineer
State:	Harry Van Drielen E.M.S. III
B.P. Minerals:	Tom De Mell General Manager

Prepared by: Claire Elliot
Date: September 30, 1989

In 1987 Amselco began processing a stockpile of carbonaceous ore. The efficiency of gold recovery from carbonaceous ore by cyanide leaching is reduced by the adsorption of the gold-cyanide complex onto the carbonaceous component of the ore. Therefore, after milling the ore is processed by oxidation to inactivate this component. The oxidized slurry is then vat leached and the gold is recovered through a carbon-in-pulp process. Activated carbon adsorbs the gold and is then strained from the slurry. The slurry is then sent through a thickener to the tailings pond. The tailings pond has a clay liner with an underdrain to a collection sump. Leakage through the tailings pond bottom is collected and pumped back into the tailings pond.

FINDINGS

1. There was no evidence of a discharge to surface water at the time of the inspection. Any drainage from the area would end up in a dry wash which leads to Long Valley. According to a memo in the NDEP files, an ephemeral lake is located in the Valley during periods of heavy precipitation. This lake could be considered a playa lake. Playa lakes are waters of the United States. Therefore any discharge to the wash tributary to this lake would be a discharge to a water of the U.S., and if unauthorized by a NPDES permit it would constitute a violation of the Clean Water Act.

2. The NDEP file on Alligator Ridge contains documentation of four discharges of cyanide containing solutions in the last 6 years. The first took place on February 25th and 26th, 1983. It was an intentional discharge of 100,000-200,000 gallons with a cyanide concentration of 20-38 ppm. The discharge was allowed to occur so that the facility could install a bypass valve. This valve enables the facility to discharge process solution to protect the pond berms in case of high water caused by rain events. The discharge was diluted with well water and the cyanide neutralized with calcium hypochlorite. The facility indicated that they could not determine the distance the discharge achieved. Two discharges are documented as taking place in 1986. One of them, in August, was due to heavy rainfall and apparently caused process water to overflow from the collection pond to the overflow pond,

and from the collection ditches into the stormwater ditches. There is no indication of whether the flowthen made it to the wash which discharges into Long Valley. There was cyanide detected in one monitoring well in September which the facility speculated was caused by this event. The second discharge documented in 1986 was also in August and consisted of 10,800-13,300 gallons of solution containing 365 ppm free cyanide. This discharge was from a tee in the pipe at the Southeast corner of leach pad number 2. No mention was found of where this discharge ended up.

In 1987 a flange in the line carrying solution to the No. 2 leach pad failed allowing 32,000-34,000 gallons of solution containing 365 ppm of free cyanide to discharge. The discharge was treated with hydrogen peroxide and diluted with potable water.

Amselco Minerals Inc. had no NPDES permit, therefore any of these discharges which entered the wash constituted violations of the Clean Water Act.

3. Monitoring of wells which were constructed in the vadose zone detected the existence of a seasonal perched aquifer with fluctuating levels of cyanide. Groundwater monitoring data in NDEP's files indicate contamination below the pregnant solution pond in 1986, and contamination below the pregnant solution collection pond in 1985 and 1986 with cyanide levels as high as 10.4 mg/l as free cyanide.

4. According to Tom DeMull the tailings pond was responsible for the death of 1,400 birds in 1987 when they came to rest on the cyanide tainted pond. Since then the facility began to add ferrous sulfate, which forms a less toxic ferro-cyanide complex, and only one bird was killed in 1988. Although converting free cyanide to a ferro-cyanide complex reduces the toxicity considerably, there is apparently recent research showing that iron complexes with cyanide may be more toxic than previously thought.

The solubility, persistence and mobility of iron-cyanide complexes varies as a function of dissolved oxygen concentration, ultraviolet radiation and the presence of other complexing agents. Iron-cyanide complexes should be quite soluble

United States
Environmental Protection
Agency

Region VIII

December, 1991

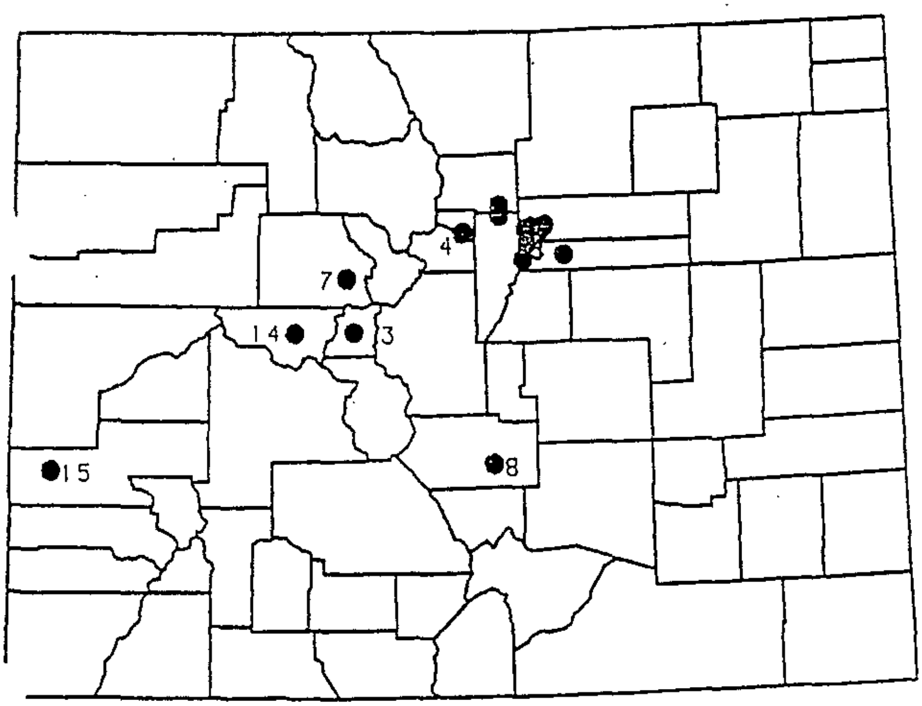
EPA contact –
Gene Taylor
303-293-1640

EPA

National Superfund Priorities List Sites:

Mine Sites

COLORADO



1- Air Force Plant PJKS Property	2- Broderick Wood Products
3- California Gulch	4- Central City-Clear Creek
5- Chemical Sales	6- Denver Radium Site
7- Eagle Mine	8- Lincoln Park
9- Lowry Landfill	10-Marshall Landfill
11-Rocky Flats Plant (USDOE)	12-Rocky Mountain Arsenal
13-Sand Creek Industrial	14-Smuggler Mountain
15-Uravan Uranium (Union Carbide)	16-Woodbury Chemical Co.

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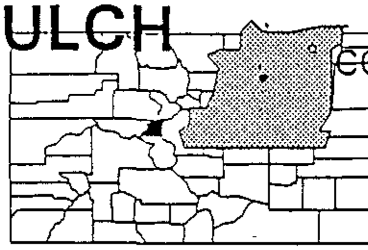
PROGRESS TOWARD CLEANUP AT NPL SITES IN THE STATE OF COLORADO

Site Name	County	NPL*	Date Listed	Initial Response	Site Studies	Remedy Selected	Remedy Design	Cleanup Ongoing	Const. Complete
AIR FORCE PLANT	JEFFERSON	Final	11/21/89	→	→				
BRODERICK WOOD	ADAMS	Final	09/21/84	→	→	→	→	→	
CALIFORNIA GULCH	LAKE	Final	09/08/83	→	→	→	→	→	
CENTRAL CITY-CLEAR CREEK	CLEAR CREEK & GILPIN	Final	09/08/83	→	→	→	→	→	
CHEMICAL SALES	ADAMS & DENVER	Final	08/30/90	→	→	→	→		
DENVER RADIUM	DENVER	Final	09/08/83	→	→	→	→	→	
EAGLE MINE	EAGLE	Final	06/10/86	→	→	→	→	→	
LINCOLN PARK	FREMONT	Final	09/21/84	→	→	→	→	→	
LOWRY LANDFILL	ARAPAHOE	Final	09/21/84	→	→				
MARSHALL LANDFILL	BOULDER	Final	09/08/83	→	→	→	→	→	
ROCKY FLATS PLANT	JEFFERSON	Final	10/04/89	→	→		→	→	
ROCKY MOUNTAIN ARSENAL	ADAMS	Final	07/01/87	→	→	→	→	→	
SAND CREEK INDUSTRIAL	ADAMS	Final	09/08/83	→	→	→	→	→	
SMUGGLER MOUNTAIN	PITKIN	Final	06/01/86	→	→	→	→		
URAVAN URANIUM	MONTROSE	Final	06/10/86		→	→	→	→	
WOODBURY CHEMICAL	ADAMS	Final	09/08/83	→	→	→	→	→	→

*National Priorities List

CALIFORNIA GULCH
COLORADO
EPA ID# COD980717938



EPA REGION 8
CONGRESSIONAL DIST. 05
Lake County
100 miles west of Denver

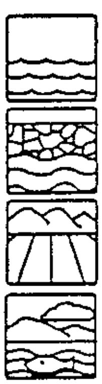
Site Description

The 130-year-old California Gulch site is a mining area covering 16 1/2 square miles of a watershed area that drains along California Gulch to the Arkansas River. Starting in 1859, the area has been mined extensively for gold, lead, silver, copper, zinc, and manganese. California Gulch contains numerous abandoned mines and wastes from mining, milling, and smelting. Miners built the Yak Tunnel to drain water from the mine works and to make mineral exploration and development easier. This tunnel drains hundreds of mines in its 4-mile underground course and discharges a total of 210 tons of various heavy metals each year into California Gulch. Although the tunnel mainly contaminates surface water, heavy metals also have moved through surface water to pollute groundwater and sediments. California Gulch also collects runoff from several other gulches that drain other mine tailings piles and pond wastes. Some of this runoff flows through local town storm drains and city streets. The Arkansas River, which receives water from the California Gulch, has been classified as a recreational resource, and is used heavily for irrigation, livestock watering, public water supply, and fisheries. Approximately 6,000 people live in nearby Leadville and Lake County.

Site Responsibility: This site is being addressed through Federal and potentially responsible parties' actions.

NPL LISTING HISTORY
Proposed Date: 12/30/82
Final Date: 09/08/83

Threats and Contaminants



The primary contaminants of concern affecting surface water, sediments, and groundwater are cadmium, copper, lead, arsenic, mercury, and zinc. The water in several shallow groundwater wells in California Gulch and in some private wells has been shown to exceed EPA drinking water standards for cadmium and zinc. Arsenic, cadmium, and lead exist in waste piles and soils. Adverse effects on the fish population have been observed in the Arkansas River. Contaminants have degraded vegetation in pastures downstream, and plant tissues in some cases contained levels of metals toxic to livestock and wildlife. Water in the main stem of California Gulch is unsafe for drinking. Soil contaminated with lead up to 10,000 ppm occurs in the residential areas of the city. The Colorado Department of Health conducted a heavy metal exposure study in Leadville (April, 1990) and reported that distribution of blood lead levels for children less than 6 years of age at >10, >15, >20 and >25 micrograms/deciliter was 26%, 5.3%, 7.3% and 2%, respectively. Accordingly, EPA has accelerated efforts to complete RI work on populated areas of the site.

Cleanup Approach

This site is being addressed in stages: a remedial action at the Yak Tunnel, and longer term remedial investigation phases focusing on cleanup of the groundwater and surface water and contaminated soils, mine wastes, tailings, and smelter slags in and adjacent to the populated areas of the site.

Response Action Status

Immediate Action: In 1986, EPA emergency workers extended public water supply system lines to residences using private wells. In 1990, the potentially responsible party improved the area storm water drainage system to prevent surface water from coming into contact with mining wastes. This storm water drain system is being upgraded to ensure that the system is effective in times when it is most needed.

Yak Tunnel: In 1988, the EPA selected a remedy to minimize the flow of acid water from the Yak Tunnel and to prevent the uncontrolled release of tunnel drainage to the environment. It features: (1) building a surge pond to capture tunnel drainage and dissipate the effect of surges from the tunnel on the Gulch and River; (2) installing a permanent system to treat the tunnel water before discharging it; (3) installing plugs at three places in the tunnel to stop the uncontrolled discharge of mine drainage; (4) sealing shafts, drill holes, and fractured rock and diverting surface water to reduce the amount of water entering the tunnel; (5) establishing a surface and groundwater monitoring system; and (6) installing a pumping or drainage system to control water levels. Under EPA monitoring, the parties potentially responsible for site contamination are designing the remedies and conducting the cleanup. The parties finished building the surge pond and filter unit in 1989 and currently are designing the permanent treatment plant, which is scheduled for completion in the summer of 1992. All cleanup activities are scheduled for completion by the end of 1993.

Groundwater and Surface Water: EPA began investigation in 1987 of materials contributing contamination on the site. Fullscale studies of surface and groundwater began in 1991 with surface water sampling, streambed sampling, and toxicity testing of the California Gulch and adjacent drainages and the Arkansas River. Installation of 56 additional monitoring wells and piezometers is being done as part of a larger groundwater study.

In 1991 EPA and the PRPs began intensive studies under the following workplans: (1) Demographics surveys, (2) House dust, paint, & gardens, (3) Soils and disturbed materials mapping, (4) Lead/Cadmium/Arsenic mapping, (5) Tailings, (6) Mine waste rock, (7) Tailings, (8) Smelters/building materials, (9) Slag, (10) Metal speciation and (11) Lead bioavailability. Workplans for backround geochemistry studies and cultural resource inventories will occur in 1992.

Environmental Progress

The Surge Pond and temporary filter unit treating surface waterflow in California Gulch have been operational since 1989. The permanent treatment facility is scheduled for completion in the summer of 1992.

WR 11389 800-232-1234

State of Oregon
Department of Environmental Quality — Memorandum

Date: August 19, 1992

To: Environmental Quality Commission

From: Fred Hansen, Director

Subject: Proposed Chemical Mining Rules

At the meeting on August 7, 1992, the Commission indicated acceptance of the Department recommendation for adoption of the proposed chemical mining rules with changes in the following areas:

- The wording for proposed as Alternative 2 for both the heap leach pad liner [OAR 340-43-065(4) on pages 14-15] and processing chemical pond liner [OAR 340-45-065(5) on pages 15-16] was accepted to replace the 12/13/91 draft wording labeled Alternative 1.

- The Commission directed the Department to develop additional wording to clearly convey the intent that alternative liner systems can be approved provided that the level of environmental protection intended by each component of the liner system specified in the rule (primary liner, leak detection system, secondary liner) is achieved, either within the component or on a cross component basis. This new wording appears as OAR 340-43-065(4)(d) on page 15 and (5)(d) on pages 16-17.

- The wording of the Purpose and Policies [OAR 340-43-006(2)(b) on page 3] and the Guidelines for Disposal of Mill Tailings [OAR 340-43-070(1) on page 18] was modified to allow "destruction" of cyanide in mill tailings as an alternative to removal and reuse.

The attached rule draft (Attachment A dated 8/13/92) displays the changes made to the 8/7/92 draft in response to the Commission direction in the traditional way: new wording is <u>underlined</u>, and deleted wording is ~~[enclosed in brackets and struck through]~~. For easy reference, the wording changes appear on pages 3, 14-17, and 18.

It is recommended that the Commission adopt the proposed chemical mining rules as presented in Attachment A.

August 17, 1992 Markup following
August 7, 1992 EQC Consideration

Attachment A

Note: At its 8/7/92 meeting, the Environmental Quality Commission considered proposed rules dated 8/7/92, and accepted the Department recommendations with some changes as noted in this draft. This 8/17/92 draft deletes the underlining from new text and removes text that was shown struck through in the 8/7/92 draft. It then shows changes made in response to Commission discussions in the following manner:

Underlined text is proposed language to be added to the rule draft as a result of the Commission discussions on 8/7/92.

~~[Bracketed and struck through]~~ text is proposed language to be deleted from the rule draft as a result of the Commission discussions on 8/7/92.

RULES PROPOSAL:

OREGON ADMINISTRATIVE RULES

CHAPTER 340

DIVISION 43

CHEMICAL MINING

OAR 340-43-006	Purpose and Policies
OAR 340-43-011	Definitions
OAR 340-43-016	Permit Required
OAR 340-43-021	Permit Application
OAR 340-43-026	Plans and Specifications
OAR 340-43-031	Design, Construction, Operation and Closure Requirements

Renumbering of some rules and other minor "house keeping" amendments proposed in the 8/7/92 rule draft were accepted by the Commission on 8/7/92.

OAR 340-43-035	Exemption from State Permits for Hazardous Waste Treatment or Disposal Facilities

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS

OAR 340-43-040	Purpose
OAR 340-43-045	General Provisions
OAR 340-43-050	Control of Surface Water Run-On and Run-Off
OAR 340-43-055	Physical Stability of Retaining Structures and Emplaced Mine Materials
OAR 340-43-060	Protection of Wildlife
OAR 340-43-065	Guidelines for Design, Construction, and Operation of Heap-Leach Facilities
OAR 340-43-070	Guidelines for Disposal of Mill Tailings
OAR 340-43-075	Guidelines for Disposal or Storage of Wasterock, Low-Grade Ore and Other Mined Materials
OAR 340-43-080	Guidelines for Heap-Leach and Tailings Disposal Facility Closure
OAR 340-43-085	Post-Closure Monitoring
OAR 340-43-090	Land Disposal of Wastewater
OAR 340-43-095	Guidelines for Open-Pit Closure

PURPOSE and POLICIES

340-43-006

(1) The purpose of these rules and guidelines is to prevent water pollution and protect the quality of the environment and public health in Oregon, consistent with the policies of ORS 468B.015 and 468B.020, by requiring application of all available and reasonable method for control of wastes and chemicals relative to design, construction, operation, and closure of mining operations which use cyanide or other toxic chemicals to extract metals or metal-bearing minerals from the ore and which produce wastes or wastewaters containing toxic materials.

This section reflects amendments to this rule as proposed in the 8/7/92 draft and accepted by the Commission.

(2) The following policies are established to provide further guidance regarding the level of environmental protection these rules are intended to achieve:

This section [340-43-006(2)] was new language proposed in the 8/7/92 rule draft. It was accepted by the Commission with amendments to (b) reflected below.

(a) Liner, leak detection and leak collection systems (systems) are necessary for heap leach pads, solution ponds, and tailings facilities to assure that any leak will be detected before toxic materials escape from the liner system and are released to the environment. For purposes of these rules, the environment is considered to begin at the bottom of the last liner. These systems shall assure that a leak is found, and that sufficient time is available to allow for the repair of the leak and clean up of any leaked material before there is a release to the environment. Natural conditions, such as depth to groundwater or net rainfall, shall be considered as additional protection but not in lieu of the protection required by the engineered liner system.

(b) The toxicity of mill tailings and the potential for long-term cyanide and toxic metals release from mill tailings shall be reduced to the greatest degree practicable through removal, ~~[and]~~ reuse, or destruction of chemical solutions prior to placement of tailings in the tailings disposal facility.

This paragraph was amended by the Commission to be consistent with the change made in rule 340-43-070 to not require reuse and to allow destruction technology to be used.

(c) The closure of heap leach pads and tailings disposal facilities shall prevent future release to the environment of residual potentially toxic chemicals contained in the facility.

DEFINITIONS

340-43-011

Unless the context requires otherwise, as used in this Division:

(1) "Chemical process mine" means a mining and processing operation for metal-bearing ores that uses chemicals to dissolve metals from ores.

(2) "Department" means the Department of Environmental Quality.

(3) "Guidelines" means this body of rules contained in 340-43-045 through 340-43-100.

(4) "Positive exclusion of wildlife" means the use of such devices as tanks, pipes, fences, netting, covers and heap-leach drip-irrigation emitters or covered emitters.

(5) "Tailings" means the spent ore resulting from the milling and chemical extraction process.

PERMIT REQUIRED

340-43-016

(1) As required by ORS 468B.050, a person proposing to construct a new chemical mining operation, commencing to operate an existing non-permitted operation, or proposing to substantially modify or expand an existing operation shall first apply for, and receive, a permit from the Department. The permit may be an NPDES (National Pollutant Discharge Elimination System) permit if there is a point-source discharge to surface waters or a WPCF (Water Pollution Control Facility)

The Commission accepted the minor clarifying amendment proposed in the 8/7/92 draft for this paragraph.

permit if there is no discharge. Consideration may be given to site-specific conditions such as climate, proximity to water, and type of wastes to establish the final permit type and requirements for the facility.

(2) The permit application shall comply with the requirements of OAR Chapter 340, Divisions 14 and 45 and be accompanied by a report that fully addresses the requirements of this Division.

(3) Prior to issuance of a permit for a chemical process mining activity under this Division, a determination of compliance with statewide planning goals and compatibility with local land use plans must be made. The Department shall determine compliance with Statewide Planning Goals and compatibility with acknowledged comprehensive plans and land use regulations in a manner consistent with its approved State Agency Coordination Program and the rules in OAR Chapter 340, Division 18. In making these determinations, the Department shall consider and may rely on the findings and recommendations made by the project coordinating committee authorized by ORS 517.965 and by the Department of Geology and Mineral Industries pursuant to their State Agency Coordination Program and OAR Chapter 632, Divisions 1 and 37.

The Commission accepted this new paragraph as proposed in the 8/7/92 draft.

PERMIT APPLICATION

340-43-021

(1) The permit application shall fully describe the existing site and environmental conditions, with an analysis of how the proposed operation will affect the site and its environment. The application shall, at a minimum, contain the information specified for the DOGAMI (Department of Geology and Mineral Industries) consolidated application under ORS 517.971 (Section 13, Chapter 735, 1991 Oregon Laws). The Department will also use the information contained in NEPA (National Environmental Policy Act), EA (Environmental Assessment), or EIS (Environmental Impact Statement) documents, if they are required for the

This paragraph reflects clarifying amendments proposed in the 8/7/92 draft and accepted by the Commission.

project, as partial fulfillment of the requirements of this paragraph.

(2) The permit application shall, in addition to the information described in Paragraph (1) above, include the following information, unless the information has been otherwise submitted:

(a) Climate/meteorology characterization, with supporting data;

(b) Soils characterization, with supporting data;

(c) Surface water hydrology study, with supporting data;

(d) Characterization of surface water and groundwater quality;

(e) Inventory of surface water and groundwater beneficial uses;

(f) Hydrogeologic characterization of groundwater, with supporting data;

(g) Geologic engineering, hazards and geotechnical study, with supporting data;

(h) Characterization of mine materials and wastes which include, for example, overburden, waste rock, stockpiled ore, leached ore and tailings. Characterization of mine materials and wastes shall include, but not be limited to the following:

(A) Chemical and mineral analysis related to toxicity;

(B) Determination of the potential for acid water formation;

(C) Determination of the potential for long-term leaching of toxic materials from the wastes;

(i) Characterization of wastewater (quantity and chemical and physical quality) produced by the operation;

(j) Assessment of the potential for acid-water formation from waste disposal facilities, low-grade ore stockpiles, waste rock piles and for surface water or groundwater accumulation in open pits that will remain after mining is ended.

(3) Data submitted by the permit applicant should be based on analysis of the actual materials, when possible, or may be based on estimates from knowledge of similar operations and professional judgment.

PLANS AND SPECIFICATIONS

340-43-026

(1) A person constructing or commencing to operate a chemical process mine or substantially modifying or expanding an existing chemical process mine shall first submit plans and specifications to the Department for construction, operation and maintenance of the facilities intended for treatment, control and disposal of wastes.

(2) The plans shall address all applicable requirements of this Division and shall include, but not be limited to, the following:

Sections (2) and (3) of this rule reflect clarifying amendments proposed by the Department and accepted by the Commission.

(a) A description of the facilities to be constructed, including tanks, pipes and other storage and conveyance means for processing chemicals and solutions and wastewaters;

(b) A management plan for control of surface water;

(c) A management plan for treatment and disposal of excess wastewater, including provisions for reuse and wastewater minimization;

(d) A facility construction plan including, as applicable, the design of low-permeability soil barriers, the type of geosynthetics to be used and a description of their installation methods, the design of wastewater treatment facilities and processes, a quality assurance plan for applicable phases of construction and a listing of construction certification reports to be provided to the Department;

(e) A preliminary closure plan;

(f) A preliminary post-closure monitoring and maintenance plan;

(g) A spill containment and control plan.

(3) The Department shall approve the plans, in writing, before construction of the facilities may be started.

DESIGN, CONSTRUCTION, OPERATION AND CLOSURE REQUIREMENTS

340-43-031

(1) All chemical process and waste disposal facilities and facilities for mixing, distribution, and application of chemicals associated with on-site mining operations; ore preparation and beneficiation facilities; and processed ore disposal facilities shall be designed, constructed, operated and closed in accordance with the guidelines contained in this Division.

(2) Alternative facilities and methods of control of wastes and potential pollutants may be approved by the Department if the permit applicant can demonstrate that the alternate facilities and methods will provide environmental protection that is fully equivalent or better than that achieved by the facilities specified in the guidelines in Sections 43-040 to 43-095 of these rules. The burden of proof of fully equivalent protection lies with the permit applicant. Written approval of any alternative by the Department shall be evidence of

This wording reflects clarifying amendments proposed by the Department and accepted by the Commission.

acceptance as equivalent or better level of environmental protection.

(3) A groundwater monitoring plan shall be submitted to, and be approved by the Department. Monitoring wells shall be installed for detection of groundwater contamination as required by OAR Chapter 340, Division 40, unless the Department concludes in writing that the hydrogeology of the site or other technical information indicates that an adverse impact on groundwater quality is not likely to occur.

This wording reflects a clarifying amendment proposed by the Department and accepted by the Commission.

(4) The Department may, in accordance with a written compliance schedule, grant reasonable time for existing facilities to comply with these rules.

EXEMPTION FROM STATE PERMIT FOR HAZARDOUS WASTE TREATMENT OR DISPOSAL FACILITIES

340-43-035

(1) The state hazardous waste program requires a permit for the "treatment", "storage" or "disposal" of any "hazardous waste" as identified or listed in OAR Chapter 340, Division 101 from the Department, prior to the treatment and disposal of wastes. Permitting requirements can be found in OAR Chapter 340, Division 105, Hazardous Waste Management.

(2) However, any operation permitted under this Division, which would otherwise require the neutralization or treatment of hazardous waste and would require a permit pursuant to OAR Chapter 340, Division 105, shall be exempt from the requirement to obtain such hazardous waste treatment permit.

(3) All mined materials disposed of under this Division shall pass Oregon's hazardous waste rule criteria or they will be considered a state hazardous waste and must be disposed of accordingly.

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS

PURPOSE

340-43-040

(1) This Division establishes criteria for the design, construction, operation and closure of chemical mining operations and supplements the provisions of OAR 340-43-006 through OAR 340-43-035. These criteria are intended to establish the minimum level of environmental protection that is necessary using a combination of performance standards and minimum design criteria. Approval of alternative facilities or methods to achieve an equivalent or better environmental result is allowed as defined in OAR 340-43-031.

This section reflects clarifying amendments proposed by the Department and accepted by the Commission.

(2) Any disapproval of submitted plans or specifications, or imposition of requirements by the Department to improve existing facilities or their operation will be referenced when appropriate, to applicable guidelines or rules.

GENERAL PROVISIONS

340-43-045

(1) Facilities permitted under either a WPCF or NPDES permit shall not discharge wastewater or process solutions to surface water, groundwater or soils, except as expressly allowed by the permit.

(2) Facilities subject to these rules shall not be sited in 100-year floodplains or wetlands. A buffer zone (a minimum of 200 feet wide) shall be established between waste disposal facilities and surface waters.

(3) All chemical conveyances (ditches, troughs, pipes, etc.) shall be equipped with secondary containment and leak detection means for preventing and detecting

release of chemicals to surface water, groundwater or soils.

(4) Acid water accumulation in open pits resulting from the mining operation must be prevented by appropriate mining practices, by measures taken in the closure process, or be treated to control pH and toxicity, for the life of the pit.

(5) Construction of surface impoundment liner systems shall conform generally to the principles and practices described in EPA/600/2-88/052, Lining of Waste Containment and Other Impoundment Facilities, September 1988.

(6) The Department may require the permittee to hire a third-party contractor to perform the functions set forth below. Selection of the contractor shall be subject to Department approval.

(a) Review and evaluate the design and construction specifications of all mined-materials disposal facilities permitted under this Division for functional adequacy and conformance with Department requirements. The Department shall not approve construction of the disposal facilities until the design and construction specifications have been evaluated.

(b) Monitor the course of construction of all mined-materials facilities for compliance with the approved design and construction specifications. The third-party contractor shall regularly document the progress of construction and the Department shall require the permittee to take corrective action if construction does not satisfactorily conform to the approved design and construction specifications.

This paragraph includes a clarifying amendment proposed by the Department and accepted by the Commission.

(c) Provide on-site inspections during ongoing operations, including but not limited to the loading of the heap, to assure protection of the integrity of the liner system and other environmental protection measures.

This paragraph is new language proposed by the Department in the 8/7/92 draft and accepted by the Commission.

CONTROL OF SURFACE WATER RUN-ON AND RUN-OFF

340-43-050

(1) Surface water run-on and run-off shall be controlled such that it will not endanger the facility or become contaminated by contact with process materials or loaded with sediment. The control systems shall be designed to accommodate a 100-year, 24-hour storm event, or any other defined climatic event that is more appropriate to the site, and be placed so as to allow for restoration of the natural drainage network, to the maximum extent practicable, upon facility closure.

(2) All mined materials shall be properly placed and protected from surface water and precipitation so as not to be eroded and contribute sediment to site stormwater run-off or to otherwise contaminate surface water.

PHYSICAL STABILITY OF RETAINING STRUCTURES AND EMPLACED MINE MATERIALS

340-43-055

(1) Permit applicants must demonstrate to the Department that the design of chemical processing facilities and waste disposal facilities is adequate to ensure the stability of all structural components of the facilities during operation, closure and post closure.

(2) Retaining structures, foundations and mine materials emplacements shall be designed by a qualified, registered professional and be constructed for long-term stability under anticipated loading and seismic conditions.

(3) Temporary structures and materials emplacements may, with written approval from the Department, be constructed to a lesser standard if it can be shown that they pose no, or minimal, threat to public safety or the environment.

PROTECTION OF WILDLIFE

340-43-060

(1) Wildlife shall be positively excluded from contact with chemical processing solutions and wastewaters containing chemicals.

(2) The Department may waive the positive exclusion requirement if the Oregon Department of Fish and Wildlife (ODF&W) certifies to the Department that the project is designed such that it will adequately protect wildlife.

GUIDELINES FOR DESIGN, CONSTRUCTION, AND OPERATION OF HEAP-LEACH FACILITIES

340-43-065

(1) This paragraph applies to heap-leach facilities using dedicated, or expanding, pads. Heap-leach facilities using on-off, reusable pads may require variations from these rules; they shall be approved on a case-by-case basis by the Department.

(2) The heap-leach facility (pad and associated ponds, pipes and tanks) shall be sized to prevent flooding of any of its components.

(3) TABLE 1 of this Division establishes minimum capacity-sizing criteria for the leach-pad and ponds. The pad and ponds may be designed to act separately or in conjunction with each other to obtain the required storage volumes. Other design criteria may be used, with Department approval, if local conditions warrant. The best available climatic data shall be used to confirm the critical design storm event and estimate the liquid levels in the system over a full seasonal cycle. The liquid mass balance may include provision for evaporation.

~~[Heap Leach Pad Liner Alternative 1]~~

The Commission selected Alternative 2 presented below. Therefore, this wording from the 12/13/91 and 8/7/92 rule drafts is marked to clearly indicate the intended deletion.

~~[(4) The heap leach pad liner system shall be of triple liner construction with between-liner leak detection consisting of:~~

~~(a) An engineered, stable, low permeability soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;~~

~~(b) Continuous flexible-membrane middle and top liners of suitable synthetic material separated by a minimum of 12 inches of permeable material (minimum permeability of 10^{-2} cm/sec);~~

~~(c) A leak detection system between the synthetic liners capable of detecting leakage of 400 gallons/day-acre within ten weeks of leak initiation.]~~

~~[Heap Leach Pad Liner Alternative 2]~~

This wording reflects the alternative from the 8/7/92 rule draft for heap leach pad liners that was accepted by the Commission. A new subparagraph (d) is presented below to incorporate the intent discussed by the Commission on 8/7/92.

(4) The heap leach pad liner system shall be designed, constructed, and operated to meet the following criteria:

(a) A primary liner consisting, at a minimum, of a continuous flexible-membrane of suitable synthetic material shall be provided. This liner shall function together with the process chemical collection system installed immediately above this liner (see section (8) of this rule) to remove process chemicals from the heap.

(b) A leak detection system shall be installed immediately below the primary liner for the purpose of detecting loss of process solutions by leakage through the primary liner. The leak detection system shall be capable of detecting leakage through the primary liner of 400 gallons/day-acre within ten weeks of leak initiation. The leak detection system shall consist of appropriately sized collection piping placed within a minimum thickness of 12 inches of permeable material (minimum permeability of 10^{-2} cm/sec) that is capable of withstanding the anticipated weight of the heap without loss of function.

(c) A secondary liner shall be placed below the leak detection system to provide assurance that any leakage through the primary liner during the operation of the heap and following closure of the heap is not released to the environment. The Secondary liner shall be of a composite design with a continuous flexible-membrane of suitable synthetic material in direct contact with an engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches.

(d) Each liner system component described in paragraphs (4)(a)-(c) above addresses a specific need and purpose with respect to environmental protection. For purposes of evaluating alternative facilities and methods of control under OAR 340-43-031(2), an alternative may be approved if the level of environmetal protection intended by each separate liner system component is achieved either within the individual component or on a cross component basis.

This new language was added based on 8/7/92 Commission discussions to clarify the Commission intent with respect to evaluation of equivalent environmental protection of liner system alternatives proposed by a permit applicant.

~~**[Processing Chemical Pond Liner Alternative 1]**~~

The Commission selected Alternative 2 presented below. Therefore, this wording from the 12/13/91 and 8/7/92 rule drafts is deleted.

~~[(5) The processing chemical pond liners shall be of triple liner construction with between-liner leak detection consisting of:~~

~~(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;~~

~~(b) Continuous flexible-membrane middle and top liners of suitable synthetic material separated by a permeable material (minimum coefficient of permeability of 10^{-2} cm/sec);~~

~~(c) A leak detection system between the synthetic liners capable of detecting leakage of 400 gallons/day-acre, within ten weeks of leak initiation.]~~

~~[Processing Chemical Pond Liner Alternative 2]~~

(5) The processing chemical pond liner system shall be designed, constructed, and operated to meet the following criteria:

This wording reflects the alternative from the 8/7/92 rule draft for processing chemical pond liners that was accepted by the Commission. A new subparagraph (d) is presented below to incorporate the intent discussed by the Commission on 8/7/92.

(a) A primary liner consisting, at a minimum, of a continuous flexible-membrane of suitable synthetic material shall be provided. This liner shall provide for positive containment of processing chemical solutions.

(b) A leak detection system shall be installed immediately below the primary liner for the purpose of detecting loss of process chemical solutions by leakage through the primary liner. The leak detection system shall be capable of detecting leakage through the primary liner of 400 gallons/day-acre within ten weeks of leak initiation. The leak detection system shall consist of appropriately sized collection piping placed within a layer of permeable material (minimum permeability of 10^{-2} cm/sec).

(c) A secondary liner shall be placed below the leak detection system to provide assurance that any leakage through the primary liner during the use of the pond is not released to the environment. The Secondary liner shall be of a composite design with a continuous flexible-membrane of suitable synthetic material in direct contact with an engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches.

<u>(d) Each liner system component described in paragraphs (5)(a)-(c) above addresses a specific need and purpose with respect to environmental protection. For purposes of evaluating alternative facilities and methods of control under OAR 340-</u>

This new language was added based on 8/7/92 Commission discussions to clarify the Commission intent with respect to evalu-

43-031(2), an alternative may be approved if the level of environmetal protection intended by each separate liner system component is achieved either within the individual component or on a cross component basis.

ation of equivalent environmental protection of liner system alternatives proposed by a permit applicant.

(6) Emergency ponds may be constructed as an alternative to larger pregnant and barren ponds. The emergency pond may be constructed to a lesser standard, with the limitation that it is to be used only infrequently and for short periods of time. The Department will specify reporting and use limitations for the ponds in the permit. A between-liner leak detection system is not required for the emergency pond.

(7) The emergency-pond liner shall be of composite construction consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-6} cm/sec) with a minimum thickness of 12 inches, and

(b) A single flexible-membrane synthetic top liner of suitable material.

(8) The heap-leach pad shall be provided with a process chemical collection system above the upper-most liner that will prevent an accumulation of process chemical within the heap greater than 24 inches in depth.

(9) The permittee shall prepare a written operating plan for safe temporary shut-down of the heap-leach facility and train employees in its implementation.

(10) The permittee shall respond to leakage collected by the heap-leach and processing-chemical storage pond leak-collection systems according to the process defined in TABLE 2.

(11) The permittee shall determine the acid-generating potential of the spent ore by acid\base accounting and other appropriate static and dynamic laboratory tests. If the spent ore is shown to be potentially acid generat-

ing under the conditions expected in the heap at closure, the permittee shall submit a plan for acid correction for Department approval prior to loading the heap.

GUIDELINES FOR DISPOSAL OF MILL TAILINGS

340-43-070

(1) Mill tailings shall be treated by cyanide removal, ~~[and]~~ re-use, or destruction prior to disposal to reduce the amount of cyanide introduced into the tailings pond to the lowest practicable level. ~~[Chemical oxidation or other means shall be additionally used, if necessary, prior to disposal to reduce the WAD cyanide level in the liquid fraction of the tailings.]~~ The permittee shall conduct laboratory column tests on mill tailings to determine the lowest practicable concentration to which the WAD cyanide (weak-acid dissociable cyanide as measured by ASTM Method D2036-82 C) can be reduced. In no event, shall the permitted WAD cyanide concentration in the liquid fraction of the tailings be greater than 30 ppm.

This rule was amended by the Commission on 8/7/92, following extensive discussion. The amendments allows the permit applicant to select cyanide destruction methodology for reducing the amount of cyanide entering the tailings pond. The amendments also require that the technology selected be designed and operated to achieve the lowest practicable level of cyanide in the tailings pond.

(2) The permittee shall determine the potential for acid-water formation from the tailings by means of acid-base accounting and other suitable laboratory static and dynamic tests. If acid formation can occur, basic materials shall be added to the tailings in the amount of three (3) times the acid formation potential or to give a net neutralization potential of at least 20 tons of $CaCO_3$ per 1000 tons of tailings, whichever is greater, before placing tailings in the disposal facility.

(3) The disposal facility shall be lined with a composite double liner consisting of a flexible-membrane synthetic top liner in tight contact with an engineered, stable, soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) having a minimum thickness of 36 inches.

Construction of the liner shall generally follow the principles and practices contained in EPA/600/2-

88/052, "Lining of Waste Containment and Other Impoundment Facilities, September, 1988.

(4) The disposal facility shall be provided with a leachate collection system above the liner suitable for monitoring, collecting and treating potential acid drainage.

GUIDELINES FOR DISPOSAL OR STORAGE OF WASTEROCK, LOW-GRADE ORE AND OTHER MINED MATERIALS

340-43-075

The permittee shall determine the acid-producing and metals-release potential of the wasterock, low-grade ore or other mined materials by acid/base accounting and other appropriate static and dynamic laboratory tests. If the mined materials are shown to be potentially acid forming, or capable of releasing toxic metals, the permittee shall submit a plan for correction and disposal for Department approval prior to permanently placing the materials.

GUIDELINES FOR HEAP-LEACH AND TAILINGS DISPOSAL FACILITY CLOSURE

340-43-080

(1) The waste disposal facilities shall be closed under these rules in conjunction with the reclamation requirements of DOGAMI (Oregon Department of Geology and Mineral Industries).

(2) An up-dated closure plan and post-closure monitoring and maintenance plan shall be submitted to the Department by the permittee at least 180 days prior to beginning closure operations or making any substantial changes to the operation. The closure plan must be compatible with DOGAMI's reclamation plan and may be part of it.

(3) Chemical conveyances (ditches, troughs, pipes, etc.) not necessary for post-closure monitoring shall be

removed. The secondary containment systems shall be checked before closure for process-chemical contamination, and contaminated soil or other materials, if any, shall be removed to an acceptable disposal facility.

(4) Closure of the heap-leach facility.

(a) The heap shall be detoxified over a suitable period of time prior to closure, using rinse/rest cycles of rinsing and chemical oxidation, if necessary. The WAD cyanide concentration in the rinsate shall be no greater than 0.2 ppm.

(b) Following detoxification as defined in (a) above, the heap shall be closed in place on the pad by covering the heap with a cover designed to prevent water and air infiltration. The cover should consist, at a minimum, of a low-permeability layer and suitable drainage and soil layers to prevent erosion and damage by animals and to sustain vegetation growth, in accordance with DOGAMI's reclamation rules.

(c) The ponds associated with the heap shall be closed by folding in the synthetic liners and filling and contouring the pits with inert material. Residual sludge may be disposed of in one of the on-site waste disposal facilities, provided it meets the criteria for such wastes in these guidelines. The process chemical collection system of the heap shall be maintained in operative condition so that it can be used to monitor the amount and quality of infiltrated water, if any, draining from the heap.

(5) The tailings disposal facility shall be closed by covering with a composite cover designed to prevent water and air infiltration and be environmentally stable for an indefinite period of time. Maximum effort shall be made to isolate the tailings from the environment. Construction of the cover shall generally follow the principles and practices contained in EPA/530-SW-89-047, Technical Guidance Document -- Final Covers on Hazardous Waste Landfills and Surface Impoundments.

POST-CLOSURE MONITORING

340-43-085

(1) The Department may continue its permit in force for thirty (30) years after closure of the operation and will include permit requirements for periodic monitoring to determine if release of pollutants is occurring.

(2) Monitoring data will be reviewed regularly by the Department to determine the effectiveness of closure of the disposal facilities. The Department will consult with DOGAMI on release of security funds that would otherwise be needed to correct problems resulting from ineffective closure.

LAND DISPOSAL OF WASTEWATER

340-43-090

(1) To qualify for land disposal of excess wastewater, the permit applicant shall demonstrate to the Department that the process has been designed to minimize the amount of excess wastewater that is produced, through use of water-efficient processes, wastewater treatment and reuse, and reduction by natural evaporation. Excess wastewater that must be released shall be treated and disposed of to land under the conditions specified in the permit.

(2) A disposal plan shall be submitted as part of the permit application that, at a minimum, includes:

(a) Wastewater quantity and quality characterization;

(b) Soils characterization and suitability analysis;

(c) Drainage and run-off characteristics of the site relative to land application of wastewater;

(d) Proximity of the disposal site to groundwater and surface water and potential impact;

(e) Wastewater application schedule and water balance;

(f) Disposal site assimilative capacity determination;

(g) Soils, surface water and groundwater monitoring plan;

(h) Potential impact on wildlife or sensitive plant species.

(3) The Department will evaluate the disposal plan and set site-specific permit conditions for the wastewater discharge.

GUIDELINES FOR OPEN-PIT CLOSURE

340-43-095

(1) Open pits that will be left as a result of the mining operation shall be assessed prior to, and following, mining operations for the potential to contaminate water to the extent that it might not meet water-quality standards due to build-up of acid or toxic metals.

(2) If the Department finds that the potential for water accumulation in the pit(s) exists, the permit applicant shall submit a closure plan for the pit that will address contamination prevention and possible remedial treatment of the water. The closure plan shall, at a minimum, examine the following alternatives:

(a) Avoidance, during mining, of acid-generating materials that can be left in place, rather than being exposed to oxidation and weathering;

(b) Removal from the pit and disposal, during or after the mining operation, of residual acid-generating materials that would otherwise be left exposed to oxidation and weathering;

(c) Protective capping in-situ of residual acid-generating materials;

(d) Treatment methods for correcting acidity and toxicity of accumulated water;

(e) Installation of an impermeable liner under ponded water to prevent groundwater contamination;

(f) Backfilling of the pit(s) above the water table to reduce oxidation of residual acid-generating materials.

TABLE 1

Heap-Leach Liquid Storage Criteria

Component	Pregnant-Solution Pond	Barren-Solution Pond
Operating Volume	Minimum necessary to maintain recirculation	Minimum necessary to maintain recirculation
Operational Surge	Anticipated draindown and rinse volume	Anticipated draindown and rinse volume
Climatic Surge	100-yr, 24-hr storm plus 10-yr snowmelt	100-yr, 24-hr storm plus 10-yr snowmelt
Safety Factor	2-ft dry freeboard	2-ft dry freeboard

TABLE 2

Required Responses to Leakage Detected from the Leach Pad and Processing Chemical Storage Ponds

Leakage Category	Response
Zero leakage to 200 gal/day-acre	Notify the Department; increase pumping and monitoring
Leakage from 200 gal/day-acre to 400 gal/day-acre	Change operating practices to reduce leakage
Leakage in excess of 400 gal/day-acre	Repair leaks under Department schedule.

(Jack)

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Senior Research Economist, Professor of Natural Resources-Environmental Law Program, University of Denver, 1967-1974

Senior Fellow, Energy & Minerals Division, Resources for the Future, Washington, D.C, 1974-1979

Senior Specialist, Energy & Mineral Resources, Congressional Research Service Library of Congress, 1979-1988

Adjunct Professor, Mineral Economics, Colorado School of Mines, 1988-1992

Industrial Experience - Research Chemist, Beryllium Corp.
Production Economics, Marathon Oil Corp
" " , Sun Oil Co.

Public Service - National Academy of Sciences
Energy & Minerals Board - 4 years
National Materials Advisory Board - 4 years

Recent Experience - Participant in the South Dakota Continuing Environmental Impact Study of Surface Gold Mining for the S.D. E. Q. B.
Author of the Society of Mining Engineers Chapter on Government & Mining in the new edition of the Mining Engineers Handbook

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COMMENTS TO THE ENVIRONMENTAL QUALITY COMMISSION
RE: Rules Proposal OAR Chapter 340, Division 43
Chemical Mining
8/7/92 Draft

The Oregon Environmental Council (OEC) would like to take this opportunity to respond to the Department of Environmental Quality (DEQ) staff recommendations on the chemical process mining rule proposal. With a few exceptions we are supportive of those recommendations and believe that the staff report does an excellent job of summarizing the consultants' report and clarifying the issues.

Policy

OEC supports the recommended addition of policy language to section 006 of the rules. We think such policy statements are especially crucial as context for the new language in section 031 which clarifies the variance procedure and alternative language which sets performance standards for the liner systems (065 (4) & (5)).

Disposal of Mill Tailings

OEC disagrees, however, with the proposed language under "Guidelines for Disposal of Mill Tailings" on the following two points:

1) OEC urges the Environmental Quality Commission (EQC) to restore language from the 6/14/91 rule draft which requires removal of heavy metals as well as cyanide from the tailings effluent, as follows:

> Mill tailings shall be treated prior to disposal to remove or detoxify available toxic metals.

Exposure to heavy metals, which bioaccumulate, can cause chronic health problems in exposed species and contribute to wildlife losses through shortened lifespans, disease or disability, as well as interfering with reproductive hormone systems. Since no standards exist for "safe exposure" OEC urges the EQC to adopt language requiring removal of heavy metals.

2) Similarly, there is no level of "safe exposure" for cyanide, as indicated by information submitted earlier by OEC and the Wilderness Society citing studies by Donald R. Clark, Jr. of the U.S. Fish and Wildlife Service Cyanide Wildlife Research Center in Laurel Maryland.

In his testimony before the House Subcommittee on Mining and Natural Resources of the Committee on Interior and Insular Affairs on April 7, 1992, Dr. John W. Grandy of The Humane Society of the United States noted that:

> "Scientists are not certain how various concentrations of cyanide in mining and mineral operations affect wildlife of different species, and what concentration is sufficiently low as to minimize threats to the species most likely to be attracted to cyanide ponds. For instance, cyanide poisonings of 12 red bats at the Ridgeway Mine in South Carolina in September and October 1990 occurred when the mine was reporting cyanide levels of less than 20 parts per million, a concentration considered to be very low....Other questions remain, including the importance of individual metals to cyanide toxicity when each is bound with cyanide and the effect of PH on toxicity."

Even Fred Hansen noted in a letter to me dated 12/10/91 in response to similar concerns which I had expressed that

> "The required cyanide detoxification level in the tailings (30 ppm) is a technology-based requirement and is not intended to be protective of wildlife. We agree that a "safe exposure" standard for cyanide and metals in tailings wastewater does not currently exist."

Fred goes on to note that, in lieu of a safe exposure standard the DEQ rules rely on positive exclusion standards. Considering the opportunities for failure of exclusion mechanisms, short of complete containment, this does not leave OEC will a high degree of confidence that we are doing all we can to protect wildlife. In any event, if 30 ppm was a technology-based requirement, the South Carolina example shows that 20 is achievable, if not protective of all species. OEC recommends that the requirement in Section 070 (1) of the proposed rules be changed to a level even below 20, since that is shown to be toxic for bat populations, which play in important role in the local ecosystems and in several instances, include listed Threatened and Endangered species.

Cyanide Standards versus Liner Requirements

Also, to respond to industry comments questioning the need for a 36" clay liner if 30 ppm is the cyanide standard in tailings ponds, it is worth noting that 1) 30 ppm is not protective of wildlife, as indicated above, and thus could contaminate groundwater which could contaminate surface waters to the detriment of fish and wildlife species; and 2) it is certainly far above the 0.2 ppm standard required for heap closure rinsate as protective of human consumption.

Cover Requirements versus Liner Requirements

OEC supports the staff recommendations not to delete the requirements to cover heaps and tailings. We do not find such a requirement redundant with the liner requirements. As indicated in the written testimony provided to you and staff by Concerned Citizens for Responsible Mining (6/25/92), a 1990 environmental assessment produced by the Bureau of Land Management (BLM) and the Montana Department of State Lands estimated that approximately 240,000 pounds of residual cyanide would be left in spent ore heaps at the mine under analysis (Landusky). Although we understand that this figure will vary with each site, the document stated that "...Precipitation infiltration and recharge of the heaps' moisture content would result in eventual discharge of contaminated effluent, as the heaps dewater to specific retention."

In addition to residual cyanide, there is also reason to be concerned about acid mine drainage from heaps and tailings, which would be prevented by covering. In addition, there are examples of toxic dust blowing off of old tailings ponds in dry climates.

Obviously, liners already in place do not adequately prevent these outcomes. While such liner systems may prevent residual cyanide or acid drainage from leaching to groundwater immediately below the facilities, nothing would be in place to prevent spills caused by heavy precipitation events from overflowing the liner systems and entering groundwater and surface waters. By capping these toxic timebombs, even though they are left in place they are at least defused for the life of the cap and liner systems.

Open Pit Closure

Finally, OEC would like to reiterate earlier comments on these rules with regard to section 340-43-095 (2), "Guidelines for Open-Pit Closure, " as follows:

Item (b) would leave an even larger scar on the land and would require removal of acid-generating materials to a disposal facility that would itself require long-term maintenance and monitoring in an endless shell game.

Item (c) has a potential for failure of the cap, especially on steep slopes.

Item (d) requires perpetual treatment with related costs and potential for failure.

Item (e) has a potential for failure that requires perpetual monitoring and potential remedial action, as well as exclosure from wildlife access.

Only items (a) and (f) offer security to future generations of Oregonians, and should be the only options available to permittees. Furthermore, OEC suggests the following amendments to (f):

Backfilling of the pit(s) [above the water table] to the level necessary to [reduce] prevent oxidation of residual acid-generating materials.

Table 2

OEC supports the proposed amendment to the title of Table 2 to inlcude processing chemical sotrage ponds, but wonders if this change also covers tailings ponds? If not, language should be added to cover tailings ponds.

Summary Charge to the EQC

In summary, OEC urges the Environmental Quality Commission to adopt the most stringent standards necessary to protect Oregon's environmental quality from the hazards to water and wildlife that we know are possible from open-pit heap-leach mining. The costs of compliance with such standards affects profits relative to the value of the ore, which, in the case of gold, has gone as high as $800 and as low as $340 since deregulation. The ore will not move or degrade with time; if our standards make it unprofitable at $340 an ounce, then mining will be profitable and will occur at $400 or more for an ounce.

Ultimately, the land is always worth more than gold, and it is your charge to protect that value for future generations. Leaving Eastern Oregon communities with a legacy of contaminated sites is not doing them a favor, in spite of whatever pressure they may put upon the Commission now.

Thank you for this opportunity to comment on behalf of Oregon's environment.

Respectfully submitted,

Jean R. Cameron

Jean R. Cameron
Policy Director
August 6, 1992

THE DARK SIDE OF GOLD MINING

ROCK GEM

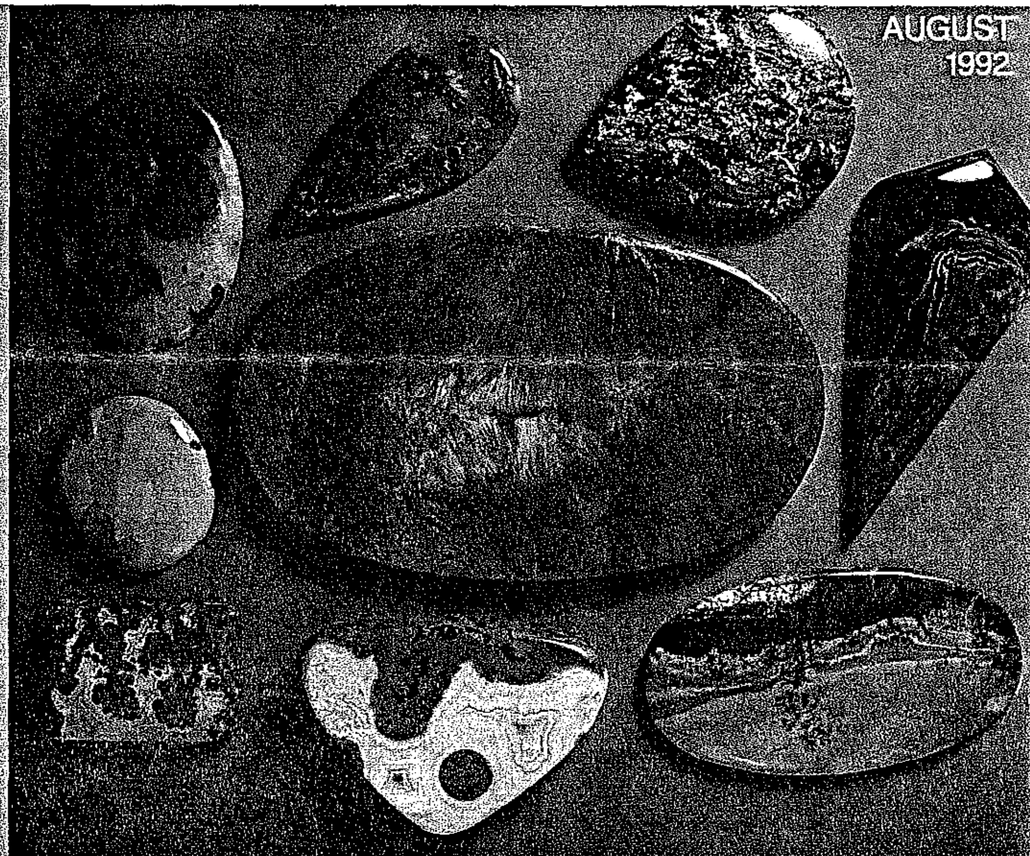
AUGUST 1992

Jewelry Making

BASIC BEZEL WIRE SETTINGS

GLOSSARY FOR BEGINNING LAPIDARIES

How To Make ROCK CLOCK FACES



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The Gold Boom

by Stephen M. Voynick

Gold mining is still surrounded by an aura of color, excitement and romance. Individuals who know nothing else about the mining industry usually know at least something about gold mining. Much of the public interest in goldmining, of course, is tied to the fact that American gold mining is now riding the crest of its greatest boom ever.

In the last decade, US. gold output has increased tenfold, and annual production now stands at 10 million troy ounces—340 tons—worth well over $3 billion. The average per-ounce operating recovery cost of $220, measured against a far higher market price of gold, meant whopping profits. Many of us shared the bonanza through gold mining company shares, which continue to outperform most other market issues.

But there is more to the story than record production and huge profits. A darker side of the gold boom is emerging, and it's a troubling tale of massive, permanent landscape alteration, chemical spills, wildlife deaths and general environmental degradation.

For example, look no further than my "Summitville Gold" article *(R&G* January 1988), which explained how modern open-pit heap-leach mining turned a "mined-out" Colorado district into a major new source of gold. The heart of the Summitville operation was an enormous cyanide leach pad that covered one-quarter of a square mile. I reported—and believed—that engineers had designed the pad's vital base with state-of-the-art materials and many extra, expensive "insurance" features to guarantee impermeability—that is, to assure that the highly toxic cyanide leaching solution would never escape into the environment.

Summitville, like most modern US gold mines, was a big success. In its projected six-year operating life, it recovered nearly 300,000 troy ounces of gold, more than the Summitville old-timers had recovered in an entire century. The value of that gold was about $90 million and the operating profit about $30 million.

As planned, the mine began shutting down in 1991. The required reclamation and restoration work would be the final chapter in a story that proved modern mining could coexist with an unspoiled environment.

But something went wrong. In a headline article on November 11, 1991, *The Denver Post* reported: *Deadly cyanide-laced water from a huge gold mine near Wolf Creek Pass has killed all aquatic life in 17 miles of the Alamosa River and the Terrace Reservoir, and it may have seeped downstream into the Rio Grande, say state and federal officials.*

No hoped-for Summitville storybook ending. In fact, it's already a horror story of environmental and financial disaster. The leach pad base, loaded permanently with some 3 million tons of crushed, cyanide-soaked ore stacked over 300 feet high, obviously cannot be "fixed." Detoxification of the pad and ore heap may cost $15 million alone, and the revised reclamation work, which may be done under the Environmental Protection Agency's rigid Superfund guidelines, could take longer than the mine actually operated.

The mine owner, Galactic Resources, Ltd., of Canada, admits it may actually lose $70 million because of " ... environmental problems it did not expect and failures in the basic design."

And Summitville is not an isolated incident. A Montana mining company spent $1 million to "fix" a leach pad that leaked cyanide into downstream tapwater. In South Dakota, investigation revealed that a big leach pad had already been leaking for six months when a company applied for a permit to double its capacity. A Utah heap-leach pad leaked within one week of going on line; another leaked within one month. When a pond dam at South Carolina's Brewer Mine broke in 1990, 10 million gallons of cyanide-laced storm water rushed into downstream creeks and rivers.

To understand some of the environmental problems of modern open-pit heap-leach gold mining, one must look at the history and technology of cyanidation itself.

When we refer to "cyanide" in a modern gold mining context, we mean sodium cyanide: a simple, white crystalline compound containing sodium, carbon and nitrogen. Its many uses range from drug and vitamin manufacture to electroplating. Like many other industrial chemicals, sodium cyanide is highly toxic, and a mere 100 milligrams (no larger than a half a grain of rice) can kill an adult. Although there are far more toxic compounds in industry's chemical inventory, cyanide's name has been forever darkened by a somewhat irrational association with gas chamber executions, spy movie "suicide pills," homemade coyote poisons and nefarious murder plots.

On the positive side, cyanide is not a carcinogen, nor does it accumulate in animal tissues, as lead and mercury, for example. Gold leaching solutions are very dilute and are measured in mere parts per million (ppm). Furthermore, under exposure to solar ultraviolet radiation, cyanide will, under most conditions, break down relatively quickly into nonlethal compounds—a property of great importance to heap leaching.

In the 1840s, German scientists discovered that dilute alkaline cyanide solutions could dissolve gold. The principle was first applied to mining in the 1880s in the New Zealand gold fields, with great success. In 1891, cyanidation was introduced to the United States at Mercur, Utah.

In the 1900s, cyanidation became the standard extraction process for oxidized gold-silver ores, almost always in controlled mill environments and with relatively high-grade ores.

In the 1960s, The U.S. Bureau of Mines and private industry perfected large-scale cyanidation processes suitable for very low-grade gold ores. Nevada's Carlin Mine, working ores grading only 0.05 troy ounces of gold per ton, became the first profitable open-pit heap-leach mine and a model that would revolutionize gold mining.

Although cyanide heap-leach technology was already in place, economic incentive was needed to kick off the modern

continued on next page

When construction was begun on the heap-leach cyanidation pit at Summitville, Colorado, in 1987, it was considered state-of-the-art and safe. It now leaks sodium cyanide into the nearby river system.

Dark Side/ *from page 37*

gold mining boom. That came in the 1970s, with establishment of the Environmental Protection Agency and passage of the Clean Water and Clean Air acts. Mining-related remedial environmental action and research focused on the scars left behind by early coal and metals mining. Priorities were surface reclamation of disturbed land and reduction of acid-heavy metal mine drainage pollution from metal sulfide mining districts.

But as government agencies and environmental activists worried about early mining problems, the mining industry itself headed for the promised land of the coming gold boom: Nevada.

Mining men have described Nevada as "the last, best place for a gold rush." They were correct environmentally, financially and politically. Most of Nevada is arid, sagebrush-covered basin and range country, administered by the Bureau of Land Management and wide open to mineral location. It is little populated and most of it is far from highways, forests, rivers, lakes, national parks and resorts, as well as from the eyes—and concerns—of the public or environmental and outdoor recreational interests. The state, with a long mining heritage and eager for 15,000 new jobs and a dramatically expanded tax base, welcomed the gold mining companies with open arms.

Nowhere else in the United States could gold mining have boomed on such a scale with so little concern or opposition. Almost before anyone knew it, Nevada had over 80 large gold mining operations producing over 6 million troy ounces of gold annually—60 percent of the entire U.S. output. Through a full decade of spectacular expansion, the newspapers told only of more gold exploration, discoveries, production and profits. The big cyanide heap-leach operations in Nevada, initially developed with few environmental controls, became the models for later mines across the western states and all the way east to the Carolinas.

Now, the bright golden glow of the boom is wearing off, and a hint of the environmental cost is emerging. Larry Henry, a spokesman for the Nevada governor's office, says, "When you fly over the state you see huge pits. ... In 30 years, this finite resource that is Nevada will be gone. What will be left behind are cyanide pools and stripped-down mountains and holes in the ground. People are starting to pay attention."

People *should* pay attention. Modern gold mining has already disturbed over 80,000 acres—about 125 square miles—of Nevada alone. The massive landscape alteration includes bench-stripped mountainsides, gaping open pits, enormous waste dumps, surface facilities to crush ores and recover gold and literally thousands of miles of wide, graded access and ore-haulage roads, and crudely bladed exploration tracks leading to countless core-drilling sites. And, of course, there are over 400 cyanide-tainted heap-leach pads, plus holding and overflow ponds that, alone, cover eight square miles.

To my knowledge, cyanide has not caused a single human death during the modern gold boom. Wildlife, however, has not been so fortunate, according to *Audubon Magazine*, which reported: *If migrating waterfowl and shorebirds, stressed by long hours in the air, suddenly spot a shimmering open pond in the desert, they may settle in, drink a swallow or two of the cyanide, and die. Nobody knows how many birds are dying because of these ponds. In Nevada alone, more than 4,500 have been found dead around them. But these are figures volunteered to the Nevada Department of Wildlife by the miners themselves, and many see the reported figures as a small fraction of the actual kill.*

Kill estimates certainly do vary—upward. A General Accounting Office congressional report estimated the five-year kill in Nevada, Arizona and California to be 9,500. Some BLM officials, who requested anonymity, estimate the 1980s Nevada kill to have been in excess of 20,000.

Audubon also reported: *A delivery person who regularly visited several large heap-leach operations in Nevada said, "You see all kinds of dead birds around the ponds. They're mostly ducks and shorebirds, but I've seen songbirds dead, and I saw a golden eagle fly down to one pond, as well as a dead deer in the water. One pond has a dozen or more dead birds around it every time I see it. I asked one of the people there about it, and they told me that if they reported every bird they killed they would be closed down."*

How much cyanide is being used in gold mining? Although leaching solutions are extremely dilute, a large heap-leach mine may have 50 million gallons of cyanide solution in pads or ponds at any one time. Not surprisingly, cyanide manufacturing has skyrocketed. The largest U.S. supplier, the Dow Chemical Company, now manufactures over 160 million pounds—80,000 tons—of sodium cyanide each year. And half of it is shipped to Nevada gold mines.

In Nevada, cyanide solutions containing less than 50 parts per million (ppm) are not considered lethal to birds. Birds sometimes use these ponds for several days, then fly off, seemingly healthy. But no testing has yet determined the cumulative effects of cyanide exposure and ingestion, especially in combination with other chemicals.

There is much uncertainty about exactly what cyanide levels are lethal. Colorado believes only 20 to 40 ppm is lethal. In permitting the new San Luis Project gold mine, the state set a pond limit of only 4.4 ppm.

But trouble developed there, too. In

continued on page 40

Dark Side/
from page 38

April 1992, the pond cyanide level shot up to 170 ppm—almost 40 times the state's limit. The mine shut down, hired guards to keep people away from the ponds and quickly installed noisemaking devices to frighten away birds and animals. The mine had relied on solar ultraviolet radiation to break down the pond cyanide, and attributed the problem to "one of the longest, coldest winters on record that prevented the sun from doing its job."

New gold mines coming on line in Nevada are now required to cover smaller ponds with nets and to chemically neutralize larger ponds.

While mandatory environmental controls are at last catching up with U.S. mining, that's not the case in many other nations.

Gold mining is booming around the world, as reflected in the record 1990 production of 1,400 tons. Most third-world countries have few environmental mining regulations at all and would be unable to enforce them if they did. Brazil is a particularly tragic example.

Brazil's huge gold production is dominated not by large companies, as is the United States, but by an estimated half-million independent gold miners. These *garimpieros* employ not high-tech cyanidation, but the ancient amalgamation process, using mercury-filled sluice riffles to maximize recovery efficiency. *Garimpieros* then separate the gold from the amalgam by simple "cooking," that is, heating in open vessels to drive off the mercury as vapor directly into the atmosphere.

The New York Times recently published an interesting account of mining on Brazil's Rio Madiera, where annual production reaches six tons of gold. *The Times* estimated that two pounds of mercury was used for every pound of gold recovered. If we conservatively estimate that only half of that gold is recovered with mercury, and only half of the mercury is cooked off, then a staggering 6,000 pounds of mercury is dumped into the Rio Madiera environment and food chain every year.

Mercury, of course, is highly toxic; it does not break down, and accumulates in animal tissue throughout the food chain. Were that much mercury dumped into any U.S. environment, it would rank as the environmental disaster of the century. In Brazil, it is repeated quietly, year after year, in the frantic jungle search for gold.

Back in the United States, the huge profits being made at environmental expense have helped unite opposition to the Mining Law of 1872. Legislation has been introduced to radically change the mineral location requirements, as well as to place a substantial federal royalty on all gold mined on public lands.

On the environmental side, legislation has also been introduced to impose a 50-

continued on page 91

Dark Side/ *from page 40*

cent excise tax on every pound of sodium cyanide used in gold mining. Half of the generated revenue—which could exceed $150 million—would go to the federal Abandon Mine Remediation Fund, and the rest to the mining states for mine-related cleanup and regulatory monitoring and enforcement.

But the damage, many environmentalists fear, may already be done. Mining jumped—with state approval—into large-scale heap-leach mining in 1980 with little experience or precedent to fall back on. No one really knew what the long-term effects of several million tons of ore on a leach pad base would be. Clearly, we now know that, because of the massive weight of the ore heaps, possible unpredictable shifting of the earthen base and, as at Summitville, "failures in basic design," no heap-leach pad can ever be truly considered "impermeable."

Surface cyanide spills and leaks can be monitored and eventually neutralized by solar ultraviolet radiation or chemical remediation. But cyanide that escapes leach pads and ponds to enter underground water supplies will receive no solar radiation to break it down. We'll learn what those effects may be 10 or 20 years down the line.

Also, a word on mandated "reclamation" and "restoration" is in order. First, the operating life of the average modern heap-leach gold mine is a mere six years—a very brief period considering the extent of surface disturbance. And don't ever think that reclamation and restoration will conceal all the effects of mining. Under state and federal regulations, tailings and the 300-foot-high ore heaps will be rinsed with water, covered and seeded. Buildings will be torn down and roads will be seeded. But the huge pits, filled with water, will be ours forever.

A South Carolina official recently said, "It's well-known in mining that problems frequently don't show up for 20 or 30 years after mining is under way." That truism is apparent as we now pay a multimillion-dollar bill for cleanup of the glories of frontier-era mining. And it's a good bet that modern heap-leach gold mining will leave us with a new, perhaps bigger, set of problems.

The modern gold mining boom will someday be looked back on as a tremendous learning experience, but not necessarily in a positive manner. Reflecting on the Summitville disaster, a senior vice president of Galactic Resources stated, "As a school, it has been an incredible learning experience," then added that Galactic was getting out of the United States and heading for South America.

The bottom line of the modern gold boom is this: It was one heck of a ride, but it won't be a free one. If we don't pay for it, our kids will because, as they say, the bill is in the mail.

(2) Will each of the various liner systems meet the stated Commission Policy?

- The OAR 340-43-065(4) Triple Liner System will generally meet the stated Commission Policy.

- The OMC Double Liner System will have difficulty meeting the stated Commission Policy.

- The Alternative Candidate Liner System will meet the stated Commission Policy.

(3) **For those liner systems which will meet the stated Commission policy, what level of certainty for achieving this policy do you assign to each system?**

- Using assigned values (refer to Section 2.3 for discussion), mathematically generated weighted average levels of certainty (the greater the number, the higher the level of certainty) are as follows:

Liner System	Table 2.2 *Equal Weight on All Components*	Table 2A *Emphasis on Lower Components*	Table 2.3 *Emphasis on Upper Components*
OAR 340 Triple Liner	28.0	~~51.0~~ 61.0	~~61.0~~ 51.0
OMC Double Liner	19.0	~~41.0~~ 35.0	~~35.0~~ 41.0
Alternative Candidate Triple Liner	29.0	~~62.0~~ 54.0	~~54.0~~ 62.0

(4) **Are there other liner systems which will achieve this policy and what level of certainty for achieving this policy do you assign to each?**

- There are a number of other liner systems which will achieve this policy. TRC selected one (the Alternative Candidate Triple Liner) for additional analysis, the results of which are presented above.

cc EQC done 7/31/92 nj

State of Oregon
DEPARTMENT OF ENVIRONMENTAL QUALITY
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JUL 29 1992
OFFICE OF THE DIRECTOR

THE WILDERNESS SOCIETY

OREGON REGION

July 29, 1992

Mr. Fred Hansen, Director
Department of Environmental Quality
811 SW Sixth Avenue
Portland, OR 97204

Dear Mr. Hansen,

The two articles enclosed from Pay Dirt magazine illustrate the grave concerns I have discussed with you and your staff regarding the TRC Engineering Consultants (TRC) draft and final reports.

Clearly, spokespersons for the mining industry believe that the Environmental Quality Commission (EQC) "selected TRC Engineering Consultants to review and rewrite environmental regulations for the state," (June article); and, TRC "was hired by the Oregon Department of Environmental Quality to find middle ground between the greens and the industry" and "it is suggesting what the mining industry suggested: more site-specific and performance-based rules," (July article). (Emphasis added.)

TRC was not hired by the EQC for any of these reasons. TRC was hired to provide technical commentary only. However, after reviewing TRC's draft and final reports, there can be no doubt that TRC saw its role as an advocate for positions consistent with those of the Northwest Mining Association and Oregon Mining Council expressed in the Pay Dirt articles.

The obvious risk of TRC becoming a policy advocate is why we so vigorously protested the Oregon Mining Council (OMC) policy papers being sent to TRC immediately following the public meeting May 5. (See attached letter dated May 19.) While we are disappointed that an "independent" consultant would produce a draft report that was an almost verbatim repetition of the May 5 OMC policy papers, we were hardly surprised.

TRC's perception of its role as a policy advocate probably also explains why TRC responded so defensively when this conflict was pointed-out by Department of Environmental Quality (DEQ) staff. Even in the final report, TRC repeatedly makes policy recommendations instead of providing technical evaluations; and, in most cases, fails to answer the direct questions posed by EQC.

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DEQ and EQC will be confronted with a monumental task August 7, to focus discussions and decisions on appropriate topics. We trust that DEQ staff will identify for EQC the consultant's numerous failures to carry out EQC's instructions. While we remain less than optimistic that the complete integrity of the process can be restored given the content and quality of TRC's work product, we will be prepared nonetheless to offer extensive comments at the August 7 meeting.

Please make this letter and the attached materials part of the Department's transmittal to the Commissioners.

Sincerely,

Larry Tuttle
Oregon Regional Director

cc: Harold Sawyer
Lydia Taylor
Anne W. Squier
Patricia McCaig

Oregon mining regulations could be in place by August

By Gary Dillard
Staff Reporter

From the way the process is moving along, it is possible that environmental regulations governing mining in the state of Oregon could be in place by August, giving mining companies a good idea of whether they can do work there.

By the end of April, the Oregon Environmental Quality Commission had selected TRC Engineering Consultants to review and rewrite environmental regulations for the state.

"We are pleased with the selection of TRC," said Robbin A. Lee, a spokesman for Denver-based Atlas Corporation. The firm is ready to develop a gold mine in Oregon and is thus at the forefront of the controversy.

She said the company has worked on similar regulations for other states and is familiar with the process.

On May 6th, the company held a public "scoping" session to get input into the process, and shortly thereafter released a timetable, which indicated that draft regulations would go to the EQC by June 5th.

After that time, the EQC would ask for comments.

"We're hoping the final regulations will be in place by August," Lee said.

Atlas expected to know well before that whether it would be able to build a mine in Oregon's Malheur County. "Once we see the draft regulations, we'll be able to have an idea where they're going," Lee said.

While the company and the rest of the industry are hopeful that these "compromise" regulations will allow development, there is always a chance it won't happen.

Last December, before the EQC came up with its first set of regulations, which shocked the industry and led to the current exercise, Atlas and industry groups felt they had educated commission members on various mining topics.

"All of that was lost to some strong, last-minute lobbying by environmental groups" which led to the most oppressive regulations that any state has come up with, she said.

Atlas is prepared to meet just about any kind of regulations. It has 2 feasibility studies for its proposed Grassy Mountain project. The first is an $80 million project that would develop a 100,000-ounce-per-year openpit gold mine that would recover 100,000 ounces each of gold and silver over an 8-year mine life.

The second, less capital-intensive, version would be an underground mine which would be aimed at recovering most of the 300,000-ounce higher-grade part of the orebody.

While an underground mine would be less noticeable, it also would waste much of the resource.

The EQC agreed December 13th to postpone enacting a set of rules that mining companies feared would put them out of business in the state before they could even get started. The agency agreed to find a neutral third party that could consider points brought up by the mining industry and others.

As *PAY DIRT* reported in December, the agency backed off at that time because of a strong presentation by industry representatives, including Mike Filion of Teck Corporation and John Parks of Atlas. The presentations brought up questions and concerns that the agency hadn't considered.

TRC will be looking at such items as closure standards, methods and measures, including waste classification testing, and the question of whether all of the required liners and caps on waste are needed.

The proposed regulations included triple-liners, detoxification of heaps and capping.

After the December 13th decision, Ivan Urnovitz, manager of governmental relations for the Northwest Mining Association, said, "It feels like a stay of execution, but at least they will be taking a long, hard look at it from a party that has no vested interest.

"We're confident that our argument is strong enough that it will be supported by the third-party reviewer."

Of Mines And Men

Crown reports loss, but finances remain strong

Crown Resources Corporation has reported a first quarter loss of $1.2 million dollars, compared with net income of $2.1 million in the year-earlier period.

But that's not as bad as it sounds, according to the company's report.

Contributing to the loss were lower gold prices, deliberately reduced gold sales, reduced gold production from a joint venture property and a writedown of gold inventories to reflect lower prices.

Also, included in the 1991 first period results was a $5 million payment received from Battle Mountain Gold for exercise of its option to enter into a joint venture with Crown for development of its Crown Jewel property in Washington state. In March of this year, Battle Mountain announced its decision to bring the property into production.

Crown sold 1,800 ounces of gold at an average realized price of $357 per ounce, compared with 3,930 ounces at $382 in the year-earlier period. The company elected to limit gold sales during the quarter, increasing its refined bullion inventories to more than 11,000 ounces.

Crown's share of production from its 30 percent interest in the Kettle River joint venture in the Republic District of northeastern Washington for the quarter was 6,574 ounces, compared with 7,423 ounces during the 1991 first period, reflecting lower ore grades.

Cash production costs at Kettle River were $287 an ounce in the first quarter, down from $319 in the fourth quarter and up from $248 in the 1991 first period when more ounces were produced.

As a result of continued high costs at Kettle River and the decline in market prices, Crown said a writedown of $421,000 was recorded at the end of the quarter to revalue its gold inventories.

At the end of the first quarter, Crown Resources said it had $6.6 million in cash on hand, compared with $11.1 million a year earlier. It said the change was mainly the result of capital and debt reduction costs associated with inclusion of the Lamefoot property into the Kettle River joint venture at the end of 1991.

RTZ to sell interest in Rio Algom, take a loss

Because of what it calls a potential conflict of interest, RTZ is in the process of selling at a loss its 51.5 percent interest in Rio Algom Ltd., a large Canadian mining company.

RTZ said the sale will result in an extraordinary loss of about 30 million pounds sterling (mps).

Explaining the reason for the sale, the June 8th RTZ announcement said:

"Rio Algom was formed in 1960 and until 1989 remained RTZ's principal Canadian mining interest. Since 1989, when RTZ acquired further substantial 100 percent-owned North American minerals interests, the potential for a conflict of interest between these and Rio Algom, with its significant 48.5 percent publicly held minority shareholding, has existed. RTZ and the Board of Rio Algom have concluded the sale is in the best interests of both companies."

Three Canadian securities firms have underwritten the placing of 22,506,336 common shares with a wide range of mainly Canadian institutional investors for (C)$16.10 a share, paid in three annually installments. The shares will not be offered in the U.S., RTZ said.

Last year Rio Algom contributed 11 mps to RTZ's net earnings of 308 mps. RTZ said its carrying value of the Rio Algom stock being sold is 148 mps. With an anticipated net return of 118 mps, the sale will result in the loss of 30 mps, RTZ said.

MINERS IN OREGON SHOULD KNOW soon what kinds of rules they will face in developing gold operations in that state. TRC Engineering Consultants was hired by the Oregon Department of Environmental Quality to find a middle ground between the greens and the industry. The consultant has presented a draft to the state, comments have been received on the draft from all concerned parties (including, interestingly, from the DEQ) and were shipped back to TRC on July 2nd, according to Ivan Urnovitz of the Northwest Mining Association. After receipt, TRC had 15 days to complete a final report. The final rules were expected to go before the Environmental Quality Commission at its meeting August 7th. At that time, Urnovitz said, "we expect the EQC to cut the baby in half." TRC, he said, "did not unconditionally back anybody." But it is suggesting what the mining industry suggested: more site-specific and performance-based rules. "That general theme is very consistent with ours," he said. Though there is no way to know what the agency will adopt, there is hope that the new rules "would build in enough flexibility to the regulatory process so the operating companies would see there's a chance of getting a permit."

A FEDERAL APPEALS COURT IN DENVER has turned down 2 motions seeking to set aside a land exchange that swapped private land in the Grand Teton National Forest for a coal leasing tract in Sheridan County, Wyoming, the Associated Press reports. The 10th U.S. Circuit Court of Appeals ruled neither the State of Wyoming nor Ash Creek Mining Company had legal standing to challenge the completed land swap. In August 1985, the Interior Department tentatively agreed to exchange 2,560 acres of federal coal in 2 Sheridan County leasing tracts for 1,106.49 acres of the JY Ranch conservation easement in the Grand Teton National Park in northeast Wyoming. Ranch owner Laurance S. Rockefeller donated the easement to The Sloan-Kettering Institute for Cancer Research in December 1987. Two years later, the Interior Department published notice of the proposed land swap, which was protested by Ash Creek Mining Company, Wyoming and others. Initially, the Oklahoma-based company challenged the Interior Department's decision to set aside the Ash Creek coal leasing tract from competitive leasing policies. That complaint was rejected by the district court and the appeals court. Wyoming also filed suit and Ash Creek filed a second complaint, saying it wanted to bid on the coal rights. In March 1991, the district court dismissed both complaints. The court said neither the state nor Ash Creek satisfied legal requirements for a standing because neither proved its alleged injury could be redressed by voiding the exchange. The appeals court affirmed both district court decisions July 8th.

A CLEANUP PLAN FOR INACTIVE IDARADO MINE SITES in Telluride and Ouray has been approved by a federal judge in Denver, ending 2 years of negotiations between the Newmont Mining Corporation subsidiary and state officials over reclamation of the sites. The settlement also includes compensation for the loss of natural resources, which will bring $1 million directly to the Ouray-Telluride area to restore and enhance natural resources. U.S. District Judge Jim R. Carrigan on July 7th signed a settlement agreement detailing the cleanup plan, according to a statement released by the state attorney general's office and the Colorado Department of Health. The cleanup plan calls for a phased approach to the cleanup project and sets performance objectives for revegetation of mine waste and for water quality improvement. The plan focuses on reclamation of several tailings piles, mine waste rock and portal discharges in the San Miguel River and Red Mountain Creek drainage basins. Standards also were set to protect human health and the environment. The plan gives Idarado 5 years to restore the sites, after which state officials will have 10 years to evaluate the success of the cleanup effort and the permanence of the company's work.

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THE WILDERNESS SOCIETY

OREGON REGION

May 19, 1992

Mr. Fred Hansen, Director
Department of Environmental Quality
811 SW Sixth Avenue
Portland, OR 97204

Dear Mr. Hansen,

Yesterday, I returned to the office following two weeks in Washington, D.C. Today was my first opportunity to review submissions to the Department which I understand are proposed to be sent to TRC Environmental Consultants, Inc. Among the materials submitted is an issue paper prepared by the Oregon Mining Council dated May 5, 1992, entitled "Proposed Chemical Mining Rules."

Mr. Hansen, the issue paper is an attempt by the Oregon Mining Council to continue to subvert both the carefully crafted RFP process established by the Environmental Quality Commission and the issues the consultant's report was designed to settle. In short, the Oregon Mining Council issue paper seeks to reargue the basic precepts of the independent analysis requested and established by the Commission. To some degree, the Oregon Mining Council sought to do this at the May 5 Public Meeting as well. However, the issue paper is a more blatant attempt to revisit the Oregon Mining Council positions fully debated and considered by the Commission.

The issue paper should not be submitted to the consultant. If the Oregon Mining Council has a problem with the Commission's decisions and the format of the RFP and independent analysis, the appropriate forum for this discussion is a properly noticed Commission meeting -- not communications through the back door to the consultant.

If the Oregon Mining Council wishes to submit a properly <u>verified</u> transcript of the December 20, 1991, or any other Commission meeting, obviously this is appropriate. However, issue paper pages 1 - 25 following the Table of Contents are inappropriate in total and should be returned to the Oregon Mining Council. Table

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(503) 248-0452

1 following the Appendix divider and several of the tables and letters in the Exhibits section are inconsistent with the issues to be considered by the consultant.

We will deliver to the Department this week a bibliography of articles and other references to be submitted to TRC Environmental Consultants, Inc. In addition, please forward copies of the tapes of the December 20, 1991, Commission meeting; and, the May 5, 1992, Public Meeting. Our check in the amount of $12.00 is enclosed to cover this expense.

Please make this letter part of the permanent record in this matter.

Sincerely,

Larry Tuttle
Oregon Regional Director

cc: Harold Sawyer

THE WILDERNESS SOCIETY

NORTHWEST REGION

August 13, 1992

Dear Mr. Hansen,

For your information, the enclosed letter was sent to all Commissioners.

Sincerely,

Val Kitchen

State of Oregon
DEPARTMENT OF ENVIRONMENTAL QUALITY
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OREGON REGION

August 13, 1992

William Wessinger
121 S.W. Salmon
Suite 1100
Portland, OR 97204

Dear Commissioner Wessinger,

It is our understanding that during the August 7, meeting of the EQC, Commissioners determined that the protection provided by the OAR triple liner system should be retained but that the mining industry should have some flexibility to propose alternative technologies. We perceive the Commission to have decided to adopt a performance standard rather than a strict design standard for liner systems, while at the same time resolving that liner system proposals must perform at least as well, with regard to environmental protection, as the OAR triple liner system.

We hesitate to argue against flexibility, since we do not wish to preclude use of new and potentially more environmentally protective technologies. However, we remain concerned about the ability of the Department to respond to a large volume of varying plans. Let us make clear that given staffing restraints, it is the volume of potential applications, and not the ability of staff, which is of concern.

The general perception seems to be that Atlas Precious Metals Inc. (Atlas) will be a single and isolated operation. However, documentation by the state office of the BLM indicates otherwise. The BLM has on record 35,000 active mineral claims in Oregon. Granted, not all of these 35,000 claims will be developed to the scale proposed by Atlas. However, we wish to challenge the mining industry's repeated assertion that just one or two claims with potential for development have been staked.

In their 1989 annual report, Euro-Nevada Mining Corporation Limited states, "the most exciting new development on the exploration front is our push into southeast Oregon where we now own 100% of nine separate prospects, in the hottest new land play to come alive in the southwest U.S. We have a prominent position in what is considered prime ground in a play that is evolving much like the Carlin Trend in the early 1980's. Our idea here is to make joint venture agreements with several major companies and we have been approached by no less than nine companies so far to do so."

A February 12, 1989, article in the Oregonian reported that, "southeastern Oregon's gold rush was sparked in large measure by discovery of the open-pit Sleeper Mine near Winnemucca, Nevada. Its red and green ores contain the richest known gold deposits in the nation. Within six months of its start-up, the Sleeper Mine yielded enough gold to pay off $27 million in exploration and development costs."

Additionally, the article noted that, "the Idaho land board recently put up 17,000 acres of Owyhee County, near the Oregon border, for competitive bidding, after a recent announcement by a company called War Eagle Mining of a 'world-class ore body' near Owyhee Lake in southeastern Oregon."

The Daily Journal of Commerce on January 30, 1990, quoted Gary Lynch, Supervisor of the DOGAMI's Mined Land Reclamation division, as saying, "the same northern Nevada geology that makes that state the nation's leading gold producer underlies Oregon east of the Cascades."

As the Commission proceeds with drafting language addressing liner system requirements, we ask that you consider the above information. On behalf of Oregon's environment and our concerned members, we thank you for your close attention to this difficult process.

Sincerely,

Valerie Kitchen

Valerie Kitchen
Regional Associate

FYI - This letter was sent to all Commissioners

THE WILDERNESS SOCIETY

OREGON REGION

August 25, 1992

William Wessinger
121 S.W. Salmon
Suite 1100
Portland, OR 97204

State of Oregon
DEPARTMENT OF ENVIRONMENTAL QUALITY
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OFFICE OF THE DIRECTOR

Dear Chair Wessinger,

We have reviewed the new wording which appears as OAR 340-43-065 (4)(d) of the Department's Chemical Mining Rules. We feel the new language accurately reflects the direction of the Commission during the August 7 meeting.

As you know, we have strong concerns about the potential high volume of mining applications and coinciding staffing restraints within the Department. However, we understand the perceived need for flexibility in the design requirements and support the direction of the Commission on this important issue.

Thank you for consideration of our comments. If you have questions prior to the September 1 Commission conference call, please do not hesitate to contact us.

Sincerely,

Valerie Kitchen
Valerie Kitchen
Regional Associate

Larry Tuttle
Regional Director

610 SOUTHWEST ALDER, SUITE 915, PORTLAND, OREGON 97205
(503) 248-0452

Date: 7-20-92 8:52am
From: Harold Sawyer:OD:DEQ
To: Fred Hansen:OD
cc: Carolyn Young:OD, Tina Payne:OD, Pete Dalke:MSD
Subj: TRC Report on Mining Rules

TRC called on Friday (I was out) to say that they would not be able to complete the revisions to the report and deliver the final to us by close of business on July 17. They indicated that response to comments received (quite a few) and significant revisions to the report (at our request) would delay delivery of the final report until Wednesday morning, July 22.

We asked them to reformat the section on liners to make it a little easier to read. That reformatting required additional effort and verification.

They indicated that they were modifying the draft as we requested to delete conclusions that we might view as dealing with policy and outside the scope of work for the contract. They did note, however, that they do not believe their draft deviated from the scope of work in the contract, but were complying with our directions.

Our intent had been to copy the report today and distribute it to the Commission and interested persons. It will now be Thursday before we can have copies available.

Concerned Citizens For Responsible Mining

• P.O. Box 957 • Ontario, Oregon 97914 •

August 28, 1992

William Wessinger
121 S.W. Salmon
Suite 1100
Portland, Oregon 97204

Dear Chair Wessinger,

The intent of this correspondence is to express our support of language revisions recently incorporated into the draft of the proposed DEQ chemical mining rules. We encourage adoption of standards which package flexibility with strong environmental protection: the revised rules provide that benefit.

Thank you for your consideration.

Sincerely,

Carolyn Brown

Carolyn Brown
CCRM

OREGON MINING COUNCIL
200 Century Tower, 1201 S.W. 12th Avenue
Portland, Oregon 97205
(503) 227-5591

State of Oregon
DEPARTMENT OF ENVIRONMENTAL QUALITY
RECEIVED
AUG 31 1992
OFFICE OF THE DIRECTOR

August 27, 1992

Mr. William Wessinger, Chair
Environmental Quality Commission
121 SW Salmon, Suite 1100
Portland, Oregon 97204

Dear Mr. Wessinger:

I feel it is important to respond to recent references related to cyanide impacts at the Landusky Mine in Montana and the Summitville Mine in Colorado. Both of these operations utilize "valley-fill" heap leach designs. As you are aware, the proposed Chemical Mining Rules require the operator, ". . . prevent an accumulation of process chemical within the heap greater than 24 inches in depth.", OAR 340-43-065 (8). Neither of these operations could be permitted in Oregon as solutions typically accumulate in a valley-fill heap in the order of tens of feet.

The long term fate of residual cyanide in the heaps of potential operations in Oregon has also repeatedly been raised as a concern. The reference identified to support this concern has been the Environmental Assessment (EA) for the Landusky Mine Expansion in Montana (May 11, 1990). Subsequent to the release of this EA, a research project was commissioned which included a study of the fate of cyanide at this facility. A final report titled "Cyanide Degradation and Decommissioning of Spent Heap-Leach Ore at the Landusky Mine" was issued on December 28, 1990. Its authors concluded that natural degradation of residual cyanide will bring the facility into compliance with regulatory standards for cyanide within 6 to 10 years.

Again, I must caution that these comparisons of valley-fill heaps and potential Oregon operations are largely misleading and inappropriate.

Sincerely,

John C. Parks

John C. Parks-Chair
Oregon Mining Council

cc: Dr. Emery Castle
Mr. Henry Lorenzen
Ms. Carol Whipple
Ms. Linda R. McMahan
Mr. Frederic Hansen
Mr. Harold L. Sawyer

State of Oregon
Department of Environmental Quality
Memorandum

Date: August 26, 1992

To: Fred Hansen

From: Harold Sawyer

Subject: Question on Mining Rules

You asked that I check with Commission members for their response to the question:

> "Do you expect that the rules, if adopted as currently proposed, will allow for approval of the TRC liner?"

Commissioner Lorenzen said "No." He expressed concern that the 1 foot of clay in the secondary liner (below the leak) detection layer was not adequate protection. He felt it would be closer if there was a membrane proposed in contact with the clay, but that still may not do it. The potential for settlement under 300 feet of ore poses a risk of damaging the liner and 3 feet of clay would be more likely to survive such settlement in tact.

Commissioner Castle said "Not necessarily, no." He expressed some of the same concerns as Commissioner Lorenzen.

Commissioner Whipple indicated there was no predetermination that the TRC liner alternative would either be approved as an equivalent liner or rejected. She was aware of the expressed Department view that the TRC liner would not be equivalent, but made no judgment on the issue one way or the other because she had not seen the detailed arguments.

I did not reach Commissioner McMahan and did not try to contract Chair Wessinger.

Oregon

DEPARTMENT OF
ENVIRONMENTAL
QUALITY

August 24, 1992

Honorable Ron Cease
Oregon State Senator
2625 N. E. Hancock
Portland, Oregon 97212

Ron
Dear ~~Senator Cease~~:

Thank you for your August 7, 1992, letter about the proposed mining rules under consideration by the Environmental Quality Commission (EQC). A copy of your letter was provided to the Commission at the August 7, 1992, meeting.

At the August 7 meeting, the mining industry indicated that the proposed rules contained redundant requirements which would increase costs without providing significant environmental enhancement; environmental representatives indicated that the rules should be adopted as proposed and be made more stringent in some areas. The EQC spent over five hours receiving comments and deliberating on the proposed rules.

The Commission generally agreed with the Department's proposed rule amendments. The Commission made changes, however, in two key areas. First, in relation to the liner systems, the Commission agreed, in part, with the mining industry that their protection goal could be approved upon demonstration by permit applicants that the alternatives provide equivalent or better environmental protection. Second, the Commission eliminated the requirement that cyanide be reused, instead indicating that this was one of three options for reducing mill tailing toxicity. This change will allow cyanide destruction technology to be used along with removal and reuse.

The Commission clearly expressed the policy position that, with the intended modifications and lack of long-term experience with heap leach mining operations following closure, the rules provide appropriate environmental protection without unnecessary redundancy.

811 SW Sixth Avenue
Portland, OR 97204-1390
(503) 229-5696

The Commission will consider final adoption of these changes during a special telephone conference meeting to be held on Tuesday, September 1, at 8:30 a.m. Although it is sometimes dangerous to measure the success of a rule making by the reaction of the opposing sides, I believe in this case the response of the mining industry and environmentalists, at least as reported in the newspaper, was of consensus if not enthusiasm.

Sincerely,

Fred Hansen
Director

HLS/kp

RON CEASE
MULTNOMAH COUNTY
DISTRICT 10

REPLY TO ADDRESS INDICATED:
☐ Senate Chamber
Salem, OR 97310
☐ 2625 NE Hancock
Portland, OR 97212

OREGON STATE SENATE
SALEM, OREGON
97310

DEPARTMENT OF ENVIRONMENTAL QUALITY
State of Oregon
RECEIVED
AUG 07 1992
OFFICE OF THE DIRECTOR

August 7, 1992

William W. Wessinger, Chair
Environmental Quality Commission
Department of Environmental Quality
811 SW Sixth
Portland, Oregon 97204

Dear Mr. Wessinger:

I am unable to attend the Commission's session this morning, but do want to encourage you and your colleagues to adopt strong rules regulating heap leach cyanide-based gold mining operations.

The Gold Mining Bill adopted by the last legislative session is a national model. But the proof is in the pudding: the regulations adopted by the Commission and the implementation and oversight of those regulations by the DEQ. Gold mining operations could be an economic boon to a number of Oregon's communities, but should be authorized only under conditions that will protect people's health and safety and the environment. It is becoming increasingly clear that the protection of the State's ground and surface waters must be given high priority. A leading question: What will be the impact of the Commission's chemical mining regulations on the waters of the State?

I urge the Commission to adopt the proposed heap leach mining regulations dated December 13, 1991.

Sincerely,

Ron Cease

Ron Cease
State Senator and Chair, Senate Water Policy Committee

Oregon

DEPARTMENT OF
ENVIRONMENTAL
QUALITY

August 24, 1992

Honorable Lenn L. Hannon
Oregon State Senator
240 Scenic Drive
Ashland, Oregon 97520

Dear Senator ~~Hannon~~ Lenn:

Thank you for your August 5, 1992, letter about the proposed mining rules under consideration by the Environmental Quality Commission (EQC). A copy of your letter was provided to the Commission at the August 7, 1992, meeting.

At the August 7 meeting, the mining industry indicated that the proposed rules contained redundant requirements which would increase costs without providing significant environmental enhancement; environmental representatives indicated that the rules should be adopted as proposed and be made more stringent in some areas. The EQC spent over five hours receiving comments and deliberating on the proposed rules.

The Commission generally agreed with the Department's proposed rule amendments. The Commission made changes, however, in two key areas. First, in relation to the liner systems, the Commission agreed, in part, with the mining industry that their protection goal could be approved upon demonstration by permit applicants that the alternatives provide equivalent or better environmental protection. Second, the Commission eliminated the requirement that cyanide be reused, instead indicating that this was one of three options for reducing mill tailing toxicity. This change will allow cyanide destruction technology to be used along with removal and reuse.

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Portland, OR 97204-1390
(503) 229-5696

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Sincerely,

Fred Hansen
Director

HLS/kp

LENN L. HANNON
JACKSON COUNTY
DISTRICT 26

REPLY TO ADDRESS INDICATED:
☐ Senate Chamber
Salem, OR 97310-1347
☐ 240 Scenic Drive
Ashland, OR 97520

COMMITTEES
Member:
Rules
Health Insurance & Bio-Ethics
Ways and Means
Sub—Education
Sub—Public Safety

Assistant Republican Leader

STATE OF OREGON 1859

OREGON STATE SENATE
SALEM, OREGON
97310-1347

August 5, 1992

Faxed copy
sent 8/6/92

Mr. Fred Hansen, Director
Department of Environmental Quality
811 SW Sixth Avenue
Portland, Oregon 97204

Dear Fred:

I have recently been briefed by the mining industry regarding proposed Department rules dealing with gold mining. I am very concerned that the matters which we discussed last December will not be included as part of the Environmental Quality Commission deliberations on August 7, 1992. You assured those of us at the meeting last December, after agreeing to hire and pay for an outside consultant, that documentation from a qualified firm would be reviewed and considered before a decision was made. Somehow, I get the distinct feeling that, for the most part, the TRC REPORT will largely be ignored on the basis that it does not reflect your stance on this issue. I certainly hope not.

As expressed to you last December, I am very concerned with the following rudimentary issues of placing additional heap leach mining administrative rules and regulations on operations wishing to establish in Oregon: a) the "over-kill" of mandates to the industry without significant increase in environmental protection; b) the cost of implementation versus significant environmental enhancement.

I agree with you that these types of operations must be conducted in an environmentally sound setting and in an appropriate manner. I cannot imagine anyone, on either side of the environmental issue, disagreeing with that. However, I am most concerned that the Department has taken a position of basically disregarding the TRC REPORT (on which thousands of state dollars were spent), which will preclude the development of any heap leach gold mining operations in Oregon.

I respectfully request that a copy of this letter be given to each Commission member prior to the work session/hearing on August 7, 1992.

Thank you for your fair consideration.

Sincerely,

Lenn

LENN L. HANNON
State Senator
District 26

LLH/dlh

State of Oregon
DEPARTMENT OF ENVIRONMENTAL QUALITY
RECEIVED
AUG 10 1992
OFFICE OF THE DIRECTOR

Oregon

DEPARTMENT OF
ENVIRONMENTAL
QUALITY

August 24, 1992

Honorable Gene Timms
Oregon State Senator
1049 N. Court
Burns, Oregon 97720

Dear Senator ~~Timms~~ Gene:

Thank you for your August 4, 1992, letter about the proposed mining rules under consideration by the Environmental Quality Commission (EQC). A copy of your letter was provided to the Commission at the August 7, 1992, meeting.

At the August 7 meeting, the mining industry indicated that the proposed rules contained redundant requirements which would increase costs without providing significant environmental enhancement; environmental representatives indicated that the rules should be adopted as proposed and be made more stringent in some areas. The EQC spent over five hours receiving comments and deliberating on the proposed rules.

The Commission generally agreed with the Department's proposed rule amendments. The Commission made changes, however, in two key areas. First, in relation to the liner systems, the Commission agreed, in part, with the mining industry that their protection goal could be approved upon demonstration by permit applicants that the alternatives provide equivalent or better environmental protection. Second, the Commission eliminated the requirement that cyanide be reused, instead indicating that this was one of three options for reducing mill tailing toxicity. This change will allow cyanide destruction technology to be used along with removal and reuse.

The Commission clearly expressed the policy position that, with the intended modifications and lack of long-term experience with heap leach mining operations following closure, the rules provide appropriate environmental protection without unnecessary redundancy.

811 SW Sixth Avenue
Portland, OR 97204-1390
(503) 229-5696

The Commission will consider final adoption of these changes during a special telephone conference meeting to be held on Tuesday, September 1, at 8:30 a.m. Although it is sometimes dangerous to measure the success of a rule making by the reaction of the opposing sides, I believe in this case the response of the mining industry and environmentalists, at least as reported in the newspaper, was of consensus if not enthusiasm.

Sincerely,

Fred Hansen
Director

HLS/kp

EUGENE (GENE) D. TIMMS
HARNEY, LAKE, MALHEUR, GRANT,
BAKER, CROOK & MORROW COUNTIES
DISTRICT 30

REPLY TO ADDRESS INDICATED:

☐ S-302
State Capitol
Salem, Oregon 97310-1347

☐ 1049 N. Court
Burns, Oregon 97720

OREGON STATE SENATE
SALEM, OREGON
97310-1347

State of Oregon
DEPARTMENT OF ENVIRONMENTAL QUALITY
AUG 10 1992

OFFICE OF THE DIRECTOR

August 4, 1992

Mr. Fred Hansen, Director
Department of Environmental Quality
811 S.W. Sixth Avenue
Portland, Oregon 97204

Dear Fred,

I have been briefed by the mining industry regarding the status of the proposed Rules dealing with gold mining and the TRC report. I am concerned that the matters which we discussed back in December will not be part of the Commission's deliberations this Friday.

Among those concerns are:

1. The question of costs without significant environmental enhancement.

2. Redundancies which result in "overkill", again with no significant increase in environmental protection.

I support the concept that these operations must be conducted in the environmentally appropriate manner. However, I am deeply concerned that the Department has taken a stance, in response to the TRC report (on which thousands of dollars were spent), which will preclude the development of any heap leach gold mining operations in Oregon.

Please convey to all of the members of the Commission my strong hope that whatever Rules are adopted will not only provide environmental protection, but will permit this very desirable economic activity to move forward.

Sincerely,

Gene

Gene Timms
State Senator
District 30

GT:mlz

Oregon

DEPARTMENT OF ENVIRONMENTAL QUALITY

August 24, 1992

Honorable Wayne Fawbush
Oregon State Senator
5000 O'Leary Road
Hood River, Oregon 97031

Wayne
Dear Senator ~~Fawbush~~:

Thank you for your August 5, 1992, letter about the proposed mining rules under consideration by the Environmental Quality Commission (EQC). A copy of your letter was provided to the Commission at the August 7, 1992, meeting.

At the August 7 meeting, the mining industry indicated that the proposed rules contained redundant requirements which would increase costs without providing significant environmental enhancement; environmental representatives indicated that the rules should be adopted as proposed and be made more stringent in some areas. The EQC spent over five hours receiving comments and deliberating on the proposed rules.

The Commission generally agreed with the Department's proposed rule amendments. The Commission made changes, however, in two key areas. First, in relation to the liner systems, the Commission agreed, in part, with the mining industry that their protection goal could be approved upon demonstration by permit applicants that the alternatives provide equivalent or better environmental protection. Second, the Commission eliminated the requirement that cyanide be reused, instead indicating that this was one of three options for reducing mill tailing toxicity. This change will allow cyanide destruction technology to be used along with removal and reuse.

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(503) 229-5696

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Sincerely,

Fred

Fred Hansen
Director

HLS/kp

WAYNE H. FAWBUSH
DESCHUTES, GILLIAM, HOOD RIVER,
JEFFERSON, SHERMAN, WASCO,
AND WHEELER COUNTIES
DISTRICT 28

REPLY TO ADDRESS INDICATED:
☐ Senate Chamber
Salem, OR 97310
☐ 5000 O'Leary Road
Hood River, OR 97031

OREGON STATE SENATE
SALEM, OREGON
97310

COMMITTEES
Co-Chairperson:
Trade and Economic Development
Member:
Water Policy
Ways & Means

August 5, 1992

Mr. Fred Hansen, Director
Department of Environmental Quality
811 S.W. Sixth Avenue
Portland, Oregon 97204

Dear Fred:

I have been briefed by the mining industry regarding the status of the proposed rules dealing with gold mining and on the TRC report. I am concerned that the matters which we discussed back in December will not be part of the Commission's deliberations this Friday.

Among those concerns are:

1. The question of costs without significant environmental enhancement.

2. Redundancies which result in "overkill" again with no significant increase in environmental protection.

I support the concept that these operations must be conducted in an environmentally appropriate manner. However, I am deeply concerned that the Department has taken a stance, in response to the TRC report (on which thousands of dollars were spent), which will preclude the development of any heap leach gold mining operations in Oregon.

Please convey to all of the members of the Commission my strong hope that whatever rules are adopted will not only provide environmental protection, but will permit this very desirable economic activity to move forward.

Very truly yours,

Wayne Fawbush

Senator Wayne Fawbush

Oregon

DEPARTMENT OF
ENVIRONMENTAL
QUALITY

August 24, 1992

Honorable John Minnis
Oregon State Representative
23765 N. E. Holladay
Woodvillage, Oregon 97060

John
Dear Mr. ~~Minnis~~:

Thank you for your August 6, 1992, letter about the proposed mining rules under consideration by the Environmental Quality Commission (EQC). A copy of your letter was provided to the Commission at the August 7, 1992, meeting.

At the August 7 meeting, the mining industry indicated that the proposed rules contained redundant requirements which would increase costs without providing significant environmental enhancement; environmental representatives indicated that the rules should be adopted as proposed and be made more stringent in some areas. The EQC spent over five hours receiving comments and deliberating on the proposed rules.

The Commission generally agreed with the Department's proposed rule amendments. The Commission made changes, however, in two key areas. First, in relation to the liner systems, the Commission agreed, in part, with the mining industry that their protection goal could be approved upon demonstration by permit applicants that the alternatives provide equivalent or better environmental protection. Second, the Commission eliminated the requirement that cyanide be reused, instead indicating that this was one of three options for reducing mill tailing toxicity. This change will allow cyanide destruction technology to be used along with removal and reuse.

The Commission clearly expressed the policy position that, with the intended modifications and lack of long-term experience with heap leach mining operations following closure, the rules provide appropriate environmental protection without unnecessary redundancy.

811 SW Sixth Avenue
Portland, OR 97204-1390
(503) 229-5696

The Commission will consider final adoption of these changes during a special telephone conference meeting to be held on Tuesday, September 1, at 8:30 a.m. Although it is sometimes dangerous to measure the success of a rule making by the reaction of the opposing sides, I believe in this case the response of the mining industry and environmentalists, at least as reported in the newspaper, was of consensus if not enthusiasm.

Sincerely,

Fred

Fred Hansen
Director

HLS/kp

I think this came out quite well.
Call if you still have any problems.

JOHN M. MINNIS
MULTNOMAH COUNTY
DISTRICT 20

REPLY TO ADDRESS INDICATED:
☐ House of Representatives
Salem, OR 97310
☑ 23765 NE Holladay
Woodvillage, OR 97060

COMMITTEES
Chairman:
Committee on Ways & Means
General Government Subcommittee
Member:
Committee on Ways & Means
Committee on Ways & Means
Transportation Subcommittee

Assistant Majority Leader
HOUSE OF REPRESENTATIVES
SALEM, OREGON
97310

August 6, 1992

State of Oregon
DEPARTMENT OF ENVIRONMENTAL QUALITY
RECEIVED
AUG 07 1992
OFFICE OF THE DIRECTOR

Mr. Fred Hansen, Director
Department of Environmental Quality
811 S.W. Sixth Avenue
Portland, Oregon 97204

Dear Fred,

It has come to my attention through the mining industry that the status of the proposed rules are detrimental to their ability to effectively move ahead with a most vital source of economic development for this state.

I am deeply concerned about the increased cost to companies wishing to enter this field which will not increase environmental efficiencies one bit. Your agency continues to alienate industry through administrative overkill and paper shuffling even though you have assured me in Ways and Means committee hearings that your intent is to become "userfriendly".

As you are well aware, I am a reasonable man who looks for balance in my deliberations. I support these operations having to use sound environmental techniques and be responsible for their actions, however, I am disturbed that the Department is choosing to ignore the TRC report and is offering rules which would preclude any leach gold mining in Oregon.

Oregon needs economic growth and balanced environmental protection. Please share my concerns with every member of the commission. I truly hope the commission will adopt rules which provide for balance and will permit this unique and very valuable industry to contribute to our state's economic prosperity.

Respectfully,

John Minnis,
State Representative Dist. 20

JM/km

Fred

OREGON MINING COUNCIL
200 Century Tower, 1201 S.W. 12th Avenue
Portland, Oregon 97205
(503) 227-5591

August 21, 1992

Mr. William Wessinger, Chair
Environmental Quality Commission
121 SW Salmon, Suite 1100
Portland, Oregon 97204

Re: Chemical Mining Rules

Dear Mr. Wessinger:

The Oregon Mining Council ("OMC") thanks the Environmental Quality Commission and the Department of Environmental Quality for the opportunity to comment on the proposed chemical process mining rules, which are now in near-final form. The improvements in those rules made as a result of the day-long hearing on August 7, though limited, are of great importance to the mining industry. However, OMC feels that the rules are still needlessly rigid and unjustifiably redundant. We hope that further drastic improvements will be made as DEQ gains experience with chemical process mines.

OMC welcomed the Commission's decision to delete the requirement to reuse cyanide because it was well founded and necessary. In its response to the TRC report, DEQ staff "fully agrees" that reuse will not lower the toxicity of mine tailings and spent ore in comparison to chemical destruction of the sodium cyanide compounds. DEQ contradicted itself by testifying on August 7 that tailings with destroyed cyanide could be more toxic than tailings with removed cyanide. Those testifying (including a mineral economist and an engineer) cautioned that they were not experts in tailings chemistry, yet their hunches were given great weight by the Commission. The DEQ's testimony conflicted directly with the opinion of TRC, Inc., the Commission's contract expert, and with the opinion of experts contributing to OMC's testimony. OMC urges the Commission to stick with its decision based on scientific analysis.

The revision that the Commission has requested to allow more flexibility in the design of alternate liner systems is also important to OMC members. Given the high cost of liner systems, mining companies will be motivated to design liner systems that can be implemented at lower cost than the liners specified in the proposed rules while still satisfying Commission policies. However, the flexibility in the liner system rules will be illusory unless alternative liners researched and designed by qualified experts are ultimately approved by DEQ staff.

OMC remains very concerned that the TRC liner proposal may not be adopted as an approved alternative. The TRC liner is as fully researched and described as the triple liner proposed by staff. TRC found that its alternative liner fully satisfied Commission policies. If DEQ staff will not accept the thoughtful recommendations of its own expert consultants, OMC members are justifiably concerned that the considerable efforts they may spend designing better liner systems will be spent in vain. OMC urges the Commission to closely monitor the implementation of the liner rules to assure that the intended flexibility becomes a reality.

OMC members are extremely disappointed with Commission's approval of the requirement to enclose all heap leach pads and tailings facilities as hazardous waste even if the spent ore and tailings are not hazardous. It was remarkable that the experts hired by DEQ to analyze these issues were not invited to the hearing to defend their recommendations! Instead, individuals who admitted their lack of expertise in chemistry were invited to speculate on the long-term chemical behavior of mine tailings. Not surprisingly, these witnesses expressed uncertainty about the long-term chemistry of the tailings. On the basis of that uncertainty, the Commission concluded that hazardous waste-type enclosures were warranted. In OMC's view, this is an illogical approach to rulemaking, leading to unreasonable and unnecessary regulatory requirements.

Cautious regulation based on scientific uncertainty is an acknowledged technique to prevent environmental harm. That is not the same as cautious regulation based on uncertainty which stems from lack of expertise. Recognized experts have testified and are prepared to defend the proposition that spent ore and tailings chemistry can be predicted with certainty. Rocks that contain no acid-forming components will not form acid. After careful consideration, TRC concluded with a high degree of certainty that hazardous waste enclosures are not necessary for non-toxic and non-acid-forming rock materials. In the face of such testimony by experts, it is shocking that public policy was based instead on the speculations of non-experts.

If any OMC members still believe they have economically viable projects in Oregon, they will likely seek approval of alternative closure systems under proposed OAR 340-43-031(2), which allows DEQ to approve alternative facilities that provide environmental protection equivalent to that provided by the other rule requirements. Approval will be sought based upon a detailed factual record on the chemistry of the spent ore and tailings for each project. If an applicant can demonstrate with certainty that its mine tailings will be non-toxic and non-acid-forming, OMC expects that the DEQ will approve alternative closure designs. Again, OMC urges the Commission to monitor such proceedings closely to assure that apparent flexibility in the rules is not arbitrarily ignored.

Finally, OMC urges the Commission to steer clear of land use regulations in the guise of water quality rules. The Commission has been urged by environmental groups to require back-filling of open pits. Many of those environmental groups have openly announced that their true desire is to ban chemical process mining in Oregon, not merely to regulate the effects of mining. The current rules already allow the DEQ to consider backfilling as necessary to control water quality in the pit. Backfilling should receive no greater weight for that purpose than any other technological remedy. In passing the new Oregon chemical process mining statute in 1991 (HB 2244), the Oregon legislature specifically considered and rejected the proposition that backfilling of open pits should be required, except where "reclamation objectives *** cannot be achieved through other mitigation activities." ORS 517.956(3)(d). The Commission should not exceed this statutory standard, which was based on months of negotiation between the Governor's office, industry representatives, environmental groups and legislators.

In summary, though OMC appreciates the modest improvements made in the chemical process mining rules to date, OMC regrets that the rules remain unnecessarily redundant and rigid. OMC only asked for fair consideration of the technical merits of the rules. In its conference call establishing the goals for review of the proposed rules by an independent consultant, the Commission expressed concern that the rules might require expensive facilities or procedures that produce no material improvement in the protection of the environment from pollution. After careful consideration, DEQ's consultant, TRC, reached firm conclusions that several of the requirements of the proposed rules provided no material improvement in environmental protection. DEQ staff urged the Commission to ignore the consultant's conclusions, despite the absence of any scientific testimony to the contrary and despite the loss of Mr. Turnbaugh, the only staff member to have studied the technical aspects of chemical mining. OMC feels that valuable professional input has been wasted without explanation and that the resulting rules are unnecessarily rigid as a result.

TRC was obviously outraged at the treatment of its work by DEQ staff, as evidenced by TRC's letter to Commissioner Lorenzen dated August 5, 1992. TRC concluded that the proposed regulations were based on DEQ's desire to ban chemical process mining in Oregon, rather than to regulate its environmental effects. TRC's conclusion is consistent with the position taken by DEQ staff in the initial workshop with the Commission on April 17, 1990. There Director Hansen asked "Do we want this type of a process in Oregon?" and later answered his own question by saying "You do understand our bias, which is we'd just as soon see these [chemical process mines] all knocked in the head." Unfortunately, it appears that staff's hostility to chemical process mining has resulted in rules that may have the effect of precluding any further exploration efforts in Oregon.

We must acknowledge that our cities and all so-called "clean" industries are built primarily from minerals that come from open pit mines. OMC members would happily concentrate on large high-grade metal deposits that could be mined by selective underground methods. But such deposits are extremely rare and would not support the mineral demands of our society. OMC feels the environmentally responsible route for our society, which uses more minerals per capita than any other, is to mine the minerals we use "in our own back yards," where we can control the environmental effects. Otherwise we will be obtaining such minerals from third-world countries where they may be mined by state-owned or indigenous mining companies that lack the capital or the technology to mine with modern and environmentally sound methods. The atrocious environmental record of the former Soviet Union, which was more technologically advanced than most foreign mineral suppliers, should cause us to question the wisdom of prohibiting mining in our own state. Unfortunately for world ecology, foreign countries currently supply the vast majority of metals used in U.S. industry.

Think globally, permit mining locally.

Sincerely,

John Parks / ojg

John Parks, Chair
Oregon Mining Council

cc: Dr. Emery Castle
Mr. Henry Lorenzen
Ms. Carol Whipple
Ms. Linda R. McMahan
Mr. Frederic J. Hansen
Mr. Harold L. Sawyer

JULY 11, 1992

FRED HANSEN
DEPT. of ENVIRONMENTAL QUALITY
811 SW 6TH AVE.
PORTLAND OR 97204

State of Oregon
DEPARTMENT OF ENVIRONMENTAL QUALITY
RECEIVED
JUL 15 1992

OFFICE OF THE DIRECTOR

MR HANSEN,

I WISH TO SEE THE STRICT RULES ON CHEMICAL PROCESS MINING PASSED, (THE RULES ORIGINALLY SCHEDULED FOR ADOPTION DECEMBER 13, 1991

IF A MINING OPERATION IS NOT ECONOMICAL WITHOUT COMPROMISING THE QUALITY OF THE ENVIRONMENT, IT SIMPLY IS NOT ECONOMICAL AT ALL. SUCH AN OPERATION SHOULD NOT BE ESTABLISH THE PRICE FOR A POLLUTED LANDSCAPE IS PAID BY SOMEONE, SOMETIME.

I DON'T WANT EITHER THE COST OR THE RISK OF POLLUTED WATERS AND A POLLUTED LANDSCAPE PAWNED-OFF TO THE PUBLIC!

THANK YOU FOR YOUR CONSIDERATION!

Mark Keller

Mark & Pam Keller
P.O. Box 25
Hines, OR 97738

Please submit my comments to the rest of the Environmental Quality Commission.

DEAR MR HANSEN, 7/13/92

WE ARE CONCERNED WITH STRICT CHEMICAL PROCESS MINING RULES, REGULATIONS.

WE SUPPORT THE RULES WHICH WERE SCHEDULED FOR ADOPTION ON DECEMBER 13, 1991.

PLEASE SHARE OUR CONCERNS WITH THE BOARD AUGUST 7, 1992. THANK YOU

MR & MRS WILLIAM A & CAROLE A. COLE

PO BOX 233
6705 CANTERBURY DRIVE
GLADSTONE, OR. 97027

TELECOPY TRANSMITTAL

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PROJECT NO. 1958

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SENT TO: William Wessinger DATE: 05 Aug 92

COMPANY/DEPARTMENT:

FAX NO.: 1-503-464-2299 SENT FROM: Jim Beck

COMMENTS:

TRC
Environmental Solutions through Technology

TRC Environmental Corporation
7002 South Revere Parkway, Suite 60
Englewood, CO 80112
☎ (303) 792-5555 Fax (303) 792-0122

August 5, 1992

VIA FAX

Mr. William W. Wessinger
121 SW Salmon, Suite 1100
Portland, OR 97204

Dear Commissioner Wessinger:

TRC Environmental Corporation (TRC), the independent contractor retained by the State of Oregon Department of Environmental Quality (DEQ) through the Request for Proposal To Provide Technical Advice on Proposed Chemical Mining Rules, has completed review of the July 30, 1992 memorandum from Mr. Fred Hansen, Director, to the Environmental Quality Commission (EQC). This memorandum provides DEQ's "Consideration of Contractor's Report on Proposed Chemical Mining Rules, and Recommendation for Adoption of Proposed Chemical Mining Rules".

It is of the utmost concern to TRC that DEQ has summarily dismissed the findings of the report. Most disconcerting is the fact that its findings have been excerpted out of context. Considerable effort was expended by TRC staff in reviewing and evaluating numerous technical documents, in complement with the utilization of individual technical expertise, in arriving at a comprehensive and objectively compiled summary of the identified issues. TRC strived to evaluate each issue within the context of the stated "policy" objectives.

We believe that this was accomplished even though the format for performing the review was such that answers to the individual questions (as responded to on an individual basis) were a foregone conclusion due to the manner in which they were posed. While TRC is not in disagreement with the DEQ's overall position that each of the three study issues independently provide (on a stand-alone basis) a material reduction in risk to the environment, we strongly disagree with DEQ's assessment that "**redundancy**" is not an issue. In fact, we respectfully submit to the Commission that this is precisely "the issue", and that the individual design parameters in each issue area (on a non-collective basis) are of secondary concern, when taken in the context of an overall and effective "**system**".

It is questionable that DEQ is providing sufficient objectivity to the process by alluding to its belief "that the Commission intends to take **economics** into account as it seeks to find an appropriate balance between environmental protection goals and requirements". It is difficult to understand how the Commission can adequately evaluate, or otherwise take into account economics when (1) the technical advice report format prohibits introduction of any discussion whatsoever; (2) redundancy economics are dismissed as "out-of-scope"; and (3), DEQ elects to dismiss the findings of the report. What has been recommended by DEQ quite clearly falls into the category of "goals" rather than "requirements". Fortunately, for the most part, the regulatory process as such, has recognized the magnitude of these two extremes, and has typically entertained negotiation between all factions to arrive at some degree of conciliation from all parties, while still achieving requirements. The fundamental basis for this approach is to assure that industry can operate in a manner that is environmentally responsible and economically sensible. **Even the U.S. EPA conducts an assessment of**

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<u>the potential economic impact resulting from proposed environmental regulation prior to full promulgation</u>. The economic impacts dictate whether or not an industry can or will "operate". One can only conclude that where regulatory proposals are so dramatically economically burdensome as the ODEQ proposed regulations, that the real objective is enactment of regulations developed solely to preclude mining, rather than regulate it in an effective manner.

TRC has provided much discussion in the report to differentiate between what may be required to achieve "goals" rather than "requirements". Put simply, the differentiation is based upon fundamental economics, e.g., where policy criteria can be achieved in a manner that is more cost effective than that prescribed in the proposed rules, it seems prudent to allow the applicant the flexibility to achieve the criteria through sound business decisions. That does not imply that the applicant should not be held accountable for certain actions or inactions. Rigorous enforcement and reclamation requirements can supplant the need for prescriptive design requirements.

While DEQ cites the opportunity provision within the proposed rules for "potentially equivalent alternative proposals", placing the burden of proof upon the applicant, one would have to judge the probabilities for success in such a submittal as extremely remote, given the consideration DEQ gave to findings in the report. To reiterate TRC's findings and to put them into recommendations for consideration by the Commission, we offer the following comments:

LINER SYSTEMS

TRC is of the opinion that composite liner <u>systems</u> offer the best means of protection to the environment, both operationally and post operationally. The liner system should be sound in design, taking into account the myriad of site-specific parameters. Most importantly, and contrary to DEQ, we believe the liner system should be designed to minimize leak <u>potential</u>, rather than to maximize leak <u>detectability</u>. If a liner system is designed such that it requires a flexible membrane liner directly atop the leak detection zone, there is a high degree of probability that it will fail. This failure may or may not impact the environment, however, it will certainly impact the economics of the operation. The operator will be required to curtail operations, resulting in loss of revenue, in addition to incurring costs associated with remedial operations.

We note that there appears to be apparent inconsistency on liner terminology amongst parties to this process. The OAR 340 liner system has always been referred to as a triple liner system when in fact it is a double liner system with a composite secondary (lowermost) liner. The TRC alternative candidate liner system is also a double liner system, however, it is comprised of a composite primary (uppermost) liner providing significantly greater resistance to puncture (to minimize leak potential). TRC undertook its assignment of evaluating the technical aspects of liner system design and documented throughout Section 2.0 of the report the literature and operating experience to substantiate our findings. Further, DEQ even acknowledges the emergence onto the market of improving leak detection technologies. This information is supportive of a liner system design based upon <u>leak prevention</u> rather than ODEQ's stated objective of leak detection as the primary design criteria. Detecting a leak using the 12-inch permeable zone or geodrain alternatives presented by TRC isn't really a problem. The problem is nobody (neither the regulator, environmentalist, or mining operator) wants to detect a leak at all. So why not design the liner system to minimize the potential for leak occurrence?

Since it has been demonstrated that the TRC alternative (or other) liner design configuration can detect the prescribed leak, and that the 12-inch lower liner provides in excess of five (5) years protection in the event of a leak, **nothing is gained by prescriptive design criteria for a 36-inch clay providing in excess of twenty (20) years of protection other than two (2) feet of redundancy.** In fact, these operations generally are active for a period not exceeding ten years (individual heaps have shorter operational duration); repairs can be effected in a matter of weeks; and the material will presumably (see below) be detoxified prior to closure, thus eliminating significant long-term concerns.

TRC has provided an alternative liner system as well as variations on the proposed OAR 340 liner system that will achieve Commission policy. The applicant should be provided the opportunity to achieve that policy through sound business judgement, and provision should be made for penalizing the applicant that fails to do so, rather than enacting an across-the-board penalization of all applicants.

CYANIDE REMOVAL AND REUSE

TRC has determined that in most instances detoxification to the levels indicated is achievable, as well as desirable, in achieving a material reduction in potential impact to the environment. However, stipulated removal **in combination with** reuse limits the technology in most instances to those technologies which are economically disadvantageous to the operator. This economic impact, when considered as part of the prescribed system, is **the second component of the cumulative economic impact resulting from redundancy** in the prescribed three-part rules. Further, reuse in no way reduces the likelihood of a release. DEQ appropriately cites a reduction in transport and handling as a result of reuse, however, that is not true in all circumstances. During facility closure and where facilities cannot reuse cyanide, loading, transport, and offloading will still result. In addition, there are substantial documented worker health and safety concerns associated with management of cyanide compounds in these reuse processes, the management of which again translates into significant economic impact.

TRC has stated that detoxification to the pre-determined level is prudent. Industry has demonstrated a willingness to comply. TRC urges the Commission to incorporate the provision for detoxification into the rules, but while doing so, allow the operator the flexibility to achieve the objective in the most cost-effective manner (i.e., allow the operator to specify the technology to take advantage of varying ore/tailing chemistry, cyanide reagent concentration, etc.). Also, due consideration should be given to incorporation of a provision encouraging (not requiring) cyanide re-use, where it can be demonstrated to be economically advantageous.

COVERING OF HEAPS AND TAILINGS

TRC is on record as stating that in many instances there are advantages to covering in addition to detoxification. Likewise, there are many instances where it serves to a disadvantage, environmentally, by reducing natural degradation processes or encouraging formation of undesired chemistry within the waste unit. In any case, a RCRA Subtitle C Hazardous Waste Unit cover system is entirely inappropriate for the given waste characteristics, and represents **the third component of the cumulative economic impact resulting from redundancy.**

Literature and operating experience have demonstrated that chemical (cyanide) and toxic metal release are dependent on varying ore/tailing chemistry, as well as a variety of site-specific parameters. The detoxification proviso, discussed above, provides sufficient management of the chemical release potential, particularly given that the material is situated upon a sound liner system. Toxic metal release is predominately dependent on acid-generating potential of the tailing or spent ore, and its potential can be accurately predicted by representative sampling and testing of the material(s). Cover systems should be designed taking into consideration the site-specific characteristics such as ore/tailing chemistry, natural site conditions, and climatologic factors.

SUMMARY

TRC is of the opinion that a regulatory program capable of achieving the stated Commission policy can be achieved through the following general provisions:

- Require a liner system that incorporates **leak prevention** along with performance criteria regarding leak detection capability, and provides a prescribed leak retention capability (e.g. 5 years) sufficient to facilitate remedial options. Provide flexibility for design to achieve these criteria. [TRC recommends that the Commission carefully examine the preferred objective, i.e, is the objective to detect a leak; or should the objective be to minimize the potential for occurrence of a leak? It would seem to TRC that the latter would be the preferred objective for protection of the environment, particularly since the alternative design that encompasses this objective is accompanied by the ability to detect a leak with equivalent rapidity to that in the proposed OAR 340 liner system.] Provide flexibility for incorporation of alternative engineered materials where it can be demonstrated that there is no net loss in performance or reliability.

- Require **detoxification** to the prescribed limits in the proposed rules. Allow the applicant flexibility to determine the most appropriate technology based on site-specific characteristics.

  Encourage reuse of cyanide to the maximum extent practicable, where it can be shown to be economically feasible.

- Require **cover systems following detoxification where it is demonstrated that there is a potential for acid generation** or other specific environmental concern (e.g. airborne particulate dispersion, etc.). Modify prescribed design standards to more appropriately reflect the toxicity risk associated with non-hazardous waste (e.g. do not require RCRA Subtitle C cover systems). Where acid generation potential is absent, require closure methods consistent with aesthetic issues and establish provision for other active management closure scenarios that can be demonstrated as capable of achieving

Commission policy where appropriate (e.g. recontouring, revegetation, stabilization, etc.).

TRC has appreciated the opportunity to become involved in the proposed rulemaking. We offer these comments as a concerned third-party with what we consider to be greater insight into the process than many other parties. This submittal is intended solely as third-party comments for your consideration, and is in no way to be construed to be associated with production of the July 21, 1992 report entitled "Final Report of Findings on Specific Technical Issues - State of Oregon Proposed Chemical Mining Rules". TRC considers performance under ODEQ Contract Number 71-92 to have concluded upon delivery of the final report. If you have specific questions regarding any of the issues addressed, please feel free to contact me directly at (303) 792-5555 at any time.

Sincerely,

TRC ENVIRONMENTAL CORPORATION

James M. Beck

James M. Beck, P.E.
Manager, Hazardous Waste Investigation and Engineering

JMB:bb

cc: F. Hansen w/o attachment
H. Sawyer w/o attachment
(via fax): L. McMahon
E. Castle
H. Lorenzen
C. Whipple

Attachment: Section 1.0 (Final Report)

Oregon Wildlife Federation
P.O. Box 67020 • Portland, OR 97267
(503) 659-9054

5 August 1992

Environmental Quality Commission
811 SW 6th
Portland, OR 97204

RE: Chemical Mining Rules

Dear Commission Members:

The Oregon Wildlife Federation (OWF) enjoys the support of over 1000 members and supporters statewide. OWF also is the state affiliate of the National Wildlife Federation, this nation's largest conservation organization.

OWF supports the 13 December 1992 draft Chemical Mining Rules. We ask that you include our support in the record and strongly urge the Commission to adopt this draft.

Sincerely,

Stu Sugarman

Stu Sugarman
President

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Oregon State Office
P.O. Box 2965 (1300 N.E. 44th Avenue)
Portland, Oregon 97208

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:
3809 (920)

July 31, 1992

State of Oregon
DEPARTMENT OF ENVIRONMENTAL QUALITY
RECEIVED
AUG 03 1992
OFFICE OF THE DIRECTOR

Fred Hansen, Director
Oregon Department of Environmental
Quality
811 S.W. 6th Ave.
Portland, Oregon 97204

Dear Mr. Hansen:

We have reviewed the proposed rules regarding chemical mining that your office has drafted (Chapter 340, Division 43, version dated 12/13/91), and provide the following comments for your consideration.

General Comments

The rules are overly stringent by establishing environmental protection standards significantly higher than those currently being used in the mining industry elsewhere in the United States. We are concerned that the rules may preclude development of mineral deposits on Federal lands managed by the Bureau of Land Management (BLM) in Oregon. Requiring excessive restrictions for every operation will present an unreasonable burden to operators on Federal land where mining has been determined to be an appropriate land use.

The use of cyanide in gold mining has allowed previously unminable deposits to now be economically mined in many states in the nation. Cyanide has been successfully used for years in other parts of the nation and industry standards have been developed for its safe use. We do not see a need to go beyond established standards for every proposed operation when such standards have proven to work effectively. Existing Federal regulations allow the BLM enough discretion to require more stringent mitigating measures on a case-by-case basis should there be a need to do so.

Heap Leach Pads

The Department of Environmental Quality (DEQ) rules for heap leach pads would require two synthetic liners over a 3 ft clay liner. This design would not meet the objectives of detection because the top liner is more susceptible to damage during installation and loading due to contact on both sides with granular materials. Solution could pass freely through holes or defects in the upper synthetic liner and when recovered from the leak detection layer, would not be indicative of solution loss to the environment; but would only reflect the quality of the upper liner installation. Therefore, the proposed leak detection system would not actually detect leakage from the facility. In almost all cases an alternative detection system would likely be preferred.

The only benefit in requiring two synthetic liners over the soil/clay liner would be to minimize hydrostatic head on the bottom synthetic liner. In some instances, the placement of a top liner over a relatively highly permeable leak detection layer may not prove to be an effective barrier to prevent transfer of hydrostatic head to the lower synthetic liner.

The requirement for a bottom soil/clay liner of at least 36 inches for all leach pads is excessive. Installation of this thickness of a clay liner may prove unfeasible on some leach pads with steep internal slopes. A liner system with multiple synthetic liners and a thick clay liner may not be stable. Current composite liner systems for heap leach pads use a single synthetic liner over a soil/clay liner. The synthetic liner prevents continual widespread contact of the leaching solution with the soil liner, while the soil liner serves as a low permeability backup to the synthetic in the event that there are pinholes or defects in the synthetic liner. Clay in the soil liner will swell upon contact with the solution and block solution passage. The 36 inch soil/clay liner requirement is twice as thick as most liners used today which have been successful as a backup to the synthetic liner.

With the proposed elaborate liner system of two synthetics, a leak collection system, and 3-feet of compacted clay, there is no need to limit process solution depth to 24 inches. Even at facilities where a composite liner system has been used (single synthetic liner over 24 inches compacted clay) containment has been maintained with up to 20-feet (240 inches) of solution depth over the liner. The requirement to keep solution depth less than 24 inches would also preclude the use of valley-fill type leach pads. These bowl shaped pads have been used successfully at many locations in the United States. Their main environmental advantages are that they limit the areal extent of leach pad per ton of ore; and that they can be used to contain pregnant solution which limits the amount of cyanide solution exposed to the environment in process ponds.

The rules fail to recognize that most leaching facilities are active for only five to ten years prior to being decommissioned and reclaimed. The liner systems being proposed would be more applicable to a hazardous waste facility with an indefinite operating period.

The probability of a 100-year, 24-hour storm event occurring in combination with a 10-year snowmelt and total heap draindown is remote. Also, the solution storage capacity requirements do not allow for the anticipated life of the project. The longer the project life, the more stringent the solution storage capacity design should be. The proposed rules require storage capacity designs for short-life facilities that are more applicable for 20+ year facilities and not for the usual 5-10 year life projects.

After rinsing the heap to <0.2mg/1 WAD cyanide, the rules require the heap to be closed in-place, on the pad, and covered to prevent water and air infiltration. If the heap has been successfully rinsed and detoxified, there is no reason to keep it on the pad. To do so does not allow for pad reshaping and slope reduction; or would require construction of a larger lined area than was necessary for heap operation. Any possibility for retained cyanide in that portion of the heap reshaped off-liner can be mitigated with enhanced rinsing or chemical treatment.

The requirement for a universal 30-year maintenance of the solution collection system and monitoring of an effluent is not reasonable. If all of the detoxification requirements are met, and acid base accounting results do not show the potential for long-term problems, there is no rationale for this lengthy timeframe. This is especially true for some heap materials that are unlikely to retain cyanide or generate acid even under worst-case assumptions. After assurance of the heap material detoxification, it would be more desirable to breach the impounding structure and/or liner system to avoid a build-up in infiltrating precipitation that could generate leachate or cause stability problems. Long term effectiveness of a low permeability cover is doubtful.

Process Ponds

The difference between process ponds and leach pads is that two synthetic liners may be workable for ponds because the upper liner is in contact with granular material on only one side, and there is no ore loading activity on the liner system. While the upper liner system could still develop leaks from installation damage, material defects, or operating activities, these could be easily repaired by lowering the pond solution level and patching the damaged leaking section. This option is not really viable for a leach pad liner due to the difficulty in locating the leak and then accessing it for repairs beneath tons of ore. As with leach pads, a 3-foot thick clay liner is rarely warranted. This is especially true for process ponds where a double synthetic liner system can be easily maintained thereby greatly reducing the need for an extra thick backup liner.

Tailings Impoundments

The proposed rules would require cyanide detoxification of the tailings (liquid fraction could not exceed 30 ppm WAD cyanide) prior to placement in the impoundment, and addition of basic material in large amounts to prevent acid rock drainage. Requiring cyanide detoxification prior to tailings placement in the impoundment would be unnecessarily costly. Measures can be taken to exclude wildlife from the impoundment during operation; and should be an option. Natural degradation of cyanide will occur during operation of the impoundment. Cyanide treatment could then be used either concurrent with the operation or upon closure. This would reduce the total amount of cyanide requiring treatment.

Assuming the rule requirements for treatment prior to disposal are implemented, then it is not necessary to require lining of the impoundment with a synthetic liner over 36 inches of compacted soil/clay; nor would it be necessary to cover the impoundment with a composite liner that must be stable for "an indefinite period of time". The requirement that this final cover follow technical guidance for "hazardous waste landfills and surface impoundments" is inappropriate for mine waste. Mine waste is not classified as a hazardous waste; yet the rules constantly address it as such. If all the treatments above have been applied, there is simply no reason for requiring this level of containment at closure.

Closing Comments

Implementation of these rules is likely to unduly restrict or even prevent the development of mineral deposits in Oregon when they could be developed in an environmentally sound manner using standard practices used elsewhere in the United States. As noted earlier in this letter, we do not feel it is necessary to require the most stringent practices to be implemented for all operations when we already have the discretion to do so on a case-by-case, as needed basis.

We hope that your Department will contemplate our comments on the draft chemical mining rules and examine mitigation measures that have been successful in other states, but do not put a unreasonable burden on the mining industry. We look forward to continuing to work with your agency to develop rules and guidelines that would apply to Federal lands to meet the objectives of both agencies. Please contact me at 503-280-7037 if you have any questions.

Sincerely,

Patrick H. Geehan

Patrick H. Geehan
Deputy State Director
for Mineral Resources

cc: Mining Law and Salable Minerals WO(660)(Room 3411 MIB)
Oregon Dept. of Geology and Mineral Industries
Anne Squier, Special Asst. to the Governor for Natural Resources
Scott Haight, Lewiston District, Montana

NATIONAL WILDLIFE FEDERATION
Suite 512 921 S.W. Morrison Portland, Oregon 97205
503-222-1429
Fax: 503-222-3203

August 6, 1992

William Wessinger
Chairman
Environmental Quality Commission
c/o Department of Environmental Quality
811 SW Sixth Ave.
Portland, OR 97204-1390

Dear Chairman Wessinger:

The National Wildlife Federation (NWF) is the nation's largest conservation organization, with over 5.3 million members and supporters. NWF represents 43,000 members in Oregon. One of our primary goals is the conservation of fish, wildlife and other natural resources.

NWF has been interested in chemical mining in Oregon since the last state legislative session when chemical mining operation legislation was passed. We have been watching with interest, and monitoring, the rulemaking process.

NWF strongly urges the Environmental Quality Commission to adopt rules regulating chemical mining in Oregon as they were written and proposed on December 13, 1991. We feel that this set of rules will best protect the resources NWF, and in particular our Oregon members, regard as a priority for protection.

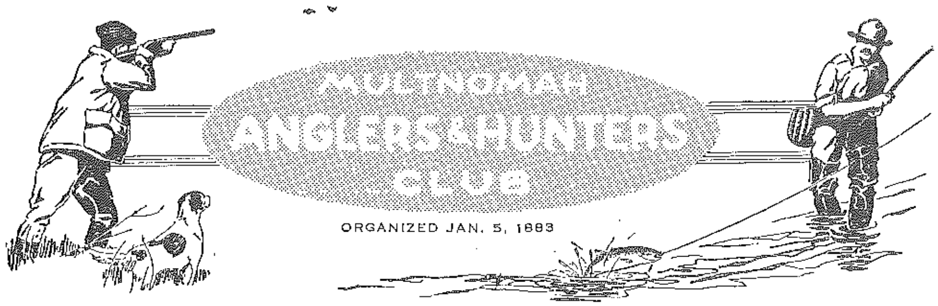
Thank you for your consideration of our position on this critical issue of importance to the state of Oregon.

Sincerely,

Jacquelyn Bonomo

Jacquelyn Bonomo
Center Director

cc: Fred Hansen



MULTNOMAH ANGLERS & HUNTERS CLUB
ORGANIZED JAN. 5, 1883

P O BOX 13771
PORTLAND, OR 97213

August 3, 1992

Fred Hansen
Department of Environmental Quality
811 S.W. 6th Avenue
Portland, Oregon 97204

Dear Mr. Hansen:

On behalf of the Multnomah Anglers & Hunter Club I am writing to let you know of our objections to the TRC Draft report reviewing some of the administrative rules which will regulate cyanide heap leach mining in Oregon. This particular contractor should not have been hired because of a conflict of interest and their report is very biased in favor of the mining companies.

The 1872 mining law is very out dated and it is allowing the "giving away" of our natural resources to the mining companies without the State getting reimbursed or getting any royalities from it.

We, as a conservation club, are definately against leach mining because of the damage to fish and wildlife, water, and damage to the land itself. Please adopt the <u>new</u> chemical process mining rules. Oregon needs to have more strict regulations to help preserve our natural resources.

Sincerely,

Jim Modrell

Jim Modrell, President
Multnomah Anglers & Hunters Club

Survival Center
Suite 1, EMU
University of Oregon
Eugene, OR 974
(503) 346-435

DEAR MR. HANSEN-

I AM WRITING TO ASK THAT YOU SUPPORT ALL CHEMICAL PROCESS REGULATION THAT WERE ADOPTED ON DECEMBER 13, 1991. I UNDERSTAND THAT AUGUST 7, 1992 IS THE LAST DAY TO RECEIVE COMMENTS PERTANED TO THE ADOPTION OF THE CHEMICAL PROCESSES MINING RULES.

CYANIDE MINING, IS THE MOST DANGEROUS CULPRIT IN MAINTAING A CLEAN AND SAFE, QUALITY ENVIRONMENT. A CYANIDE MINE USES 1,000 TO 1,500 GALLONS OF WATER A SECOND, 2 million GALLONS A DAY. THIS LACK OF WATER FORCES WILDLIFE TO DRINK FROM THE TOXIC CYANIDE POOLS. CYANIDE PITS SCARES THE EARTH, LIVING A PERMANENT PIT (OR RECLAMATED AT ~~THE~~ TAXPAYERS EXSPENSE) WHICH COULD ROUGHLY FIT TWO EMPIRE STATE BUILDINGS.

SINCERLY,
Tom Ragland

John Williams
12770 SW Foothill Dr.
Portland OR 97225
503-626-5736
(fax) 503-641-5507
August 1, 1992

State of Oregon
DEPARTMENT OF ENVIRONMENTAL QUALITY
RECEIVED
AUG 04 1992

OFFICE OF THE DIRECTOR

Dear Mr. Hansen:

I am a consultant for the TAME TIC Committee, a non-profit group funded by voluntary contributions from building trades unions to evaluate the environmental and economic implications of large construction projects. Pipefitters Local 290 in Portland, and other pipefitter locals with offices in Washington and Idaho, together represent thousands of skilled workers who live and work in Oregon. These unions are among the supporters of the TAME TIC program. The members of these unions will be working at any future chemical mines that will operate under the final version of the proposed DEQ rules.

Here are comments on the draft TRC report regarding prospective DEQ regulations for the chemical mining industry. Our remarks are narrowly limited to one issue; the reuse and recycling of cyanide. In your own July 2nd letter commenting on the TRC report, you state "Reuse (of cyanide) would reduce the quantity of chemicals transported ... and would ... reduce the potential for accidental release during transport, storage, handling, etc."

TAME TIC strongly supports your position on this issue, Mr. Hansen. Here is evidence that every handling and storage event regarding cyanide releases this highly toxic chemical into the environment.

Mine Safety and Health Administration (MSHA) records obtained under the Freedom of Information Act list many cases of worker injuries caused by cyanide releases during the handling of this substance. Here are examples:

> "After mixing chemicals ... operator ... received a cyanide dust exposure." (Druid Mine, CO., MSHA no. #05-4431, 11/8/91)

> "(Three workers) ... had just finished unloading cyanide from tractor trailer. (One worker) ...passed out ... and (was) taken to hospital." (Western States Minerals, NV., MSHA no. #27-1661, 7/27/89)

Finally, Mr. Hansen, the proposed air permit for the Echo Bay/McCoy mine in Nevada shows that the cyanide loading and unloading emission rates at this facility's cyanide storage silo are .16 and .12 lbs/hr., with 1095 hr/year of loading allowed, and 8760 hr/yr. of unloading allowed.

This permit and worker injury information clearly shows that any increased handling and storage of cyanide increases the emissions of cyanide to the environment. In the instance of the Echo Bay/McCoy facility, delivery, unloading and storage of cyanide potentially emits 1200 lb./yr. of this material.

Therefore recycling and reuse of cyanide, as opposed to increased delivery, storage and handling of this material, could reduce emissions of cyanide.

Relevant portions of the quoted materials are enclosed. I regret that I may be ineligible to testify at the August 7 EQC hearing because of my inability to participate in earlier hearings on this rulemaking, but I hope this material is useful to you, and will be provided to the EQC for consideration.

Thank you in advance for your cooperation.

Yours,

John Williams

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2002574 4641 193 MICHIGAN 05/03 291280030 391280046	 YES M 26 [illegible] 36	MINER NEC OPR FRONT-END LOADER OTHER UNDERGROUND METAL -GOLD (LODE AND PL FRONT-END LODR,TRACTR SHV OTHER 0000 0000 0000	POISONING (TOXIC MATER) NOXIOUS MINE GASES,NEC POISONING,SYSTEMIC BODY SYSTEM-POISON,NERVE NOT REPORTED *********** [illegible]Y[illegible]W 3Y 6W [illegible]Y[illegible]W 1[illegible]	THE EMPLOYEE WAS WORKING ON THE 1600 LEVEL IN AN IMPROPERLY VENTILATED AREA WHILE RUNNING LOADER AND OTHER EQUIPMENT.
2601661 7851 023 NEVADA 07/27 2912901[illegible]0	 YES M [illegible] [illegible] 3[illegible]	CLNPLT/MED/BONEYOPR/CRSHR HANDL SUPPL,MTRL,LOAD/UNL STRIP/OPEN PIT METAL -GOLD (LODE AND PL ************************** ********** 0000 0000 0000	POISONING (TOXIC MATER) NOXIOUS MINE GASES,NEC POISONING,SYSTEMIC BODY SYSTEM-POISON,NERVE ************ *********** [illegible]	[illegible] AND 2 OTHERS HAD JUST FINISHED UNLOADING CYANIDE BOXES FROM TRACTOR TRAILER [illegible] OPERATING BACKHOE USED TO UNLOAD BOXES. THE 3 WERE STANDING AT BACK OF TRAILER WHEN [illegible] PASSED OUT. [illegible] WAS SENT FOR AND [illegible] GIVEN OXYGEN AND TAKEN TO HOSPITAL.
3000039 2881 039 NEW YORK 01/27 2907901[illegible]3	 YES M 2[illegible] [illegible] 2[illegible]	LABORER/UTILITY MAN/GNRL HAND TOOLS,[illegible],MUCKING MILL/PREP PLANTS,ETC STONE -CRUSH HANDTOOL,[illegible] POWERD,WRENCH ********** 0000 0000 0000	POISONING (TOXIC MATER) NOXIOUS MINE GASES,NEC POISONING,SYSTEMIC BODY SYSTEM-POISON,NERVE NOT REPORTED *********** 1Y 5W 1[illegible] 5W 1Y 5W 1[illegible]	AFTER SHOVELING COAL [illegible] AT [illegible] IN RECLAIM TUNNEL FOR APPROX. 5 HOURS, EMPLOYEE WENT TO CONTROL ROOM. WHEN DESCENDING STAIRS FROM CONTROL ROOM, HE ALLEGEDLY STARTED FEELING DIZZY. LATER HE FELT NAUSEOUS AND [illegible] LACK OF COORDINATION. DURING THE NEXT TWO DAYS THE SYMPTOMS REMAINED.
3000300 2601 091 PENNSYLVA 11/07 293330047 393330062	 YES M 3[illegible] [illegible] [illegible]	[illegible] OPR HAULAGE TRUCK STRIP/OPEN PIT STONE -LIMESTONE (CRUSH OFF HIGHWAY [illegible] TRUCK ********** 0000 0000 0000	POISONING (TOXIC MATER) NOXIOUS MINE GASES,NEC POISONING,SYSTEMIC BODY SYSTEM-POISON,NERVE CATERPILLAR [illegible] 11 [illegible]	EMPLOYEE WAS OPERATING A BACK DUMP TRUCK WHEN HE STARTED COUGHING AND FEELING PAINS IN THE CHEST. AT THIS TIME HE NOTICED EXHAUST FUMES IN THE CAB OF THE TRUCK.

APPLICATION REVIEW

Echo Bay - McCoy Mine

Echo Bay Minerals Company of Battle Mountain, Nevada submitted a request to amend the following existing permits for modifications to existing hours of operation - (PC 1307, 2606, 2160, 1991, 2163, OP 1812, 1813, 1814). Echo Bay Minerals Company also submitted a request and applications for the addition of one new diatomaceous earth silo, one new Pebble lime silo, one new Conbelt cement/lime silo, a reduction in cyanide storage bins and for a temporary pilot plant. A summary of all equipment (both proposed and existing) is contained in Table I. The McCoy Mine is located approximately 56.3 kilometers (35 miles) south of Battle Mountain, Nevada in Hydrographic Area 59, Lower Reese River Valley. This area is designated non-attainment for particulate and unclassified for all other pollutants that have an ambient air quality standard and as such Echo Bay Minerals Company must provide for the Lowest Achievable Emission Rate (LAER) for all particulate emissions.

Modifications to existing permits:

PC 1307 ...... Echo Bay Minerals Company has requested the loading time be increased to 3 hours per day and 1095 hours per year, and the discharge time to be increased to 24 hours per day and 8760 hours per year, for the lime/cement silo.

PC 2606 ...... Echo Bay Minerals Company has requested to reduce from three (3) to two (2) calcium cyanide storage silos and to reduce the loading time to 3 hours per day and 1095 hours per year. One silo may also be used for the storage and discharge of lime.

PC 2160 ...... Echo Bay Minerals Company has requested the loading time be increased to 3 hours per day and 1095 hours per year for the diatomaceous earth silo.

PC 1991 ...... Echo Bay Minerals Company has requested the throughput be increased to [illegible] short tons per hour for the pug mill.

PC 2163 ...... Echo Bay Minerals Company has requested the hours of operation be increased to 24 hours per day and 8760 hours per year for the two (2) bullion furnaces.

Modifications requiring new permits to construct.

OP 1812 ...... Echo Bay Minerals Company has requested the hours of operation be increased to 24 hours per day and 8760 hours per year for the mercury retort.

OP 1813 ...... Echo Bay Minerals Company has requested the hours of operation be increased to 24 hours per day and 8760 hours per year for the carbon kiln.

OP 1814 ...... Echo Bay Minerals Company has requested the hours of operation be increased to 24 hours per day and 8760 hours per year for the T-Thermal solution heater.

EMISSIONS

An emission summary of the proposed equipment and the existing permitted equipment is contained in Table II.

PSD EMISSION DETERMINATION

Since this area is defined as non-attainment for particulate, PSD regulations are not appropriate for this pollutant. However, PSD regulations do apply for all other pollutants. The only other criteria (listed in the Clean Air Act) pollutant emitted from the mine is sulfur dioxide. Sulfur dioxide emissions are contributed from the solution heating boiler. The yearly emission impact of sulfur dioxide is 95.0 ST/yr, which is less than the 250 ST/yr emission rate necessary required for a source to trigger PSD review. Also, this source is exempt from PSD/NSR review because of a requirement that operation is limited to the operating hours specified in Table I. Any relaxation of the emission limits or operating hours that increases the potential to emit above the applicable PSD/NSR threshold will require a full PSD/NSR review of the source as though construction had not yet commenced.

TABLE I

Source	Operating Rate	Operating Hours (Day/Annual)	Proposed Controls
New Equipment			
Cambell Lime/Cement Silo - (loading)	48.50 ST/hr	3/1095	Baghouse
Cambell Lime/Cement Silo - (discharge lime)	[illegible] ST/hr	24/8760	Uncontrolled
Cambell Lime/Cement Silo - (discharge cement)	5.0 ST/hr	24/8760	Uncontrolled
Diatomaceous Earth Silo - (loading)	37.5 ST/hr	3/1095	Baghouse
Diatomaceous Earth Silo - (discharge)	.5 ST/hr	24/8760	Uncontrolled
Valmac Lime Silo - (loading)	20.0 ST/hr	2/730	Baghouse
Valmac Lime Silo - (discharge)	1.4 ST/hr	24/8760	Uncontrolled
Pilot Plant Jaw Crusher and Screen	10.0 ST/hr	8/2920	Pneumatic Fogging Water Sprays
Pilot Plant 3 Belt Conveyor Transfers	10 ST/hr	8/2920	Pneumatic Fogging Water Sprays
Pilot Plant Roll Crusher	[illegible]	8/2920	Uncontrolled
Pilot Plant Bucket Elevator	[illegible]	8/2920	Pneumatic Fogging Water Sprays
Modifications Requiring Amendments			
PC 1302 - Lime/Cement Silo - (loading)	[illegible]	3/1095	Baghouse
PC 1302 - Lime/Cement Silo - (discharge lime)	[illegible]	24/8760	Uncontrolled
PC 1302 - Lime/Cement Silo - (discharge cement)	[illegible]	24/8760	Uncontrolled
PC 2806 - (2) Calcium Cyanide Storage Bins - (loading)	30.0 ST (each)	3/1095	Baghouse
PC 2806 - (2) Calcium Cyanide Storage Bins - (discharge)	1.5 ST/hr (each)	24/8760	Uncontrolled
PC 2100 - Diatomaceous Earth Silo - (loading)	[illegible] ST/hr	3/1095	Baghouse
PC 2100 - Diatomaceous Earth Silo - (discharge)	1.5 ST/hr	24/8760	Uncontrolled
PC 1931 - Rod Mill	1100 ST/hr	24/8760	Wet Process
PC 2103 - (2) Boiler Furnaces	1.0 ST/hr (combined)	24/8760	[illegible]
Modifications Requiring A New Permit To Construct			
PC 1912 - [illegible]	2.5 ST/hr	24/8760	Closed System
PC 1914 - [illegible]	0.15 ST/hr	24/8760	Uncontrolled
PC 1874 - [illegible] Solution Heater	[illegible]	24/8760	Water [illegible] Mist Eliminator
Existing Equipment			
PC 1970 - Transfer To Crusher	750 ST/hr	24/8760	Fogging Water Sprays W/Surf.
PC 1970 - Mill Crushing Circuit	750 ST/hr	24/8760	Baghouse
PC 1970 - Transfer To Stacker Conveyor	750 ST/hr	24/8760	Baghouse
PC 1970 - Transfer To Radial Stacker	750 ST/hr	24/8760	Fogging Water Sprays W/Surf. & [illegible]
PC 1970 - Transfer Stacker To Stockpile	750 ST/hr	24/8760	Fogging Water Sprays W/Surf. & [illegible]
PC 1970 - Mill Reclaim System	750 ST/hr	24/8760	Baghouse
PC 2625 - Transfer To Wobbler Feeder	1100 ST/hr	24/8760	Pneumatic Fogging Water Sprays
PC 2625 - Transfer Feeder To Crusher	1100 ST/hr	24/8760	Pneumatic Fogging Water Sprays
PC 2625 - Heapleach Primary Crusher	1100 ST/hr	24/8760	Pneumatic Fogging Water Sprays
PC 2625 - Transfer To Radial Stacker	1100 ST/hr	24/8760	Pneumatic Fogging Water Sprays
PC 2625 - Transfer Stacker To Stockpile	1100 ST/hr	24/8760	Pneumatic Fogging Water Sprays
PC 2626 - Heapleach Secondary Crushing	1100 ST/hr	24/8760	Baghouse
PC 2626 - 2 Conveyor Transfers	1100 ST/hr	24/8760	Baghouse
PC 2627 - Heapleach Secondary Screening	1100 ST/hr	24/8760	Baghouse
PC 2628 - Heapleach Tertiary Crusher	1100 ST/hr	24/8760	Baghouse
PC 2629 - Heapleach Tertiary Screening	1100 ST/hr	24/8760	Baghouse
PC 2629 - Transfer To Bins	1100 ST/hr	24/8760	Pneumatic Fogging Water Sprays
PC 2629 - Transfer To Stacker	1100 ST/hr	24/8760	Pneumatic Fogging Water Sprays
PC 2629 - 15 Conveyor Transfers [illegible]	1100 ST/hr	24/8760	Controlled By Moisture Content Of Material
PC 2159 - Valmac Lime Silo - (loading)	20 ST/hr	2/730	Baghouse
PC 2159 - Valmac Lime Silo - (discharge)	3 ST/hr	24/8760	Uncontrolled
PC 1858 - Assay Lab Equipment	[illegible]	24/8760	Baghouse
PC 2161 - Slag Handling System	[illegible] ST/hr	24/8760	Baghouse
PC 2162 - Flux Handling System	2.5 ST/hr	24/8760	HEPA/ULPA Filter System

OFFSET DETERMINATION

The highest particulate emission impact is 138.61 ST/yr as summarized in Table III. The latest total offset requirement, which has been fulfilled, was determined to be 142.12 ST/yr (135% of the predicted emission level at the time of previous review: 143.04 ST/yr). The latest emission inventory includes consideration for the actual controlled emission rates from the source tested processes. Since Echo Bay has complied with the 143.04 ST/yr offset requirement previously determined, and since the calculated facility emissions have decreased to 138.61 ST/yr, a decrease of 3.51 ST/yr, no offset will be required for the stationary source emissions inventory.

TABLE II

Source	Operating Rate	Uncontrolled Emission Factor (lb/T)	Uncontrolled Emissions (lb/hr)	Control (Actual) Emissions (lb/hr)	NAC Allow. Emissions (lb/hr)
New Equipment					
Cambelt Lime/Cement Silo - (loading)	[illegible]	0.27	[illegible]	0.12	25.3
Cambelt Lime/Cement Silo - (discharge [illegible])	[illegible]	0.04	0.0[illegible]	0.02	[illegible]
Cambelt Lime/Cement Silo - (discharge [illegible])	[illegible]	0.04	0.2	0.01	[illegible]
Diatomaceous Earth Silo - (loading)	[illegible]	0.27	10.13	0.01	[illegible]
Diatomaceous Earth Silo - (discharge)	[illegible]	0.04	0.06	0.00	[illegible]
Vulmac Lime Silo - (loading)	[illegible]	0.27	[illegible].50	0.14	26.7
Vulmac Lime Silo - (discharge)	2.4 ST/hr	0.04	0.10	0.10	[illegible]
Pilot Plant Crusher and Screen	[illegible]	0.05	0.50	0.03	[illegible]
Pilot Plant 1 Conveyor Transfers	[illegible]	0.06	0.06	0.02	[illegible]
Pilot Plant Roll Crusher	[illegible]	0.05	0.05	0.05	[illegible]
Pilot Plant Rocking Classifier	[illegible]	0.05	0.08	0.01	[illegible]
Modifications Requiring Amendments					
PC [illegible] - Lime/Cement Silo - (loading)	[illegible]	[illegible]	10.4	0.30	[illegible]
PC 1301 - Lime/Cement Silo - (discharge [illegible])	[illegible]	0.04	0.08	0.03	[illegible]
PC 1307 - Lime/Cement Silo - (discharge [illegible])	[illegible]	0.04	0.20	0.20	[illegible]
PC 1606 - (2) Calcium Cyanide Storage - (loading)	30.0 ST/hr (each)	0.27	[illegible]	0.1[illegible]	46.0
PC 2606 - (2) Calcium Cyanide Storage - (discharge)	[illegible] ST/hr (each)	0.04	0.12	[illegible]	10.[illegible]
PC 2160 - Diatomaceous Earth Silo - (loading)	[illegible] ST/hr	0.27	10.13	0.10	25.2
PC 2160 - Diatomaceous Earth Silo - (discharge)	[illegible]	0.04	0.06	[illegible]	[illegible]
[illegible] Bag Mill	[illegible]	N/A	N/A	[illegible]	N/A
PC 2159 - Screen Processing [illegible]	[illegible] ST/hr (each)	[illegible]	12.0	[illegible]	[illegible]
Modifications Requiring A New Permit To Construct					
[illegible] - Mercury Retort	[illegible]	N/A	N/A	N/A	N/A
[illegible] - Carbon Kiln	[illegible]	[illegible]	0.049	[illegible]	[illegible]
[illegible] - Thermal [illegible] Heater	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Existing Equipment					
PC 1970 - Transfer To Crusher	750 ST/hr	0.06	44.4	[illegible]	[illegible]
PC 1970 - Mill Crushing Circuit	750 ST/hr	0.05	[illegible]	[illegible]	[illegible]
PC 1970 - Transfer To Stack Conveyor	750 ST/hr	0.06	45.0	[illegible]	45
PC 1970 - Transfer To Radial Stacker	750 ST/hr	0.06	45.0	[illegible]	45
PC 1970 - Transfer Stacker To Stockpile	750 ST/hr	0.06	45.1	[illegible]	[illegible]
PC 1970 - Mill Reclaim System	750 ST/hr	0.08	44.4	[illegible]	[illegible]
PC 2625 - Transfer To Wobbler Feeder	1100 ST/hr	0.08	47.3	[illegible]	[illegible]
PC 2625 - Transfer Feeder To Crusher	1100 ST/hr	0.06	47.3	3.30	[illegible]
PC 2625 - Roughneck Primary Crusher	1100 ST/hr	0.05	55.0	2.75	[illegible]
PC 2625 - Transfer To Radial Stacker	1100 ST/hr	0.06	47.3	1.88	[illegible]
PC 2625 - Transfer Stacker To Stockpile	1100 ST/hr	0.06	47.3	1.65	[illegible]
PC 2626 [illegible] - Roughneck Secondary Crushing & Screening	1100 ST/hr	[illegible]	198.0	[illegible]	[illegible]
PC 2626 - 2 Conveyor Transfers	1100 ST/hr	0.06	[illegible]	[illegible]	[illegible]
PC 2626 [illegible] - Roughneck Tertiary Crushing & Screening	1100 ST/hr	0.18	198.0	[illegible]	[illegible]
PC 2629 - Transfer To Sand	1100 ST/hr	0.06	66.0	[illegible]	[illegible]
PC 2629 - Transfer To Stacker	1100 ST/hr	0.06	66.0	[illegible]	[illegible]
PC [illegible]	[illegible]	[illegible]	[illegible]	0.41	[illegible]
PC 2159 - Vulmac Lime Silo (loading)	[illegible]	0.27	[illegible]	[illegible]	[illegible]
PC 2159 - Vulmac Lime Silo (discharge)	[illegible]	0.04	[illegible]	[illegible]	[illegible]
PC [illegible] - Agglomeration Equipment	Variable	N/A	N/A	N/A	N/A
PC [illegible] - Slag Handling System	[illegible] ST/hr	N/A	[illegible]	[illegible]	[illegible]
PC [illegible] - [illegible] Handling System	[illegible] ST/hr	N/A	0.003	0.003	N/A

TABLE III

Source	Emission Rate (lb/hr)	Operating Hours (/year)	Actual Emission Rate (ST/yr)
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	3.29	[illegible]	[illegible]
[illegible]	[illegible]	145,163	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

[illegible] has been determined [illegible]

[illegible] 0.87 pounds per hour.

[illegible] October 1988 source tested emission rate of 1.88 pounds per hour.

[illegible] October 1988 source tested emission rate of 0.40 pounds per hour.

Richard H Sommer
240 Vineyard Lane
Roseburg, OR 97470 673-3709
Jul 25, 1992 9:03 AM

Regional Environmental Officer
US Bureau of Reclamation
550 West Fort Street
Boise, Idaho 83724

Mr Fred Hanson

RE: DEIS Milltown Hill Project

Dear Sir,

I thank you for alerting me to the environmental consequences of this project. That is exactly what a DEIS is supposed to do. As one educated in agriculture and natural resources and with 31 years experience as a grapegrower and winemaker I feel qualified to review the DEIS of the Milltown Hill Project and I request this statement be made part of the record.

I commend the people of the agencies for producing this exhaustive and informative document. Particularily useful is section 4.2 'Chronololgy of Consultation and Coordination' a where the history of the project was traced from Nov 26, 1985 with the signing of the 'Memorandum of Understanding' to August 11, 1991 with the completion of the Biological Assessment. I also liked the maps, table 2-3 (Reviews and Permits). The descriptions in chapter 2 were exhaustive but illuminating. Although the heading of Chapter 3 - 'Affected Environment and Environmental Consequences' threw me off and was a little confusing I found much useful information therein.

Although most of the essential environment information is included in this DEIS it needs a thorough rearranging to meet the NEPA requirements. I think it can be done administratively by the cooperating agencies and not have to resort to judicial review.

Here are my comments and suggestions:

Before the Milltown Hill Project proceeds any further (DEIS - FEIS - record of decision - funding) a comphrensive on-site biological survey and monitoring program needs to be done to examine all the plants, animals, fishes, insects, etc.

I am especially concerned the old mercury prospects and mines may pose a health hazard to the environment. The mine tailings should be isolated, disposed of, or cleaned up (superfund -EPA) in such a way as to eliminate the possibilty of making the reservoir a catch and release fishery or the possibility of having to treat the water before it can be used for domestic purposes. The DEQ should be receiving all the supporting documents that you and Douglas County have gathered or generated.

This survey must include the mine tailings and waste piles. What kind of plants grow there. An there any plants or plant associations that tolerate elevated levels of mercury or associated metals. Are there any indicator plants? This survey must include in-stream or seep aquatic plant and animal life.

An aquatic biologist needs to examine all streams that feed the reservoir site.What kind of aquatic life? Any indicator plants or insects, mollusks, fishes - both anadromous and resident?

Here a fishery person needs to examine and monitor the resident and migratory fishery. Will the aquatic life support these fisheries? What is the nature and extent of the spawning areas.

An on-site plant survey and monitoring program needs to be done. If any rare or endangered or sensitive plants found what are the consequences of their (its) demise. Does it grow on similar habitats in adjacent watersheds?

An animal survey for large and small ones needs to be done. Are their any habitats critical to an animals survival. Winter range, summer moisture, a special kind of forage required.

Just as a dam requires a firm footing a complete biological survey will give the DEIS a firm footing and be in compliance with NEPA requirements.

I thank you for receiving these comments and I look forward to a revised DEIS, or DEIS or FEIS

Sincerely Yours,
Richard H. Sommer
Richard H Sommer
Richard H. Sommer

State of Oregon
DEPARTMENT OF ENVIRONMENTAL QUALITY
RECEIVED
JUL 28 1992
OFFICE OF THE DIRECTOR

S.R. 2, 102 Oil Well Rd.
Burns, OR   97720

July 21, 1992

Fred Hansen
Dept. of Environmental Quality
811 S.W. 6th Ave.
Portland, OR   97204

Re: Chemical Process Mining Rules

Dear Mr. Hansen:

This letter is in support of the original chemical process mining rules first scheduled for adoption on December 13, 1991 and now rescheduled for adoption on August 7, 1992. We feel strict regulations should be enforced for Oregon to ensure the history of severe environmental problems caused by cyanide leach mining in other states, such as Nevada, is not repeated in Oregon. These concerns include but are not limited to the potential:

* Release of cyanide-contaminated solutions into groundwater.

* Poisoning of cattle.

* Poisoning of of migratory waterfowl that land in tailings ponds.

* Failure of reclamation attempts.

We are requesting that these comments be shared with the members of the EQC Board.

Sincerely,

Sally B. Hendry   Joseph C. Hendry
Sally B. Hendry   Joseph C. Hendry

SIERRA CLUB

Oregon Chapter

July 31, 1992

Environmental Quality Commission
c/o Oregon Department of
Environmental Quality
811 SW 6th
Portland, OR 97204

Re: Chemical Mining Rules

The Oregon Chapter Sierra Club supports the December 13th, 1991 draft Chemical Mining Rules. We ask that our support be made a part of the record and request that the Commission adopt this draft.

Sincerely,

Liz Frenkel

Liz Frenkel, Legislative Coordinator
1413 SE Hawthorne
Portland, OR 97214

State of Oregon
DEPARTMENT OF ENVIRONMENTAL QUALITY
RECEIVED
AUG 03 1992
OFFICE OF THE DIRECTOR

cc: The Wilderness Society

State of Oregon
DEPARTMENT OF ENVIRONMENTAL QUALITY
RECEIVED
JUL 15 1992

OFFICE OF THE DIRECTOR

1565 Jamestown St., S.E.
Salem, Oregon 97302

July 14, 1992

MR. FRED HANSEN
DEPARTMENT OF ENVIRONMENTAL QUALITY
811 S.W. 6TH AVENUE
PORTLAND, OREGON 97204

Dear Mr. Hansen;

I urge that the Commission not be deterred from adopting strict regulations for cyanide heap-leach mining in Oregon. The rules scheduled for adoption on December 13 of last year should be adhered to.

The lesson of placer mining should not be forgotten. Large areas of western North America have been permanently removed from productivity for the remaining scope of the earth's human occupancy. Most of the endless boulder fields--and the lost forests, meadows, and hillsides they represent--were the result of marginal economic activity at best; many terminated in just plain bankruptcy. All this permanent destruction was in the name of a commodity of limited practical use; one that has always been in utilitarian oversupply.

Frontier days are far behind us. Our development is at the stage where challenges to a diminishing environment must be strictly managed for the long term. The future extends far beyond tomorrow and there is no excuse for more moonscapes on earth. In no way should present economic activities, especially those of such frivolous utility, be allowed to burden and trash the future.

Please share these comments with members of the EQC board.

Sincerely,

Jay C. Quast

Jay C. Quast

July 13, 1992

FRED HANSEN
DEPARTMENT OF ENVIRONMENTAL QUALITY
811 S.W. 6TH AVE.
PORTLAND, OREGON 97204

Dear Mr. Hansen & EQC Board Members,

I write to you because of my love and concern for Oregon ' s future and the livability of her environment for future generations to come. I am the fourth generation on homestead land and fully realize the absolute necessity to continually build and improve and protect our home lands.

I WRITE SEEKING YOUR COMMISSION TO GUARD OREGON'S ENVIRONMENT. As Reub Long might have wondered, "Are you looking for someone smarter than your selves to make the tough decisions"..like the realization that it is your responsibilty to say..."NO ! Oregon is too grand a land to pit and toxify!"

Any ordinary group can hire 'COMPANY MEN' to lay 'fixed regulations suggestions.....but that will not help you conscience for what you KNOW is your commission....Oh! it may suggest some rhetoric for your excuses". Too many Oregon citizens are watching your acts....counting on you to pump up your integrity....to preserve OREGON'S ENVIRONMENTAL QUALITY.

ENCLOSED IS: My Feb. 92 letter to Mr. Wessinger & the EQC Board. Please consider my plea and share these letters again at your board meeting..... not just paper shuffled under the table ...so that you can get on with listening to Mining biased report from lobby interest.....

DEQ Oregonians are watching and listening !

Thank you for your time !

Dorcas McElheran

Dorcas McElheran
Rt 1 Box 432
Maupin, Oregon 97037

FEBRUARY 4, 1992

WILLIAM WESSINGER, CHAIR EQC
121 S.W. Salmon, Suite 1100
Portland, Oregon 97204

Dear Mr. Wessinger and EQC Board,

CONCERNING : POSSIBLE CYANIDE HEAP LEACH seepage & pollution of Oregon environment, no matter how far from Portland

I write to you as a concerned lifetime resident of Eastern Oregon. I write to you because you seem to be the Chair Power, whoes hands hold the responsibility of Oregon's environment.

Making decisions..... long term decisions....decisions which will enrich or devastate (as our early Americans suggest-- the next seven generations) is not an easy task. I do not envy the weight of your load.....pressure to go with mine profits...... pressure to keep Oregon Living Quality upheld. Rich ! Viewed from two different angles. But, how can TOXIC be RICH ?

I SUPPORT THE ADOPTION OF RULES WHICH WERE SCHEDULED FOR ADOPTION ON DECEMBER 13, 1991. I SEEK YOUR COMMITMENT TO A FAIR AND UNBIASED APPROACH IN THE SELECTION OF A REVIEW CONTRACTOR FOR THE EQC RULES. You surely agree that the economics of operating a mine should not be the consideration of the rulemaking !

Please give full consideration to prevent leaks - I support even more than triple liner system....

Please require detoxification and covering during closures.

Please require action that eliminate tailings toxic metals release...... even unto seven generations.

Please let's protect Oregon's citizens and environment.

THANK YOU FOR YOUR ATTENTION .

Dorcas McElheran

Dorcas McElheran .... for all our family
Rt 1 Box 432
Maupin, Oregon 97037 tel. 395-2612

Rest the West

P.O. Box 10065
Portland, OR 97210

(503) 645-6293 / Bruce Apple
(503) 653-9781 / Steve Alf

July 14, 1992

K. S. Myron
158 S.W. 11th Avenue
Canby, OR 97013

Fred Hansen, Director
Department of Environmental Quality
811 S.W. 6th Avenue
Portland, OR 97204

Mining Rules Originally Scheduled for Adoption December 13, 1991

Dear Mr. Hansen:

I write as a citizen of Oregon and on behalf of Rest the West. As we wrote in August 1991, supporting the then-proposed mining rules, we write now urging you to stand firm on those proposed rules of 1991. We ask also that you share these comments with the members of the Environmental Quality Commission.

Our position has not altered since we wrote nearly a year ago. I attach those comments to be revisited by you and the EQC now. We encourage you to obtain the following document from the U.S. Fish and Wildlife Service, if you have not already considered it. The report is available from the Publications Unit, U.S. Fish and Wildlife Service, 1849 C Street, N.W., Mail Stop 130--ARLSQ, Washington, D.C. 20240.

Cyanide Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. Eisler, Ronald. Biological Report 85(1.23), Contaminant Hazard Reviews Report 23, December, 1991.

Table 2, page 15 - 17 lists background concentrations of cyanide in selected living resources and nonbiological materials including humans, plants, a few insects, sewage sludge, uncontaminated water, wastewaters/runoff, and wastewater treatment plants. Gold mine cyanide extraction leach ponds in California, Nevada, and Arizona are listed as containing concentrations (mg/kg or mg/L) at the following levels: "Usually 200-300, frequently 700, occasionally 9,000." The report notes that

> Cyanide ions are not strongly absorbed or retained on soils, and leaching into the surrounding ground water will probably occur. ...
> Under normal conditions cyanide has relative low persistence in air, usually between 30 days and 1 year (Way 1981), although some atmospheric HCN may persist for up to 11 years (Marrs and Ballantyne 1987). Data are lacking on the distribution and transformation of cyanide in the atmosphere (Towill et al. 1978) and should be acquired. (section on "Persistence in Water, Soil, and Air." Pg. 18)

The report discusses lethal and sublethal effects upon terrestrial and aquatic flora and invertebrates, fish, birds, and mammals, with those effects on selected species summarized in a series of tables pages 21-32 and 36-45. Table 6 gives proposed free cyanide criteria for the protection of living resources and human health, noting the resource, criterion, and other values with respect to cyanide concentration.

This U.S. Fish and Wildlife Service Contaminant Hazard Review series includes reports on mercury, selenium, lead, arsenic, cadmium, and other contaminants, several of which I recall as being frequently associated with hard rock mining activities. While I have not yet received those reports, the quality of the Cyanide Hazards report leads me to believe the others would also contain information valuable to sound decision making with respect to Oregon's mining rules. All are available through the FWS Publications Unit.

This hazards report, together with other available information on severe environmental problems in hard rock mining states, makes a strong argument against relaxing Oregon's proposed set of fixed mining regulations governing mining operations throughout the entire state. And against diluting protection to the time-consuming and tax-spending smoke screen of "site specific" regulations. Cyanide heap leach mining operations are not that dissimilar, nor are their poorly regulated hazards. Oregon has not been bathed in cyanide site specifically--and there is no justification for sacrificing Oregon's present environment and human health so that microscopic gold can be obtained from thousands of tons of ravaged earth.

The issue here is not keeping the global hard rock mining community happy by maximizing their profits. The issue is health: the health of Oregon's streams and reservoirs, Oregon's soils and plants, mammals, fish, bacteria, algae--Oregon's wildlife, and Oregon's human community--Oregon's environment as a whole. Surely, making the business of gold extraction cheaper and easier for a few affected commercial interests--who have an outstandingly poor record for preventing environmental destruction and human health and economic upheaval--is not the mandated business of Oregon's Department of Environmental Quality? Surely, protection, restoration, and preservation of Oregon's environmental quality is the mandated business of the department. As Nike would say, "Just Do It!" Keep the language of the rules scheduled for adoption December 13, 1991--and adopt them now--for Oregon's sound and healthy future.

Please do not merely summarize these comments. Please convey them to the EQC board members in their entirety. Thank you.

Sincerely,

Kathleen Simpson Myron

cc: Alf Enc: August 1991 Comments on Mining Rules

bc:

Fred Hansen
Department of Environmental Quality
811 S.W. 6th Avenue
Portland, OR 97204

Hollander
150 Broadway #2
Bend, OR 97702

July 13, 1992

Mr Hansen:

It has come to my attention that within a few weeks, legislation will be processed determining the fate of some of the most valuable land this state possesses. When the Environmental Quality Commission decides on the severity of rules governing chemical process mining on August 7, it is my hope that the rules adopted tend towards those favored for adoption on December 13 of last year.

If we are to allow heap-leach mining into the state --as it appears "we" are-- then the least we can do is implement regulations stringent enough to keep some of the disastrous consequences of this process to a minimum. Not a fair trade considering the sure environmental toll exacted by heap-leach methods, but a vital measure nonetheless. The people of Eastern Oregon deserve better than to have the land that is their livelihood stolen from under them by a profit-motivated group of out-of-state investors: push for the strictest chemical process mining regulations possible at this time. Thank you for your time and energy.

Sincerely,

Zaz Hollander, Bend

P.S. Please share these comments with the EQC board.

Willamette
UNIVERSITY
1842 150 Years 1992

900 State St. • Salem • Oregon 97301

State of Oregon
DEPARTMENT OF ENVIRONMENTAL QUALITY
RECEIVED
JUL 17 1992
OFFICE OF THE DIRECTOR

July 14, 1992

Fred Hansen
Department of Environmental Quality
811 SW 6th Avenue
Portland, Oregon 97204

Dear Mr. Hansen,

Having learned of the choice of TRC Environmental Consultants to review selected sections of the proposed rules to regulate cyanide heap leach mining in Oregon, I question their objectivity. TRC and its employees have extensive connections with the mining industry -- can they in fact deliver an unbiased review?

I urge you to enact the rules that were scheduled for adoption on December 13, 1991. It is critical that the fragile ecosystem in eastern Oregon be protected from the massive cyanide spills and acid mine drainage that have plagued heap leach mines in Idaho, Montana, and Nevada. Please share my comments with members of the Environmental Quality Consultant board.

Sincerely,

Todd Silverstein

Todd Silverstein
Assistant Professor of Chemistry

TS/pg

Chemistry Department
(503) 370-6013 • FAX (503) 370-6148

Fred Hansen
Department of Environmental Quality
811 S.W. 6th Avenue
Portland, Oregon. 97204

Dear Sir,

I am in support of the adoption of the rules as they pertain to the chemical mining process being proposed by the Environmental Quality Commission.

For too many years the mining companies have been "subsidized" by the people of America. The mining companies in many cases pay no royalties on the harvest they reap for the land.

The "new" type of mining called "Heap Leach" is moving at too great of speed to allow for proper studies on the negative impacts that might be forever detrimental to the natural resources and ecosystems they effect.

Please feel free to share these concerns with the members of the EQC board.

Sincerly,

James A. Nutt

James A. Nutt
P.O. Box 210
Coeburn, Virginia 24230

Gary Kish 29395 NW Reeder Road Sauvie Island Oregon 97231-6906

July 17, 1992

Fred Hansen
Department of Environmental Quality
811 SW 6th Ave
Portland OR 97204

Re: Adoption of Chemical Process Mining Rules

Dear Mr. Hansen & DEQ Board Members:

I'm writing to express my support for strict "chemical process" mining rules. I understand that a hearing on this issue is scheduled for 8/7/92.

However, I must first express my concern over the hiring of TRC Consultants Inc. to review proposed administrative rules. TRC collectively and some of its employees individually appear to have an uncomfortably close relationship with the mining industry and its lobbying groups. I have no confidence that TRC can produce an unbiased review and this concern is borne out by TRC's draft proposal filled with mining industry propaganda.

Given the mining industry's record throughout the West, DEQ should take all steps to ensure that the disastrous effects on water and wildlife that other states have experienced do not occur here. Let's learn from other state's mistakes and not allow them to happen again in Oregon. We only have to look at our National Forest crisis to see that in the long run, strict regulations are necessary to maintain our environment and Oregon's economy.

Of major concern to me is our fisheries. In the midst of a seven year drought, with water supplies over-appropriated throughout Eastern Oregon, and not enough left in the streams for fish and wildlife, where is the huge quantity of water needed for heap-leaching going to come from?

Therefore, I urge you and the DEQ Board to set aside TRC's report and <u>enact the strictest of mining regulations to control gold mining in Oregon</u>.

Sincerely,

Gary Kish

Gary Kish

cc: Gov. Roberts / M. Pagel

Travel Time Through Soil Liners

Permeability, cm/sec	Hydraulic Head, feet	Material (liner) thickness, feet	Breakthrough time (as noted)
10^{-7}	1	1	4.8 years
		2	12.9 years
		3	21.8 years
	3	3	14.5 years
	10	3	6.7 years
10^{-6}	1	3	2.2 years
10^{-5}	1	3	2.6 months
10^{-2}	1	3	1.9 hours

Notes:

$$\text{time, years} = \frac{\text{Thickness, feet}}{(\text{Permeability, cm/sec})(\text{head, ft/thickness, ft} + 1)(1.035 \times 10^{6}\ \text{ft-sec/cm-year})}$$

Oregon

DEPARTMENT OF ENVIRONMENTAL QUALITY

Public Meeting Notice

The Subject

Chemical Mining Rules -- Discussion of a consultant study which will provide technical advice to the Environmental Quality Commission.

The Meeting Time

Date: Tuesday, May 5, 1992

Time: 1:00 p.m.

Location: Department of Environmental Quality
Executive Building
811 S. W. 6th Avenue
Portland, Oregon
Conference Room 3a

The Purpose of the Public Meeting

The Environmental Quality Commission (Commission) is considering adoption of rules to require mining operations using cyanide or other toxic chemicals to protect soils, groundwater, surface waters, and wildlife from contamination or harm by process solutions and waste waters. Prior to final action to adopt proposed rules, the Commission elected to seek an evaluation and advice on specific technical questions from an independent, knowledgeable contractor. The questions deal with liners, leak detection and leak collection systems, tailings treatment to reduce the potential for release of toxics, and closure of heap leach and tailings facilities. The consulting firm of **TRC Environmental Consultants, Inc.**, from Englewood, Colorado, has been selected as the contractor.

The purpose of this public meeting will be to:

- Inform the interested public on the contractors approach and schedule for addressing the questions posed.
- Identify any anticipated need to contact persons who presented testimony in the proceeding for additional information to assist in addressing the questions posed.
- Respond to questions.

811 SW Sixth Avenue
Portland, OR 97204-1390
(503) 229-5696

State of Oregon
Department of Environmental Quality — Memorandum

Date: August 17, 1992

To: Environmental Quality Commission

From: Fred Hansen

Subject: Closure of Open Pits -- Mining Rules

This memo provides some additional information as requested by the Chair in response to Jean Cameron's comments regarding closure of open pits at the August 7, 1992, mining discussion. Below on the left is the wording on this issue from the current rule proposal. Jean's Cameron's comments are on the right. Our comments follow. Then, for your reference, the Department of Geology's rule on "Reclamation and Mine Closure Standards" is reproduced to give you a sense of how our rules fit with theirs. Finally, some information on the financial security (reclamation bond) provisions and consolidated permit process of HB 2244 and Geology's rules is provided.

GUIDELINES FOR OPEN-PIT CLOSURE

340-43-095

(1) Open pits that will be left as a result of the mining operation shall be assessed prior to, and following, mining operations for the potential to contaminate water to the extent that it might not meet water-quality standards due to build-up of acid or toxic metals.	
(2) If the Department finds that the potential for water accumulation in the pit(s) exists, the permit applicant shall submit a closure plan for the pit that will address contamination prevention and possible remedial treatment of the water. The closure plan shall, at a minimum, examine the following alternatives:	
(a) Avoidance, during mining, of acid-generating materials that can be left in place, rather than being exposed to oxidation and weathering;	Jean supports this option.

(b)	Removal from the pit and disposal, during or after the mining operation, of residual acid-generating materials that would otherwise be left exposed to oxidation and weathering;	Jean recommends deleting this option because it's use would leave an even larger scar on the land and would require removal of acid-generating materials to a disposal facility that would itself require long term maintenance and monitoring in an endless shell game.
(c)	Protective capping in-situ of residual acid-generating materials;	Jean recommends deleting this option because of the potential for failure of a cap, especially on steep slopes.
(d)	Treatment methods for correcting acidity and toxicity of accumulated water;	Jean recommends deleting this option because it requires perpetual treatment with related costs and potential for failure.
(e)	Installation of an impermeable liner under ponded water to prevent groundwater contamination;	Jean recommends deleting this option because of the potential for failure that requires perpetual monitoring and potential remedial action, as well as exclosure from wildlife access.
(f)	Backfilling of the pit(s) above the water table to reduce oxidation of residual acid-generating materials.	Jean supports keeping this option in the rules but amending it to read "Backfilling of pit(s) ~~[above the water table]~~ <u>to the level necessary</u> to ~~[reduce]~~ <u>prevent</u> oxidation of residual acid-generating materials."

The intent of paragraph 2 of this rule was to require evaluation of potential options for control and development of a closure plan in the event water accumulation in the pit is a possibility. While some of these options may seem to have drawbacks, we do not think it is appropriate to eliminate any of them from evaluation and potential use at this stage. With respect to the suggested modification of (f), we would agree that "to the level necessary" is probably better wording than "water table". We also agree with the intent of preventing oxidation, but are not sure that backfilling, by itself, could "prevent" oxidation in all cases. Perhaps wording to the effect of "... to the level necessary to, <u>in conjunction with other appropriate control measures,</u> prevent oxidation..." would accomplish the purpose.

The Department of Geology and Mineral Industries adopted fairly extensive rules in October 1991, in response to HB 2244. Rule OAR 340-37-130, entitled "Reclamation and Mine Closure Standards", reproduced below, gives a sense of their current direction regarding reclamation.

632-37-130 The Department shall require a chemical process mine to comply with reclamation and mine closure standards utilizing the best available, practicable and necessary technology to assure compliance with environmental standards. The reclamation and mine closure standards shall include but not be limited to the following:

(1) Surface reclamation shall assure environmental protection and the protection of human health and safety, as well as livestock, fish and wildlife.

(2) Surface reclamation of a chemical process mine shall require certification of the Department of Fish and Wildlife and the Department of Agriculture that a self-sustaining ecosystem, comparable to undamaged ecosystems in the area, has been established in satisfaction of the permittee's habitat restoration obligations.

(3) Post-closure monitoring shall be required by the Department to insure compliance with decommissioning performance standards.

(4) Revegetation shall be considered successful if it is consistent with the establishment of a self-sustaining ecosystem, comparable to undamaged ecosystems in the area of the mine. Vegetation test plots and chemical/physical soil and subsoil analysis may be required to insure establishment feasibility.

(5) Native species shall be established unless the use of non-native species is justified and approved by the Technical Review Team.

(6) Seedmixes, fertilizer rates and other requirements will be derived from departmental experience and advice from such sources as the Oregon Department of Agriculture, U.S. Soil Conservation Service, Oregon State University Extension Service, the Oregon Department of Transportation, the Bureau of Land Management, the Forest Service, local soil conservation districts and private sector experts.

(7) All final slopes shall be stable, blend into adjacent terrain and be compatible with the establishment of a self-sustaining ecosystem, comparable to undamaged ecosystems in the area of the mine.

(8) Reclaimed highwalls shall not have slopes exceeding 1-1/2 horizontal to 1 vertical (1-1/2:1). The Department may grant exceptions for steeper slopes when the applicant can document that the slopes will be stable and if the steeper slopes:

(a) Blend into the adjacent terrain features;
(b) Existed prior to mining; or
(c) Are consistent with the establishment of a self-sustaining ecosystem, comparable to undamaged ecosystems in the area of the mine.

(9) Fill Slopes shall be 2:1 or flatter unless steeper slopes are approved by the Department. Technical data supporting steeper slope stability may be required by the Department.

(10) In-water slopes to six feet below water level for permanent water impoundments when necessary shall be 3:1. Reasonable alternatives may be approved by the Department when they are consistent with the reclamation plan. For example, safety benches with no more than two feet below water level and five feet wide may be substituted for the slope requirement where the Department determines that sloping is not practical.

(11) Permanent structures may remain if they are part of the approved reclamation plan.

(12) Any standards adopted by rule by a permitting or cooperating agency related to reclamation or closure of a chemical process mine.

(13) Backfilling or partial backfilling of pits shall be required if the Department determines that:

(a) Backfilling is necessary to achieve the reclamation objectives set forth in ORS Chapter 517 or Chapter 735, 1991 Oregon Laws;

(b) Reclamation objectives, including but not limited to compliance with environmental standards, cannot be achieved through mitigation or other reclamation technologies; and

(c) Backfilling is the best available, practicable and necessary technology to assure compliance with environmental standards.

Geology's rules (OAR 632-37-135) also deal with the issue of financial security. The rules require a reclamation bond (or approved alternative security) to be posted prior to the start of any mining operations. The amount of the financial security is to be calculated on the basis of the estimated actual cost of reclamation and closure and shall not be limited. The rules detail factors to be considered in determining the amount of security and provide that the calculation shall also consider environmental protection costs based on a credible accident analysis. The rules require Geology to assess annually the overall cost of reclamation. If changes in the operation or modifications to a permit cause the cost of reclamation to exceed the amount of the financial security currently held by the state, the permittee shall post additional security for the difference. Permits are to be suspended if the permittee fails to post necessary security.

HB 2244 and Geology's rules also provide for a consolidated permit application process. A Reclamation and Closure Plan is required as part of the application. Public notice must be given at various stages of the process, including notice of a consolidated public hearing and opportunity for written comment on the draft permits of all agencies. Therefore, there will be opportunity for review and comment on pit closure and reclamation issues before permits are finally issued.

Finally, existing permit process rules adopted by the Commission allow the Department to initiate modification of a permit at any time due to changing conditions or standards, receipt of additional information, or any other reason pursuant to applicable statutes.

The combination of these provisions would seem to give us reasonable opportunity to deal with pit closure issues as more information becomes available in the future.

FH:l

State of Oregon

DEPARTMENT OF ENVIRONMENTAL QUALITY

REQUEST FOR PROPOSALS
FOR
TECHNICAL ADVICE ON MINING RULES

February 7, 1992

TABLE OF CONTENTS

ATTACHMENTS

I. GENERAL INFORMATION

A. Introduction

The Environmental Quality Commission (Commission) is considering adoption of rules to require mining operations using cyanide or other toxic chemicals to protect soils, groundwater, surface waters, and wildlife from contamination or harm by process solutions and waste waters. The protective measures required by the proposed rules include cyanide recovery and re-use, chemical detoxification of cyanide residues, and extensive lining and engineered closure of waste disposal facilities.

During the public participation process on the proposed rules, mining companies and associations have argued that some of the requirements are unnecessarily stringent or are unproven or are unavailable. Environmental protection organizations have argued that the proposed rules may not be adequately protective in certain respects.

The Commission has studied the proposed rules and the public comments received, and has extensively debated the policy issues associated with the rule proposal. Prior to final action to adopt proposed rules, the Commission has elected to seek an evaluation and advice on specific technical questions from an independent, knowledgeable contractor.

The entire record of the rulemaking proceeding is available for inspection as background material for this proposal request. The record can be reviewed in the headquarters office of the Department of Environmental Quality (DEQ or Department or Agency). A full copy of the draft proposed rules being considered by the Environmental Quality Commission is attached as Attachment B.

B. Proposed Project Timeline

Date	Action
February 7, 1992	Mail Request for Proposal
February 28, 1992	Information Exchange (to take place only between mailing of the RFP and this date)
March 10, 1992	Written Proposals Due
March 20, 1992	Selection of Contractor (written notice of award to successful proposer)

March 30, 1992	Protest Period (protests must be filed by this date)
April 10, 1992	Execution of Standard State Personal Service Contract (target date)
Within 15 calendar days of Contract Execution:	Participate in Public Meeting.
Within 45 calendar days of Contract Execution:	Draft Written Report submitted to DEQ.
Within 15 calendar days of Receipt of Comments from DEQ:	Submit Final Report.

C. Services Requested

DEQ is requesting proposals from individuals acting as independent contractors (see attached Independent Contractor Certification Statement form), firms, joint ventures or teams for providing advice to the Commission on technical issues related to proposed rules for mining operations using chemicals to extract metals from ores. Companies interested in pooling their resources through contractor/subcontractor, joint ventures or team arrangements can do so provided that one entity is identified which ultimately will bear total contract responsibility.

D. Scope of Work

Three policies have been established by the Commission. The selected contractor shall evaluate and address specific technical questions surrounding these policies. The Commission is not asking for alternative policy recommendations or evaluation of economic issues. The task of the contractor is to answer the questions posed in the following paragraphs based on their knowledge, expertise, experience, review of current published technical data, and technical evaluation of the issues.

1. Questions on Liners, Leak Detection, and Leak Collection Systems

a. Statement of Policy:

The Commission establishes as policy that a liner, leak detection and leak collection system are necessary to assure that any leak will be detected before toxic materials escape from the liner system and are released to the environment. These systems must assure that if a leak is found, sufficient time is available to allow for the repair of the leak and clean up of any leaked material before there is a release to the environment. Natural

conditions, such as depth to groundwater or net rainfall, shall be considered as additional protection but not in lieu of the protection required by the required engineered protection.

NOTE: Definition of "environment" or use of defining qualifiers is central to the issue. The Commission considers that the environment begins at the bottom of the last liner.

b. Issue:

In the proposed rule contained in 340-43-065(4), the requirements for heap leach pad liners are as follows:

(4) The heap leach pad liner system shall be of triple liner construction with between liner leak detection consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;

(b) Continuous flexible membrane middle and top liners of suitable synthetic material separated by a minimum of 12 inches of permeable material (minimum permeability of 10^{-2} cm/sec);

(c) A leak detection system between the synthetic liners capable of detecting leakage of 400 gallons/day acre within ten weeks of leak initiation.

As opposed to this liner system, the Oregon Mining Council has proposed a liner characterized either as a composite liner or as a double liner and generally described as follows:

Composite Liner -- a composite liner system construction with between liner leak detection consisting of:

- An engineered, stable, low-permeability soil/clay bottom liner (maximum coefficient of permeaability of 10^{-7} cm/sec) with a minimum thickness of 12 inches;

- Continuous flexible membrane top liner of suitable synthetic material;

- A geotextile layer between the liner materials for leak detection. The leak detection and recovery system would also include collector pipes tied to the geotextile, spaced at appropriate intervals to achieve the 10-week leak initiation detection performance standard.

c. Question:

Will either or both liner systems meet the stated policy objective of the Commission?

d. Method to Answer or Address Question:

(1) Are each of the various liner systems proposed technically feasible?

(2) Will each of the various liner systems meet the stated Commission policy?

(3) For those liner systems which will meet the stated Commission policy, what level of certainty for achieving this policy do you assign to each system?

(4) Are there other liner systems which will achieve this policy and what level of certainty for achieving this policy do you assign to each?

The consultant is also asked to provide a simple comparison of typical costs for installation of the various liner configurations.

2. Questions on Tailings Treatment to Reduce the Potential for Release of Toxics

a. Statement of Policy:

The Commission establishes as policy that the toxicity and potential for long-term cyanide and toxic metals release from mill tailings should be reduced to the greatest degree practicable through tailings treatment.

b. Issue:

The proposed rules in 340-43-070(1) state the following:

(1) Mill tailings shall be treated by cyanide removal and re-use prior to disposal to reduce the amount of cyanide introduced into the tailings pond. Chemical oxidation or other means shall be additionally used, if necessary, prior to disposal to reduce the WAD cyanide level in the

liquid fraction of the tailings. The permittee shall conduct laboratory column tests on mill tailings to determine the lowest practicable concentration to which the WAD cyanide (weak-acid dissociable cyanide as measured by ASTM Method D2036-82 C) can be reduced. In no event, shall the permitted WAD cyanide concentration in the liquid fraction of the tailings be greater than 30 ppm.

The rules do not require removal of potentially toxic metals from tailings prior to placement in the tailings pond. The rules do require steps to control acid formation in the tailings pond and require covering upon closure with a composite cover designed to prevent water and air infiltration.

c. Question:

Do the requirements for **removal** and **reuse** of cyanide materially reduce toxicity and potential for long-term cyanide and toxic metals release from mill tailings?

d. Method to Answer or Address Question:

(1) Are **removal** and **reuse** technically feasible?

Potential factors for consideration include:

- Is the process technically defined and understood?
- Has the process been demonstrated in practical application, and if so, where?
- Are engineering firms available to design and oversee construction?
- Are materials and equipment available to construct?

(2) Do **removal** and **reuse** (evaluated separately) materially reduce the toxicity and potential for long-term cyanide and toxic metals release from mill tailings?

(3) What is the level of certainty you give to the answers provided above?

(4) Are there other tailings treatment technologies which will equally, or more effectively achieve the policy of the Commission?

3. Questions on Closure of the Heap Leach and Tailings Facilities

a. Statement of Policy:

The Commission establishes as policy that the closure of the heap leach and tailings disposal facilities will prevent release to the environment of toxic chemicals contained in the facility.

b. Issue:

Rule 340-43-080(4)(a), as proposed, requires that the heap shall be "... detoxified over a suitable period of time prior to closure, using rinse/rest cycles of rinsing and chemical oxidation, if necessary. The WAD cyanide concentration in the rinsate shall be no greater than 0.2 ppm."

In 340-43-080(4)(b), the proposed rules require that the closure of the heap shall be "... by covering the heap with a cover designed to prevent water and air infiltration."

In 340-43-080(5), the proposed rules state that "The tailings disposal facility shall be closed by covering with a composite cover designed to prevent water and air infiltration and be environmentally stable for an indefinite period of time."

c. Question:

Do the requirements of detoxification (cyanide removal by rinsing) of the heap and covering of the heap and tailings facility to exclude air and water materially reduce the likelihood of any release to the environment of toxic chemicals and metals contained in the heap over the long term?

d. Method to Answer or Address Question:

(1) Are detoxification and covering (as prescribed in this rule) technically feasible?

(2) Do detoxification and covering (evaluated separately and together) materially reduce the likelihood of a release of toxic chemicals and metals to the environment?

(3) What is the level of certainty you give to the answers provided above?

(4) Are there other technologies which can equally or more effectively achieve the policy of the Commission?

4. Public Meeting

In addition to answering the above questions, the selected contractor will be expected to participate in a meeting with persons who have expressed an interest in the rulemaking proceeding by presenting testimony at public hearings. The purpose of this meeting will be to:

- Inform the interested public on the contractors approach and schedule for addressing the questions posed.

- Identifying any anticipated need to contact persons who presented testimony in the proceeding for additional information to assist in addressing the questions posed. The Commission expects an open process where all interested parties will have the opportunity to attend the meeting.

This meeting will be scheduled at a time and place mutually agreeable to DEQ and the selected contractor. DEQ will arrange the meeting and provide notice to interested parties.

5. Written Report

A written report shall be submitted as the final product of this contract. The report shall state the question being answered, summarize the methodologies for evaluating and responding to the question, and clearly state the results of the evaluation and answer given.

A draft report shall be submitted to the Department for review. The Department will provide written comments to the contractor. The contractor will then complete the report and file a single master copy, ready for reproduction, with the Department. The report shall become the property of the Department. The Department may copy and distribute the report as it deems appropriate.

E. Type of Contract

DEQ anticipates awarding a fixed price contract. The State of Oregon standard personal service contract will be signed.

DEQ will, in its sole discretion, reserve the right to renew the contract.

F. Payment Procedure

Payment schedules for any contract entered into as a result of the RFP will be mutually agreed upon by DEQ and the prime contractor.

G. Managing Conflict of Interest

Proposing contractors (including subcontractors) shall disclose any potential conflicts of interest. A potential conflict of interest includes, but is not limited to, any involvement during the past five years with mining companies, mining industry groups, or environmental groups active in working on mining regulations and permitting or holding any interest in property in Oregon that may have mineral development potential. During the proposal development period and, if awarded the contract, during the contract period, the selected contractor shall maintain an arm's length relationship with all parties who are or could be interested in the rule making procedure before the Commission. The selected contractor is required to disclose all contacts, either to or by them, during the proposal process and the life of the contract.

II. INSTRUCTIONS FOR PREPARATION OF PROPOSALS

A. General Instructions

Each proposer's submittal shall be prepared on standard 8 1/2-inch by 11-inch paper and limited to 50 pages, exclusive of resumes. Charts and spread sheets may be larger. Standard brochures are not to be included in the proposal. To be considered responsive, the proposal must be organized in the same order that the information is requested in Section III and clearly identified with appropriate headings. There should be no unnecessary attachments, enclosures, or exhibits.

B. Questions regarding the RFP may be directed to:

Department of Environmental Quality
Attention: Harold Sawyer, Inter/Intra Program Coordinator
811 S. W. Sixth Avenue
Portland, OR 97204
Telephone: (503) 229-5776

Questions will be received between the hours of 8:00 a.m. and 5:00 p.m. through February 28, 1992.

C. Number of Proposals to Submit, Deadline, Mail and Hand Delivery Addresses

Seven copies of the proposal must be submitted in a sealed package prominently marked: **"Confidential: Proposal for Technical Advice on Mining Rules"**. Proposals must be received by Mr. Sawyer at DEQ Headquarters, Portland, Oregon, no later that 4:00 p.m., Pacific Standard Time, March 10, 1992. Proposals will be time stamped upon arrival at DEQ. Telegraphic, telephonic facsimile, or telephone proposals will not be accepted. For hand or courier deliveries, the street address is The Executive Building, 811 SW Sixth Ave., 6th Floor, Portland, Oregon. The mailing address is:

State of Oregon
Department of Environmental Quality
Attention: Harold L. Sawyer (6th Floor)
811 SW Sixth Avenue
Portland, OR 97204

Any proposal or part thereof received after the designated time will not be considered.

The DEQ may reject any proposal not in compliance with all prescribed public bidding procedures and requirements, and may reject for good cause any or all bids upon a finding by the DEQ it is in the best interest to do so.

D. Changes in Proposals

Modification of proposals already received by DEQ may be made if they are received by DEQ prior to the scheduled deadline for proposal submission. All modifications must be made in writing over the signature of the proposer.

E. Public Disclosure of Information Contained in Proposals

Proposals received shall remain confidential until the written notice of award of the contract has been made to the successful proposer. Thereafter, all proposals submitted in response to this request shall be deemed public record as defined in ORS 192.410 (4). Any actual proposer to this request who is adversely affected or aggrieved by the Agency's award of the contract to another proposer shall have ten (10) calendar days from the date of the award to file a written protest to the notice of award. No protest shall be entertained that is submitted after this time period.

If the protest is not settled or resolved by mutual agreement, the Director of DEQ, or his designee, shall promptly issue a written decision on this protest.

In the event that a proposer desires to claim portions of its proposal as exempt from disclosure under the provisions of ORS 192.410 et seq., it is incumbent upon the proposer to identify those portions in the transmittal letter. The transmittal letter must identify the page and particular exception(s) from disclosure upon which it is making its claim. Each page claimed to exempt from disclosure must clearly be identified by the "CONFIDENTIAL" printed in bold print on the top of the page.

DEQ will consider a proposer's request(s) for exemption from disclosure; however, DEQ will make a decision predicated upon applicable laws. An assertion by a proposer that the entire proposal is exempt from disclosure will not be honored.

F. Incurring Costs

DEQ will not be liable for any costs associated with the preparation and presentation of a proposal submitted in response to this RFP.

III. CONTENTS OF PROPOSAL

The proposal shall address the information contained in the following paragraphs. The information shall be presented in the order presented below:

A. <u>Description of Project Team.</u>

This section shall include the following for the prime contractor and each subcontractor or team member: name, areas of expertise, and summary of proposed project roles and services to be provided in performance of this contract. Also, if applicable, include a brief history of the firm; size; financial background and capability.

Disclosure of potential conflicts of interest, must be made in this section. As described in Section G of Part I, a potential conflict of interest includes, but is not limited to, any involvement during the past five years with mining companies, mining industry groups, or environmental groups active in working on mining regulations and permitting or holding any interest in property in Oregon that may have mineral development potential. Proposing contractors shall clearly state: a) whether any such involvement produced a substantial portion of their income, and; b) their approach to assuring that results of this study would not be biased by any such prior involvement.

The name, address, and telephone number of one person to contact regarding the proposal shall be included.

MBE/WBE/ESB Participation:

The Department of Environmental Quality is committed to acting affirmatively to encourage and facilitate the participation of Emerging Small Businesses (ESB), Minority Business Enterprises (MBE), and Women Business Enterprises (WBE). All businesses which are to be counted as a minority, women, or emerging small business must be registered with the Office of Minority, Women's, and Emerging Small Business Enterprises. A list of firms may be obtained from that office by calling (503) 378-5651.

B. <u>Description of Project Management Plan.</u>

This section shall include the proposer's schedule and approach to responding to each of the questions listed in Section D of Part I. A description of project considerations and problems perceived by the proposer shall be identified. Communication methods within the proposer's project team and with the DEQ shall be discussed. Each proposer shall provide a list of proposed key personnel and their proposed office location during the contract period.

C. <u>Description of Team Members Experience and Capabilities.</u>

This section shall include relevant management and technical experience, and capabilities of the proposer and team members (firms). Briefly discuss your experience and capabilities in the following areas:

1. Regulatory Experience

   Provide a description of demonstrated project experience in dealing with interpretation and compliance with environmental laws and regulations.

2. Scientific/Technical Knowledge

   Provide a description of project experience which reflects knowledge and skills in the following scientific/technical areas. The proposal must address each area clearly and concisely.

   - Liner technology, including design, installation, and repair.

   - Chemical processing technology, including technology specifically related to cyanide destruction, recovery and reuse.

3. Project Experience

   Provide names, addresses, and telephone numbers of professional references from no more than three different projects for which key personnel proposed for work on this contract have also performed.

   The presentation of project experience in this section shall provide a clear description of the work involved. This description shall include a concise statement of prime and subcontractor roles and responsibilities on each of the projects listed. Each project described shall include references that can be checked by DEQ. All representative project descriptions provided shall include the month and year the project was completed, the location of the project, employing agency/firm, the name and telephone number of a knowledgeable contact person.

4. Personnel.

   Submit resumes for each person identified to perform under this contract.

D. <u>Project Budget.</u>

IV. EVALUATION OF PROPOSALS

Each proposal will be reviewed and evaluated on the basis of the criteria listed below. A committee consisting of Department staff and one or more advisors external to the Department will make a recommendation to the Director of the Department. The Director will make the final determination on contractor selection.

A. Proposer's organizational (team) framework and relationship between the prime and subcontractors are defined and appropriate.

B. Approach to planning, organizing and managing this project to meet scope objectives and schedules.

C. Experience and capabilities to perform all scientific and technical phases of requested activities.

D. Project experience and reference responses.

E. Adequacy and expertise of project management and technical staff.

F. Conciseness, quality, clarity and thoroughness of the written proposal.

G. The approach to managing potential conflict of interest.

H. Price

The Department reserves the right to conduct interviews with selected proposers prior to making a final selection.

DEQ reserves the right to reject any or all proposals and to award the contract to the firm or firms which in DEQ's sole and absolute judgment, will best serve the needs of the state.

2/7/92
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INDEPENDENT CONTRACTOR CERTIFICATION STATEMENT *

State agency certifies the contracted work meets the following standards:

1. Contractor will provide labor and services free from direction and control, subject only to the accomplishment of specified results.
2. Contractor is responsible for obtaining all assumed business registrations or professional occupation licenses required by state or local law.
3. Contractor will furnish the tools or equipment necessary to do the work.
4. Contractor has the authority to hire and fire employees to perform the work.
5. Contractor will be paid on completion of the project or on the basis of a periodic retainer.

______________________________ ______________________

Agency Signature Date

Independent contractor certifies he/she meets the following standards as required by ORS chapters 316, 656, 657 and 670:

1. You filed federal and state income tax returns for the business for the previous year, if you performed labor or services as an independent contractor in the previous year.
2. You represent to the public that you are an independently established business by meeting four (4) or more of the following:

_____ A. You work primarily at a location separate from your residence, or work primarily in a specific portion of the residence, which portion is set aside as the location of the business.

_____ B. You have purchased commercial advertising, business cards, or have a trade association membership.

_____ C. You use a telephone listing and service separate from your personal residence listing and service.

_____ D. You perform labor or services only pursuant to written contracts.

_____ E. You perform labor or services for two or more different persons within a period of one year.

_____ F. You assume financial responsibility for defective workmanship or for service not provided as evidenced by the ownership of performance bond, warranties, errors and omission insurance or liability insurance relating to the labor or services to be provided.

Contractor
Signature ______________________________ Date ______________

Entity ______________________________

***Corporations are not required to complete this form.**

RULES PROPOSAL:

OREGON ADMINISTRATIVE RULES

CHAPTER 340

DIVISION 43

CHEMICAL MINING

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS

PURPOSE

340-43-005

The purpose of these rules and guidelines is to protect the quality of the environment and public health in Oregon by requiring application of "... all available and reasonable methods...", Oregon Revised Statutes (ORS) 468.710, for control of wastes and chemicals relative to design, construction, operation, and closure of mining operations which use cyanide or other toxic chemicals to extract metals or metal-bearing minerals from the ore and which produce wastes or wastewaters containing toxic materials.

DEFINITIONS

340-43-010

Unless the context requires otherwise, as used in this Division:

(1) "Chemical process mine" means a mining and processing operation for metal-bearing ores that uses chemicals to dissolve metals from ores.

(2) "Department" means the Department of Environmental Quality.

(3) "Guidelines" means this body of rules contained in 340-43-045 through 340-43-100.

(4) "Positive exclusion of wildlife" means the use of such devices as tanks, pipes, fences, netting, covers and heap-leach drip-irrigation emitters or covered emitters.

(5) "Tailings" means the spent ore resulting from the milling and chemical extraction process.

PERMIT REQUIRED

340-43-015

(1) A person proposing to construct a new chemical mining operation, commencing to operate an existing non-permitted operation, or proposing to substantially modify or expand an existing operation shall first apply for, and receive, a permit from the Department. The permit may be an NPDES (National Pollutant Discharge Elimination System) permit if there is a point-source discharge to surface waters or a WPCF (Water Pollution Control Facility) permit if there is no discharge. Consideration may be given to site-specific conditions such as climate, proximity to water, and type of wastes to establish the final permit type and requirements for the facility.

(2) The permit application shall comply with the requirements of OAR Chapter 340, Divisions 14 and 45 and be accompanied by a report that fully addresses the requirements of this Division .

PERMIT APPLICATION

340-43-020

(1) The permit application shall fully describe the existing site and environmental conditions, with an analysis of how the proposed operation will affect the site and its environment. The Department shall, at a minimum, require the information specified for the DOGAMI consolidated application under Section 13, Chapter 735, 1991 Oregon Laws. The Department will also use the information contained in NEPA (National Environmental Policy Act), EA (Environmental Assessment), or EIS (Environmental Impact Statement) documents, if they are required by the project, as partial fulfillment of the requirements of this paragraph.

(2) The permit application shall, in addition to the information described in Paragraph (1) above, include the following information, unless the information has been otherwise submitted:

(a) Climate/meteorology characterization, with supporting data;

(b) Soils characterization, with supporting data;

(c) Surface water hydrology study, with supporting data;

(d) Characterization of surface water and groundwater quality;

(e) Inventory of surface water and groundwater beneficial uses;

(f) Hydrogeologic characterization of groundwater, with supporting data;

(g) Geologic engineering, hazards and geotechnical study, with supporting data;

(h) Characterization of mine materials and wastes which include, for example, overburden, waste rock, stockpiled ore, leached ore and tailings. Characterization of mine materials and wastes shall include, but not be limited to the following:

(A) Chemical and mineral analysis related to toxicity;

(B) Determination of the potential for acid water formation;

(C) Determination of the potential for long-term leaching of toxic materials from the wastes;

(i) Characterization of wastewater (quantity and chemical and physical quality) produced by the operation;

(j) Assessment of the potential for acid-water formation from waste disposal facilities, low-grade ore stockpiles, waste rock piles and for surface water or groundwater accumulation in open pits that will remain after mining is ended.

(3) Data submitted by the permit applicant should be based on analysis of the actual materials, when possible, or may be based on estimates from knowledge of similar operations and professional judgment.

PLANS AND SPECIFICATIONS

340-43-025

(1) A person constructing or commencing to operate a chemical process mine or substantially modifying or expanding an existing chemical process mine shall first submit plans and specifications to the Department for construction, operation and maintenance of the facilities intended for treatment, control and disposal of wastes.

(2) The Department shall approve the plans, in writing, before construction of the facilities may be started. The plans shall address all applicable requirements of this Division and shall include, but not be limited to, the following:

(a) A description of the facilities to be constructed, including tanks, pipes and other storage and conveyance means for processing chemicals and solutions and wastewaters;

(b) A management plan for control of surface water;

(c) A management plan for treatment and disposal of excess wastewater, including provisions for reuse and wastewater minimization;

(d) A facility construction plan including, as applicable, the design of low-permeability soil barriers, the type of geosynthetics to be used and a description of their installation methods, the design of wastewater treatment facilities and processes, a quality assurance plan for applicable phases of construction and a listing of construction certification reports to be provided to the Department;

(e) A preliminary closure plan;

(f) A preliminary post-closure monitoring and maintenance plan;

(g) A spill containment and control plan.

DESIGN, CONSTRUCTION, OPERATION AND CLOSURE REQUIREMENTS

340-43-030

(1) All chemical process and waste disposal facilitiesand facilities for mixing, distribution, and application of chemicals associated with on-site mining operations; ore preparation and beneficiation facilities; and processed -ore

disposal facilities shall be designed, constructed, operated and closed in accordance with the guidelines contained in this Division.

(2) A groundwater monitoring plan shall be submitted to, and be approved by the Department. Monitoring wells shall be installed for detection of groundwater contamination as required by OAR Chapter 340, Division 40, unless the hydrogeology of the site or other technical information indicates that an adverse impact on groundwater quality is not likely to occur.

(3) Alternative methods of control of wastes may be acceptable if the permit applicant can demonstrate that the alternate methods will provide fully-equivalent environmental protection. The burden of proof of fully-equivalent protection lies with the permit applicant.

(4) The Department may, in accordance with a written compliance schedule, grant reasonable time for existing facilities to comply with these rules.

EXEMPTION FROM STATE PERMIT FOR HAZARDOUS WASTE TREATMENT OR DISPOSAL FACILITIES

340-43-035

(1) The state hazardous waste program requires a permit for the "treatment", "storage" or "disposal" of any "hazardous waste" as identified or listed in OAR Chapter 340, Division 101 from the Department, prior to the treatment and disposal of wastes. Permitting requirements can be found in OAR Chapter 340, Division 105, Hazardous Waste Management.

(2) However, any operation permitted under this Division, which would otherwise require the neutralization or treatment of hazardous waste and would require a permit pursuant to OAR Chapter 340, Division 105, shall be exempt from the requirement to obtain such hazardous waste treatment permit.

(3) All mined materials disposed of under this Division shall pass Oregon's hazardous waste rule criteria or they will be considered a state hazardous waste and must be disposed of accordingly.

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS

PURPOSE

340-43-040

(1) This Division establishes criteria for the design, construction, operation and closure of chemical mining operations and supplements the provisions of OAR 340-43-005 through OAR 340-43-035.

(2) Any disapproval of submitted plans or specifications, or imposition of requirements by the Department to improve existing facilities or their operation will be referenced when appropriate, to applicable guidelines or rules.

GENERAL PROVISIONS

340-43-045

(1) Facilities permitted under either a WPCF or NPDES permit shall not discharge wastewater or process solutions to surface water, groundwater or soils, except as expressly allowed by the permit.

(2) Facilities subject to these rules shall not be sited in 100-year floodplainsor wetlands. A buffer zone (a minimum of 200 feet wide) shall be established between waste disposal facilities and surface waters.

(3) All chemical conveyances (ditches, troughs, pipes, etc.) shall be equipped with secondary containment and leak detection means for preventing and detecting release of chemicals to surface water, groundwater or soils.

(4) Acid water accumulation in open pits resulting from the mining operation must be prevented by appropriate mining practices, by measures taken in the closure process, or be treated to control pH and toxicity, for the life of the pit.

(5) Construction of surface impoundment liner systems shall conform generally to the principles and practices described in <u>EPA/600/2-88/052, Lining of Waste Containment and Other Impoundment Facilities, September 1988</u>.

(6) The Department may require the permittee to hire a third-party contractor to perform the functions set forth below. Selection of the contractor shall be subject to Department approval.

(a) Review and evaluate the design and construction specifications of all mined-materials disposal facilities permitted under this Division for functional adequacy and conformance with Department requirements. The Department shall not approve construction of the disposal facilities until the design and construction specifications have been evaluated.

(b) Monitor the course of construction of all mined-materials disposal facilities for compliance with the approved design and construction specifications. The third-party contractor shall regularly document the progress of construction and the Department shall require the permittee to take corrective action if construction does not satisfactorily conform to the approved design and construction specifications.

CONTROL OF SURFACE WATER RUN-ON AND RUN-OFF

340-43-050

(1) Surface water run-on and run-off shall be controlled such that it will not endanger the facility or become contaminated by contact with process materials or loaded with sediment. The control systems shall be designed to accommodate a 100-year, 24-hour storm event, or any other defined climatic event that is more appropriate to the site, and be placed so as to allow for restoration of the natural drainage network, to the maximum extent practicable, upon facility closure.

(2) All mined materials shall be properly placed and protected from surface water and precipitation so as not to be eroded and contribute sediment to site stormwater run-off or to otherwise contaminate surface water.

PHYSICAL STABILITY OF RETAINING STRUCTURES AND EMPLACED MINE MATERIALS

340-43-055

(1) Permit applicants must demonstrate to the Department that the design of chemical processing facilities and waste disposal facilities is adequate to ensure the stability of all structural components of the facilities during operation, closure and post closure.

(2) Retaining structures, foundations and mine materials emplacements shall be designed by a qualified, registered professional and be constructed for long-term stability under anticipated loading and seismic conditions.

(3) Temporary structures and materials emplacements may, with written approval from the Department, be constructed to a lesser standard if it can be shown that they pose no, or minimal, threat to public safety or the environment.

PROTECTION OF WILDLIFE

340-43-060

(1) Wildlife shall be positively excluded from contact with chemical processing solutions and wastewaters containing chemicals.

(2) The Department may waive the positive exclusion requirement if the Oregon Department of Fish and Wildlife (ODF&W) certifies to the Department that the project is designed such that it will adequately protect wildlife.

GUIDELINES FOR DESIGN, CONSTRUCTION, AND OPERATION OF HEAP-LEACH FACILITIES

340-43-065

(1) This paragraph applies to heap-leach facilities using dedicated, or expanding, pads. Heap-leach facilities using on-off, reusable pads may require variations from these rules; they shall be approved on a case-by-case basis by the Department.

(2) The heap-leach facility (pad and associated ponds, pipes and tanks) shall be sized to prevent flooding of any of its components.

(3) TABLE 1 of this Division establishes minimum capacity-sizing criteria for the leach-pad and ponds. The pad and ponds may be designed to act separately or in conjunction with each other to obtain the required storage volumes. Other design criteria may be used, with Department approval, if local conditions warrant. The best available climatic data shall be used to confirm the critical design storm event and estimate the liquid levels in the system over a full seasonal cycle. The liquid mass balance may include provision for evaporation.

(4) The heap-leach pad liner system shall be of triple liner construction with between-liner leak detection consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;

(b) Continuous flexible-membrane middle and top liners of suitable synthetic material separated by a minimum of 12 inches of permeable material (minimum permeability of 10^{-2} cm/sec);

(c) A leak-detection system between the synthetic liners capable of detecting leakage of 400 gallons/day-acre within ten weeks of leak initiation.

(5) The processing-chemical pond liners shall be of triple liner construction with between-liner leak detection consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;

(b) Continuous flexible-membrane middle and top liners of suitable synthetic material separated by a permeable material (minimum coefficient of permeability of 10^{-2} cm/sec);

(c) A leak detection system between the synthetic liners capable of detecting leakage of 400 gallons/day-acre, within ten weeks of leak initiation.

(6) Emergency ponds may be constructed as an alternative to larger pregnant and barren ponds. The emergency pond may be constructed to a lesser standard, with the limitation that it is to be used only infrequently and for short periods of time. The Department will specify reporting and use limitations for the ponds in the permit. A between-liner leak detection system is not required for the emergency pond.

(7) The emergency-pond liner shall be of composite construction consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-6}cm/sec) with a minimum thickness of 12 inches, and

(b) A single flexible-membrane synthetic top liner of suitable material.

(6) The heap-leach pad shall be provided with a process chemical collection system above the upper-most liner that will prevent an accumulation of process chemical within the heap greater than 24 inches in depth.

(7) The permittee shall prepare a written operating plan for safe temporary shut-down of the heap-leach facility and train employees in its implementation.

(8) The permittee shall respond to leakage collected by the heap-leach and processing-chemical storage pond leak-collection systems according to the process defined in TABLE 2.

(9) The permittee shall determine the acid-generating potential of the spent ore by acid\base accounting and other appropriate static and dynamic laboratory tests. If the spent ore is shown to be potentially acid generating under the conditions expected in the heap at closure, the permittee shall submit a plan for acid correction for Department approval prior to loading the heap.

GUIDELINES FOR DISPOSAL OF MILL TAILINGS

340-43-070

(1) Mill tailings shall be treated by cyanide removal and re-use prior to disposal to reduce the amount of cyanide introduced into the tailings pond. Chemical oxidation or other means shall be additionally used, if necessary, prior to disposal to reduce the WAD cyanide level in the liquid fraction of the tailings. The permittee shall conduct laboratory column tests on mill tailings to determine the lowest practicable concentration to which the WAD cyanide (weak-acid dissociable cyanide as measured by ASTM Method D2036-82 C) can be reduced. In no event, shall the permitted WAD cyanide concentration in the liquid fraction of the tailings be greater than 30 ppm.

(2) (Deleted)

(3) The permittee shall determine the potential for acid-water formation from the tailings by means of acid-base accounting and other suitable laboratory static and dynamic tests. If acid formation can occur, basic materials shall be added to the tailings in the amount of three (3) times the acid formation potential or to give a net neutralization potential of at least 20 tons of $CaCO_3$ per 1000 tons of tailings, whichever is greater, before placing tailings in the disposal facility.

(4) The disposal facility shall be lined with a composite double liner consisting of a flexible-membrane synthetic top liner in tight contact with an engineered,

stable, soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) having a minimum thickness of 36 inches.

Construction of the liner shall generally follow the principles and practices contained in EPA/600/2-88/052, "Lining of Waste Containment and Other Impoundment Facilities, September, 1988.

(5) The disposal facility shall be provided with a leachate collection system above the liner suitable for monitoring, collecting and treating potential acid drainage.

GUIDELINES FOR DISPOSAL OR STORAGE OF WASTEROCK, LOW-GRADE ORE AND OTHER MINED MATERIALS

340-43-075

The permittee shall determine the acid-producing and metals-release potential of the wasterock, low-grade ore or other mined materials by acid/base accounting and other appropriate static and dynamic laboratory tests. If the mined materials are shown to be potentially acid forming, or capable of releasing toxic metals, the permittee shall submit a plan for correction and disposal for Department approval prior to permanently placing the materials.

GUIDELINES FOR HEAP-LEACH AND TAILINGS DISPOSAL FACILITY CLOSURE

340-43-080

(1) The waste disposal facilities shall be closed under these rules in conjunction with the reclamation requirements of DOGAMI (Oregon Department of Geology and Mineral Industries).

(2) An up-dated closure plan and post-closure monitoring and maintenance plan shall be submitted to the Department by the permittee at least 180 days prior to beginning closure operations or making any substantial changes to the operation. The closure plan must be compatible with DOGAMI's reclamation plan and may be part of it.

(3) Chemical conveyances (ditches, troughs, pipes, etc.) not necessary for post-closure monitoring shall be removed. The secondary containment systems shall be checked before closure for process-chemical contamination, and contaminated soil or other materials, if any, shall be removed to an acceptable disposal facility.

(4) Closure of the heap-leach facility.

(a) The heap shall be detoxified over a suitable period of time prior to closure, using rinse/rest cycles of rinsing and chemical oxidation, if necessary. The WAD cyanide concentration in the rinsate shall be no greater than 0.2 ppm.

(b) Following detoxification as defined in (a) above, the heap shall be closed in place on the pad by covering the heap with a cover designed to prevent water and air infiltration. The cover should consist, at a minimum, of a low-permeability layer and suitable drainage and soil layers to prevent erosion and damage by animals and to sustain vegetation growth, in accordance with DOGAMI's reclamation rules.

(c) The ponds associated with the heap shall be closed by folding in the synthetic liners and filling and contouring the pits with inert material. Residual sludge may be disposed of in one of the on-site waste disposal facilities, provided it meets the criteria for such wastes in these guidelines. The process chemical collection system of the heap shall be maintained in operative condition so that it can be used to monitor the amount and quality of infiltrated water, if any, draining from the heap.

(5) The tailings disposal facility shall be closed by covering with a composite cover designed to prevent water and air infiltration and be environmentally stable for an indefinite period of time. Maximum effort shall be made to isolate the tailings from the environment. Construction of the cover shall generally follow the principles and practices contained in EPA/530-SW-89-047, Technical Guidance Document -- Final Covers on Hazardous Waste Landfills and Surface Impoundments.

POST-CLOSURE MONITORING

340-43-085

(1) The Department may continue its permit in force for thirty (30) years after closure of the operation and will include permit requirements for periodic monitoring to determine if release of pollutants is occurring.

(2) Monitoring data will be reviewed regularly by the Department to determine the effectiveness of closure of the disposal facilities. The Department will consult with DOGAMI on release of security funds that would otherwise be needed to correct problems resulting from ineffective closure.

LAND DISPOSAL OF WASTEWATER

340-43-090

(1) To qualify for land disposal of excess wastewater, the permit applicant shall demonstrate to the Department that the process has been designed to minimize the amount of excess wastewater that is produced, through use of water-efficient processes, wastewater treatment and reuse, and reduction by natural evaporation. Excess wastewater that must be released shall be treated and disposed of to land under the conditions specified in the permit.

(2) A disposal plan shall be submitted as part of the permit application that, at a minimum, includes:

(a) Wastewater quantity and quality characterization;

(b) Soils characterization and suitability analysis;

(c) Drainage and run-off characteristics of the site relative to land application of wastewater;

(d) Proximity of the disposal site to groundwater and surface water and potential impact;

(e) Wastewater application schedule and water balance;

(f) Disposal site assimilative capacity determination;

(g) Soils, surface water and groundwater monitoring plan;

(h) Potential impact on wildlife or sensitive plant species.

(3) The Department will evaluate the disposal plan and set site-specific permit conditions for the wastewater discharge.

GUIDELINES FOR OPEN-PIT CLOSURE

340-43-095

(1) Open pits that will be left as a result of the mining operation shall be assessed prior to, and following, mining operations for the potential to contaminate

water to the extent that it might not meet water-quality standards due to build-up of acid or toxic metals.

(2) If the Department finds that the potential for water accumulation in the pit(s) exists, the permit applicant shall submit a closure plan for the pit that will address contamination prevention and possible remedial treatment of the water. The closure plan shall, at a minimum, examine the following alternatives:

(a) Avoidance, during mining, of acid-generating materials that can be left in place, rather than being exposed to oxidation and weathering;

(b) Removal from the pit and disposal, during or after the mining operation, of residual acid-generating materials that would otherwise be left exposed to oxidation and weathering;

(c) Protective capping in-situ of residual acid-generating materials;

(d) Treatment methods for correcting acidity and toxicity of accumulated water;

(e) Installation of an impermeable liner under ponded water to prevent groundwater contamination;

(f) Backfilling of the pit(s) above the water table to reduce oxidation of residual acid-generating materials.

TABLE 1

Heap-Leach Liquid Storage Criteria

Component	Pregnant-Solution Pond	Barren-Solution Pond
Operating Volume	Minimum necessary to maintain recirculation	Minimum necessary to maintain recirculation
Operational Surge	Anticipated draindown and rinse volume	Anticipated draindown and rinse volume
Climatic Surge	100-yr, 24-hr storm plus 10-yr snowmelt	100-yr, 24-hr storm plus 10-yr snowmelt
Safety Factor	2-ft dry freeboard	2-ft dry freeboard

TABLE 2

Required Responses to Leakage Detected from the Leach Pad

Leakage Category	Response
Zero leakage to 200 gal/day-acre	Notify the Department; increase pumping and monitoring
Leakage from 200 gal/day-acre to 400 gal/day-acre	Change operating practices to reduce leakage
Leakage in excess of 400 gal/day-acre	Repair leaks under Department schedule.

State of Oregon

DEPARTMENT OF ENVIRONMENTAL QUALITY

REQUEST FOR PROPOSALS
FOR
TECHNICAL ADVICE ON MINING RULES

February 7, 1992

TABLE OF CONTENTS

ATTACHMENTS

I. GENERAL INFORMATION

A. Introduction

The Environmental Quality Commission (Commission) is considering adoption of rules to require mining operations using cyanide or other toxic chemicals to protect soils, groundwater, surface waters, and wildlife from contamination or harm by process solutions and waste waters. The protective measures required by the proposed rules include cyanide recovery and re-use, chemical detoxification of cyanide residues, and extensive lining and engineered closure of waste disposal facilities.

During the public participation process on the proposed rules, mining companies and associations have argued that some of the requirements are unnecessarily stringent or are unproven or are unavailable. Environmental protection organizations have argued that the proposed rules may not be adequately protective in certain respects.

The Commission has studied the proposed rules and the public comments received, and has extensively debated the policy issues associated with the rule proposal. Prior to final action to adopt proposed rules, the Commission has elected to seek an evaluation and advice on specific technical questions from an independent, knowledgeable contractor.

The entire record of the rulemaking proceeding is available for inspection as background material for this proposal request. The record can be reviewed in the headquarters office of the Department of Environmental Quality (DEQ or Department or Agency). A full copy of the draft proposed rules being considered by the Environmental Quality Commission is attached as Attachment B.

B. Proposed Project Timeline

Date	Action
February 7, 1992	Mail Request for Proposal
February 28, 1992	Information Exchange (to take place only between mailing of the RFP and this date)
March 10, 1992	Written Proposals Due
March 20, 1992	Selection of Contractor (written notice of award to successful proposer)

March 30, 1992	Protest Period (protests must be filed by this date)
April 10, 1992	Execution of Standard State Personal Service Contract (target date)
Within 15 calendar days of Contract Execution:	Participate in Public Meeting.
Within 45 calendar days of Contract Execution:	Draft Written Report submitted to DEQ.
Within 15 calendar days of Receipt of Comments from DEQ:	Submit Final Report.

C. Services Requested

DEQ is requesting proposals from individuals acting as independent contractors (see attached Independent Contractor Certification Statement form), firms, joint ventures or teams for providing advice to the Commission on technical issues related to proposed rules for mining operations using chemicals to extract metals from ores. Companies interested in pooling their resources through contractor/subcontractor, joint ventures or team arrangements can do so provided that one entity is identified which ultimately will bear total contract responsibility.

D. Scope of Work

Three policies have been established by the Commission. The selected contractor shall evaluate and address specific technical questions surrounding these policies. The Commission is not asking for alternative policy recommendations or evaluation of economic issues. The task of the contractor is to answer the questions posed in the following paragraphs based on their knowledge, expertise, experience, review of current published technical data, and technical evaluation of the issues.

1. Questions on Liners, Leak Detection, and Leak Collection Systems

a. Statement of Policy:

The Commission establishes as policy that a liner, leak detection and leak collection system are necessary to assure that any leak will be detected before toxic materials escape from the liner system and are released to the environment. These systems must assure that if a leak is found, sufficient time is available to allow for the repair of the leak and clean up of any leaked material before there is a release to the environment. Natural

conditions, such as depth to groundwater or net rainfall, shall be considered as additional protection but not in lieu of the protection required by the required engineered protection.

NOTE: Definition of "environment" or use of defining qualifiers is central to the issue. The Commission considers that the environment begins at the bottom of the last liner.

b. Issue:

In the proposed rule contained in 340-43-065(4), the requirements for heap leach pad liners are as follows:

(4) The heap leach pad liner system shall be of triple liner construction with between liner leak detection consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;

(b) Continuous flexible membrane middle and top liners of suitable synthetic material separated by a minimum of 12 inches of permeable material (minimum permeability of 10^{-2} cm/sec);

(c) A leak detection system between the synthetic liners capable of detecting leakage of 400 gallons/day acre within ten weeks of leak initiation.

As opposed to this liner system, the Oregon Mining Council has proposed a liner characterized either as a composite liner or as a double liner and generally described as follows:

Composite Liner -- a composite liner system construction with between liner leak detection consisting of:

- An engineered, stable, low-permeability soil/clay bottom liner (maximum coefficient of permeaability of 10^{-7} cm/sec) with a minimum thickness of 12 inches;

- Continuous flexible membrane top liner of suitable synthetic material;

- A geotextile layer between the liner materials for leak detection. The leak detection and recovery system would also include collector pipes tied to the geotextile, spaced at appropriate intervals to achieve the 10-week leak initiation detection performance standard.

c. Question:

Will either or both liner systems meet the stated policy objective of the Commission?

d. Method to Answer or Address Question:

(1) Are each of the various liner systems proposed technically feasible?

(2) Will each of the various liner systems meet the stated Commission policy?

(3) For those liner systems which will meet the stated Commission policy, what level of certainty for achieving this policy do you assign to each system?

(4) Are there other liner systems which will achieve this policy and what level of certainty for achieving this policy do you assign to each?

The consultant is also asked to provide a simple comparison of typical costs for installation of the various liner configurations.

2. Questions on Tailings Treatment to Reduce the Potential for Release of Toxics

a. Statement of Policy:

The Commission establishes as policy that the toxicity and potential for long-term cyanide and toxic metals release from mill tailings should be reduced to the greatest degree practicable through tailings treatment.

b. Issue:

The proposed rules in 340-43-070(1) state the following:

(1) Mill tailings shall be treated by cyanide removal and re-use prior to disposal to reduce the amount of cyanide introduced into the tailings pond. Chemical oxidation or other means shall be additionally used, if necessary, prior to disposal to reduce the WAD cyanide level in the

liquid fraction of the tailings. The permittee shall conduct laboratory column tests on mill tailings to determine the lowest practicable concentration to which the WAD cyanide (weak-acid dissociable cyanide as measured by ASTM Method D2036-82 C) can be reduced. In no event, shall the permitted WAD cyanide concentration in the liquid fraction of the tailings be greater than 30 ppm.

The rules do not require removal of potentially toxic metals from tailings prior to placement in the tailings pond. The rules do require steps to control acid formation in the tailings pond and require covering upon closure with a composite cover designed to prevent water and air infiltration.

c. Question:

Do the requirements for **removal** and **reuse** of cyanide materially reduce toxicity and potential for long-term cyanide and toxic metals release from mill tailings?

d. Method to Answer or Address Question:

(1) Are **removal** and **reuse** technically feasible?

Potential factors for consideration include:
- Is the process technically defined and understood?
- Has the process been demonstrated in practical application, and if so, where?
- Are engineering firms available to design and oversee construction?
- Are materials and equipment available to construct?

(2) Do **removal** and **reuse** (evaluated separately) materially reduce the toxicity and potential for long-term cyanide and toxic metals release from mill tailings?

(3) What is the level of certainty you give to the answers provided above?

(4) Are there other tailings treatment technologies which will equally, or more effectively achieve the policy of the Commission?

3. Questions on Closure of the Heap Leach and Tailings Facilities

a. Statement of Policy:

The Commission establishes as policy that the closure of the heap leach and tailings disposal facilities will prevent release to the environment of toxic chemicals contained in the facility.

b. Issue:

Rule 340-43-080(4)(a), as proposed, requires that the heap shall be "... detoxified over a suitable period of time prior to closure, using rinse/rest cycles of rinsing and chemical oxidation, if necessary. The WAD cyanide concentration in the rinsate shall be no greater than 0.2 ppm."

In 340-43-080(4)(b), the proposed rules require that the closure of the heap shall be "... by covering the heap with a cover designed to prevent water and air infiltration."

In 340-43-080(5), the proposed rules state that "The tailings disposal facility shall be closed by covering with a composite cover designed to prevent water and air infiltration and be environmentally stable for an indefinite period of time."

c. Question:

Do the requirements of detoxification (cyanide removal by rinsing) of the heap and covering of the heap and tailings facility to exclude air and water materially reduce the likelihood of any release to the environment of toxic chemicals and metals contained in the heap over the long term?

d. Method to Answer or Address Question:

(1) Are detoxification and covering (as prescribed in this rule) technically feasible?

(2) Do detoxification and covering (evaluated separately and together) materially reduce the likelihood of a release of toxic chemicals and metals to the environment?

(3) What is the level of certainty you give to the answers provided above?

(4) Are there other technologies which can equally or more effectively achieve the policy of the Commission?

4. Public Meeting

In addition to answering the above questions, the selected contractor will be expected to participate in a meeting with persons who have expressed an interest in the rulemaking proceeding by presenting testimony at public hearings. The purpose of this meeting will be to:

- Inform the interested public on the contractors approach and schedule for addressing the questions posed.

- Identifying any anticipated need to contact persons who presented testimony in the proceeding for additional information to assist in addressing the questions posed. The Commission expects an open process where all interested parties will have the opportunity to attend the meeting.

This meeting will be scheduled at a time and place mutually agreeable to DEQ and the selected contractor. DEQ will arrange the meeting and provide notice to interested parties.

5. Written Report

A written report shall be submitted as the final product of this contract. The report shall state the question being answered, summarize the methodologies for evaluating and responding to the question, and clearly state the results of the evaluation and answer given.

A draft report shall be submitted to the Department for review. The Department will provide written comments to the contractor. The contractor will then complete the report and file a single master copy, ready for reproduction, with the Department. The report shall become the property of the Department. The Department may copy and distribute the report as it deems appropriate.

E. Type of Contract

DEQ anticipates awarding a fixed price contract. The State of Oregon standard personal service contract will be signed.

DEQ will, in its sole discretion, reserve the right to renew the contract.

F. Payment Procedure

Payment schedules for any contract entered into as a result of the RFP will be mutually agreed upon by DEQ and the prime contractor.

G. Managing Conflict of Interest

Proposing contractors (including subcontractors) shall disclose any potential conflicts of interest. A potential conflict of interest includes, but is not limited to, any involvement during the past five years with mining companies, mining industry groups, or environmental groups active in working on mining regulations and permitting or holding any interest in property in Oregon that may have mineral development potential. During the proposal development period and, if awarded the contract, during the contract period, the selected contractor shall maintain an arm's length relationship with all parties who are or could be interested in the rule making procedure before the Commission. The selected contractor is required to disclose all contacts, either to or by them, during the proposal process and the life of the contract.

II. INSTRUCTIONS FOR PREPARATION OF PROPOSALS

A. General Instructions

Each proposer's submittal shall be prepared on standard 8 1/2-inch by 11-inch paper and limited to 50 pages, exclusive of resumes. Charts and spread sheets may be larger. Standard brochures are not to be included in the proposal. To be considered responsive, the proposal must be organized in the same order that the information is requested in Section III and clearly identified with appropriate headings. There should be no unnecessary attachments, enclosures, or exhibits.

B. Questions regarding the RFP may be directed to:

Department of Environmental Quality
Attention: Harold Sawyer, Inter/Intra Program Coordinator
811 S. W. Sixth Avenue
Portland, OR 97204
Telephone: (503) 229-5776

Questions will be received between the hours of 8:00 a.m. and 5:00 p.m. through February 28, 1992.

C. Number of Proposals to Submit, Deadline, Mail and Hand Delivery Addresses

Seven copies of the proposal must be submitted in a sealed package prominently marked: **"Confidential: Proposal for Technical Advice on Mining Rules"**. Proposals must be received by Mr. Sawyer at DEQ Headquarters, Portland, Oregon, no later that 4:00 p.m., Pacific Standard Time, March 10, 1992. Proposals will be time stamped upon arrival at DEQ. Telegraphic, telephonic facsimile, or telephone proposals will not be accepted. For hand or courier deliveries, the street address is The Executive Building, 811 SW Sixth Ave., 6th Floor, Portland, Oregon. The mailing address is:

State of Oregon
Department of Environmental Quality
Attention: Harold L. Sawyer (6th Floor)
811 SW Sixth Avenue
Portland, OR 97204

Any proposal or part thereof received after the designated time will not be considered.

The DEQ may reject any proposal not in compliance with all prescribed public bidding procedures and requirements, and may reject for good cause any or all bids upon a finding by the DEQ it is in the best interest to do so.

D. Changes in Proposals

Modification of proposals already received by DEQ may be made if they are received by DEQ prior to the scheduled deadline for proposal submission. All modifications must be made in writing over the signature of the proposer.

E. Public Disclosure of Information Contained in Proposals

Proposals received shall remain confidential until the written notice of award of the contract has been made to the successful proposer. Thereafter, all proposals submitted in response to this request shall be deemed public record as defined in ORS 192.410 (4). Any actual proposer to this request who is adversely affected or aggrieved by the Agency's award of the contract to another proposer shall have ten (10) calendar days from the date of the award to file a written protest to the notice of award. No protest shall be entertained that is submitted after this time period.

If the protest is not settled or resolved by mutual agreement, the Director of DEQ, or his designee, shall promptly issue a written decision on this protest.

In the event that a proposer desires to claim portions of its proposal as exempt from disclosure under the provisions of ORS 192.410 et seq., it is incumbent upon the proposer to identify those portions in the transmittal letter. The transmittal letter must identify the page and particular exception(s) from disclosure upon which it is making its claim. Each page claimed to exempt from disclosure must clearly be identified by the "CONFIDENTIAL" printed in bold print on the top of the page.

DEQ will consider a proposer's request(s) for exemption from disclosure; however, DEQ will make a decision predicated upon applicable laws. An assertion by a proposer that the entire proposal is exempt from disclosure will not be honored.

F. Incurring Costs

DEQ will not be liable for any costs associated with the preparation and presentation of a proposal submitted in response to this RFP.

III. CONTENTS OF PROPOSAL

The proposal shall address the information contained in the following paragraphs. The information shall be presented in the order presented below:

A. Description of Project Team.

This section shall include the following for the prime contractor and each subcontractor or team member: name, areas of expertise, and summary of proposed project roles and services to be provided in performance of this contract. Also, if applicable, include a brief history of the firm; size; financial background and capability.

Disclosure of potential conflicts of interest, must be made in this section. As described in Section G of Part I, a potential conflict of interest includes, but is not limited to, any involvement during the past five years with mining companies, mining industry groups, or environmental groups active in working on mining regulations and permitting or holding any interest in property in Oregon that may have mineral development potential. Proposing contractors shall clearly state: a) whether any such involvement produced a substantial portion of their income, and; b) their approach to assuring that results of this study would not be biased by any such prior involvement.

The name, address, and telephone number of one person to contact regarding the proposal shall be included.

MBE/WBE/ESB Participation:

The Department of Environmental Quality is committed to acting affirmatively to encourage and facilitate the participation of Emerging Small Businesses (ESB), Minority Business Enterprises (MBE), and Women Business Enterprises (WBE). All businesses which are to be counted as a minority, women, or emerging small business must be registered with the Office of Minority, Women's, and Emerging Small Business Enterprises. A list of firms may be obtained from that office by calling (503) 378-5651.

B. Description of Project Management Plan.

This section shall include the proposer's schedule and approach to responding to each of the questions listed in Section D of Part I. A description of project considerations and problems perceived by the proposer shall be identified. Communication methods within the proposer's project team and with the DEQ shall be discussed. Each proposer shall provide a list of proposed key personnel and their proposed office location during the contract period.

C. <u>Description of Team Members Experience and Capabilities.</u>

This section shall include relevant management and technical experience, and capabilities of the proposer and team members (firms). Briefly discuss your experience and capabilities in the following areas:

1. Regulatory Experience

   Provide a description of demonstrated project experience in dealing with interpretation and compliance with environmental laws and regulations.

2. Scientific/Technical Knowledge

   Provide a description of project experience which reflects knowledge and skills in the following scientific/technical areas. The proposal must address each area clearly and concisely.

   - Liner technology, including design, installation, and repair.
   - Chemical processing technology, including technology specifically related to cyanide destruction, recovery and reuse.

3. Project Experience

   Provide names, addresses, and telephone numbers of professional references from no more than three different projects for which key personnel proposed for work on this contract have also performed.

   The presentation of project experience in this section shall provide a clear description of the work involved. This description shall include a concise statement of prime and subcontractor roles and responsibilities on each of the projects listed. Each project described shall include references that can be checked by DEQ. All representative project descriptions provided shall include the month and year the project was completed, the location of the project, employing agency/firm, the name and telephone number of a knowledgeable contact person.

4. Personnel.

   Submit resumes for each person identified to perform under this contract.

D. <u>Project Budget.</u>

IV. EVALUATION OF PROPOSALS

Each proposal will be reviewed and evaluated on the basis of the criteria listed below. A committee consisting of Department staff and one or more advisors external to the Department will make a recommendation to the Director of the Department. The Director will make the final determination on contractor selection.

A. Proposer's organizational (team) framework and relationship between the prime and subcontractors are defined and appropriate.

B. Approach to planning, organizing and managing this project to meet scope objectives and schedules.

C. Experience and capabilities to perform all scientific and technical phases of requested activities.

D. Project experience and reference responses.

E. Adequacy and expertise of project management and technical staff.

F. Conciseness, quality, clarity and thoroughness of the written proposal.

G. The approach to managing potential conflict of interest.

H. Price

The Department reserves the right to conduct interviews with selected proposers prior to making a final selection.

DEQ reserves the right to reject any or all proposals and to award the contract to the firm or firms which in DEQ's sole and absolute judgment, will best serve the needs of the state.

2/7/92
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INDEPENDENT CONTRACTOR CERTIFICATION STATEMENT *

State agency certifies the contracted work meets the following standards:

1. Contractor will provide labor and services free from direction and control, subject only to the accomplishment of specified results.
2. Contractor is responsible for obtaining all assumed business registrations or professional occupation licenses required by state or local law.
3. Contractor will furnish the tools or equipment necessary to do the work.
4. Contractor has the authority to hire and fire employees to perform the work.
5. Contractor will be paid on completion of the project or on the basis of a periodic retainer.

______________________________ ____________________

Agency Signature Date

Independent contractor certifies he/she meets the following standards as required by ORS chapters 316, 656, 657 and 670:

1. You filed federal and state income tax returns for the business for the previous year, if you performed labor or services as an independent contractor in the previous year.
2. You represent to the public that you are an independently established business by meeting <u>four</u> (4) or more of the following:

_____ A. You work primarily at a location separate from your residence, or work primarily in a specific portion of the residence, which portion is set aside as the location of the business.

_____ B. You have purchased commercial advertising, business cards, or have a trade association membership.

_____ C. You use a telephone listing and service separate from your personal residence listing and service.

_____ D. You perform labor or services only pursuant to written contracts.

_____ E. You perform labor or services for two or more different persons within a period of one year.

_____ F. You assume financial responsibility for defective workmanship or for service not provided as evidenced by the ownership of performance bond, warranties, errors and omission insurance or liability insurance relating to the labor or services to be provided.

Contractor
Signature ______________________________ Date ________________

Entity ______________________________

***Corporations are not required to complete this form.**

RULES PROPOSAL:

OREGON ADMINISTRATIVE RULES

CHAPTER 340

DIVISION 43

CHEMICAL MINING

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS

OAR 340-43-065	Guidelines for Design, Construction, and Operation of Heap-Leach Facilities
OAR 340-43-070	Guidelines for Disposal of Mill Tailings
OAR 340-43-075	Guidelines for Disposal or Storage of Wasterock, Low-Grade Ore and Other Mined Materials
OAR 340-43-080	Guidelines for Heap-Leach and Tailings Disposal Facility Closure
OAR 340-43-085	Post-Closure Monitoring
OAR 340-43-090	Land Disposal of Wastewater
OAR 340-43-095	Guidelines for Open-Pit Closure

PURPOSE

340-43-005

The purpose of these rules and guidelines is to protect the quality of the environment and public health in Oregon by requiring application of "... all available and reasonable methods...", Oregon Revised Statutes (ORS) 468.710, for control of wastes and chemicals relative to design, construction, operation, and closure of mining operations which use cyanide or other toxic chemicals to extract metals or metal-bearing minerals from the ore and which produce wastes or wastewaters containing toxic materials.

DEFINITIONS

340-43-010

Unless the context requires otherwise, as used in this Division:

(1) "Chemical process mine" means a mining and processing operation for metal-bearing ores that uses chemicals to dissolve metals from ores.

(2) "Department" means the Department of Environmental Quality.

(3) "Guidelines" means this body of rules contained in 340-43-045 through 340-43-100.

(4) "Positive exclusion of wildlife" means the use of such devices as tanks, pipes, fences, netting, covers and heap-leach drip-irrigation emitters or covered emitters.

(5) "Tailings" means the spent ore resulting from the milling and chemical extraction process.

PERMIT REQUIRED

340-43-015

(1) A person proposing to construct a new chemical mining operation, commencing to operate an existing non-permitted operation, or proposing to substantially modify or expand an existing operation shall first apply for, and receive, a permit from the Department. The permit may be an NPDES (National Pollutant Discharge Elimination System) permit if there is a point-source discharge to surface waters or a WPCF (Water Pollution Control Facility) permit if there is no discharge. Consideration may be given to site-specific conditions such as climate, proximity to water, and type of wastes to establish the final permit type and requirements for the facility.

(2) The permit application shall comply with the requirements of OAR Chapter 340, Divisions 14 and 45 and be accompanied by a report that fully addresses the requirements of this Division .

PERMIT APPLICATION

340-43-020

(1) The permit application shall fully describe the existing site and environmental conditions, with an analysis of how the proposed operation will affect the site and its environment. The Department shall, at a minimum, require the information specified for the DOGAMI consolidated application under Section 13, Chapter 735, 1991 Oregon Laws. The Department will also use the information contained in NEPA (National Environmental Policy Act), EA (Environmental Assessment), or EIS (Environmental Impact Statement) documents, if they are required by the project, as partial fulfillment of the requirements of this paragraph.

(2) The permit application shall, in addition to the information described in Paragraph (1) above, include the following information, unless the information has been otherwise submitted:

(a) Climate/meteorology characterization, with supporting data;

(b) Soils characterization, with supporting data;

(c) Surface water hydrology study, with supporting data;

(d) Characterization of surface water and groundwater quality;

(e) Inventory of surface water and groundwater beneficial uses;

(f) Hydrogeologic characterization of groundwater, with supporting data;

(g) Geologic engineering, hazards and geotechnical study, with supporting data;

(h) Characterization of mine materials and wastes which include, for example, overburden, waste rock, stockpiled ore, leached ore and tailings. Characterization of mine materials and wastes shall include, but not be limited to the following:

(A) Chemical and mineral analysis related to toxicity;

(B) Determination of the potential for acid water formation;

(C) Determination of the potential for long-term leaching of toxic materials from the wastes;

(i) Characterization of wastewater (quantity and chemical and physical quality) produced by the operation;

(j) Assessment of the potential for acid-water formation from waste disposal facilities, low-grade ore stockpiles, waste rock piles and for surface water or groundwater accumulation in open pits that will remain after mining is ended.

(3) Data submitted by the permit applicant should be based on analysis of the actual materials, when possible, or may be based on estimates from knowledge of similar operations and professional judgment.

PLANS AND SPECIFICATIONS

340-43-025

(1) A person constructing or commencing to operate a chemical process mine or substantially modifying or expanding an existing chemical process mine shall first submit plans and specifications to the Department for construction, operation and maintenance of the facilities intended for treatment, control and disposal of wastes.

(2) The Department shall approve the plans, in writing, before construction of the facilities may be started. The plans shall address all applicable requirements of this Division and shall include, but not be limited to, the following:

(a) A description of the facilities to be constructed, including tanks, pipes and other storage and conveyance means for processing chemicals and solutions and wastewaters;

(b) A management plan for control of surface water;

(c) A management plan for treatment and disposal of excess wastewater, including provisions for reuse and wastewater minimization;

(d) A facility construction plan including, as applicable, the design of low-permeability soil barriers, the type of geosynthetics to be used and a description of their installation methods, the design of wastewater treatment facilities and processes, a quality assurance plan for applicable phases of construction and a listing of construction certification reports to be provided to the Department;

(e) A preliminary closure plan;

(f) A preliminary post-closure monitoring and maintenance plan;

(g) A spill containment and control plan.

DESIGN, CONSTRUCTION, OPERATION AND CLOSURE REQUIREMENTS

340-43-030

(1) All chemical process and waste disposal facilitiesand facilities for mixing, distribution, and application of chemicals associated with on-site mining operations; ore preparation and beneficiation facilities; and processed -ore

disposal facilities shall be designed, constructed, operated and closed in accordance with the guidelines contained in this Division.

(2) A groundwater monitoring plan shall be submitted to, and be approved by the Department. Monitoring wells shall be installed for detection of groundwater contamination as required by OAR Chapter 340, Division 40, unless the hydrogeology of the site or other technical information indicates that an adverse impact on groundwater quality is not likely to occur.

(3) Alternative methods of control of wastes may be acceptable if the permit applicant can demonstrate that the alternate methods will provide fully-equivalent environmental protection. The burden of proof of fully-equivalent protection lies with the permit applicant.

(4) The Department may, in accordance with a written compliance schedule, grant reasonable time for existing facilities to comply with these rules.

EXEMPTION FROM STATE PERMIT FOR HAZARDOUS WASTE TREATMENT OR DISPOSAL FACILITIES

340-43-035

(1) The state hazardous waste program requires a permit for the "treatment", "storage" or "disposal" of any "hazardous waste" as identified or listed in OAR Chapter 340, Division 101 from the Department, prior to the treatment and disposal of wastes. Permitting requirements can be found in OAR Chapter 340, Division 105, Hazardous Waste Management.

(2) However, any operation permitted under this Division, which would otherwise require the neutralization or treatment of hazardous waste and would require a permit pursuant to OAR Chapter 340, Division 105, shall be exempt from the requirement to obtain such hazardous waste treatment permit.

(3) All mined materials disposed of under this Division shall pass Oregon's hazardous waste rule criteria or they will be considered a state hazardous waste and must be disposed of accordingly.

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS

PURPOSE

340-43-040

(1) This Division establishes criteria for the design, construction, operation and closure of chemical mining operations and supplements the provisions of OAR 340-43-005 through OAR 340-43-035.

(2) Any disapproval of submitted plans or specifications, or imposition of requirements by the Department to improve existing facilities or their operation will be referenced when appropriate, to applicable guidelines or rules.

GENERAL PROVISIONS

340-43-045

(1) Facilities permitted under either a WPCF or NPDES permit shall not discharge wastewater or process solutions to surface water, groundwater or soils, except as expressly allowed by the permit.

(2) Facilities subject to these rules shall not be sited in 100-year floodplainsor wetlands. A buffer zone (a minimum of 200 feet wide) shall be established between waste disposal facilities and surface waters.

(3) All chemical conveyances (ditches, troughs, pipes, etc.) shall be equipped with secondary containment and leak detection means for preventing and detecting release of chemicals to surface water, groundwater or soils.

(4) Acid water accumulation in open pits resulting from the mining operation must be prevented by appropriate mining practices, by measures taken in the closure process, or be treated to control pH and toxicity, for the life of the pit.

(5) Construction of surface impoundment liner systems shall conform generally to the principles and practices described in EPA/600/2-88/052, Lining of Waste Containment and Other Impoundment Facilities, September 1988.

(6) The Department may require the permittee to hire a third-party contractor to perform the functions set forth below. Selection of the contractor shall be subject to Department approval.

(a) Review and evaluate the design and construction specifications of all mined-materials disposal facilities permitted under this Division for functional adequacy and conformance with Department requirements. The Department shall not approve construction of the disposal facilities until the design and construction specifications have been evaluated.

(b) Monitor the course of construction of all mined-materials disposal facilities for compliance with the approved design and construction specifications. The third-party contractor shall regularly document the progress of construction and the Department shall require the permittee to take corrective action if construction does not satisfactorily conform to the approved design and construction specifications.

CONTROL OF SURFACE WATER RUN-ON AND RUN-OFF

340-43-050

(1) Surface water run-on and run-off shall be controlled such that it will not endanger the facility or become contaminated by contact with process materials or loaded with sediment. The control systems shall be designed to accommodate a 100-year, 24-hour storm event, or any other defined climatic event that is more appropriate to the site, and be placed so as to allow for restoration of the natural drainage network, to the maximum extent practicable, upon facility closure.

(2) All mined materials shall be properly placed and protected from surface water and precipitation so as not to be eroded and contribute sediment to site stormwater run-off or to otherwise contaminate surface water.

PHYSICAL STABILITY OF RETAINING STRUCTURES AND EMPLACED MINE MATERIALS

340-43-055

(1) Permit applicants must demonstrate to the Department that the design of chemical processing facilities and waste disposal facilities is adequate to ensure the stability of all structural components of the facilities during operation, closure and post closure.

(2) Retaining structures, foundations and mine materials emplacements shall be designed by a qualified, registered professional and be constructed for long-term stability under anticipated loading and seismic conditions.

(3) Temporary structures and materials emplacements may, with written approval from the Department, be constructed to a lesser standard if it can be shown that they pose no, or minimal, threat to public safety or the environment.

PROTECTION OF WILDLIFE

340-43-060

(1) Wildlife shall be positively excluded from contact with chemical processing solutions and wastewaters containing chemicals.

(2) The Department may waive the positive exclusion requirement if the Oregon Department of Fish and Wildlife (ODF&W) certifies to the Department that the project is designed such that it will adequately protect wildlife.

GUIDELINES FOR DESIGN, CONSTRUCTION, AND OPERATION OF HEAP-LEACH FACILITIES

340-43-065

(1) This paragraph applies to heap-leach facilities using dedicated, or expanding, pads. Heap-leach facilities using on-off, reusable pads may require variations from these rules; they shall be approved on a case-by-case basis by the Department.

(2) The heap-leach facility (pad and associated ponds, pipes and tanks) shall be sized to prevent flooding of any of its components.

(3) TABLE 1 of this Division establishes minimum capacity-sizing criteria for the leach-pad and ponds. The pad and ponds may be designed to act separately or in conjunction with each other to obtain the required storage volumes. Other design criteria may be used, with Department approval, if local conditions warrant. The best available climatic data shall be used to confirm the critical design storm event and estimate the liquid levels in the system over a full seasonal cycle. The liquid mass balance may include provision for evaporation.

(4) The heap-leach pad liner system shall be of triple liner construction with between-liner leak detection consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;

(b) Continuous flexible-membrane middle and top liners of suitable synthetic material separated by a minimum of 12 inches of permeable material (minimum permeability of 10^{-2} cm/sec);

(c) A leak-detection system between the synthetic liners capable of detecting leakage of 400 gallons/day-acre within ten weeks of leak initiation.

(5) The processing-chemical pond liners shall be of triple liner construction with between-liner leak detection consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;

(b) Continuous flexible-membrane middle and top liners of suitable synthetic material separated by a permeable material (minimum coefficient of permeability of 10^{-2} cm/sec);

(c) A leak detection system between the synthetic liners capable of detecting leakage of 400 gallons/day-acre, within ten weeks of leak initiation.

(6) Emergency ponds may be constructed as an alternative to larger pregnant and barren ponds. The emergency pond may be constructed to a lesser standard, with the limitation that it is to be used only infrequently and for short periods of time. The Department will specify reporting and use limitations for the ponds in the permit. A between-liner leak detection system is not required for the emergency pond.

(7) The emergency-pond liner shall be of composite construction consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-6}cm/sec) with a minimum thickness of 12 inches, and

(b) A single flexible-membrane synthetic top liner of suitable material.

(6) The heap-leach pad shall be provided with a process chemical collection system above the upper-most liner that will prevent an accumulation of process chemical within the heap greater than 24 inches in depth.

(7) The permittee shall prepare a written operating plan for safe temporary shut-down of the heap-leach facility and train employees in its implementation.

(8) The permittee shall respond to leakage collected by the heap-leach and processing-chemical storage pond leak-collection systems according to the process defined in TABLE 2.

(9) The permittee shall determine the acid-generating potential of the spent ore by acid\base accounting and other appropriate static and dynamic laboratory tests. If the spent ore is shown to be potentially acid generating under the conditions expected in the heap at closure, the permittee shall submit a plan for acid correction for Department approval prior to loading the heap.

GUIDELINES FOR DISPOSAL OF MILL TAILINGS

340-43-070

(1) Mill tailings shall be treated by cyanide removal and re-use prior to disposal to reduce the amount of cyanide introduced into the tailings pond. Chemical oxidation or other means shall be additionally used, if necessary, prior to disposal to reduce the WAD cyanide level in the liquid fraction of the tailings. The permittee shall conduct laboratory column tests on mill tailings to determine the lowest practicable concentration to which the WAD cyanide (weak-acid dissociable cyanide as measured by ASTM Method D2036-82 C) can be reduced. In no event, shall the permitted WAD cyanide concentration in the liquid fraction of the tailings be greater than 30 ppm.

(2) (Deleted)

(3) The permittee shall determine the potential for acid-water formation from the tailings by means of acid-base accounting and other suitable laboratory static and dynamic tests. If acid formation can occur, basic materials shall be added to the tailings in the amount of three (3) times the acid formation potential or to give a net neutralization potential of at least 20 tons of $CaCO_3$ per 1000 tons of tailings, whichever is greater, before placing tailings in the disposal facility.

(4) The disposal facility shall be lined with a composite double liner consisting of a flexible-membrane synthetic top liner in tight contact with an engineered,

stable, soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) having a minimum thickness of 36 inches.

Construction of the liner shall generally follow the principles and practices contained in EPA/600/2-88/052, "Lining of Waste Containment and Other Impoundment Facilities, September, 1988.

(5) The disposal facility shall be provided with a leachate collection system above the liner suitable for monitoring, collecting and treating potential acid drainage.

GUIDELINES FOR DISPOSAL OR STORAGE OF WASTEROCK, LOW-GRADE ORE AND OTHER MINED MATERIALS

340-43-075

The permittee shall determine the acid-producing and metals-release potential of the wasterock, low-grade ore or other mined materials by acid/base accounting and other appropriate static and dynamic laboratory tests. If the mined materials are shown to be potentially acid forming, or capable of releasing toxic metals, the permittee shall submit a plan for correction and disposal for Department approval prior to permanently placing the materials.

GUIDELINES FOR HEAP-LEACH AND TAILINGS DISPOSAL FACILITY CLOSURE

340-43-080

(1) The waste disposal facilities shall be closed under these rules in conjunction with the reclamation requirements of DOGAMI (Oregon Department of Geology and Mineral Industries).

(2) An up-dated closure plan and post-closure monitoring and maintenance plan shall be submitted to the Department by the permittee at least 180 days prior to beginning closure operations or making any substantial changes to the operation. The closure plan must be compatible with DOGAMI's reclamation plan and may be part of it.

(3) Chemical conveyances (ditches, troughs, pipes, etc.) not necessary for post-closure monitoring shall be removed. The secondary containment systems shall be checked before closure for process-chemical contamination, and contaminated soil or other materials, if any, shall be removed to an acceptable disposal facility.

(4) Closure of the heap-leach facility.

(a) The heap shall be detoxified over a suitable period of time prior to closure, using rinse/rest cycles of rinsing and chemical oxidation, if necessary. The WAD cyanide concentration in the rinsate shall be no greater than 0.2 ppm.

(b) Following detoxification as defined in (a) above, the heap shall be closed in place on the pad by covering the heap with a cover designed to prevent water and air infiltration. The cover should consist, at a minimum, of a low-permeability layer and suitable drainage and soil layers to prevent erosion and damage by animals and to sustain vegetation growth, in accordance with DOGAMI's reclamation rules.

(c) The ponds associated with the heap shall be closed by folding in the synthetic liners and filling and contouring the pits with inert material. Residual sludge may be disposed of in one of the on-site waste disposal facilities, provided it meets the criteria for such wastes in these guidelines. The process chemical collection system of the heap shall be maintained in operative condition so that it can be used to monitor the amount and quality of infiltrated water, if any, draining from the heap.

(5) The tailings disposal facility shall be closed by covering with a composite cover designed to prevent water and air infiltration and be environmentally stable for an indefinite period of time. Maximum effort shall be made to isolate the tailings from the environment. Construction of the cover shall generally follow the principles and practices contained in <u>EPA/530-SW-89-047, Technical Guidance Document -- Final Covers on Hazardous Waste Landfills and Surface Impoundments</u>.

POST-CLOSURE MONITORING

340-43-085

(1) The Department may continue its permit in force for thirty (30) years after closure of the operation and will include permit requirements for periodic monitoring to determine if release of pollutants is occurring.

(2) Monitoring data will be reviewed regularly by the Department to determine the effectiveness of closure of the disposal facilities. The Department will consult with DOGAMI on release of security funds that would otherwise be needed to correct problems resulting from ineffective closure.

LAND DISPOSAL OF WASTEWATER

340-43-090

(1) To qualify for land disposal of excess wastewater, the permit applicant shall demonstrate to the Department that the process has been designed to minimize the amount of excess wastewater that is produced, through use of water-efficient processes, wastewater treatment and reuse, and reduction by natural evaporation. Excess wastewater that must be released shall be treated and disposed of to land under the conditions specified in the permit.

(2) A disposal plan shall be submitted as part of the permit application that, at a minimum, includes:

- (a) Wastewater quantity and quality characterization;
- (b) Soils characterization and suitability analysis;
- (c) Drainage and run-off characteristics of the site relative to land application of wastewater;
- (d) Proximity of the disposal site to groundwater and surface water and potential impact;
- (e) Wastewater application schedule and water balance;
- (f) Disposal site assimilative capacity determination;
- (g) Soils, surface water and groundwater monitoring plan;
- (h) Potential impact on wildlife or sensitive plant species.

(3) The Department will evaluate the disposal plan and set site-specific permit conditions for the wastewater discharge.

GUIDELINES FOR OPEN-PIT CLOSURE

340-43-095

(1) Open pits that will be left as a result of the mining operation shall be assessed prior to, and following, mining operations for the potential to contaminate

water to the extent that it might not meet water-quality standards due to build-up of acid or toxic metals.

(2) If the Department finds that the potential for water accumulation in the pit(s) exists, the permit applicant shall submit a closure plan for the pit that will address contamination prevention and possible remedial treatment of the water. The closure plan shall, at a minimum, examine the following alternatives:

(a) Avoidance, during mining, of acid-generating materials that can be left in place, rather than being exposed to oxidation and weathering;

(b) Removal from the pit and disposal, during or after the mining operation, of residual acid-generating materials that would otherwise be left exposed to oxidation and weathering;

(c) Protective capping in-situ of residual acid-generating materials;

(d) Treatment methods for correcting acidity and toxicity of accumulated water;

(e) Installation of an impermeable liner under ponded water to prevent groundwater contamination;

(f) Backfilling of the pit(s) above the water table to reduce oxidation of residual acid-generating materials.

TABLE 1

Heap-Leach Liquid Storage Criteria

Component	Pregnant-Solution Pond	Barren-Solution Pond
Operating Volume	Minimum necessary to maintain recirculation	Minimum necessary to maintain recirculation
Operational Surge	Anticipated draindown and rinse volume	Anticipated draindown and rinse volume
Climatic Surge	100-yr, 24-hr storm plus 10-yr snowmelt	100-yr, 24-hr storm plus 10-yr snowmelt
Safety Factor	2-ft dry freeboard	2-ft dry freeboard

TABLE 2

Required Responses to Leakage Detected from the Leach Pad

Leakage Category	Response
Zero leakage to 200 gal/day-acre	Notify the Department; increase pumping and monitoring
Leakage from 200 gal/day-acre to 400 gal/day-acre	Change operating practices to reduce leakage
Leakage in excess of 400 gal/day-acre	Repair leaks under Department schedule.

State of Oregon
DEPARTMENT OF ENVIRONMENTAL QUALITY
RECEIVED
AUG 24 1992
OFFICE OF THE DIRECTOR

August 20, 1992

Fred Hansen, Director
Oregon Department of Environmental Quality
811 S.W. 6th Avenue
Portland, Oregon
97204

Dear Mr. Hansen,

I have just reviewed TRC's report as well as the BLM's position paper regarding chemical mining legislation in Oregon. In both cases I found their comments much more reasonable than the DEQ's proposed regulations.

Specifically, the DEQ seems to want a cookbook approach which can be used at every site. The TRC, BLM, and mining industry representatives have suggested all along that the geochemistry, climate, and topography at a proposed minesite requires site-specific solutions. Similarly, treating **all** mine waste as hazardous waste is ridiculous, as only a small portion of mine waste from some mines is hazardous. Requiring covers on top of spent heaps and tailings is usually detrimental to degradation of cyanide species, and should be used only in specific instances (i.e., acid-generation situations).

It appeared in reading through ODEQ's questions and TRC's responses that TRC was trying to point out that many of their conclusions were contingent on the way you had structured your questions. TRC was trying to make a point that, taken together, your regulations are in places redundant and would not help materially in achieving your policy objectives. Your response to this valid input seemed in some cases to be "we're not listening, because it wasn't part of the questions we were asking you".

Being a geologist in the mineral industry, and before that an environmental activist with little knowlege of the mining industry, I can appreciate the difficulties you must be experiencing here in the middle of a controversial issue. And I appreciate the DEQ allowing for impartial review of your proposed regulations, which I must say appear wildly stringent. Please, take a closer look at them, and allow for flexibility.

Sincerely,

Richard E. Zehner

Richard E. Zehner

405 Smithridge Park
Reno, Nevada 89502

OREGON MINING COUNCIL

COMMENTS ON DEQ CHEMICAL MINING RULES AND PROPOSED AMENDMENTS
August 7, 1992

ISSUE I. LINERS:

(a) DEQ should expressly approve the alternate liner proposed by TRC, including variations;

(b) DEQ should replace the reference to 36" of clay and synthetic membranes in the bottom liner guidelines to simply 12" of clay; and

(c) The DEQ and TRC liner specifications should be deemed acceptable, not starting points.

Rationale:

(a) **TRC showed its alternative leach pad liner meets EQC** policies with a high degree of certainty and prevents leaks better than the DEQ triple liner. The DEQ triple liner encourages leaks, resulting in high operating costs.

(b) TRC found 12" of clay gives more than enough time after initial leak detection to remedy leaks. 36" is 4 times more than enough.

(c) DEQ calls its guidelines "minimum" criteria, implying that more may be required for specific projects. TRC found that the specified liners would meet EQC policies with a high degree of certainty. If an applicant agrees to build the DEQ or TRC liner system rather than seek a variance, **the application should be approved.**

PROPOSED AMENDMENTS:

340-43-065(4) [guidelines for heap leach pad liners]

ok?

(b) [last sentence] The leak detection system shall consist of appropriately sized collection piping placed within a minimum thickness of 12 inches of permeable material (minimum permeability of 10^{-2} cm/sec) or equivalent liquid conducting material of different thickness that is capable of withstanding the anticipated weight of the heap without loss of function.

(c) A secondary liner shall be placed below the leak detection system to provide assurance that any leakage through the primary liner during the operation of the heap and following closure of the heap is not released to the environment. The

Secondary liner shall consist of~~be of a composite design with a continuous flexible membrane of suitable synthetic material in direct contact with~~ an engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 12~~36~~ inches, or materials providing protection against leaks for an equivalent period.

(d) [new] The following two heap leach pad liner designs are approved by the Department as satisfying the policies in 43-006(2) and these guidelines with a high degree of certainty. An applicant that elects to incorporate either of these designs into its facilities shall be deemed to have satisfied the requirements of these rules with respect to heap leach pad liners.

(i) <u>Alternate Liner I</u>: A triple liner with the following three layers: (a) an engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches; (b) continuous flexible-membrane middle and top liners of suitable synthetic material separated by a minimum of 12 inches of permeable material (minimum coefficient of permeability of 10^{-2} cm/sec); and (c) a leak detection piping system between the synthetic liners capable of detecting leakage of 400 gallons/day-acre within ten weeks of leak initiation.

(ii) <u>Alternate Liner II</u>: (As described in the final report of TRC Environmental Consultants, Inc. under ODEQ Contract No. 71-92) A triple liner system with the following three layers: (a) an engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 12 inches; (b) a top liner consisting of a continuous flexible membrane of suitable synthetic material underlain by low permeability soil/clay (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 6 inches (or equivalent prefabricated composite liner consisting of a flexible membrane with attached bentonite layer of lesser thickness); and (c) a leak detection system between the top and bottom liners consisting of a minimum of 12 inches of permeable material (minimum coefficient of permeability of 10^{-2} cm/sec) and piping capable of detecting leakage of 400 gallons/day-acre within ten weeks of leak initiation.

<u>340-43-65(5)</u> [guidelines for Processing Chemical Pond Liners]

(b) [second sentence] The leak detection system shall consist of appropriately sized collection piping or equivalent liquid conducting materials ...

(c) A secondary liner shall be placed below the leak detection system to provide assurance that any leakage through the primary liner during the operation of the heap and following closure of the heap is not released to the environment. The Secondary liner shall consist of ~~be of a composite design with a continuous flexible membrane of suitable synthetic material in direct contact with~~ an engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 12~~36~~ inches, or materials providing protection against leaks for an equivalent period.

<u>ISSUE II. CYANIDE REMOVAL AND REUSE</u>:

(a) DEQ should delete cyanide reuse from its guideline requirements; cyanide destruction alone should be allowed; and

(b) detoxification to 30 ppm WAD cyanide should be deemed sufficient.

<u>Rationale</u>:

(a) TRC found cyanide <u>reuse</u> does <u>not</u> further the EQC policies of reducing toxicity or preventing long-term release of cyanide from the facilities. There is no evidence that one or two trucks per month bringing cyanide to a mine pose a material risk to the environment, justifying the expenditure of $2 to $5 million dollars on cyanide reuse technology.

Cyanide reuse technology requires the use of large quantities of fresh water, electrical power, sulfuric acid and caustics. Acid and caustics would have to be transported to the facility in lieu of cyanide. The reduction in cyanide transportation risk (which is minimal) would be offset by these other environmental costs.

(b) OAR 340-135-50(2)(f) [DEQ's toxic use reduction and hazardous waste reduction rule] expressly allows all other industries in Oregon to determine, on a site-specific basis, the technological and economic feasibility of reuse. DEQ has not justified treating the chemical mining industry differently than all other industries in Oregon by mandating cyanide reuse.

(c) TRC found no environmental risk basis for lowering cyanide residuals in tailings below 50 ppm. Industry would be willing to aim for 30 ppm, to add an additional margin of caution. Requiring expenditures for greater reductions without identifiable environmental benefits is unreasonable.

<u>PROPOSED AMENDMENTS</u>:

<u>340-43-006(2)(b)</u> [policy statement]

The toxicity of mill tailings and the potential for long-term cyanide and toxic metals release from mill tailings shall be reduced to the greatest degree practicable through removal, neutralization or destruction of cyanide and toxic metals compounds ~~and reuse of chemical solutions~~ **prior to placement of tailings in the tailings disposal facility.** **Reduction of residual WAD cyanide to 30 ppm or less shall be deemed sufficient.**

<u>340-65-070(1)</u> [guidelines for disposal of mill tailings]

Mill tailings shall be treated by cyanide removal or destruction ~~and re-use~~ prior to disposal to reduce the amount of cyanide introduced into the tailings pond. Chemical oxidation or other means shall be additionally used, if necessary, prior to disposal to reduce the WAD cyanide level in the liquid fraction of the tailings. ~~The permittee shall conduct laboratory column tests on mill tailings to determine the lowest practicable concentration to which the WAD cyanide (weak acid dissociable cyanide as measured by ASTM Method D2036-82 C) can be reduced.~~ In no event~~,~~ shall the permitted **WAD cyanide concentration in the liquid fraction of the tailings be greater than 30 ppm.**

<u>ISSUE III. COVERING HEAPS AND TAILINGS FACILITIES</u>:

Hazardous waste covers should not be required unless the decommissioned heap or tailings contain toxic or acid-generating material. If the tailings are treated to be nontoxic and non-acid forming, a 12" composite liner is sufficient.

<u>Rationale</u>:

(a) TRC found that absent acid forming materials in the heap or tailings facility, a hazardous waste cover adds no material environmental protection. The cost of hazardous waste covers is very high (millions of dollars). Mining and transporting the clay for covers and burning fossil fuels to construct such covers would create negative environmental impacts while the covers would provide no benefits.

The proposed rule changes make cover requirements consistent with treatment of other solid or hazardous waste facilities in Oregon.

PROPOSED AMENDMENTS

340-43-080(4)(b) [guidelines for heap leach closure]

Following detoxification as defined in (a) above, if the spent ore are not state hazardous wastes as determined under existing rules and will not be acid generating, then the heap shall be reclaimed as required by the Department of Geology and Mineral Industries. If the tailings are state hazardous wastes or will be acid generating, then the heap shall be closed in place on the pad by covering the heap with a cover designed to prevent water and air infiltration. The cover should consist, at a minimum *** (continue with existing language).

340-43-080(5) [guidelines on covering tailings facility at closure]

[new first sentence] If the tailings, after all processing and treatments provided by the applicant, are not state hazardous wastes as determined under existing rules and will not be acid generating, then the tailings shall be reclaimed as required by the Department of Geology and Mineral Industries. If the tailings are state hazardous wastes or will be acid generating, then t~~T~~he tailings disposal facility shall be closed by covering with a composite cover designed to prevent water and air infiltration and be environmentally stable for an indefinite period of time. (continue with existing language)......

340-43-070(3) [guidelines for mill tailings liner]

If the tailings, after all processing and treatments to be provided by the applicant, will not be state hazardous wastes as determined under existing rules and will not be acid generating, then the tailings disposal facility shall be lined with a composite double liner consisting of a flexible-membrane synthetic top liner in tight contact with an engineered, stable, soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) having a minimum thickness of 12~~36~~ inches. If the tailings are state hazardous wastes or will be acid generating, then the minimum thickness of the clay liner shall be 36 inches.

<u>ISSUE IV.</u> <u>ALTERNATIVE FACILITIES AND METHODS</u>:

> **(a) DEQ should specify that alternative facilities that satisfy EQC policies with a high degree of certainty will be approved; and**
>
> **(b) the rules should provide for review of proposed alternative facilities by a qualified consultant, selected with DEQ approval, at the <u>applicant's</u> request and expense. The consultant's opinion should be given substantial weight by the DEQ.**

<u>Rationale</u>:

> The current rule on alternative facilities focuses on exceeding the performance of guideline <u>technologies</u> rather than satisfying EQC <u>policies</u>. Example: TRC found that 12" of clay (without a synthetic membrane) allows more than enough time to repair leaks, assuring compliance with EQC policy with a "high degree of certainty." DEQ rejects the TRC proposal on page 24 of DEQ's July 30 memo because DEQ believes 36" of clay (which allows four times longer to correct a leak) is more protective.
>
> Under the rules, DEQ dictates the schedule for correcting significant leaks. DEQ offers no explanation why it could not require leak correction within the time frame provided by the 12" liner.

<u>PROPOSED AMENDMENTS</u>

<u>340-43-031(2)</u> [provision for approval of alternative facility designs and methods]

Alternative facilities and methods of control of wastes and potential pollutants shall~~may~~ be approved by the Department if the permit applicant can demonstrate that the alternate facilities and methods will provide environmental protection that satisfies the policies set forth in 43-006(2) with a high degree of certainty.~~is fully equivalent or better than that achieved by the facilities specified in the guidelines in Sections 43-040 to 43-095 of these rules.~~ The burden of proof

~~of fully equivalent protection~~ lies with the permit applicant. Written approval of any alternative by the Department shall be evidence of acceptance as ~~equivalent or better level of~~ environmental protection that satisfies the policies set forth in 43-006(2) with a high degree of certainty. The applicant may provide for review of proposed alternative facilities and methods by an independent consultant, approved by the Department. The Department shall give substantial weight to the consultant's findings.

340-43-040(1) [statement of purposes for guidelines]

This Division establishes criteria for the design, construction, operation and closure of chemical mining operations and supplements the provisions of OAR 340-43-006 through OAR 340-43-035. **These criteria are intended to establish the minimum level of environmental protection that is necessary using a combination of performance standards and** example~~minimum~~ design criteria. Approval of alternative facilities or methods to satisfy the policies set forth in 43-006(2) with a high degree of certainty and to achieve an equivalent or better environmental result as the facilities and methods set forth in the following criteria is allowed as defined in OAR 340-43-031. To encourage innovation and technical advances, the Department shall evaluate alternative facilities and methods in terms of their overall ability to satisfy the policies in 43-006(2) and the following guidelines rather than requiring that each design element of a proposed alternative match the elements of the facilities and methods set forth below.

Rest the West

P.O. Box 68345
Portland, OR 97268

(503) 645-6293 / Bruce Apple
(503) 653-9781 / Steve Alf

August 26, 1991

K. S. Myron
158 S.W. 11th Avenue
Canby, OR 97013

Fred Hansen, Director
Oregon Environmental Quality Commission
522 SW Fifth Avenue
P.O. Box 1760
Portland, OR 97207

Mining Operation Regulation/Rules

Dear Mr. Hansen:

Rest the West is a newly formed conservation organization based in Portland, Oregon. Our organization is comprised of concerned citizens focused on protecting healthy western ecosystems and on the recovery and protection of currently degraded systems. We are especially concerned with the effects of livestock grazing and chemical mining. Although we are a young organization, our members have been actively addressing environmental concerns for decades. The purpose of this letter is to submit formal comments to the Oregon Environmental Quality Commission on the proposed mining regulations for Oregon. We appreciate this opportunity to comment and participate in the public process.

<u>STRONG REGULATIONS NEEDED TO PROTECT OREGON</u>

Rest the West strongly encourages the commission to approve the mining rules proposed by the Department of Environmental Quality. Do not allow yourselves to be swayed by mining industry arguments. Oregon and Oregonians deserve the strongest possible protection from degradation and pollution which can or will result from chemical mining. The track record of the major companies is written across the western states. Acid mine drainage situations, polluted undrinkable groundwater, poisoned fish and wildlife habitat, attractive "nuisance" tailings ponds still lethal to resident and migratory wildlife, unfilled and unrestored pits and heaps are the legacy left to the western states to live with and attempt to clean up. Oregon does not need Super Fund sites; Oregonians deserve better. Hold the line on strong regulations; approve the proposed regulations.

SPECIFIC CONCERNS

1. Any and all structures containing cyanide (or any leaching chemical) MUST have leak detection systems, including all heap leach pads. In Oregon we require fire alarms in domestic structures to alert citizens to dangerous situations. Trojan and Hanford have leak alarm systems. Arguing that leak detection systems should be site specific reveals a lack of responsible attitudes on the part of an industry seeking to operate in Oregon. Safety first; approve the requirement for leak detection systems. It must simply be a cost of doing responsible business in Oregon.

2. Another safety concern: Oregon deserves the best that fallible human technology can currently provide. Approve the rule requiring three liners, two synthetic--no exceptions. See 1 above. Prevention is the best approach. Clean up is costly--and even questionable. Damage is best left undone with as many safety features built in as possible.

3. Neutralization of acid mine drainage and detoxification of tailings ponds, etc. are musts. "End-of-pipe treatment" is the ounce of prevention that is the best approach to detoxification of toxic chemicals, cyanide for example. Oregon itself and Oregonians should not bear the risks provided by token safety measures, as has and is occurring in other states. Acid mine drainage is an ongoing mining catastrophe unacceptable to environmentally-conscious, concerned Oregonians. Rest the West believes the responsibility for keeping Oregon's quality of life and diversity of landscapes and native species (plant and animal) lies with the state agencies who regulate the use and disposal of toxic and dangerous chemicals within Oregon. DEQ and the EQC must be the ones to determine which treatment processes are allowed in Oregon. The track record of the mining industry proves the wisdom of not allowing the industry to make this selection. It is best to have this spelled out in regulations which can be enforced. This, too, must be a cost of business in Oregon.

4. Wildlife are a vital and valued part of Oregon's quality of life. Sacrificing migratory birds, small mammals, etc., to the mining industry's priorities is unacceptable. If mining companies want to operate here, they must get the message clearly that the wildlife of Oregon is not expendable. The best protection available must be the required minimum. Gambling with the lives of native species so that mining companies can save a few dollars is obscene. "Nets" and/or (preferably both) detoxification of all pond solutions needs to be a "must do" in Oregon. Rest the West urges the EQC to require this protection for Oregon's vulnerable wildlife.

CONCLUSION

In contemplating approval of the proposed rules, Rest the West asks the EQC to keep in mind that mining demands upon Oregon ecosystems will be in addition to existing heavy demands already placed upon the environment. In establishing environmental quality regulations in Oregon, the commission has the opportunity to avoid many of the errors made through ignorance or misplaced trust in other western states. The commission is encouraged by Rest the West to examine the history of mining operations in other western states, even looking just as far as our eastern and southern neighbors should be eye-opening--and make clear the need to approve the proposed DEQ regulations. If any changes are considered, the rules should be examined for further strengthening, not weakening. Gold and precious metal mining do profit the companies. Should that profit be the result of selling short the inhabitants of Oregon and the ecosystems upon which we all are dependent for life? Should Oregon's quality of life be sacrificed so that mining investors receive greater profit? Do Oregonians have a right to protect their state from the ravages suffered in other states?

Rest the West members say no to selling short (or cheaply) our quality and diversity of life, Oregon's ecosystems, and all inhabitants. We believe Oregon citizens do have a right to protect this state from damages which accrue from mining operations and which are documented in other western states. Support the proposed regulations. They merely set the standards for doing business in Oregon. Ethical operators will not dispute them.

Rest the West appreciates the opportunity to share our perceptions and beliefs with the commission on this vitally important Oregon issue. Thank you.

Sincerely,

Kathleen Simpson Myron
Oregon Ecosystems Coordinator

cc: Governor Roberts
Martha Pagel
file

bc:

MARIPOSA IMAGES
158 S.W. 11th Avenue Canby, Oregon 97013
503 266-1263

August 19, 1991

Fred Hansen, Director
Oregon Environmental Quality Commission
522 SW Fifth Avenue
P.O. Box 1760
Portland, OR 97207

Mining Operation Regulations/Rules

Dear Mr. Hansen:

The purpose of this letter is to urge the department and the Environmental Quality Commission to stand firm for the most stringent regulation of mining operations in Oregon possible. Once any damage is done in Oregon, our state will be in the position of other western states, begging absent mining corporations to come back and clean up, if possible, the results of their actions, or taxing Oregon's citizens for clean up funds. "Baubles and bangles" are not a priority in my life. A clean and healthy earth is. I want to live in an environment that is as clean and safe as possible. That means placing degradation of the environment where it belongs--on the "No, not here, not in Oregon" list. It is unacceptable to me that Oregon's mountains, deserts, streams, and valleys should be subject to chemical mining practices which disturbs hundreds of tons of earth in order to extract hundredths or thousandths of an ounce of gold, silver, or other valuable minerals, particularly for the benefit of international corporations. When the primary use of such minerals is to produce jewelry, such mining operations become an abomination, the pits, poison ponds, and spoil heaps physical obscenities upon the earth. The following are conditions which must be imposed before any such mining operation is considered as even a remote possibility in Oregon.

1A. Where mining companies wish to employ tailings ponds, treatment ponds, or any other such liquid features, the companies must be required to cover those nets completely with screening nets. These screening nets must be strong enough and with openings small enough to prevent the entry of large mammals as well as migrating birds and butterflies.

1B. All such liquid features, "ponds", must have their contents detoxified, completely detoxified. Gambling that man knows which amounts of toxic chemicals will not harm native wildlife in some manner is not acceptable.

Neutralizing or detoxifying poisons and/or toxic chemicals/compounds resulting from man's activities is a basic requirement for doing business in Oregon.

The native fauna of Oregon must not be made to pay for the desire of man for gold and other precious metals. Creating Superfund sites is not a goal in Oregon.

2. The selection of the detoxification or neutralizing treatment process shall be determined by the State of Oregon. I strongly urge the DEQ and EQC to stand firm in requiring the mining industry to employ "end-of-pipe" treatment where any effluent is discharged or stored, be this to a tailings pond, or any other site. That material which is returned to the soil, air, and groundwater of Oregon must be as free from accumulated heavy metals and treatment chemicals as the soil, air, and water were prior to any possible mining industry activities.

Oregonians have a right to expect businesses operating within the state's boundaries to employ only those methods which are state-of-the-art, most effective, safest, and cleanest. Most economical to mining corporations is not a valid consideration. These are the people who want to disarrange and rearrange Oregon's landscapes; who want to extract from Oregon irreplaceable materials "economically" as determined by themselves. The mining industry must realize that what may be economic or "good enough" by industry standards has not been and will not be acceptable in Oregon. Quality of life in Oregon is a value not to be sacrificed cheaply. I believe the purpose of mining operation rules is to prevent future pollution resulting from such operations, to prevent degradation of present ecosystems, and to protect the citizens of Oregon and all the state's native species of plants and animals, from immediate and future threats to their safety and continuance of life. The convenience and comfort of the mining industry is not the issue; protection of Oregon is.

Further mines tend to be short-term affairs by their nature; the resources extracted are finite. But citizens such as myself look farther into the future than even merely the length of our own lives. I hope to live a life similar in length to my maternal grandmother and her sisters and brothers who lived to 89 or on to nearly 100 years old. I know that the more minerals the mining industry wants to extract, the more earth must be disturbed, the more associated resources are affected. I believe that the decisions made to protect Oregon will reverberate across these lands not for mere decades, but for centuries. Flexibility, moderation, and leniency in regulations now mean generations of environmental problems. It is not my intent to leave my home state riddled with a multitude of pollution situations for the grandchildren of my grandchildren to deal with and clean up, nor even for my own grandchildren to have to face.

My responsibility as a thinking adult concerned with personally living an ethical life, working for justice for all the earth, and not just "for the gusto" is to leave this earth a place better for my having lived, an environment clean enough that present and future generations of humanity and all living things might be expected to continue for at least as many generations as have preceded me. Poisoning the earth for short-term jobs, for the satisfaction of some humans' desires for gold and precious metals, because a powerful few want to mine the earth is not a human action I can support or condone.

3. Oregon must formally recognize acid-generating materials such as certain mine tailings as hazardous wastes and require treatment of them as such. Acid-generation must be neutralized. Acid mine drainage situations exist in the western states. Oregon has only to look to Idaho (NERCO DeLamar Silver Mine, Owyhee County) for one such actuality. The problems associated with these situations do not eventually go away. Action is required. There can be no accommodation on this issue. Acid mine drainage is not acceptable in Oregon. Prevention or neutralization must be a cost of doing business in Oregon.

4. Containment measures must be multi-faceted. DEQ must require triple liners as per the proposed rules. And leak detection systems must also be required. Liners leak; human endeavors are not fail proof. Leak detection systems merely alert operators to the actuality of inevitable leaks. Lack of such systems allow mining operations to claim no leaks while poisoning their surroundings and potentially most devastating, groundwater. Triple liners and leak detection systems are minimum requirements for mine operations in Oregon. They need to be required wherever chemicals are used, but especially at all mines and under all areas where cyanide is used. How else does the industry intend to prevent soil and water contamination? To prevent chemical interactions which degrade current conditions?

Short term thinking is a problem here. What is clear to those of us who look not only to our own immediate situation but beyond to future generations, to decades and centuries ahead, is not clear to the mining industry which considers its wants to be the number one consideration outweighing all concerns. In a dinner talk with an international mining representative, I learned the man believed so totally in the efficacy of technology that he advocated for building a chemical heap leach mining operation a few feet from a premier anadromous fish spawning stream located inches above groundwater here in the Northwest. When I asked him about factoring in human fallibility and the to me obvious need to exclude mining operations from anadromous fish habitat, he reiterated his complete faith in technology.

This is the mentality Oregon is facing with the mining industry. These are not the people that I want to see deciding which method of detoxification or protection is best or most effective. These are not people I believe can make prudent and responsible decisions about Oregon's environment and resources. The Department of Environmental Quality and the Environmental Quality Commission must stand firm for what is best and safest for Oregon--now and on into the future.

Thank you for this opportunity to comment.

Sincerely,

Kathleen Simpson Myron

cc: Governor Roberts
Martha Pagel
file

Golder Associates Inc.

200 Union Boulevard, Suite 100
Lakewood, CO USA 80228
Telephone (303) 980-0540
Fax (303) 985-2080

Golder Associates

August 5, 1992

Carol A. Whipple
21755 Highway 138 W
Elkton, Oregon 97436

RE: [illegible]

Dear Ms. Whipple:

I have had the opportunity to participate in the development of the Proposed Chemical Mining Rules for Oregon. My participation was limited to review of draft rules and preparation of comments over the last year on behalf of the mining industry. I have some 20 years experience in teaching, research and consulting in the technical aspects of heap leaching, tailings, and waste rock disposal. During this period I have published about 50 technical papers and notes dealing with a range of subjects including drainage, stability and risk issues of these facilities. My contributions have been in the national and international areas.

In reviewing the Memorandum for Director Fred Hansen of the Oregon Department of Environmental Quality (DEQ) (dated July 30,1992) and the proposed rules (Chapter 340, Division 43, Chemical Mining), I realize how important and how difficult the decision is that you have to make on August 7, 1992. The proposed rules deal with a very complex issue, although it seems to be purely technical on the surface, many undertones of a political nature must be recognized. Environmental protection should be the primary principle, however, the potential growth of an industry and the economic and employment opportunities it can create must also be recognized.

An independent consultant (TRC Environmental Consultants Inc) was employed by the DEQ over the past 3 months to provide technical advice on specific technical questions related to the proposed rules. The Memorandum form Director Hansen clearly indicated that most of TRC's technical advice was disregarded by DEQ in the development of the proposed rules. For example, TRC concludes that a one foot clay layer in the secondary liner system can meet the Commissions' policy. DEQ recommends that 3 feet be maintained because it "will increase the long range protection of the environment". The extra cost for marginal protective increase associated with a three feet thick clay vs. a one foot thick clay layer is not justified, as was concluded by TRC. The example above is only one of the issues where DEQ decided to ignore TRC's advice. Similarly, DEQ disregarded the recommendations with respect to treatment and covers.

DEQ also makes statements which are not based on field experience, e.g. "a leak in the upper membrane would tend to enlarge rapidly, resulting in a greater volume of leakage and earlier detection". This is just not true in practice. Very often small leaks are clogged by fines or remain the same (I can provide examples off the record). Leaks only enlarge if settlement is allowed, which does not happen in well designed facilities. I can continue highlighting issues where DEQ disregarded TRC's recommendation on where inconsistencies exist in the DEQ Memorandum and the proposed rules, however, this letter will become too long. I have to conclude that the proposed rules will result in the development of very few employment opportunities in gold (or other "chemical") mining in Oregon. Oregon could thereby loose the opportunity to join responsible environmental development of resources in the U.S.

It is recognized that you need to complete the regulatory development process for mining in Oregon, however, I would like to urge you to evaluate the proposed rules carefully before making a decision.

I trust that the discussion above will emphasize the complexity of the issues you have to decide. Your careful consideration is urged.

Sincerely,

GOLDER ASSOCIATES INC.

Brent Bronsen, for

Dirk Van Zyl, P.E., Ph.D.
Principal

DVZ/tsr

TRC
Environmental Solutions through Technology

TRC Environmental Corporation
7002 South Revere Parkway, Suite 60
Englewood, CO 80112
☎ (303) 792-5555 Fax (303) 792-0122

August 5, 1992

VIA FAX

Ms. Carol A. Whipple
21755 Hwy 138 W
Elkton, OR 97436

Dear Commissioner Whipple:

TRC Environmental Corporation (TRC), the independent contractor retained by the State of Oregon Department of Environmental Quality (DEQ) through the Request for Proposal To Provide Technical Advice on Proposed Chemical Mining Rules, has completed review of the 30, 1992 memorandum from Mr. Fred Hansen, Director, to the Environmental Quality Commissi This memorandum provides DEQ's "Consideration of Contractor's Report on Proposed Chemical and Recommendation for Adoption of Proposed Chemical Mining Rules".

It is of the utmost concern to TRC that DEQ has summarily dismissed the findings of the report Most disconcerting is the fact that its findings have been excerpted out of context. Considerable effort was expended by TRC staff in reviewing and evaluating numerous technical documents, in complement with the utilization of individual technical expertise, in arriving at a comprehensive and objective compiled summary of the identified issues. TRC strived to evaluate each issue within the context the stated "policy" objectives.

We believe that this was accomplished even though the format for performing the such that answers to the individual questions (as responded to on an individual basis) were conclusion due to the manner in which they were posed. While TRC is not in disagreement with the DEQ's overall position that each of the three study issues independently provide (on a stand-alone basis) material reduction in risk to the environment, we strongly disagree with DEQ's assessment that undancy" is not an issue. In fact, we respectfully submit to the Commission that this is precisely issue", and that the individual design parameters in each issue area (on a non-collective basis) are secondary concern, when taken in the context of an overall and effective "<u>system</u>".

It is questionable that DEQ is providing sufficient objectivity to the process by alluding to its hat the Commission intends to take <u>economics</u> into account as it seeks to find an appropriate etween environmental protection goals and requirements". It is difficult to understand how the Commission can adequately evaluate, or otherwise take into account economics when (1) the technical advice report format prohibits introduction of any discussion whatsoever; (2) redundancy economics are dismissed as "out-of-scope"; and (3), DEQ elects to dismiss the findings of the report been recommended by DEQ quite clearly falls into the category of "goals" rather than s". Fortunately, for the most part, the regulatory process as such, has recognized the of these two extremes, and has typically entertained negotiation between all factions to some degree of conciliation from all parties, while still achieving requirements. The mental basis for this approach is to assure that industry can operate in a manner that is environmentally responsible and economically sensible. <u>Even the U.S. EPA conducts an assessment of</u>

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the potential economic impact resulting from proposed environmental regulation prior to full promulgation. The economic impacts dictate whether or not an industry can or will "operate". One can only conclude that where regulatory proposals are so dramatically economically burdensome as the ODEQ proposed regulations, that the real objective is enactment of regulations developed solely to preclude mining, rather than regulate it in an effective manner.

TRC has provided much discussion in the report to differentiate between what may be required to achieve "goals" rather than "requirements". Put simply, the differentiation is based upon fundamental economics, e.g., where policy criteria can be achieved in a manner that is more cost effective than that prescribed in the proposed rules, it seems prudent to allow the applicant the flexibility to achieve the criteria through sound business decisions. That does not imply that the applicant should not be held accountable for certain actions or inactions. Rigorous enforcement and reclamation requirements can supplant the need for prescriptive design requirements.

While DEQ cites the opportunity provision within the proposed rules for "potentially equivalent alternative proposals", placing the burden of proof upon the applicant, one would have to judge the probabilities for success in such a submittal as extremely remote, given the consideration DEQ gave to findings in the report. To reiterate TRC's findings and to put them into recommendations for consideration by the Commission, we offer the following comments:

LINER SYSTEMS

TRC is of the opinion that composite liner **systems** offer the best means of protection to the environment, both operationally and post operationally. The liner system should be sound in design, taking into account the myriad of site-specific parameters. Most importantly, and contrary to DEQ, we believe the liner system should be designed to minimize leak **potential**, rather than to maximize leak **detectability**. If a liner system is designed such that it requires a flexible membrane liner directly atop the leak detection zone, there is a high degree of probability that it will fail. This failure may or may not impact the environment, however, it will certainly impact the economics of the operation. The operator will be required to curtail operations, resulting in loss of revenue, in addition to incurring costs associated with remedial operations.

We note that there appears to be apparent inconsistency on liner terminology amongst parties to this process. The OAR 340 liner system has always been referred to as a triple liner system when in fact it is a double liner system with a composite secondary (lowermost) liner. The TRC alternative candidate liner system is also a double liner system, however, it is comprised of a composite primary (uppermost) liner providing significantly greater resistance to puncture (to minimize leak potential). TRC undertook its assignment of evaluating the technical aspects of liner system design and documented throughout Section 2.0 of the report the literature and operating experience to substantiate our findings. Further, DEQ even acknowledges the emergence onto the market of improving leak detection technologies. This information is supportive of a liner system design based upon **leak prevention** rather than ODEQ's stated objective of leak detection as the primary design criteria. Detecting a leak using the 12-inch permeable zone or geodrain alternatives presented by TRC isn't really a problem. The blem is nobody (neither the regulator, environmentalist, or mining operator) wants to detect a leak at all. So why not design the liner system to minimize the potential for leak occurrence?

Since it has been demonstrated that the TRC alternative (or other) liner design configuration can detect the prescribed leak, and that the 12-inch lower liner provides in excess of five (5) years protection in the event of a leak, **nothing is gained by prescriptive design criteria for a 36-inch clay providing in excess of twenty (20) years of protection other than two (2) feet of redundancy.** In fact, these operations generally are active for a period not exceeding ten years (individual heaps have shorter operational duration); repairs can be effected in a matter of weeks; and the material will presumably (see below) be detoxified prior to closure, thus eliminating significant long-term concerns.

TRC has provided an alternative liner system as well as variations on the proposed OAR 340 liner system that will achieve Commission policy. The applicant should be provided the opportunity to achieve that policy through sound business judgement, and provision should be made for penalizing the applicant that fails to do so, rather than enacting an across-the-board penalization of all applicants.

CYANIDE REMOVAL AND REUSE

TRC has determined that in most instances detoxification to the levels indicated is achievable, as well as desirable, in achieving a material reduction in potential impact to the environment. However, stipulated removal **in combination with** reuse limits the technology in most instances to those technologies which are economically disadvantageous to the operator. This economic impact, when considered as part of the prescribed system, is **the second component of the cumulative economic impact resulting from redundancy** in the prescribed three-part rules. Further, reuse in no way reduces the likelihood of a release. DEQ appropriately cites a reduction in transport and handling as a result of reuse, however, that is not true in all circumstances. During facility closure and where facilities cannot reuse cyanide, loading, transport, and offloading will still result. In addition, there are substantial documented worker health and safety concerns associated with management of cyanide compounds in these reuse processes, the management of which again translates into significant economic impact.

TRC has stated that detoxification to the pre-determined level is prudent. Industry has demonstrated a willingness to comply. TRC urges the Commission to incorporate the provision for detoxification into the rules, but while doing so, allow the operator the flexibility to achieve the objective in the most cost-effective manner (i.e., allow the operator to specify the technology to take advantage of varying ore/tailing chemistry, cyanide reagent concentration, etc.). Also, due consideration should be given to incorporation of a provision encouraging (not requiring) cyanide re-use, where it can be demonstrated to be economically advantageous.

COVERING OF HEAPS AND TAILINGS

TRC is on record as stating that in many instances there are advantages to covering in addition to detoxification. Likewise, there are many instances where it serves to a disadvantage, environmentally, by reducing natural degradation processes or encouraging formation of undesired chemistry within the waste unit. In any case, a RCRA Subtitle C Hazardous Waste Unit cover system is entirely inappropriate for the given waste characteristics, and represents **the third component of the cumulative economic impact resulting from redundancy**.

Literature and operating experience have demonstrated that chemical (cyanide) and toxic metal releases are dependent on varying ore/tailing chemistry, as well as a variety of site-specific parameters. The detoxification proviso, discussed above, provides sufficient management of the chemical release potential, particularly given that the material is situated upon a sound liner system. Toxic metal release is predominately dependent on acid-generating potential of the tailing or spent ore, and its potential can be accurately predicted by representative sampling and testing of the material(s). Cover systems should be designed taking into consideration the site-specific characteristics such as ore/tailing chemistry, natural site conditions, and climatologic factors.

SUMMARY

TRC is of the opinion that a regulatory program capable of achieving the stated Commission policy can be achieved through the following general provisions:

- Require a liner system that incorporates leak prevention along with performance criteria regarding leak detection capability, and provides a prescribed leak retention capability (e.g. 5 years) sufficient to facilitate remedial options. Provide flexibility for design to achieve these criteria. [TRC recommends that the Commission carefully examine the preferred objective, i.e. is the objective to detect a leak; or should the objective be to minimize the potential for occurrence of a leak? It would seem to TRC that the latter would be the preferred objective for protection of the environment, particularly since the alternative design that encompasses this objective is accompanied by the ability to detect a leak with equivalent rapidity to that in the proposed OAR 340 liner system.] Provide flexibility for incorporation of alternative engineered materials where it can be demonstrated that there is no net loss in performance or reliability.

- Require **detoxification** to the prescribed limits in the proposed rules. Allow the applicant flexibility to determine the most appropriate technology based on site-specific characteristics.

  Encourage reuse of cyanide to the maximum extent practicable, where it can be shown to be economically feasible.

- Require **cover systems following detoxification where it is demonstrated that there is a potential for acid generation** or other specific environmental concern (e.g. airborne particulate dispersion, etc.). Modify prescribed design standards to more appropriately reflect the toxicity risk associated with non-hazardous waste (e.g. do not require RCRA Subtitle C cover systems). Where acid generation potential is absent, require closure methods consistent with aesthetic issues and establish provision for other active management closure scenarios that can be demonstrated as capable of achieving commission policy where appropriate (e.g. recontouring, revegetation, stabilization, etc.).

TRC has appreciated the opportunity to become involved in the proposed rulemaking. We offer these comments as a concerned third-party with what we consider to be greater insight into the process than many other parties. This submittal is intended solely as third-party comments for your consideration, and is in no way to be construed to be associated with production of the July 21, 1992 [illegible] entitled "Final Report of Findings on Specific Technical Issues - State of Oregon Proposed Chemical Mining Rules". TRC considers performance under ODEQ Contract Number 71-92 to have concluded upon delivery of the final report. If you have specific questions regarding any of the issues addressed, please feel free to contact me directly at (303) 792-5555 at any time.

Sincerely,

TRC ENVIRONMENTAL CORPORATION

James M. Beck, P.E.
Manager, Hazardous Waste Investig[illegible]n and Engineering

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State of Utah
DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF WATER QUALITY

Norman H. Bangerter
Governor
Kenneth L. Alkema
Executive Director
Don A. Ostler, P.E.
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288 North 1460 West
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RECEIVED
JUN 24 1992

June 17, 1992

Mr. Chris McKinnon
Western Governors' Association
600 17th Street Suite 1705
South Tower
Denver, CO 80202-5442

RE: Recent Utah Evaluation of Cyanide Mobility and Analytical Methods.

Dear ~~Mr. Chris McKinnon~~ Chris:

Our staff have recently completed an evaluation of a report on the attenuation of cyanide in soils entitled "Cyanide Attenuation/Degradation in Soil, Final Report", by Dr. Terrence D. Chatwin of the Resource Recovery and Conservation Company, dated December 1989 and an appendix dated October, 1990.

Comparison of Dr. Chatwin's data with attenuation/mobility data from the literature for other contaminants has brought to light some very interesting conclusions, which I would like to share with you. In addition, our staff has done some research into cyanide analytical methods which is also presented in the attached memorandum.

We are open to any suggestions or comments you or other WGA members may have regarding our research or this topic in general. Please contact myself or Loren Morton at (801) 538-6146 if you have any further questions.

Sincerely,

Don

Don A. Ostler, P.E.
Director

Enclosure

DAO:LBM

cc w/encl.: Tom Durkin, South Dakota Dept. of Env. and Nat. Res.
Birgit McDade, South Carolina Dept. of Health and Env. Control

Q:WGACNNEU.LTR
FILE:UW-WESTERN GOVERNOR'S ASSOC.

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M E M O R A N D U M

TO: Don Ostler, Director
Division of Water Quality

THROUGH: Larry Mize, Chief
Ground Water Protection Section, and

Kiran Bhayani, Section Chief
Design Evaluation Section

FROM: Loren Morton, Environmental Scientist
Ground Water Protection Section

DATE: June 16, 1992

SUBJECT: Review of "Cyanide Attenuation/Degradation in Soil - Final Report", December, 1989; Review of Approaches Taken in Other States, and Recommendation for Cyanide Neutralization Limits for Cyanide Leaching Facilities.

EXECUTIVE SUMMARY

The purpose of this study is to: 1) summarize recent research conducted on the behalf of mining companies that use cyanide, 2) place that research in perspective with characteristics of other chemical compounds, many of which are known contaminants of ground water, and 3) propose a policy and concentration criteria for the neutralization of cyanide leaching operations.

Evaluation of the air-water partitioning ratio (K_{aw}) for hydrogen cyanide indicates that due to its high solubility, a significant fraction of hydrogen cyanide will remain in ground water. In fact, hydrogen cyanide is about 10 times more likely to remain in solution than ammonia. Twenty three other RCRA regulated organic contaminants have similar K_{aw} values including: DDT, TCE, benzene, toluene, napthalene, and others.

Research evaluated here on the transformation of free cyanide to less toxic cyanide complexes during subsurface transport is applicable to barren cyanide solution spills only, and not to releases of pregnant liquors. With the exception of cobalt, gold, platinum, and palladium complexes, metallo-cyanide complexes can dissociate in a ground water environment and thereby release hydrogen cyanide to ground water. When cyanide complexes do not completely dissociate, they facilitate the transport of heavy metals in the ground water and can later dissociate upon ingestion as drinking water, producing toxic free cyanide. Iron cyanide complexes have been shown to dissociate in ultraviolet light and to slowly dissociate in the dark over long periods of time, conditions which will be found in the subsurface.

Of the several cyanide analytical methods available, Total Cyanide has the ability to detect the largest number of metallo-cyanide compounds/complexes and do it more effectively than WAD or Free Cyanide, thanks to its rigorous digestion technique. Reduced sulfur and thiocyanate interference, long cited by the mining industry as reason to avoid the Total Cyanide method, actually causes low readings of cyanide mass in water (negative interference), and should be cause for concern for the regulator. Although not perfect, Total Cyanide is the best method available for detection of the broadest suite of metallo-cyanide complexes.

Experimental results for soil-water partitioning coefficients (K_d) show that total cyanide is highly mobile in a ground water environment, on the same order as 44 of the most mobile organic compounds (e.g. benzene, toluene, TCE, aldicarb, carbon tetrachloride, lindane, 2,4-D, etc.), and two mobile heavy metals; arsenic, and hexavalent chromium. Claims by the mining industry that cyanide is attenuated in the subsurface have been overstated. Any transport pathway and fate analysis must be considered on a site specific basis.

Of seven states incorporating 20 dedicated heap and valley leach projects surveyed by the Western Governor's Association, six states had imposed strict cyanide neutralization criteria on 16 projects with concentrations at or below 0.5 mg/l cyanide. Although cyanide analytical methods varied from project to project and state to state, 10 of the 20 projects had required WAD cyanide analysis over Total or Free Cyanide methods. Three of the seven states required compliance with strict NPDES standards (5.2 ug/l Total Cyanide), or EPA drinking water health advisories (0.2 mg/l Total Cyanide) for cyanide. Three states had also set neutralization criteria for heavy metals by stipulating EPA NPDES or Drinking Water Standards or by requiring a return to natural background concentrations. One state also mandated neutralization criteria for nutrients.

In order to eliminate the potential for a release to ground water and to allow the mine operator to conduct the simplest closure of a leaching facility, the staff proposes use of rinsate neutralization criteria of 0.2 mg/l Total Cyanide with concentration limits for metals and nutrients equivalent to the Utah Ground Water Quality Standards. After an adequate demonstration that the neutralization standards had been reached, this approach would allow the operator to be released from his/her obligation to maintain the facility under authorization of a ground water discharge permit for perpetuity. In order to provide flexibility of regulatory requirements and accommodate special needs, other options are also discussed for alternative neutralization concentration limits and/or facility closure design options.

Introduction

The following discussion focuses on three areas: 1) an evaluation of the research carried out by Terry Chatwin of R^2C^2 Consultants (Chatwin, 1989 and 1990), and funded by a consortium of mining companies, 2) a summary of available information on how other states regulate the neutralization of cyanide heap and valley leaching operations, and 3) recommendation for Utah criteria for neutralization of cyanide at dedicated heap and valley leaching facilities.

Evaluation of Chatwin Report

Mr. Terry Chatwin of R^2C^2 Consultants describes several chemical mechanisms that are significant in degrading or attenuating barren cyanide solutions in soils, as follows (Chatwin, 1989):

Volatilization - of hydrogen cyanide to soil gases.

Chelation - or complexation of free cyanide with naturally occurring metals in the soil.

Precipitation - a special case of chelation which produces an insoluble product.

Adsorption - of free cyanide on organic carbon, clay and feldspar minerals.

Oxidation - of free cyanide to cyanate.

Biodegradation - conversion of cyanide to less toxic compounds by biological processes.

Each of these mechanisms is discussed below with additional staff comments and interpretation.

1. Volatilization - Chatwin presents the air/water partitioning coefficient (K_{aw}) for hydrogen cyanide gas from bench tests of 19 soil samples from the western U.S (Chatwin, 1989, Table 1). This dimensionless coefficient represents the ratio of the hydrogen cyanide mass partitioned into the soil gas phase versus the mass partitioned into the soil water in his bench scale soil column tests (C_a/C_s). The greater this ratio, the more the cyanide partitions to the air and can be removed from the soil system.

   Chatwin's tests with hydrogen cyanide generated a range of $K_{aw\text{-}hcn}$ values from 2.23×10^{-3} to 1.32×10^{-2}, with an average of 6.31×10^{-3}. The stirred reactor tests reported in Appendix B, were run at a temperature of 22 °C (Chatwin, 1990, Appendix B, Section II).

   For comparison, I calculated the K_{aw} for two other compounds at the same temperature: 1) carbon dioxide, a gas that rapidly evolves from water, and 2) ammonia, a gas that is highly soluble in water. If the aqueous solubility of the contaminant is equal to or less than 1 mole/liter, the following expression holds true (Utah State University, p. 9):

$$K_{aw} = \frac{H}{R * T} \quad \text{Eq. 1}$$

where:
- H = Henry's Law Constant for contaminant,
- R = Universal Gas Constant = 0.08205 l*atm/mole*degrees Kelvin, and
- T = Temperature in degrees Kelvin. = 273° + 22° C = 295° K.

In order to accommodate for greater solubilities, substitute for H, where:

$H = P_v / S$, and P_v = Vapor Pressure in atmospheres
S = Aqueous solubility in mole fractions per liter

K_{aw}, now becomes:

$$K_{aw} = \frac{P_v}{S * R * T} \qquad \text{Eq. 2}$$

Table 1: Air-Water Partitioning Coefficients @ 22° C

Contaminant	P_v (atm)	S (moles/liter)	K_{aw} (dimensionless)
Carbon Dioxide	60 [1]	0.00384 [2]	64.414
Ammonia	24.819 [3]	29.74 [4]	3.44×10^{-2}
Hydrogen Cyanide (Chatwin-average)			6.31×10^{-3}

Footnotes:
1) Vapor pressure @ 22.4° C (Weast, p.D-188).
2) Based on linear interpolation for 22° C: 0.1693 gm/l * 1 mole/44.009 gm = 0.00384 mole/l (ibid., p.B-102).
3) Based on linear interpolation for 22° C (ibid., p. D-188).
4) Based on linear interpolation for 22° C: 506.5 gm/l * 1 mole/17.03 gm = 29.74 mole/l (Lange, p. 1099).

As can be seen above, the K_{aw} for carbon dioxide is five-orders of magnitude greater than the average K_{aw} value reported by Chatwin for hydrogen cyanide. This indicates that for the same temperature, hydrogen cyanide is about ten thousand times more prone to partition to the water than CO_2. Table 1 also shows that hydrogen cyanide is more prone to remain in solution in water than ammonia, by about an order of magnitude.

In order to check Chatwin's data, I calculated K_{aw} for hydrogen cyanide based on an equation in the literature for its Henry's Law Constant (Bodek, et.al., p.10.13-3):

For molar concentrations between 0.01 to 0.5 M, and in units of mm Hg•l/M:

$$\log H_{hcn} = \frac{-1272.9}{T} + 6.238, \text{ where: } T = °K.$$

After solving for 22° C:

$$H_{hcn} = 83.7693 \text{ mm Hg•l/M} * 1 \text{ atm}/760 \text{ mm Hg}$$
$$= 0.2204 \text{ l•atm/M}$$

Now substitute and solve for K_{aw}, using Equation No. 1, above:

$$K_{aw\text{-}hcn} = \frac{H}{R * T} = \frac{0.2204 \text{ l}\cdot\text{atm/M}}{0.08205 \text{ l}\cdot\text{atm/M}\cdot{}^{\circ}\text{K} * 295^{\circ} \text{ K}}$$

$$K_{aw} = 9.11 \times 10^{-3}.$$

This shows that Chatwin's experimental data compares favorably with research carried out by others at a lower cyanide concentration. Chatwin used about 25 gm/l of cyanide in the stirred reactor tests, which is approximately a 1 M concentration (Chatwin, 1990, Appendix B, Section II, Mole Wt. = 27.03 gm/mole). Consequently, it appears the Kaw and Henry's Law expressions for HCN hold true for concentrations that approach 1 M.

Chatwin's air-water partitioning studies involved soil column experiments with a simple cyanide solution, and not a mixture of cyanide and metal solutes that would be characteristic of a pregnant liquor. Consequently, Chatwin's research is more applicable to the spill of cyanide product or barren solution, and not pregnant liquor. Experimental evidence has shown that when a nonvolatile substance, such as a heavy metal, is dissolved in a liquid, the vapor pressure of the liquid is lowered (Nebergall, et.al., p. 290). If this relationship holds true for a pregnant liquor solution, then the Henry's Law Constant (H) and the K_{aw} would also be lowered due to the presence of the solutes in solution. As a result, less cyanide mass would be partitioned to the air, and more cyanide mass would remain in the water phase, than predicted by Chatwin's research. Consequently, Chatwin's work on air-water partitioning represents a best case scenario. Actual K_{aw} ratios for pregnant liquor would be lower.

As a final comparison, I ran a search of the Soil Transport and Fate (STF) Database, Ver. 2.0 (Sims et.al.) developed by Utah State University to determine if any of the 400 or so RCRA regulated compounds had K_{aw} values in the same range as Chatwin reported for hydrogen cyanide (2.23E-3 to 1.32E-2). This search showed that 24 petroleum related products, solvents, dyes, and pesticides had similar K_{aw} values, as listed in Table 2, below.

Of the 24 compounds listed in Table 2, 12 have been identified as known contaminants of ground water in the United States. Although this generalization says very little about the hydrogeology of each site, i.e., the depth to water table, types of soils, soil partitioning capacity, duration and concentration of the source term, etc; it does indicate that these compounds tend to partition to the water phase, which in turn contributes to the ground water contamination that has been observed across the country. If hydrogen cyanide has a similar range of K_{aw}, it means that it has the potential to become a ground water contaminant. For more information on soil-water partitioning see Section 3, Adsorption on Soils, below.

Table 2: RCRA Contaminants with Similar K_{aw} Values as HCN, as Reported by Chatwin

Contaminant	K_{aw}	Contaminant	K_{aw}
1,1-Dichloroethane[1&2]	5.50E-3	Chrysene	3.89E-3
1,1,1-Trichloroethane[1&2]	4.07E-3 to 4.90E-3	**DDT**[1]	3.63E-3
1,2-Dichloropropane	2.75E-3	Dibromomethane	1.29E-2
1,2-trans-Dichloroethylene[1&2]	4.07E-3	Dichloromethane	3.02E-3
1,2,4-Trichlorobenzene	2.34E-3	Endosulfan	3.63E-3 to 3.72E-3
2-Chloronapthalene	1.29E-2	Fluorene	3.47E-3
Aldrin[1]	1.17E-2	Heptachlor	2.29E-3
Anthracene	2.40E-3	m-Dichlorobenzene	2.95E-3
Benzene[1&2]	4.37E-3	**Napthalene**[2]	1.07E-2
Chlordane[1]	3.98E-3	Phenanthrene	5.01E-3
Chlorobenzene[2]	3.72E-3	**Toluene**[1&2]	5.13E-3 to 6.46E-3
Chloroform[2]	3.02E-3 to 3.39E-3	**Trichloroethene (TCE)**[1&2]	1.17E-2

Footnotes:
1) Organic compounds known to have caused ground water contamination (Fetter, p.407)
2) 20 of the most abundant organic contaminants found in ground water at 183 waste disposal sites in the U.S., (Domenico & Schwartz, p. 582).

Summary on Volatilization - Chatwin's conclusion that volatilization of hydrogen cyanide can remove a significant amount of cyanide mass from the system is an overstatement (Chatwin, 1989, p. iv). After comparison of Chatwin's experimental results for K_{aw} to those of other compounds, it is easy to see that hydrogen cyanide preferentially partitions to the water phase.

2. Chelation & Precipitation - the complexation of free cyanide with naturally occurring metals in the soil can remove cyanide from the system if the metallo-cyanide complex is insoluble and precipitates on the soil matrix. Otherwise, the metallo-cyanide compound or complex is transported thru the soil with the flow of the ground water. Simple cyanide compounds are those which consist of a single metal cation combined with the CN^-

radical; whereas cyanide complexes are those represented by two separate metal cations, generally an alkali-metal and a transition metal, in combination with a number CN^- radicals. Of all the metallo-cyanide complexes, iron-cyanide complexes are the most insoluble, see attached memo of June 7, 1990 (also note solubilities of Ag/Fe and Zn/Fe complexes). Consequently, the behavior of iron cyanide complexes would form a "best case" scenario in a soil column test because all other metallo-cyanide complexes are more soluble, and hence more mobile. As a side note, iron complexes are also important to study since iron is one of the most abundant metals in soils.

Chatwin's soil column tests showed a chromatic dispersion of metallo-cyanide complexes, see Chatwin's Figures 5 and 7 (Chatwin, 1989). These tests conducted on two different natural soils showed that the nickel-cyanide complexes leached out of the column first, later followed by the copper-cyanide complexes, and finally by the iron-cyanide complexes. From these results, the following conclusions can be reached:

1) Iron-cyanide complexes are less mobile than nickel and copper complexes.

2) Free cyanide will first leach those metals which form the most soluble complexes. These complexes are mobilized relatively rapidly, somewhere between the first and second pore volume of leachate effluent. This is no surprise since free cyanide is a known solvent of metals, and any solvent will preferentially select the most soluble solutes. Available data indicates that many of these soluble transition metals would be heavy metals, including: barium, cadmium, and mercury (also silver and chromium, complexed with potassium; see attached June 7, 1990 memorandum). Metals forming less soluble complexes like iron would be solubilized and mobilized later. As a result, the leading edge of any contaminant plume should contain a higher concentration of the most soluble metal complexes, most of which will also be the most toxic, see next paragraph.

Chatwin makes the argument that chelation transfers free cyanide mass to less toxic forms such as iron and other metallo-cyanide complexes (Chatwin, 1989, p. 19). While this is true, three other factors must also be considered:

1) Available Iron - the amount of iron available in a natural soil may be limited depending on local conditions, e.g. a silica sand may contain little iron. Once the available iron is exhausted, this transformation will be limited, and cyanide mass will be transported in its more toxic forms.

2) Stability of Cyanide Complexes - the stability of metallo-cyanide complexes requires a high concentration of the free cyanide ion in the solution (Huiatt, et.al., p. 1-6). In other words, as the concentration of free cyanide ion falls in a solution, metallo-cyanide complex molecules become unstable and breakdown into a alkali metal cation and a metallo-cyanide complex ion, as follows (ibid. p. 1-5):

$$A_yM(CN)_x \longleftrightarrow {}_yA^{+(x)} + (M(CN)_x)^{-yw}$$

where:

A =	Alkali metal
M =	Heavy metal
y =	number of alkali metal atoms
x =	number of CN groups
w =	oxidation state of A

As can be seen in the equation above, when the metallo-cyanide complex dissociates it parts first with the alkali metal, while clinging to the heavy metal and forming a complex ion. This complex ion can then undergo further dissociation by releasing a cyanide ion, CN^-:

$$(M(CN)_x)^{-yw} \longleftrightarrow M(CN)_{(x-1)} + CN^-$$

In most natural waters this cyanide ion occurs as HCN (ibid, pp. 4 & 5). The resulting metallo-cyanide compound can then further dissociate (ibid. p. 5):

$$M(CN)_{x-1} \longleftrightarrow M^{+(x-1)} + {}_{(x-1)}CN^-$$

The rate and degree of dissociation is controlled by pH and the concentration of total cyanide in the solution. At acid pH the degree of dissociation is high as all the cyanide occurs as HCN (ibid. p. 1-3). As the total cyanide concentration (both free cyanide and complexes) falls in a solution, the rate of dissociation also increases. This is consistent with the need for a high cyanide ion concentration in order for complexes to be stable. Rates of dissociation also vary among the various cyanide complexes (ibid. p. 1-6). One would expect that an equilibrium would be established between the complex molecule, complex ion, and HCN. As HCN is removed from the system the above reaction equations would be shifted to the right. However, after consideration of the HCN air/water partitioning coefficient, K_{aw}, it is apparent that a significant amount of HCN will remain in solution in the ground water (see discussion above). As a result, the possibility exists that the dissociation of complex cyanide will be incomplete and consequently, heavy metals will also be transported by the ground water flow system.

Now consider the fate of the metallo-cyanide complex as it travels in a ground water environment. Simple dispersion of the cyanide solution as it travels in the aquifer will decrease the total concentration of the cyanide solution per unit volume, thus driving the above equations to the right. Because the optimum pH range for gold cyanidation is 10.3 (ibid. p. 1-8), most pregnant liquors will have a high pH. As this pregnant liquor is diluted by the dispersion process, the overall pH of the solution will fall, since most ground waters have pH in the pH range of 6 - 8. As a result, many of the metallo-cyanide complexes will dissociate and produce HCN. If dissociation is not complete at the point of ground water uptake, it can be completed upon ingestion as drinking water, where it will encounter an acidic pH environment in the stomach (U.S. Public Health Service, pp.23 and 40).

3) Exposure Pathway, Established Standards, and Analytical Methods - due to our arid conditions and lack of surface water, ground water is the medium that will be impacted first at most Utah cyanide leaching operations. Because ground water may be withdrawn and consumed as drinking water, ground water is the critical human exposure pathway. As a result, drinking water standards are more appropriate for comparison than effluent quality or surface water aquatic standards.

Little is known about the human or animal toxicity of all the various cyanide compounds and complexes. Review of one U.S. government study shows that the majority of the available cyanide toxicology data is founded only on studies for hydrogen cyanide, a few alkali metal-cyanide compounds (KCN, NaCN, CaCN), and only one metallo-cyanide complex (potassium silver cyanide or $K[Ag(CN)_2]$, U.S. Public Health Service, 1988, p. 39-72). EPA's Drinking Water Health Advisory and their proposed drinking water standard is based on toxicology studies of hydrogen cyanide (U.S. EPA, 1987, p.9 and U.S. EPA, 1990, pp. 30379-30380). However, EPA chose the most conservative analytical technique to measure drinking water compliance, Total Cyanide. This is likely an attempt to compensate for the uncertainty surrounding the toxicity of the various cyanide compounds and complexes. A summary of the cyanide compounds that each analytical method can detect is summarized in Table 3, below (Huiatt, et.al., pp. 5-2 & 1-12, and Clesceri, et.al., p. 4-21).

The Total Cyanide method is the most conservative technique, primarily because of its rigorous digestion procedure, where the sample is refluxed in the presence of a strong acid (sulfuric acid) for at least one hour (Clesceri et.al., 1989, p.4-28). As a result, the method is able to detect even the most strongly bound cyanide complexes, including all the WAD and Free Cyanide parameters. However, some tightly bound complexes are only partially recovered by the method, these include: cobalt, gold, platinum, and palladium (ibid., p.4-23).

Some discussion is presented in the literature on the lack of toxicity of iron-cyanide complexes. Huiatt et.al. (p. 3-19) report that the U.S. Food and Drug Administration has established a concentration level for sodium ferrocyanide in table salt (13 mg), where it is used as an anticaking agent. The World Health Organization has also recommended daily intake limits for sodium, calcium, and potassium ferrocyanide (ibid., 0.025 mg/kg of body weight). No information on human toxicity was found for ferricyanide compounds. However, the ferricyanide complex ion is known to combine with many other cations, some of which are highly soluble, including: calcium, potassium, sodium, and ammonium. The ferricyanide complex ion also combines with three heavy metals: copper, lead, and silver (see attached memo of June 7, 1990).

Table 3: Reported Detectable Parameters for Cyanide Analytical Methods

Analytical Method	Examples of Detectable Parameters	Method Recovery	Notes
Total Cyanide			
Strong Complexes	Iron Complexes (e.g. $Fe(CN)_6^{-4}$)	Majority[1]	Mobile in ground water[2].
	Co, Au, Pt, Pd (e.g. $Co(CN)_6^{-4}$, $Au(CN)_2^-$)	Partial[3]	
All WAD CN Parameters	See below		
Weak Acid Dissociable (WAD)			
Moderately Strong Complexes	$Cu(CN)_2^-$, $Cu(CN)_3^{-2}$, $Ni(CN)_4^{-2}$, $Ag(CN)_2^-$	Cu complexes: 70%[1] Ni complexes: ≈100%	Both mobile in ground water[2].
Weak Complexes	$Cd(CN)_3^-$, $Cd(CN)_4^{-2}$, $Zn(CN)_4^{-2}$	Cd complexes: 30%[1] Zn complexes: ≈100%	Solubility increases with decreased bonding strength.
All Free CN Parameters	See below		
Free Cyanide			
Simple CN Compounds	NaCN, KCN, $Ca(CN)_2$, $Hg(CN)_2$	No data available	Highly soluble, occur as metal & CN ions in solution
	Zn(CN)2, CuCN, Ni(CN)2, AgCN	No data available	Less soluble
Other	CN^- ion & HCN	No data available	Extremely soluble

Footnotes:
1) Struhsacker and Smith, 1988, p.3
2) Chatwin, 1989, Figs. 5 & 7.
3) Clesceri, et.al., 1989, p. 4-23.

However, both ferri- and ferro-cyanide complexes have been known to dissociate, and produce toxic forms of cyanide. Huiatt, et.al. (p.1-6) reports that two complex ions, $(Fe(CN)_6)^{-4}$ and $(Fe(CN)_6)^{-3}$ at acid pH produced a high percentage of free cyanide. Iron cyanide complexes are also photosensitive, meaning that with exposure to ultraviolet light they dissociate to more toxic forms (ibid., p. 3-18). Toxicology studies on freshwater fish have shown that in dark environments, acutely toxic levels of HCN (about 5.2 ug.l) are attained with concentrated solutions of iron-cyanides that have been aged for a long time (Clesceri et.al., 1989, p.4-21; and Duodoroff, 1976; and Burdick and Lipschuetz, 1948). What this suggests is that in a dark subsurface environment where long periods of time are available, iron-cyanide complexes can dissociate and produce small amounts of HCN, during the ground water transport process. Upon withdrawal of any contaminated ground water, the iron-cyanides can further dissociate upon contact with sunlight. Finally, upon ingestion as drinking water, iron-cyanide complexes encounter an acidic environment in the stomach, where they can dissociate even further, and thus produce more toxic HCN. As a result, though iron-cyanide complexes are less toxic in a surface water environment, they are potentially toxic upon ingestion as drinking water.

Table 3 also shows that the WAD Cyanide method is only able to achieve a recovery of 30% and 70% of cadmium and copper cyanide complexes, respectively. Both of these complexes have a much higher potential to dissociate and produce toxic HCN and CN^- than the iron cyanide complexes. Furthermore, during search of the available literature, no reports were found regarding the ability of the analytical methods to detect barium and lead cyanide complexes, both of which are regulated heavy metal contaminants under the Ground Water Quality Protection Regulations. Barium cyanide [$Ba(CN)_2$] and barium ferrocyanide are soluble in water, 80,000 and 1,700 mg/l, respectively. Lead cyanide compounds are also reported to be slightly soluble in cold water (attached June 7, 1990 memo). All four of these heavy metals have the potential to be found associated with ores and subject to cyanide leaching. However, since the Total Cyanide method includes an aggressive digestion technique and can detect iron complexes, it is expected that the total method would be able to detect the majority of these parameters.

Arguments have been presented by several parties that the Total Cyanide method is less reliable due to interference, primarily by thiocyanate and reduced sulfur (Huiatt, et.al., p. 5-3). However, interference by thiocyanate and reduced sulfur results in a low analysis of cyanide concentration (ibid., pp. 5-18 and 19). Consequently, an analytical result may be lower than the actual concentration in the solution (negative interference). This should be a concern for the regulator, however, it may be offset by the fact that the method also partially measures cyanide complexes of cobalt and several noble metals, including gold, platinum, and palladium. Because these complexes are so strongly bound that the Total Cyanide technique only partially detects them, they are expected to be less toxic than other more weakly bound complexes and compounds.

In light of all the considerations above, it is no surprise that EPA has taken a conservative approach by adopting a Total Cyanide standard. Considering that iron-cyanide complexes have the potential to dissociate in a ground water environment and that the reported interferences do not appear to significantly impede regulatory needs, it is recommended that the Total Cyanide method be used to measure cyanide neutralization compliance. If at some future date additional toxicology information is developed for iron-cyanide complexes or additional data is provided on analytical interference concerns or long term transport and fate of cyanide complexes, then this position may be reconsidered.

Summary on Chelation and Precipitation - Chatwin's argument that chelation is a valid mechanism for the transformation of free cyanide to less toxic forms is not conclusive; primarily due to: 1) the process is reversible for most of the moderately strong and weakly bound complexes, which include complexes with most of the heavy metals, and 2) strong complexes such as the iron-cyanides are mobile in a ground water environment and can later dissociate during transport or ingestion as drinking water. Only cobalt and the noble metal complexes appear to be stable in a ground water/drinking water exposure pathway. Furthermore, this chelation provides a vehicle for the leaching and transport of naturally occurring heavy metals in soils.

All of Chatwin's work was based on experiments with free cyanide, a solvent with a high capacity to dissolve metals. Consequently, this work is most comparable to spills or releases of cyanide product or barren solutions. A pregnant liquor on the other hand should have a different behavior as it passes thru a natural soil, in that it already carries an abundance of metals in solution. Chatwin's argument for retardation due to chelation by transition metals in the soil may not be valid for a pregnant liquor if the solution is near saturation with these metals before it enters the soil. In that case, the pregnant solution may pass thru the soil without any or very little reaction or transformation to less toxic species. Substitution of one metal for another could occur during transport through the soil, however, this substitution would likely be for another metal with a higher solubility. Considering that the mining operation has already concentrated the ores with the highest grades for leaching, it is unlikely that native undisturbed soils and rock would contain metals in any higher concentration than the ore for the purpose of chelation. Consequently, chelation is not likely a significant factor for the transformation of cyanide to less toxic species in the case of pregnant solutions.

3. Adsorption on Soils - adsorption of free cyanide onto soil particles is due to two processes: 1) adsorption onto organic carbon, and 2) adsorption onto clay and feldspar minerals. Regardless of the individual mechanism, the affinity of a soil to partition a contaminant is measured by a general parameter called the soil-water partitioning coefficient, or K_d. This coefficient is a ratio of the concentration of the contaminant partitioned on the soil (C_s)over the final concentration of the contaminant in the leachate (C_w), where $K_d = C_s/C_w$. Results are usually expressed in mg/kg per mg/ml or l/kg, which is equivalent to ml/gm. Most experiments run to determine K_d are bench scale stirred reactor or soil column tests, though field scale tests are done on occasion. Stirred reactor tests are run long enough to accomplish chemical equilibrium, usually 24 to 48 hours.

Since chemical reactions are sensitive to temperature, this testing must be run at a uniform temperature.

Chatwin conducted stirred reactor tests for total cyanide on 22 separate soil samples from various mines in the western U.S. (see Chatwin, 1989, Table 4, p. 29). An initial solution concentration of 21.5 to 28.5 mg/l was applied to 100 gm of soil material, and stirred at a constant temperature for 24 hours (see Chatwin, 1990, Appendix B, Section II). Chatwin's K_d results for total cyanide range from a low of 0.0000 ml/gm to a high of 0.57416 ml/gm, with an average of 0.0979 ml/gm, see Figure 1, attached. *Comparison of these values with other contaminants from the literature, show that total cyanide is highly mobile in a ground water environment, see Figure 2, attached* (Association of Ground Water Scientists and Engineers, Chapter 9, p.71). As can be seen on Figure 2, Chatwin's research indicates that *total cyanide is as mobile as the most mobile organic chemicals, arsenic, and hexavalent chromium.* As a result, total cyanide undergoes very little attenuation or retardation by natural soils relative to many other common contaminants.

Review of the raw data in Appendix B of Chatwin's report (Chatwin, 1990, Section II) allowed identification of the source of several of the soil samples included in Table 4 of the Final Report (Chatwin, 1989, p. 29). From this information, it was determined that sample B2 from Chatwin's Table 4 was a soil sample from Barrick Mercur's Dump Leach No. 2. Close review of Appendix B (Chatwin, 1990, Section II) showed that the K_d testing had included analysis of Free Cyanide. In addition, replicate testing had been done on many soil samples at different temperatures, different water to soil mixture ratios, and higher initial concentrations of cyanide. Barrick's soil samples had been tested at two different initial cyanide concentrations (C_{wi}), which allowed independent calculation of the K_d coefficients, summarized in attached Figure 3. As can be seen in the figure, when the testing was run with an initial cyanide concentration of 25.6 mg/l, both the total and free cyanide K_d values were approximately equal at about 0.07 ml/gm. When the initial cyanide concentration was increased by about an order of magnitude to 262.5 mg/l and the test run again, the Kd fell to about 50% and 70% of the original value for total cyanide and free cyanide, respectively (the 50% value, however, may not be accurate since the CN mass balance is poor, see Figure 3). If this relationship holds true for the remainder of the samples, then it can be expected that for actual barren solutions, which commonly range upwards of 200 mg/l or more cyanide, will have even lower K_d values, and hence be even more mobile in ground water. From Figure 2 it can be seen that if cyanide's K_d values were to fall close to 1.0×10^{-2} ml/gm, they would approximate those for chloride and nitrate, contaminants which are known to flow freely in ground water unimpeded by retardation reactions.

Little information is provided in the report on K_d for bedrock materials. However, Chatwin does summarize a field study from the Annie Creek Mine in South Dakota where K_d coefficients were calculated for total and free cyanide for a number of different geological materials at a proposed spent cyanide ore disposal site (Chatwin, 1990, Appendix F, Table 2). According to testing done by a Colorado consultant, the Kd for limestone materials was about two-orders of magnitude lower than those for clay, for both total and free cyanide. This is not unexpected, considering the lower clay and feldspar mineral and organic carbon content that limestones can have. Another factor may be the type of porosity a limestone could exhibit. If a limestone had very little primary porosity, then the secondary or fracture porosity in the media will produce a lower surface contact area to water volume ratio than granular porosity. Regardless the specific mechanism, limestone typically has less ion sites available for retardation reactions with the cyanide than clay or clay bearing soils.

After consideration of these factors and the fact that soils at most western mining sites are usually thin and have a low organic carbon content; it would appear that Chatwin's lab derived values for K_d may represent values closer to the "best case" scenario. Field case K_d values will probably be lower, especially in fractured bedrock media; perhaps by one to two orders of magnitude lower.

For a final comparison, I ran a search of Soil Transport and Fate (STF) Database (Sims, et. al.) to determine how many of the RCRA regulated compounds had a K_d value within the range reported by Chatwin for total cyanide ($K_d \leq 5.74E\text{-}1$) in a barren solution. This search located 44 separate RCRA regulated organic compounds that have been found to be just as mobile as total cyanide, see Table 4, below.

Table 4 shows that at least 16 of the 44 contaminants are known to have caused ground water contamination in the United States. The table also shows that 14 of the 44 contaminants are currently regulated under the EPA Drinking Water Protection Regulations and our Ground Water Quality Protection Program, or are proposed to have Ground Water Quality Standards set for them in the near future.

<u>Summary on Soil Adsorption</u> - Chatwin's average distribution coefficient for low concentrations of total cyanide in soils shows it to be rather mobile in a ground water environment, in comparison with the K_d for other contaminants. Tests done with cyanide solutions more representative of a barren solution further increased the mobility of total cyanide. Based on reports in the literature, total cyanide is expected to be more mobile in bedrock environments, perhaps by as much as two orders of magnitude. This could cause total cyanide to be as mobile as chloride and nitrate, both of which are the most mobile of all ground water contaminants. Comparison of total cyanide K_d with the distribution coefficient of other contaminants shows it to be as mobile as 44 RCRA regulated contaminants, many of which are known to have contaminated ground water in the United States.

Table 4: RCRA Contaminants with Equivalent K_d as Total Cyanide (based on Chatwin, 1989)

Contaminants	K_d	Contaminants	K_d
1-Methylnapthalene	4.37E-1 to 5.13E-1	Chloromethyl methyl ether	1.78E-2 to 3.39E-1
1,1-Dichloroethylene[1,3]	1.45E-1 to 2.69E-1	Dichlorodifluoro-methane	2.00E-1 to 5.75E-1
1,1,1-Trichloroethane[1,2,3]	1.2E-1 to 3.72E-1	Dimethoate	5.01E-1
1,1,2-Trichloro-1,2,2-trifluoroethane	9.77E-2 to 1.86E-1	Dimethyl phthalate	3.98E-1
1,1,2,2-Tetrachloro-ethane (PCA)[1]	3.47E-1 to 4.37E-1	Ethylene dibromide[3]	3.02E-1
1,1,2-Trichloroethane[1]	8.91E-2 to 5.25E-1	Formaldehyde	1.10E-1
1,2-Dibromo-3-chloropropane (DBCP)[1&3]	5.37E-1	Furan	1.91E-1 to 4.68E-1
1,2,3-Trichloropropane	5.13E-1	Hydroxydimethyl-arsine oxide	2.00E-1 to 3.72E-1
2-sec-Butyl-4,6-dinitrophenol	4.27E-1	**Lindane**[1&3]	3.63E-1
2,4-D[3]	2.57E-1 to 2.88E-1	Methyl ethyl ketone (MEK)	2.19E-1 to 4.37E-1
2,4-Dinitrophenol	1.15E-1	Methyl parathion	2.00E-1
2,4,5-T	3.72E-1 to 5.50E-1	**Naphthalene**[2]	2.69E-1 to 5.75E-1
Acetophenone	5.01E-2 to 5.25E-1	Nitrobenzene	6.17E-2 to 2.00E-1
Acrylonitrile	7.08E-2 to 2.19E-1	o-Dichlorobenzene[3]	1.00E-1 to 3.63E-1
Aldicarb[3]	1.12E-2 to 4.90E-1	Phenol[1&2]	1.10E-1 to 5.25E-1
Aldrin[1]	1.50E-2 to 2.88E-2	Phorate	4.37E-2
Aniline	2.00E-2 to 4.68E-1	Pyridine	2.29E-1
Benzene[1,2,3]	7.59E-2 to 4.17E-1	Tetrachloroethene (PCE)[2&3]	2.00E-1 to 5.62E-1

Table 4 - Continued: RCRA Contaminants with Equivalent K_d as Total Cyanide

Contaminants	K_d	Contaminants	K_d
Bis(chloromethyl) ether	3.31E-1	Tetrahydrofuran[1]	1.20E-1 to 3.47E-1
Carbon Tetrachloride[3]	3.24E-1 to 5.37E-1	**Toluene**[1,2,3]	1.10E-1
Chlorobenzene[2&3]	3.02E-1	**Trichloroethene (TCE)**[1,2,3]	1.41E-1
Chloroform[2]	1.91E-1 to 5.62E-1	Trichloromono-fluoroethane	3.98E-1

Footnotes:
1) Organic compounds known to have caused ground water contamination, (Fetter, p. 407).
2) 20 of the most abundant organic contaminants found in ground water at 183 waste disposal sites in the U.S. (Domenico & Schwartz, p. 582).
3) Contaminants with current EPA Drinking Water Standards and existing or proposed Ground Water Quality Standards (Utah Division of Water Quality).

4. <u>Oxidation and Biodegradation</u> - Chatwin describes oxidation of cyanide to cyanate on inorganic mineral surfaces as a minor degradation mechanism (Chatwin, 1989, p. 31). Because the water table is isolated from the atmosphere it is unlikely that oxygen could be supplied at a high enough rate to effectively oxidize a cyanide contaminant plume to cyanate. As a result, the small amount of oxygen that may occur in ground water at and below the water table would be quickly exhausted.

   Chatwin also describes biodegradation as a minor removal mechanism for cyanide from spills of barren solutions, due to the long periods of time needed for native soil bacteria to acclimate to cyanide as a metabolic substrate (Chatwin, 1989, pp. 37 & 41). However, where a soil's microbiota have acclimated to barren cyanide, such as at an established land treatment facility, it may be a viable treatment method.

General Conclusions on Chatwin Research

The air-water partitioning ratio (K_{aw}) for hydrogen cyanide indicates that a large fraction of hydrogen cyanide will remain in ground water, due to its high solubility. In fact, hydrogen cyanide is about 10 times more likely to remain in solution than ammonia. Pregnant liquors will tend to partition even more so to the water phase due to the presence of insoluble metals in solution, which depress the vapor pressure and the K_{aw} of the solution. Transformation of free cyanide to less toxic cyanide complexes during transport through soils is applicable to barren cyanide solution spills only, and not to releases of pregnant liquors. With the exception of cobalt, gold, platinum, and palladium complexes, many metallo-cyanide complexes can dissociate in a ground water environment and thereby release hydrogen cyanide which in turn will prefer to remain in the ground water. When cyanide complexes do not completely dissociate, they facilitate the transport of heavy metals in the ground water and can later dissociate upon ingestion as drinking water. Iron-cyanides dissociate in ultraviolet light, and have been shown to dissociate slowly in dark conditions and to a high degree in acid conditions. Because the stomach represents an acid environment and could cause dissociation to occur, it appears EPA chose to measure cyanide in drinking water with the conservative Total Cyanide method. Chatwin's experimental results for soil-water partitioning coefficients show that total cyanide is highly mobile in a ground water environment, on the same order as 44 of the most mobile organic compounds, and arsenic, and hexavalent chromium. Higher mobility is expected for bedrock environments and pregnant liquors, where total cyanide could be as mobile as the most mobile of all ground water contaminants, chloride and nitrate.

Approach of Other States to Cyanide Neutralization

The staff reviewed a recent survey funded by the U.S. EPA and the Western Governor's Association in an effort to determine how cyanide leaching operations were regulated (Weatherup and McDade, 1991). The survey included seven states, Alaska, Colorado, Montana, Nevada, South Carolina, South Dakota, and Utah, and covered a wide variety of topics related to permitting cyanide leaching operations. Table 5 below shows a short summary of how each state dealt with cyanide neutralization (ibid. pp. 37-39) at 20 dedicated heap leach and valley leach operations surveyed.

As seen in Table 5, the majority of the projects (16 of 20) have a very low rinsate concentration standard for cyanide, on the order of 0.5 mg/l or less. This is justified after consideration of the high mobility of cyanide in the ground water environment. The lower the limit, the less the potential for cyanide release to the environment after closure.

The analytical method required varies from Total Cyanide to Free Cyanide, with the half of the projects (10 of 20) imposed with a WAD Cyanide standard. However, total cyanide would form the most conservative of the analytical methods, because it can detect the majority of the cyanide complexes. This method is justified after consideration of the potential for dissociation of many metal complexes, the mobility of cyanide in a ground water environment, and the use of ground water as drinking water near many mining operations (see Table 3 and related discussion, above).

Five of the twenty projects have also been imposed with a metals concentration standard. This is important due to the ability of cyanide to mobilize heavy metals, as discussed above. The table also suggests that the Free Cyanide standard of 5.0 mg/l imposed on Barrick Dump 2 in the Construction Permit is lenient in comparison with other states.

Based on their experience of monitoring spent ore dumps, the South Dakota Department of Environment and Natural Resources (DENR) indicates that when spent ores are neutralized (on-off pads) to at or below 0.5 mg/l WAD CN, that most of the parameters of concern, including many heavy metals, meet the EPA Drinking Water MCLs with a few exceptions. These exceptions include: TDS, sulfate, nitrate, nitrite, arsenic, and pH (Durkin, 1990, p. 6). South Dakota then requires owner/operators of spent ore piles to either:

1) Collect and treat the leachates to meet surface or ground water quality standards, whichever is applicable, before discharge to waters of the state, or

2) Conduct pathway and fate analysis to determine at what location the standards can be met, and then establish the point of compliance at said location. The point of compliance then forms a perimeter of operational pollution.

In addition to cyanide destruction, South Dakota DENR required Wharf Resources near Lead, South Dakota to install an ion exchange treatment system to remove nitrate and nitrite from leachates generated by their spent ore pile before discharge to ground or surface water (telecommunication, T.V. Durkin, May 12, 1992).

Table 5: EPA/WGA Seven State Survey of Dedicated Heap Leach and Valley Leach Operations

Rinsate Neutralization Criteria	Concentration (mg/l)	No. of Mines	States (mine)
Drinking Water Standards	Total CN = 0.2	1	Alaska (Citigold)[3]
	WAD CN = 0.2	5	Nevada (Ivanhoe, Marigold, Rain, Surprise Heap, Wood Gulch)
State Surface Water Standards (NPDES)	Total CN = 0.0052 Metals = NPDES Stds[1].	2	South Carolina (Brewer Gold, Haile)
Site Specific Detoxification Standard	Total CN = 0.5	1	Colorado (Alta Tailings)
	WAD CN = 0.22	1	Montana (Basin Creek)
	WAD CN < 0.5, Metals & Nutrients = EPA DW Stds[2]	1	South Dakota (Richmond Hill)
	WAD CN < 0.2 & Total CN < 0.75	3	Utah (Gold Strike, Jumbo, North Lily)
	Free CN = 0.2	1	Colorado (Druid)
	Free CN = 0.2, Metals = Background	1	Colorado (Summitville)
	Free CN = 1.0, Metals = Background	1	Colorado (Cameron/Newport)
	Free CN = 5.0	1	Utah (Barrick Dump 2)
	To be determined	1	Utah (Barney's Canyon)
Monitor Ground Water	?	1	Colorado (Crystal Hill)
	TOTAL	20	

Footnotes:

1) Birgit McDade, South Carolina Department of Health and Environmental Control, Telecommunication, May 13, 1992. The one and only operator to attempt neutralization has not been able to meet this stringent NPDES standard, but has been able to meet a concentration of 0.2 Free Cyanide.

2) Tom Durkin, South Dakota Department of Environment and Natural Resources, Telecommunication, May 12, 1992, State GW Quality Standards = EPA DW Standards.

3) Telephone contact with Alaska personnel indicates that neutralization criteria is 1.0 mg/l WAD cyanide (rinsate), and 5.2 ug/l Free cyanide at the ground water or surface water point of compliance (John Kennington).

Recommendations for Neutralization Policy

Based on all the above considerations, the staff recommends the Division adopt the following policy requirements regarding cyanide neutralization at heap and valley leach operations that will primarily impact ground water quality:

1. Neutralization of heap and valley leach facilities meet all of the following rinsate quality criteria before closure and abandonment of a facility:

Table 6: Recommended Rinsate Quality Standards
Cyanide Heap and Valley Leach Facilities

Rinsate Parameter	Concentration (mg/l)
Total Cyanide	0.2
Ground Water Quality Standards	
pH	6.5 - 8.5 units
Fluoride	2.4
Nitrate + Nitrite	10.0
Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium	0.05
Copper	1.0
Lead	0.05
Mercury	0.002
Selenium	0.01
Silver	0.05
Zinc	5.0

Rest periods during rinsing must be required in order to manage concentration rebound. Statistical analysis of monitoring results must be conducted to ensure adequate neutralization of the heap or dump leach. Neutralization to these concentrations would allow an operator to close-out the facility as if it were mine waste rock, without the need for long-term monitoring and maintenance that a continuing ground water discharge permit would require.

2. Where an operator cannot achieve these limits for any reason, he/she may propose any of three alternatives available, provided a complete technical justification is submitted and approved by the Executive Secretary. This may include one or more of the following options:

   A. Propose an alternate total cyanide neutralization limit after a thorough pathway and fate analysis, with the reestablishment of the point of compliance at another location. Pursuant to UAC R317-6-6.9B, this new location cannot be beyond the mines property boundary without permission of adjacent landowners and cannot be within the area of influence of any public water supply (wellhead or spring protection area). The pathway and fate analysis would include at least one-dimensional ground water flow and contaminant transport modeling, based on conservative assumptions [Upon adoption of the Ground Water Cleanup Rules, additional procedures for Alternative Concentration Limits may be available], or

   B. Propose substitution of another analytical method for compliance purposes, after adequate evaluation for why said method is more representative and protective of human health and the environment. Such a study would need to fully evaluate the toxicity of iron and other metallo-cyanide complexes, and the ability of the method to measure all cyanide compounds or complexes that could be potentially harmful to human health or the environment, or

   C. Closure of the heap or dump leach with a multi-layer impermeable cap that will provide isolation from the environment and prevent infiltration of water and any resulting seepage. Such a cover system would include a vegetated upper surface, one or more drainage layers underlain by one or more impermeable liners. This approach would also require long-term post-closure maintenance of the facility.

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Attachments

LBM:lm

cc: Dave Wham, DWQ
John Kennington, DWQ
John Whitehead, DWQ

O:CN-NEUT.MEM
FILE:GW-BARRICK

DEPARTMENT OF HEALTH
DIVISION OF ENVIRONMENTAL HEALTH

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MEMORANDUM

TO: Ground Water Staff

THROUGH: Larry Mize, Manager LM
Ground Water Protection Section

FROM: Loren Morton, Env. Health Scientist Loren
Ground Water Protection Section

DATE: June 7, 1990

SUBJECT: Solubility of Cyanide Salts and Complexes

After some recent research, I put together the attached table summarizing the solubility of various cyanide compounds. Some observations and conclusions can be reached from this data.

Observations

1. Cyanide salts appear to have a higher solubility, comparably, than cyanide complexes for the same given element.

2. Of the salts and complexes with quantified solubilities, most are much greater (several orders of magnitude) than the 0.2 mg/l EPA health advisory for total cyanide.

3. Compounds rated as insoluble by the CRC Handbook, were found in two cases to have solubilities in excess of the EPA health advisory for cyanide, see values for zinc ferrocyanide and iron ferrocyanide (III).

4. Potassium cyanide can complex with many other metals to form highly soluble compounds.

Conclusions

The implications of this data are:

1. Cyanide can combine with many metals or cations and form compounds which are highly soluble. This is the reason why cyanide is used in leaching operations.

2. The solubilities of most of these cyanide compounds are several orders of magnitude

above applicable limits for ground water discharge permits; even some compounds rated as insoluble could exceed these health based limits. Therefore, cyanide leachates have the potential to contaminate ground water and adversely impact human health and the environment.

3. Due to the high solubility of these compounds they have the potential to be transported readily through ground water flow systems.

4. Further research is necessary to establish the solubility of these compounds in varying environments of pH and temperature. Rates of reaction for the formation and dissociation of cyanide salts and complexes may also be important to understanding the persistence and mobility of these compounds and their implications on dump and heap neutralization.

LM:kc
Q:Cyansalt.MEM

Solubilities of Cyanide Salts & Complexes*

Cyanide Salt/Complex		Root Name	Solubility (cold water)			
			gm/100cc	gm/l	mg/l	Temp.(°C)
HEAVY METALS						
As-	none	--	-	-	-	-
Ba-	$Ba(CN)_2$	cyanide	80	800	80,000	14°
	$Ba_2Fe(CN)_6 \cdot 6H_2O$	ferrocyanide	0.17	1.7	1,700	15°
	$BaPt(CN)_4 \cdot 4H_2O$	cyanoplatinate	3	30	30,000	16°
Cd-	$Cd(CN)_2$	cyanide	1.7	17	17,000	15°
	$Cd(CN)_2 \cdot 2KCN$	potassium cyanide	33.3	333	333,000	?
	$Cd_2Fe(CN)_6 \cdot xH_2O$	ferrocyanide	i	-	-	-
Cr-	none					
Cu-	CuCN	cyanide (I)	i	-	-	-
	$Cu(CN)_2$	cyanide (II)	i	-	-	-
	$Cu_3Fe(CN)_6$	ferricyanide (I)	i	-	-	-
	$Cu_3[Fe(CN)_6]_2 \cdot 14H_2O$	ferricyanide (II)	i	-	-	-
	$Cu_2Fe(CN)_6 \cdot xH_2O$	ferrocyanide	i	-	-	-
Pb-	$Pb(CN)_2$	cyanide	sls	-	-	-
	$Pb_3[Fe(CN)_6]_2 \cdot 5$ or $6H_2O$	ferricyanide	sls	-	-	-
	$Pb_2Fe(CN)_6 \cdot 3H_2O$	ferrocyanide	i	-	-	-
Hg-	$Hg(CN)_2$	cyanide	9.3	93	93,000	14°
Se-	none		-	-	-	-
Ag-	AgCN	cyanide	$2.3x10^{-5}$	$2.3x10^{-4}$	0.23	20°
	$Ag_3Fe(CN)_6$	ferricyanide	$6.6x10^{-5}$	$6.6x10^{-4}$	0.66	20°
	$Ag_4Fe(CN)_6 \cdot H_2O$	ferrocyanide	i	-	-	-
Zn-	$Zn(CN)_2$	cyanide	$5x10^{-4}$	$5x10^{-3}$	5	20°
	$Zn_2Fe(CN)_6$	ferrocyanide	i	$2.6x10^{-3}$**	2.6**	?
	$Zn_2Fe(CN)_6 \cdot 3H_2O$	ferrocyanide trihydrate	i	$2.2x10^{-5}$**	$2.2x10^{-2}$**	?

Cyanide Salt/Complex		Root Name	Solubility (cold water)			Temp.(°C)
			gm/100cc	gm/l	mg/l	
OTHER METALS						
Al-	$Al_4[Fe(CN)_6]_3 \cdot 17H_2O$	ferrocyanide	sls	-	-	-
Au-	AuCN	cyanide	vsls	-	-	-
	$Au(CN)_3 \cdot 3H_2O$	cyanoauric acid (III)	vs	-	-	-
Ca-	$CaPt(CN)_4 \cdot 5H_2O$	cyanoplatinate	s	-	-	-
	$Ca_3[Fe(CN)_6]_2 \cdot 12H_2O$	ferricyanide	vs	-	-	-
	$Ca_2Fe(CN)_6 \cdot 11$ or $12H_2O$	ferrocyanide	86.8	868	868,000	25°
Co-	$Co(CN)_2 \cdot 2H_2O$	cyanide dihydrate	4.1×10^{-3}	4.1×10^{-2}	41.8	18°
	$Co(CN)_2 \cdot 3H_2O$	cyanide trihydrate	i	-	-	-
Fe-	$Fe_3[Fe(CN)_6]_2$	ferricyanide (II)	i	-	-	-
	$Fe[Fe(CN)_6]$	ferricyanide (III)	?	-	-	-
	$Fe_2[Fe(CN)_6]$	ferrocyanide (II)	i	-	-	-
	$Fe_4[Fe(CN)_6]_3$	ferrocyanide (III)	i	2.5×10^{-4}**	0.25**	?
Mg-	$Mg(CN)_2$	cyanide	s	-	-	-
	$Mg_2Fe(CN)_6 \cdot 12H_2O$	ferrocyanide	33	330	330,000	?
	$MgPt(CN)_4 \cdot 7H_2O$	cyanoplatinate	vs	-	-	-
Mn-	$Mn_2Fe(CN)_6 \cdot 7H_2O$	ferrocyanide	i	-	-	-
Ni-	$Ni(CN)_2$	cyanide	i	-	-	-
	$Ni(CN)_2 \cdot 4H_2O$	tetrahydrate	i	-	-	-
	$Ni_2Fe(CN)_6 \cdot xH_2O$	ferrocyanide	i	-	-	-
K-	KCN	cyanide	50	500	500,000	?
	$K[Ag(CN)_2]$	cyanoargentate	25	250	250,000	20°
	$K[Au(CN)_2]$	cyanoaurate	14.3	143	143,000	?
	$K[Au(CN)_4 \cdot 1\frac{1}{2}H_2O$	cyanoaurate (III)	s	-	-	-
	$K_2[Cd(CN)_4]$	cyanocadmate	33	330	330,000	?
	$K_3[Cr(CN)_6]$	cyanochromate (III)	30.9	309	309,000	20°
	$K_4[Co(CN)_6]$	cyanocobaltate (II)	s	-	-	-
	$K_3[Co(CN)_6]$	cyanocobaltate (III)	s	-	-	-
	$K_3[Cu(CN)_4]$	cyanocuprate (I)	vs	-	-	-

Cyanide Salt/Complex		Root Name	Solubility (cold water) gm/100cc	gm/l	mg/l	Temp.(°C)
K-	(cont'd)					
	$K_4[Mn(CN)_6]\cdot 3H_2O$	cyanomanganate (II)	s	-	-	-
	$K_3[Mn(CN)_6]$	cyanomanganate (III)	s	-	-	-
	$K_2[Hg(CN)_4]$	cyanomercurate	s	-	-	-
	$K_4[Mo(CN)_8]\cdot 2H_2O$	cyanomolybdate	vs	-	-	-
	$K_2[Ni(CN)_4]\cdot H_2O$	cyanonickelate (II)	s	-	-	-
	$K_4[W(CN)_8]\cdot 2H_2O$	cyanotungstate (IV)	130	1,300	1,300,000	18°
	$K_3Fe(CN)_6$	ferricyanide	33	330	330,000	4°
	$K_4Fe(CN)_6\cdot 3H_2O$	ferrocyanide	27.8	278	278,000	12°
Na-	NaCN	cyanide	48	480	480,000	10
	$NaAu(CN)_2$	cyanoaurite	s	-	-	-
	$NaCu(CN)_2$	cyanocuprate (I)	s	-	-	-
	$Na_2[Pt(CN)_4]\cdot 3H_2O$	cyanoplatinate	s	-	-	-
	$Na_3Fe(CN)_6\cdot H_2O$	ferricyanide	18.9	189	189,000	0°
	$Na_4Fe(CN)_6\cdot 10H_2O$	ferrocyanide	31.85	318.5	318,500	20°
Sr-	$Sr(CN)_2\cdot 4H_2O$	cyanide	vs	-	-	-
	$Sr[Pt(CN)_4]\cdot 5H_2O$	cyanoplatinate	?	-	-	-
Tl-	TlCN	cyanide	16.8	168	168,000	28.5°
	$TlFe(CN)_6\cdot 2H_2O$	ferrocyanide	0.37	3.7	3,700	18°

OTHER

	Free Cyanide $(CN)_2$	cyanogen	450	4,500	4,500,000	20°
NH_4-	NH_4CN	cyanide	vs	-	-	-
	$NH_4Au(CN)_4\cdot H_2O$	cyanaurate	vs	-	-	-
	$NH_4Au(CN)_2$	cyanaurite	vs	-	-	-
	$(NH_4)_2Pt(CN)_4\cdot H_2O$	cyanoplatinite	s	-	-	-
	$(NH_4)_3Fe(CN)_6$	ferricyanide	vs	-	-	-
	$(NH_4)_4Fe(CN)_6\cdot 3H_2O$	ferrocyanide	s	-	-	-

*Source: CRC Handbook of Chemistry & Physics, 64th ed. 1983-84
** Data from: Cyanide from Mineral Processing, Utah Mining and Mineral Resources Research Institute, February, 1983, p.4-10.

Footnotes:

s = soluble i = insoluble sls = slightly soluble vs = very soluble vsls = very slightly soluble

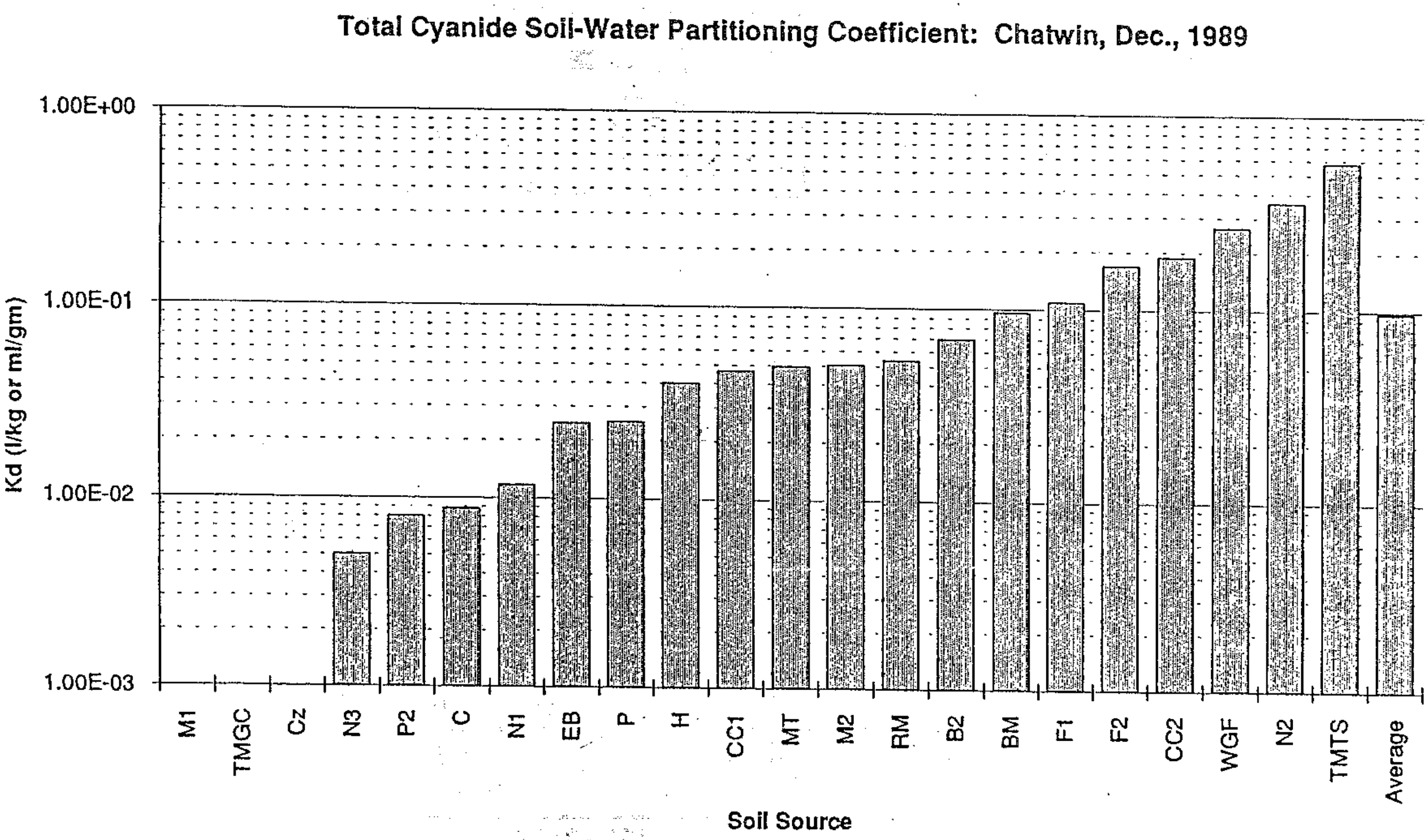
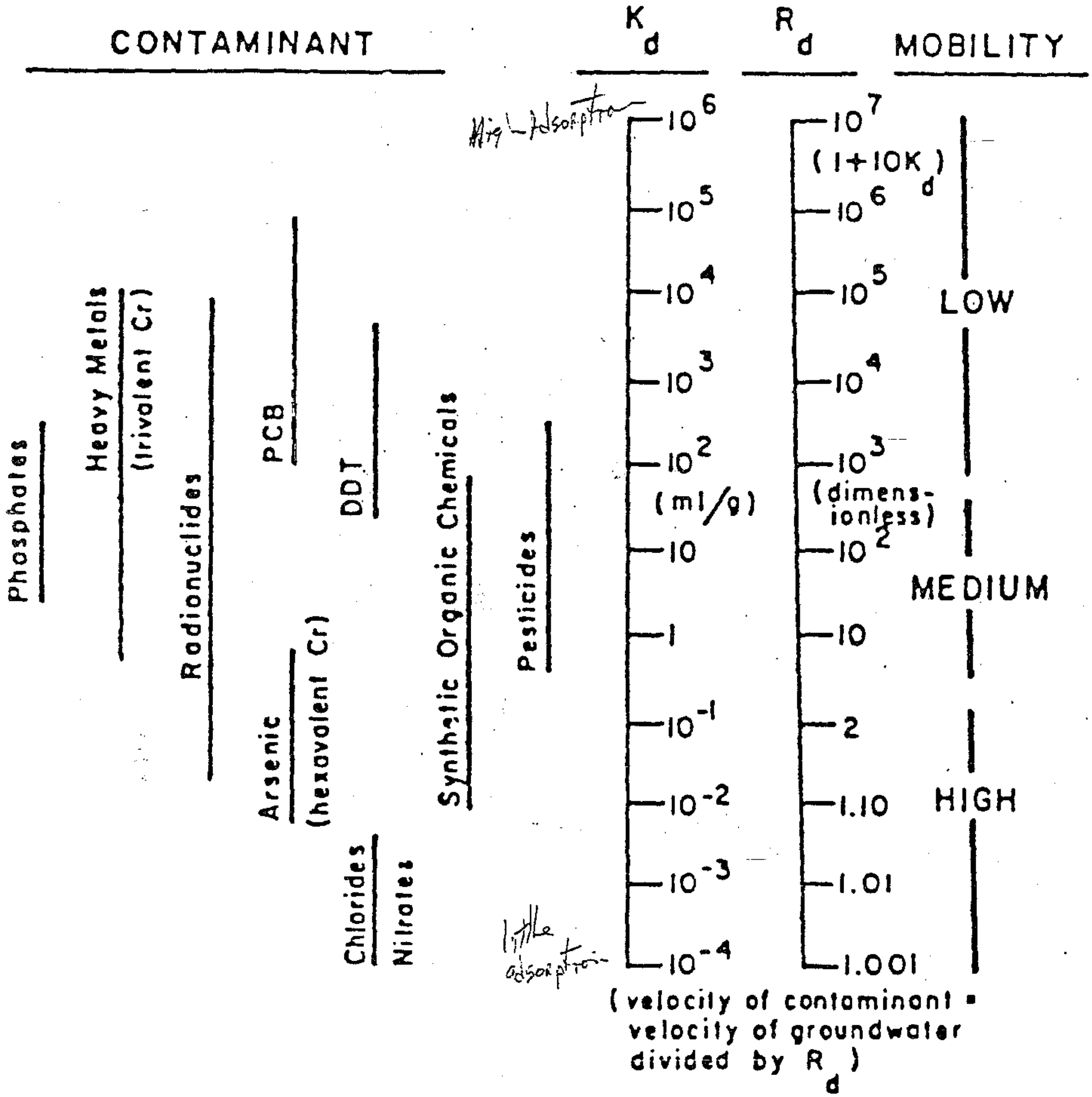

Total Cyanide Soil-Water Partitioning Coefficient: Chatwin, Dec., 1989
1.00E+00
1.00E-01
1.00E-02
1.00E-03
Kd (l/kg or ml/gm)
M1
TMGC
Cz
N3
P2
C
N1
EB
P
H
CC1
MT
M2
RM
B2
BM
F1
F2
CC2
WGF
N2
TMTS
Average
Soil Source

Figure 1

Figure 2



after Walton, 1985)

$V_{cont} = \frac{V_{gw}}{R_d}$

		CN Concentration				Barrick Mercur Dump 2: Cyanide Soil-Water Partioning Coeff.						
Soil Material	CN Species	Ci, Initial Liquid Conc. (mg/l)	Ceq, Final Liquid Conc. (mg/l)	S, Solid Phase Conc. (mg/100 gm)	Gas Phase Conc. (mg)	CN Mass Balance (mg)	Kd, Distrib. Coeff.	Comments				
Stirred Reactors												
October, 1990 Report: "Cyanide Attenuation/Degradation in Soil" by Terry Chatwin, R2C2 Consultants, Appendix B.												
Dump 2 soil	Total-CN	262.5	256	1	0.4	0.980571	0.039063	100 grams soil + 1 liter of water + 24 hours				
"	Free-CN	262.5	175	0.85		0.669905	0.048571	"				
									Ratio of high CN conc. Kd/low CN conc. Kd			
"	Total-CN	25.6	24.4	0.17	0.1	0.963672	0.069672	"	T-CN	1-kdh/kdl	F-CN	1-kdh/kdl
"	Free-CN	25.6	24.1	0.17		0.948047	0.070539	"	0.560662	0.439338	0.688571	0.311429

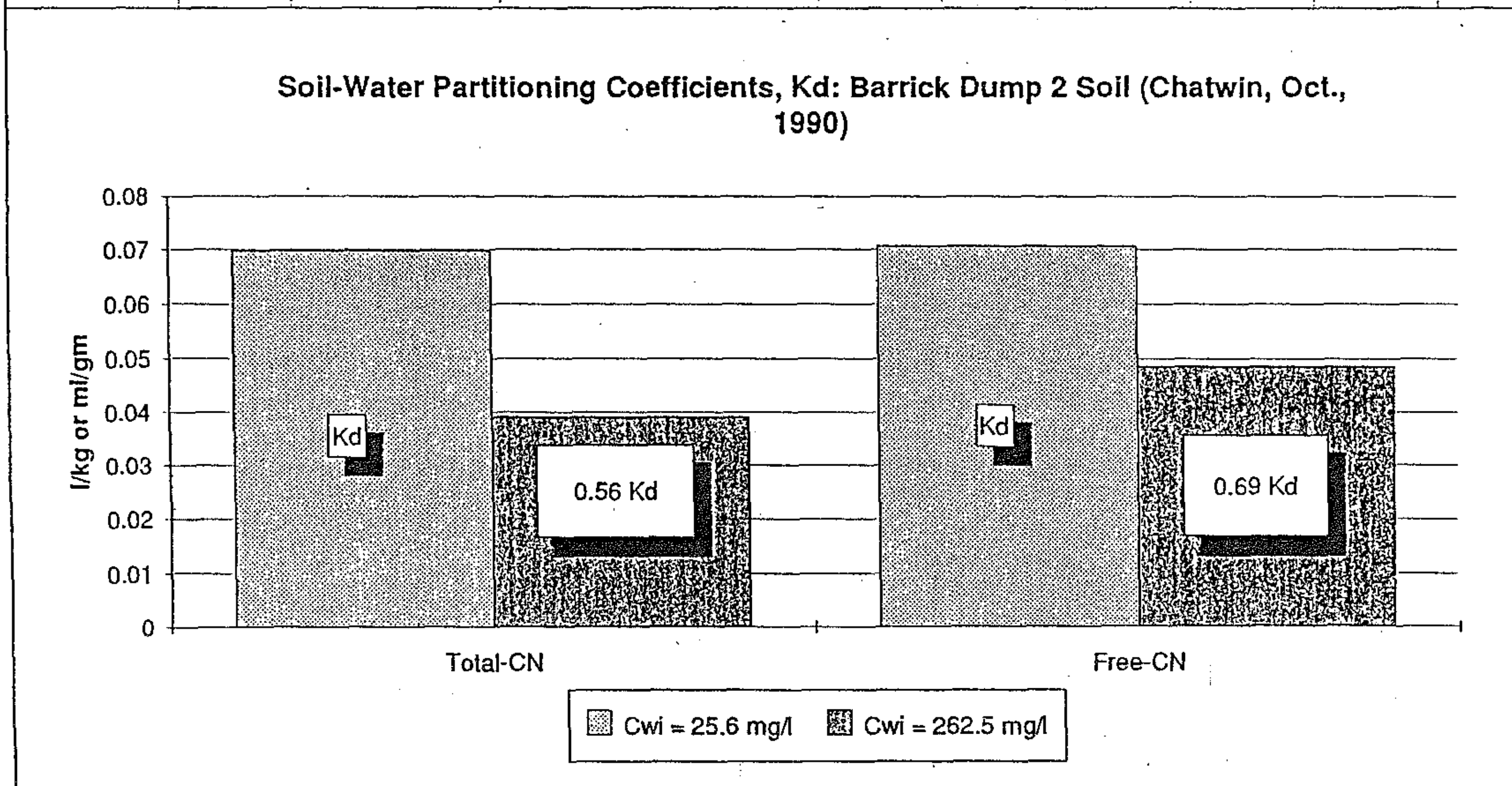


Figure 3

Golder Associates Inc.

200 Union Boulevard, Suite 100
Lakewood, CO USA 80228
Telephone (303) 980-0540
Fax (303) 985-2080

Golder Associates

FAX TRANSMISSION

TO: William W. Wessinger	*REF. NO.:*
COMPANY:	*DATE:* August 5, 1992
FAX No.: 503-464-2299	*# of Pgs. (Including Cover):* 3

FROM:	Dirk Van Zyl
RE:	PROPOSED RULES FOR CHEMICAL MINING FOR OREGON

MESSAGE

Thank you for your time and consideration

If you have any questions, please call:
GOLDER - DENVER OFFICE - 303-980-0540

Golder Associates Inc.

200 Union Boulevard, Suite 100
Lakewood, CO USA 80228
Telephone (303) 980-0540
Fax (303) 985-2080

Golder Associates

August 5, 1992

William W. Wessinger
121 SW Salmon, Suite 1100
Portalnd, Oregon 97204

RE: PROPOSED RULES FOR CHEMICAL MINING FOR OREGON

Dear Mr. Wessinger:

I have had the opportunity to participate in the development of the Proposed Chemical Mining Rules for Oregon. My participation was limited to review of draft rules and preparation of comments over the last year on behalf of the mining industry. I have some 20 years experience in teaching, research and consulting in the technical aspects of heap leaching, tailings, and waste rock disposal. During this period I have published about 50 technical papers and notes dealing with a range of subjects including drainage, stability and risk issues of these facilities. My contributions have been in the national and international areas.

In reviewing the Memorandum for Director Fred Hansen of the Oregon Department of Environmental Quality (DEQ) (dated July 30,1992) and the proposed rules (Chapter 340, Division 43, Chemical Mining), I realize how important and how difficult the decision is that you have to make on August 7, 1992. The proposed rules deal with a very complex issue. although it seems to be purely technical on the surface, many undertones of a political nature must be recognized. Environmental protection should be the primary principle, however, the potential growth of an industry and the economic and employment opportunities it can create must also be recognized.

An independent consultant (TRC Environmental Consultants Inc) was employed by the DEQ over the past 3 months to provide technical advice on specific technical questions related to the proposed rules. The Memorandum form Director Hansen clearly indicated that most of TRC's technical advice was disregarded by DEQ in the development of the proposed rules. For example, TRC concludes that a one foot clay layer in the secondary liner system can meet the Commissions' policy. DEQ recommends that 3 feet be maintained because it "will increase the long range protection of the environment". The extra cost for marginal protective increase associated with a three feet thick clay vs. a one foot thick clay layer is not justified, as was concluded by TRC. The example above is only one of the issues where DEQ decided to ignore TRC's advice. Similarly, DEQ disregarded the recommendations with respect to treatment and covers.

DEQ also makes statements which are not based on field experience, e.g. "a leak in the upper membrane would tend to enlarge rapidly, resulting in a greater volume of leakage and earlier detection". This is just not true in practice. Very often small leaks are clogged by fines or remain the same (I can provide examples off the record). Leaks only enlarge if settlement is allowed, which does not happen in well designed facilities. I can continue highlighting issues where DEQ disregarded TRC's recommendation on where inconsistencies exist in the DEQ Memorandum and the proposed rules, however, this letter will become too long. I have to conclude that the proposed rules will result in the development of very few employment opportunities in gold (or other "chemical") mining in Oregon. Oregon could thereby loose the opportunity to join responsible environmental development of resources in the U.S.

It is recognized that you need to complete the regulatory development process for mining in Oregon, however, I would like to urge you to evaluate the proposed rules carefully before making a decision.

I trust that the discussion above will emphasize the complexity of the issues you have to decide. Your careful consideration is urged.

Sincerely,

GOLDER ASSOCIATES INC.

Brent Swanson for

Dirk Van Zyl, P.E., Ph.D.
Principal

DVZ/tsr

Options for Managing Third Party Contractor Services

<u>Option 1 -- Permittee Hires Third-Party Contractor</u> (Existing Rule Language)

Under this option, the permittee would select the third-party contractor subject to Department approval. The third-party contractor would perform specified services for DEQ, subject to DEQ direction. The permittee would pay the contractor.

Existing rule language [OAR 340-43-045(6)] provides that "the Department may require the permittee to hire a third-party contractor to perform the functions set forth ... Selection of the contractor shall be subject to Department approval."

This option has the advantage of being readily implemented under existing authority.

The major disadvantage is the perception that the third-party contractor is not truly "independent" because of the direct contractual relationship between the permittee and the contractor.

<u>Option 2 -- DEQ Hires Third-Party Contractor</u>

Under this option, DEQ would select, hire, direct, and pay the third-party contractor. The permittee would be required to pay a fee to DEQ to cover the costs of the third-party contractor. If payments by the permittee exceed the obligation for payments to the contractor, the excess would be refunded. If the obligation exceeds the initial fee, the permittee would be required to make additional payments to DEQ.

This option could not be implemented without Legislative (or E-Board) authorization to receive and expend the fee revenue for purposes of employing the contractor. DEQ cannot enter into a contract without legislatively approved budget authorization.

The major advantage of this option is the fact that there would be no direct tie between the contractor and the permittee.

The major disadvantage is the added burden upon DEQ for administration of the fee account and the contractor, and the appearance of increased budget for DEQ at a time when budgets are being reduced in response to Ballot Measure 5.

have ability to operate for w/o legislative action the (we are expanding other programs) but prudent to get EB approval.

Option 3 -- A Neutral Party Holds Permittee's Fee and Pays Contractor

Under this option, DEQ would approve the selection of a contractor. The permittee would place the funds for payment of the contractor in an escrow account established for the purpose of assuring neutral party payment of the contractor.

> Legal counsel advises that this approach may be legally precluded for a public agency. Therefore, if this approach were deemed desirable, legislation would appear to be needed to clearly establish the authority for the agency to select or approve the selection of a contractor, provide for payment of the contractor from an escrow account that is established for the purpose outside of the state budget process, and either enter into a contract directly (without obligation on the state general fund) or provide some other independent mechanism for executing a contract.

Audubon Society of Portland
5151 N.W. Cornell Road
Portland, Oregon 97210
503-292-6855

State of Oregon
DEPARTMENT OF ENVIRONMENTAL QUALITY
RECEIVED
AUG 07 1992

OFFICE OF THE DIRECTOR

August 5, 1992

Oregon Environmental Quality Commission
811 SW 6th
Portland, OR 97204

RE: ***Rules Proposal: OAR Chapter 340, Division 43, Chemical Mining***

Dear Commissioners,

We recommend Commission adoption of the December 13, 1991 proposed rules governing chemical mining. We concur with testimony of The Wilderness Society supporting the December 13, 1991 rules proposal.

Thank you for your consideration of our views.

Sincerely,

Paul Ketcham

Paul Ketcham
Conservation Director

cc: Fred Hansen

Aug 5 1992

Dear Mr Hansen

I would like for DEQ to adopt strict rules on cyanide heap leaching in Oregon & any other chemical that could be used.

Other mining sites in other states have horrible contamination problems with water due to heap leach & associated mining activities. Please take a closer look at these states surrounding Oregon and adopt stricter rules so our great state doesn't end up in an environmental mess.

Please keep me posted on your regulations that you adopt.

Sincerely

Beverly Stone
HC 60 Box 1954
Quartz Mt.
Lakeview Or 97630-9704

State of Oregon
DEPARTMENT OF ENVIRONMENTAL QUALITY
RECEIVED
AUG 21 1992
OFFICE OF THE DIRECTOR

Dear, Mr. Hansen-

I am wrïting because I want to know the outcome of the August 7th meeting which was the scheduled date of adoption of the chemical process mining rules . Please let me know what rules were adopted and what were not.

Thank You Very much,

Sincerly,

Tom Ragland

TOM RAGLAND
SURVIVAL CENTER, EMU SUITE 1
U OF O
EUGENE, OR
97403

July 29, 1992

Dear Fred Hansen and Harold Sawyer,

You will soon be making critical decisions regarding rules to regulate chemical process mining. Since the focus of your review will be directed toward prevention of release of toxics to the environment, I have completed a notebook dealing with that subject.

Enclosed is a compilation of information relating to toxic releases from gold mines. The information is summarized by state and by date and is supported by documentation. Some of the information has previously been reviewed by your office, but a majority will be new to you.

Thanks for your willingness to understand the complexities of this emerging issue!

Sincerely,

Carolyn Brown

Carolyn Brown
P.O. Box 957
Ontario, Oregon 97914

California

March 29, 1991 Mt. Gaines Mine, Mariposa County, California
"the wall of a pond containing cyanide residue collapsed, sending that water into another pond, which in turn overflowed. In all, the state says about 308,000 gallons of liquid containing diluted cyanide leaching solution, used in getting the gold out of the ore, was discharged into a creek that ran into other creeks. The inspection report by the state says the concentration "of cyanide and copper exceeded EPA water quality criteria to protect freshwater aquatic life in Burns Creek," which flows from near the mine into Hornitos." *(State seeking a fine after Mt. Gaines Mine spill, Mariposa Gazette; June 20, 1991)*

May 17, 1989 Carson Hill Mine, California
"State and county officials say the small portion of cyanide solution that seeped into New Melones Reservoir yesterday from a 110,000-gallon spill at Carson Hill Mine is no threat to drinking water. The spill was blamed on a failed gasket on a drainage pipe that served as a protective system against overflow of the leachate collection ponds." *(Failsafe system fails, spills toxic waste near Melones, The Union Democrat; Wednesday, May 17, 1989)*

January 30 - February 11,1988 Morning Star Mine, Vanderbilt Gold Corporation near Nipton, California and Baker, Ca.
"About 24,000 gallons of a solution containing cyanide leaked Jan. 30 from a leach pad at the Morning Star Mine in the Ivanpah Mountain Range, about 30 miles east of Baker...Ripley said the cyanide spilled into the soil after a berm, or a type of earthen wall, "failed"." *(Officials study cyanide spill near Baker, Daily Press)* "A second spill at a gold-mining operation here has left 2,000 gallons of a cyanide solution in the ground, county environmental health officials report. A valve at the Morning Star Mine in the Ivanpah Mountain Range failed on a collection system and discharged about 2,000 gallons of a solution containing dissolved cyanide and precious metals into the ground Feb. 11, said Don Ripley, an environmental health specialist with the county's Environmental Health Services Department." *(Company says cyanide spilled for second time, Daily Press)*

1986 Beaver Resources, California
"The liner was installed properly but heavy machinery was permitted to drive across the liner which tore and weakened it. The leak was localized and the leachate was contained in the leak detection system." *(Heap Leach Technology and Potential Effects in the Black Hills, U.S. EPA; September 30, 1986)*

1986 American Mine, Mojave Desert, California
"Breaks in the PVC liners used below several inactive leach heaps allowed rainwater to percolate through the heaps and into the soil at 59 sample locations. Two heaps had free cyanide concentrations from 10 to 150 mg/l. Free cyanide was not detected in the water from the barren pond but the sediment from the pond contained up to 500 mg/l free cyanide. Liner failures below the barren, pregnant, and overflow ponds occurred, and free cyanide was detected in soil cores with free cyanide concentrations up to 300 mg/l." *(Heap Leach Technology and Potential Effects in the Black Hills, U.S. EPA; September 30, 1986)*

1986 Can-Gold, Piccho Gold Mine, California
"ponded water on top of a heap leach pile breached a levee and flowed into a collection pond. Can-Gold is currently involved in subsurface investigations because cyanide was detected in two groundwater monitoring wells." *(Heap Leach Technology and Potential Effects in the Black Hills, U.S. EPA; September 30, 1986)*

Spring, 1986 Cal-Gon Mine, Canyon Dam, California
"Waters from the process ponds had to be released after a large snowstorm....6 million gallons of 5 to 20 mg/l free cyanide had to be released. The outflow was 20 feet from a tributary stream. The stream contained 20-30 mg/l of free cyanide. The higher concentrations of cyanide in the tributary are believed to be a result of mismanaged tailings from past operations." *(Heap Leach Technology and Potential Effects in the Black Hills, U.S. EPA; September 30, 1986)*

Feb. 1982 Noranda, Grey Eagle Mine, Siskiyou County, Ca.
"Although the Noranda tailings are a Group A mining waste, no clay liner was installed, as the impoundment facility was built before the revised Subchapter 15 (land disposal) provisions of Title 23 of the California Code of Regulations came into effect in 1984. When these provisions came into effect, the facility was granted a waiver on the liner requirements outlined in Subchapter 15 because of the unreasonable cost of retrofitting. In February 1982, it was discovered that the tailings dam was leaking about 20 - 30 gpm of solution containing free cyanide and metal cyanide complexes. It is thought that seepage occurred along discrete fractures under the embankment foundation and possibly through the grout curtain...It has been estimated that unattenuated cyanide seepage from the tailings will persist for up to twenty years. (Kor, 1988) Waste discharge requirements also require erosion control and maintenance of drainage facilities to maintain the structural integrity of the reservoir dam and cover material." *(Mining Waste Study, Mining Waste Study Team, U of California at Berkeley; July 1, 1988)*

Idaho

<u>September 21, 1990</u> Hecla Mining, Lucky Friday Mine, Mullan, ID "Hecla Mining Co. will appeal the EPA'S decision to list it's Lucky Friday Mine near Mullan as a polluter of the Coeur d'Alene River's south fork, company officials say. EPA proposed to place the South Fork on the state's list, with the Lucky Friday Silver Mine named as a source. Lead level standards...for the South Fork near Mullan range from 0.8 to 1.8 micrograms per liter." *(Hecla Mining will fire back at EPA on pollution listing, Idaho Statesman, Friday, September 21, 1990)*

<u>August 5, 1990</u> Silver City, Idaho "A company that previously owned mining claims in Florida Mountain hit Silver's water supply several years ago, and you couldn't use the water to clean chamberpots for two weeks." *(Times-News, Twin Falls, Idaho; Sunday, August 5, 1990)*

<u>April 11, 1990</u> Pioneer Metals, Stibnite, Idaho Idaho DEQ and Payette National Forest conducted tests on Meadow Creek and documented "water quality monitoring data which indicate an imminent and substantial danger to the environment." Meadow Ck. pond at the edge of the tails had 3.57 mg/l of cyanide. *(Letter from Craig Shepard, State of Idaho, Water Quality Division, to Jim Tompkins, Pioneer Metals, April 20, 1990)* "The cyanide sampling results indicate that the cyanide is probably entering the Meadow Creek surface water system from the spent ore that has been placed on top of the old tailing pile and backwater pond." *(Benowitz letter to Jim Thompkins, May 22, 90)* "A sample taken April 11, 1990, indicated 0.051 mg/l total cyanide in Meadow Creek below the keyway and 0.098 mg/l in Meadow Creek at the upper crossing. A sample taken on April 20, 1990, indicated 0.049 mg/l total cyanide in Meadow Creek below the keyway and 0.076 mg/l total cyanide in Meadow Creek at the upper crossing. Penalty:$20,000. *(Notice of Violation, from Richard Donovan, Idaho Dept. of Health and Welfare to Pioneer Metals Corp.; June 6, 1990)*

March 10, 1990 Precious Metals Technology, Princess Blue Ribbon Mine, Smoky Mountains, Idaho

"The wall of a tailings pond at Princess Blue Ribbon Mine in the Smoky Mountains collapsed early Saturday morning, sending a flash flood of mud and debris into Beaver Creek and Willow Creek downstream. No toxic chemicals were released during the flood, but the eight-foot-high wall of water gouged a deep channel in the Beaver Creek streambed and left behind thick layers of sediment. Although the mine uses cyanide for gold ore processing, the pond that failed did not contain cyanide. At least two miles of rainbow trout spawning grounds in both creeks were destroyed." *(Mine pond dam breaks, Wood River Journal, March 10, 1990)* "A consent order issued to Precious Metals Technology, Inc. today cites violations of the state's water quality standards and wastewater treatment requirements stemming from a March 1990 incident. At that time, a tailings impoundment pond at the mine site overflowed discharging tailings containing cyanide onto the ground and into nearby Big Beaver and Willow creeks. The spill adversely affected the beneficial uses for cold water biota and salmonid spawning. According to the Department, PMT did not, as required, notify the state of the spill nor seek review and approval of the April 1990 construction of a new tailings impoundment structure. *(News Release from Mary Keltz, Public Information Officer, DEQ, Twin Falls, Id.; 5/31/91)* "On March 10, 1990, Tailings Impoundment 1A at the Princess Blue Ribbon Mine site was breached and discharged tailings containing cyanide onto the ground and into Big Beaver and Willow Creeks. Water samples taken indicated the presence of cyanide in levels exceeding the fresh water aquatic limit of .02 mg/l. The streams are protected for cold water biota and salmonid spawning. The discharge of cyanide exceeding the aquatic limit adversely affected the beneficial uses of Big Beaver and Willow Creeks. Penalty: $10,000. On March 10, 1990, Tailings Impoundment 1A at the Princess Blue Ribbon Mine was breached. The responsible person in charged failed to notify the Department of the spill. Penalty: $2,500. *(Notice of Violation, from Richard Donovan, Idaho Department of Health and Welfare, to Precious Metals Technology; April 19, 1990)*

1985 - Feb. 1986 Comeback Mine, 57 miles NE of Boise, Idaho "A review of the evidence since production began in 1984 reveals a facility that was inadequately planned, designed, operated, and as it turns out, underfinanced. During the second season of operation, the upper liner of the pad's double-liner system sprung a leak. Solution high in cyanide was found discharging from the drain pipes between the double liner. However, the leak was not reported to the Bureau, although that was a specific condition of approval. The leak, instead, was discovered about a month later. It was during an inspection in the fall of 1985 that the third breach of agreement occurred and the company's financial problems came to light. The operating plan stated that cyanide solutions would be neutralized and applied to the land in order to lower pond levels before winter closure. The field inspection revealed that the cyanide solution was at toxic concentrations and the pond level was too high. The pond overflowed in February, 1986 and although the company was required by law to stop the continuing spill, no action was taken. Finally, in order to stop the continuing spill, the U.S. Environmental Protection Agency stepped in to do the job with the intent of billing the company later." *(Heap Leaching at Comeback Mine examined, Bureau cites problems of cyanide use in mining operations, Idaho Clean Water, Fall 1986)*
"During 1985, the primary liner under the heap developed a leak. Solution containing up to 1200 ppm free cyanide flowed at a rate of five gallons per day from two drain pipes between the double liner...There was no certification that PVC liners had been properly installed. In addition, water control dikes around the heap were poorly constructed. About six feet of snow covered the heap that year. During a warm rain-on-snow event in February the barren pond overflowed through a discharge pipe installed just days before by the operator to prevent a dike failure. As a result, water contaminated with 168 to 183 ppm weak acid dissociable cyanide flowed downhill half a mile to Grimes Creek. Much of it seeped into the ground...The operator took no action to stop and correct the continuing discharge...A total of $95,000 was spent by EPA that year." *(Development and Evaluation of Regulations for Cyanide Heap and Vat Leaching Operations in Idaho by Irene Nautch, Senior Surface Water Quality Analyst, Idaho Dept. of Health and Welfare, Division of Environmental Quality, Boise, Idaho)* "process pond containing a concentration of 200 mg/l WAD and free cyanide overflowed. The discharge flowed over snow and ice covered land for approximately 0.5 miles before it reached the stream, where less that 1 mg/l of free cyanide was detected." *(Heap Leach Technology and Potential Effects in the Black Hills, U.S. EPA, September 30, 1986)*

<u>1983 - 1984</u> Buster Gold Mill, Elk City, Idaho

"Shortly after construction began, inspections by federal and state agencies revealed many deficiencies including inadequate site drainage, an undersized spill trench, improperly constructed monitoring wells, and a pad liner that did not connect with the spill trench liner. (IDHW, 1983a). Traces of cyanide appeared in two monitoring wells by November of 1983. In December, the total cyanide level in the groundwater was up to 0.9 ppm. Little corrective action was taken by the company and the department issued a notice of violation in March, 1984. Shortly thereafter, a sample of the Elk City drinking water intake showed 6.0 ppm total cyanide, thirty times the drinking water standard. The intake was shutdown and the reservoir was heavily chlorinated. Meanwhile, a critical water problem was developing as ponds and trenches were filling with cyanide contaminated water. An unlined impoundment contained a cyanide concentration of 5 ppm. Finally, enough problems with groundwater and soil contamination were evident that the department determined that closure and cleanup were required. During the short time of operation, approximately $20,000 worth of gold and silver were recovered; the cleanup cost, however, approached half a million dollars." *(Development and Evaluation of Regulations for Cyanide Heap and Vat Leaching Operations in Idaho by Irene Nautch, Senior Surface Water Quality Analyst, Idaho Department of Health and Welfare Division of Environmental Quality, Boise, Idaho)* "leakage problems in the primary trench leading to the pregnant pond. Samples indicated contamination of both the groundwater and soil. Groundwater was contaminated up to 150 feet beyond the problem area. Evidence of soil contamination was found 1 foot below the surface. High total cyanide (6 mg/l) was found in Elk Creek and the Elk City water supply just downstream. The leak was located approximately 400 feet from the creek. Cleanup costs are estimated at $500,000." *(Heap Leach Technology and Potential Effects in the Black Hills, U.S. EPA, September 30, 1986)*

Spring 1983 Yellowjacket Mine, Salmon River, Idaho

"In late October of 1982, the process ponds were not neutralized and dewatered. It was a high snowpack year. The following spring, the department was notified that the pond level had dropped eighteen inches. It was evident that process water had escaped, probably a month earlier, either via a leak in the pregnant pond liner or by an overflow caused by spring runoff. A tributary of Yellow Jacket Creek just below the mine site was used for drinking water by a family living downstream a quarter of a mile. It was tested and found to contain 0.3 ppm total cyanide; the standard was 0.2 ppm (Idaho Dept of Health and Welfare, or IDHW, 1983). In May, 1983, a leak was in fact detected in the pregnant pond. Process water was lost through the leak and overflow of the barren pond, resulting from high spring runoff, was also suspected. Pond water was neutralized by the fall, and the operator indicated the intent to operate again. The following year meltwater drained the heap and filled the ponds with more cyanide contaminated water. In 1984, the department issued a board order to stipulate neutralization activities and prevent further releases until reclamation of the site could be performed. By this time the operator left the state and cancelled his reclamation bond....liners had been punctured by deer and other wildlife and were damaged due to weathering." *(Development and Evaluation of Regulations for Cyanide Heap and Vat Leaching Operations in Idaho by Irene Nautch, Senior Surface Water Quality Analyst, Idaho Department of Health and Welfare, Division of Environmental Quality, Boise, Idaho)* "The accident is believed to have been an overflow pond problem. A total cyanide concentration of 0.29 mg/l was detected in the surface water. There was also evidence of a punctured liner in either the barren or pregnant pond, which may have resulted in a leak to groundwater." *(Heap Leach Technology and Potential Effects in the Black Hills, U.S. EPA, September 30, 1986)*

1981 - 1982 Sunbeam Mine, Idaho

"In 1981, the department was informed of a suspected cyanide leakage three months after the company's lab documented the problem. In 1982, after pilot scale testing was completed, a violation was issued when a process pond overflowed into an unlined pond during a winter thaw. Shallow monitoring wells showing up to 5 ppm cyanide were pumped and the water was treated (USDA, 1984)" *(Development and Evaluation of Regulations for Cyanide Heap and Vat Leaching Operations in Idaho by Irene Nautch, Senior Surface Water Quality Analyst, Idaho Department of Health and Welfare, Division of Environmental Quality, Boise, Idaho)* "The first spill was reported in 1981, three months after the pond overflow occurred. The second spill at Sunbeam occurred in the spring of 1982 when a pond overflowed again. There was evidence of surface water contamination and a notice of violation was issued by the State of Idaho." *(Heap Leach Technology and Potential Effects in the Black Hills, U.S. EPA, September 30, 1986)*

Colorado

<u>April 5, 1992</u> Battle Mountain Gold; San Luis, Colorado
"My review of the 1989, 1990, and 1991 annual reports for BMG discerned only one water quality analysis report for the leak detection system (LD 130) and one analysis for the tailings area slurry (TP 130). Both of these samples were collected on January 30, 1992. The tailings slurry sample showed cyanide levels (Free Cyanide = 170ppm, Total Cyanide = 240ppm, and W.A.D. Cyanide = 210ppm) far in excess of the permitted characterization of 4.4 ppm. Further, the leak detection sample reports elevated Cyanide levels (Free Cyanide = 80ppm, Total Cyanide = 120ppm, and W.A.D cyanide 99ppm), indicating that the primary liner is leaking. Water quality monitoring results have only been reported for one of the groundwater monitoring wells in the vicinity of the tailings disposal area, well M-9. These results have been reported for quarterly samples, rather than monthly. However, none of the water quality results reported for well M-9 show any detectable cyanide." *(Water Quality Monitoring Inadequacies - Battle Mountain Gold Mine, memo from Jim Pendleton to Larry D. Oehler; Mined Land Reclamation Division, Department of Natural Resources; State of Colorado; Denver, Colorado)*

<u>April 4, 1992</u> Battle Mountain Gold; San Luis, Colorado
"A deadly 38-fold increase in the cyanide level of the tailings pond about the southern Colorado town of San Luis has prompted the shutdown of the Battle Mountain Gold Co. mill, at state request...the state agreed to a cyanide level of 4.4 parts per million, but the concentration has jumped to 170 parts per million...a dose of 20 to 40 parts per million is enough to kill wildlife. The tailings pond contains 52 acre-feet, or 17 million gallons, of cyanide-laced water, which is used to extract gold from crushed ore inside a mill before the water and tailings flow into the pond." *(Pond cyanide up; gold mine shut, The Denver Post; April 4, 1992)*

<u>March 25, 1992</u> Nerco, Inc., Cripple Creek
"A section of ore heap collapsed blocking the solution collection ditch. Pregnant cyanide solution flowed off the liner onto frozen unlined ground and into a pregnant solution pond." *(Mineral Policy Center, Mining Report Card, Nerco, Inc.; April 10, 1992)*

<u>March 25, 1992</u> Nerco, Inc., Cripple Creek
"An estimated 200 to 300 gallons of pregnant cyanide solution spilled out of the lined solution containment system into the environment." *(Mineral Policy Center, Mining Report Card, Nerco, Inc.; April 10, 1992)*

March 1986 - November 12, 1991   Galactic Resources, Summitville Mine, Alamosa, Colorado

"Water carrying cyanide from a gold mine near Wolf Creek Pass has killed all the aquatic life in a 17-mile stretch of the Alamosa River and the Terrace Reservoir, state and federal officials said...about 100 gallons of water a minute are leaking from the leach heap. That's about 144,000 gallons a day. The first reported fish kill attributed to the mine occurred in 1986, shortly after the operation began. The most recent was six weeks ago, when 500 to 1,000 gallons of the cyanide-laced water spilled into Whiteman Creek." *(Cyanide leak from Colorado gold mine annihilates life in river, The Santa Fe New Mexican, November 12, 1991)* "A Colorado Department of Health video of the seepage showed brilliant blue sludge and water - ranging in color from orange to yellow to molasses - leaking into natural waterways from the mine site last summer." *(Mine's toxic leaks render river lifeless, The Denver Post, Nov. 11, 1991)*
"Jim Horn, a Durango-based district engineer for the health department, said he found evidence of a daily discharge totaling 510 pounds of copper, 5 pounds of cyanide, 180 pounds of iron, and 195 pounds of zinc flowing into the Wightman Fork of the Alamosa River at the mine site during a "one-day grab sample" earlier this year." *(New curbs put on mine after cyanide leak, The Denver Post, Nov. 20, 1991)* "Pleadings from a lawsuit filed in Canada involving Summitville's leach pad designer, Klohn Leonoff, allege that avalanches of snow pulled plastic geomembrane liners out of their anchor trenches causing the liners to be torn during March and April of 1986. The pleadings also allege that the clay liner and monitoring sand underlying the leach pad were severely eroded by water from Spring runoff in 1986, and subsequently, cyanide solution began to leak from the leach pad. The Colorado Mined Land Reclamation Board (CMLRB) issued a Notice of Violation to the Summitville Mine on July 24, 1986, for failure to follow the mine plan and failure to minimize the effects to the prevailing hydrologic balance. On Nov.20, 1987, CMLRB held another hearing and found that Summitville had violated its permit by failing to maintain a non-discharging status. CMLRB issued a Notice of Potential Violation on Feb. 6, 1991, for failure to minimize disturbance to the quality of surface water during mining operations, and again on September 20, 1991, for a surface spill of heap leach solution which occurred on September 16, 1991. The Water Quality Control Division...has issued Notices of Violation and Cease and Desist Orders (NOV/CDO's) to the Summitville Mine on several occasions. On Dec. 24, 1987, an NOV/CDO was issued for unauthorized discharges from the french drain system below the leach pad which occurred on ten days between June 19, 1987, and Oct. 27, 1987. On Feb. 4, 1991, another NOV/CDO was issued for unauthorized discharges occurring on July 23, 1990, and Oct. 10, 1990. This NVO/CDO was amended on May 6, 1991 to include an unauthorized discharge observed on Feb. 7, 1991. Yet another NOV/CDO was issued on Oct. 3, 1991, for a spill which occurred on September 15, 1991. Another spill occurred on Nov. 11,1991."
(Correspondence from Arne Leonard, Rocky Mountain Office, Sierra Club Legal Defense Fund, to Carolyn Brown, January 9, 1992)

<u>October 25, 1991</u> Gold Hill Ventures
"In reference to 3rd possible violation listed, failure to repair rips in the tailings pond liner using the method approved in the permit and failure to prevent additional punctures, Staff said that as of May 22, 1992 inspection, all of the (80) holes in the liner had been repaired....Staff said that both operators agreed that a discharge occurred on October 25, 1991." *(Summary of Minutes, Colorado Mined Reclamation Board; May 27-28,1992)*

<u>May, 1989</u> Newmont Mining, Black Cloud, Colorado
Notice of Violation "Exceeded concentrations permissible by permit for zinc, copper, and cyanide in effluent." *(Mineral Policy Center, Mining Report Card: Newmont Mining Company)*

<u>1986</u> Mine Development Company, Neglected Mine, Colorado
"A leak was discovered in the liner and cyanide was released. There was some evidence of cyanide contamination in the soils." *(Heap Leach Technology and Potential Effects in the Black Hills, U.S. EPA, September 30, 1986)*

<u>1986 (?)</u> Ruby Heap Leach site, Colorado
"During abandonment, the carbon columns were drained and the cyanide flowed around the ponds and into an adjacent ephemeral drainage." *(Heap Leach Technology and Potential Effects in the Black Hills, U.S. EPA, September 30, 1986)*

<u>1984</u> Newport Minerals, Cameron Mine, Colorado
"a large storm caused a pond to overflow. The berm failed on the overflow pond due to inadequate drainage control. The spill flowed into the adjacent creek, but there was no information on how much cyanide was released." *(Heap Leach Technology and Potential Effects in the Black Hills, U.S. EPA, September 30, 1986)*

<u>Date Unknown</u> Keystone Mine
"Prior to acquisition of the property by Climax, the Keystone tailings ponds had failed, spilling water and tailings down the hillside into nearby Coal Creek. Fish life in Coal Creek had disappeared years before." *(Rocky Mountain Pay Dirt, Page 22A, March 1992)*

Montana

October 2, 1991 Kendall Mine, Montana
"The Kendall Mine near Lewistown has reported its second cyanide leak this year...An estimated 2,500 to 3,000 gallons of cyanide solution spilled from the mine's metal-recovery plant when a pipe ruptured inside the plant....The solution had nowhere to go, so it flowed out the door, across the parking lot area, into an unlined ditch and down. It filled two different sumps, or pits, that the ditch intercepted." *(Kendall Mine reports 2nd cyanide leak, Gazette; October 2, 1991)*

Nov. 1989 - Feb. 1991 Pegasus, Basin Creek Mine, Montana
"In November 1989 DSL found a puddle contaminated with cyanide off the leach pad's lined surface. Pegasus claimed it was caused by transportation of materials off the lined surface. DSL staff recommended a $6,000 fine. It was not until a settlement conference in February 1991 that DSL and Pegasus agreed on a $2,600 - $2,900 range for the fine." *(Water Damages: Shortfalls in Metal Mine Regulations, A Northern Plains Resource Council Factsheet; Feb. 1991)*

January 31, 1991 C.R. Kendall Corporation, Hilger, Montana
"The initial leak was found at the metal extraction plant and involved the grouting around a pipe going through a wall into a drainage pipeline...Much of the solution that leaked there went into a nearby holding pond, but the rest was absorbed into the ground. Later it was determined that the lining in another pond had been torn and presented a separate problem." *(Cyanide leak said stopped, The Montana Standard, Butte, Montana; Tuesday, Feb. 12, 1991)*

Nov. 22, 1989 - Jan. 8, 1991   Blue Range Mining Co., Montana
"Residents in the Heath area were assured Tuesday night that a cyanide process planned by Blue Ridge Mining Co. posed no threat to their water supplies. "There will be more contamination running off in any barnyard than you would get from cyanide," said Larry Hoffman, mine superintendant...Hoffman said no water flowed through the Shoemaker mine but it did have a stagnant pool in it that rose and fell at times. He said no one knew where the water went when it fell but it probably is deep underground in gigantic caverns in the Madison limestone." *(Heath residents' questions center around cyanide, Lewistown News-Argus; Nov. 22, 1989)* "Blue Range Mining Co., which mines gold and silver in the Judith Mountains near Lewistown, has shut down its entire operations because of cyanide discovered in a monitoring well....The well where the cyanide was found is in the lower aquifer, a narrow, horizontal fracture zone in the gypsum bed, about 100 feet lower than the domestic wells...Hoffman said it appears the Shoemaker mine leaks. The level of cyanide found in the monitoring well is 30 ppm, he said. The EPA drinking water standard is .22 ppm." *(Cyanide leak prompts mine to shut down, Billings Gazette; Jan. 8, 1991)*

September 1990   Pegasus, Zortman-Landusky Mine, Montana
"The cyanide that is turning gold ore into gold at this mine....is making lots of money for Pegasus. It is also entering the aquifer of the Fort Belknap Indian Reservation." *(The Progressive; Sept., 1990)*

1980 - August 1990 Viking Mine, Powell County, Elliston, Montana
"The Viking Mine operated a cyanide heap leach operation in Powell county until 1982. In 1985 the WQB reported that the mine's tailings pond had been overflowing for 5 years, releasing cyanide and heavy metals...In August 1990, the Forest Service notified the owner his $6,875 bond would be forfeited if a reclamation bond was not received in 30 days. According to the WQB, it was cheaper for the operator to forfeit the bond." *(Water Damages: Shortfalls in Metals Mine Regulations, A Northern Plains Resource Council Factsheet; Feb. 1991)*
"Miner just pumped solution out the side of his pond with no concern for environmental effects." *(Environmental Problems Associated with Cyanide Heap Leaching, notes regarding testimony presented by Steve Pilcher to EQC; March 9, 1990 hearings)*

May 1990   Chelsea Resources, Spotted Horse Mine, Montana
"In December 1989 the DSL suspended the company's operating permit because of improper placement of tailings...In May 1990 a six inch rain storm filled the mine tailings pond with cyanide laden water. As of Feb. 1991 the DSL has spent $10,000 to cleanup the contaminated water." *(Water Damages: Shortfalls in Metal Mine Regulations, A Northern Plains Resource Council Factsheet; Feb. 1991)*

Late 1980's Copper Elk Mine, Lewistown, Montana
"unpermitted, abandoned, cyanide heap leach operation with a torn liner..."very little" was known about how much cyanide was lost from this mine." *(Environmental Problems Associated with Cyanide Heap Leaching, notes regarding testimony presented by Steve Pilcher to EQC; March 9, 1990)*

Jan 30,1987 Placer Dome, Golden Sunlight Mine, Montana
"complaint detailing alleged water losses caused by the mining activities of Golden Sunlight Mines. Conclusions: A preponderance of the evidence indicates that cyanide seepage at the Golden Sunlight slurry cutoff wall is responsible for the cyanide concentrations at the Senechal and McCafferty wells." *(In Re Compliant Senechal and McCafferty, Dept. of State Lands; Dennis Hammer, Commissioner; May 22, 1987)* "cyanide contamination was first detected in groundwater in 1983, and...the agencies estimate there may be now a 7 million gallon plume of cyanide contaminated groundwater headed towards the Jefferson River." *(Correspondence from Bruce Farling, Deputy Director Clark Fork - Pend Oreille Coalition to Carolyn Brown; January 9, 1992)*

September 26, 1986 Pegasus, Zortman-Landusky Mine, Montana
"On September 26, 1986, the mine received 5.6 inches of rain in 18 hours on top of an already above normal precipitation year. The result was an excess of approximately 30 million gallons to the solution inventory. Disposal of the cyanide was required to prevent pad or pond overtopping, to insure adequate freeboard for winter shut-down, and to provide for additional precipitation. The disposal action utilized several different treatment strategies employing calcium hypochlorite to neutralize the cyanide. The treated solution was then land applied using sprinkler irrigation. Approximately 20 million gallons of leachate was treated and disposed of over 17 acres. The most noticeable affects to vegetation was some superficial "burning" of pine trees in the land application area. This was due to excess chlorine in solution left from cyanide neutralization." *(Emergency Treatment and Land Application of Excess Cyanide Solution at the Zortman Mine, Phillips County, Montana; by Scott Haight and Joe Frazier, Lewistown District BLM, Montana)*

May 9, 1986 Placer Dome, Golden Sunlight Mine, Montana
"Quale Lusty estimates the discharge to have been 15 gpm with a total discharge of 2,000 gallons. The discharge flowed under a fence (not the permit boundary fence) and ponded in a flat area and continued to run somewhat further estimated at two hundred feet. Five cattle drank from the ponded area and died." *(Memo from Gary Lynch to Terry Grotbo, State of Montana; May 9, 1986)*

Spring, 1985 Golden Maple Mine, Gilt Edge, Montana

"the ponds were close to breaching, so the operation released pond water to prevent destruction of their dike. The released pond water contained concentrations of 35 mg/l total cyanide and 27 mg/l chlorine amenable cyanide. The released pond water flowed down a dry streambed and infiltrated the alluvium. Cyanide was detected in a groundwater monitoring well located within the mine permit area and in a ranch well approximately 0.25 miles away. The highest cyanide concentration, measured from samples from the rancher's well was 0.199 mg/l total cyanide and 0.14 mg/l chlorine amenable cyanide in November 1985." *(Heap Leach Technology and Potential Effects in the Black Hills, U.S. EPA; September 30, 1986)* "It will cost the state approximately $115,000 to $120,000 to clean up the cyanide-contaminated heap-leaching gold mine near Gilt Edge in the Judith Mountains north of Lewistown...the cyanide problem at the Golden Maple Mining and Leaching Inc. of Lewistown site is "essentially a first" for the department which must deal with 1.5 to 2 million gallons of leach process operation fluids contaminated with cyanide and other chemicals." *($115,000 - $120,000 to clean up mine site, Lewistown News; August 7, 1986)*

1985 Falcon Exploration Co., Montana

"Wastewater with high levels of dissolved metals and significant levels of cyanide was seeping from dangerously full storage ponds threatening both surface and groundwater." *(Northern Plains Resource Council Factsheet: Hard Rock Mining in Montana: The Need for Reform, August 1989)* "Seepage from an inadequately lined facility surfaced outside of the impoundment area, flowed down the hill and contaminated the groundwater monitoring well, flowed into a stream, and resulted in a fish kill and cattle dying. Pilcher reported that DHES "spent a lot of time and a lot of money [with] the bottom line being that the guy (miner) skipped the country." Pilcher said, "He's in Arizona and he's just laughing at us, because we had to use what small bone the Forest Service had to try to reclaim the area and deal with the problems." *(Environmental Problems Associated with Cyanide Heap Leaching, notes regarding testimony presented to EQC by Steve Pilcher; March 9, 1990)*

June 7, 1982 - Dec. 28, 1982 Pegasus, Zortman-Landusky Mine, Montana

"On at least six occasions between June 7, 1982, and December 28, 1982, cyanide solution escaped from the leaching system and entered the ground and/or surface waters in Alder Gulch and other drainages. Most of these releases were small (under 1,000 gallons), but a release on December 28, 1982, may have been as large as 50,000 gallons. This release significantly contaminated Alder Gulch and the Kalal system which supplies the community of Zortman, Montana, with it's drinking water. Sampling of the Kalal system water at the time of the release detected concentrations of cyanide as high as 3.2 mg/l." *(Rod Lorang to C. Rothenstein, Results of Mine Waste Site Reviews, EPA; 4/8/86)*

<u>Spring 1982</u>   Nellie Grant Mine, Montana
"The Nellie Grant Mine 20 miles southwest of Helena was abandoned in 1982 after the company, Sparrow Resources Ltd. of Canada, folded...The state has already spent $60,000 on the site which is contaminated with heavy metals, cyanide and arsenic. The company also left behind over $200,000 in fines for water quality violations." *(Water Damages: Shortfalls in Metal Mines Regulations, A Northern Plains Resource Council Factsheet, Feb. 1991)*

Nevada

<u>Present, On-going</u> Battle Mountain Gold, Fortitude Mine
"Groundwater monitoring has shown the tailings impoundment is leaking. The current investigation shows total dissolved solids have exceeded 6,000 mg/l near the impoundment and elevated levels have been detected 3,500 feet downgradient of the impoundment." *(Information compiled by Doug Zimmerman, Nevada DEP)*

<u>Present, On-going</u> Richard Sorenson and Phil Courtney
Cindy Millsite, Beatty
"The processing of ore at this site included the use of mercury in the circuit. The waste from the operation was discharged to unlined sumps. Samples from the sumps show elevated mercury levels. The area is subject to flash floods and the downgradient rancher is concerned about the mercury levels." *(Information compiled by Doug Zimmerman, Nevada DEP)*

<u>1984 to present</u> Belmont Resources, Wonder Mine
"Unknown concentrations of cyanide remain in the heap and ponds." *(Information compiled by Doug Zimmerman, Nevada DEP)*

<u>March 5, 1991</u> Independence Mining Company, Jerritt Canyon
"Water quality analysis results of samples collected from numerous monitoring wells downgradient of the tailings impoundment showed elevated levels of TDS (up to 19,000 mg/l), chloride (up to 12,000 mg/l), WAD cyanide, selenium, cadmium, lead and mercury. A hydrogeologic investigation which included installing 18 monitoring wells showed contaminated groundwater greater than 1000 feet downgradient of the impoundment. Seven additional wells and 14 recovery wells will be installed by July, 1991." *(Information compiled by Doug Zimmerman, Nevada DEP)*

<u>1986 - 1991</u> Placer Dome, Cortez Mine, Nevada
This area has four sites which have uncontrolled mill waste discharge. Two of the sites are the product of historic mining, which has caused soil contamination from heavy metals and cyanide. The historic material was not managed properly, and storm events have carried contaminants from the canyon to the valley nearby. Vegetation is absent in these areas and the soil is white in color. Groundwater is contaminated as well. The other two sites revolve around a large unlined tailings impoundment of approximately 50 to 100 acres. This impoundment has been leaking high concentrations of cyanide into groundwater for the last five years. *(Carolyn Brown, telephone communication with the Battle Mountain BLM, Nevada, October 2, 1991)*

<u>December 17, 1990</u> First Miss Gold, Getchell Mine
"Laboratory samples from the CIL and autoclave circuits were routinely dumped into an unlined ditch outside the sample room door. This practice was ongoing for at least 1.5 years."
(Information compiled by Doug Zimmerman, Nevada DEP)

<u>December 5, 1990</u> Sonora Mining Company, Buckskin Mine, Smith Valley
"Cyanide was detected in a groundwater monitoring well below the tailings impoundment." *(Information compiled by Doug Zimmerman, Nevada DEP)*

<u>November 15, 1990</u> Alta Gold, Taylor Ward Project
"Tailings delivery pipe separated at a connection discharging approximately 30,000 gallons of tailings fluid and about 45 tons of tailings solids into a dry wash. About 1.5 miles of drainage channel were impacted by the discharge." *(Information compiled by Doug Zimmerman, Nevada DEP)*

<u>June 1, 1990</u> Dee Gold
"WAD cyanide detected in monitoring wells down gradient of the impoundment. To date, more than 30 monitoring wells have been installed to define the extent of the plume." *(Information compiled by Doug Zimmerman, Nevada DEP)*

<u>May 17, 1990</u> Jumbo Mining Company, South of Sleeper Mine
"Inspection on 4/2/90 showed site not in operation and not being maintained. In numerous places the sides of the heaps had failed and overtopped the berm. No data documenting heap rinsing has been submitted. A 600 square foot area of hydrocarbon contaminated soil indicated spillage." *(Information compiled by Doug Zimmerman, Nevada DEP)*

<u>May 11, 1990</u> Newmont Mining, Gold Quarry, Nevada James Creek Tailings Dam
Finding of Alleged Violation "Cyanide was found in monitoring wells downgradient of the tailings impoundment. Solution seeped from the toe of the tailings dam." *(Mineral Policy Center, Mining Report Card, Newmont Mining Corporation)* "Investigation and remediation included enlarging the underdrain system, repairing pipe leaks in the fluid return system, installing 29 monitoring wells to delineate the vertical and lateral extent of the plume and 13 recovery wells to remove contaminated groundwater. The plume had moved about 2,500 feet down gradient of the impoundment." *(Information compiled by Doug Zimmerman, Nevada NDEP)*

April 26, 1990   Western States Minerals, Northumberland Mine
"Leakage (500 to 1000 gallons per week) through the primary liners of the pregnant and barren ponds significantly exceeded permit limits for 9 months. Leakage could not be controlled and ponds had to be relined." *(Information compiled by Doug Zimmerman, Nevada DEP)*

April 26, 1990   Alta Gold, Elder Creek
"No collection sumps were provided for the leach pad or barren pond leak detection systems. Pipes daylighted directly onto ground surface. Solution was dripping from one pipe." *(Information compiled by Doug Zimmerman, Nevada DEP)*

April 3, 1990   Arimetco, Weed Heights
"Instead of the required 10 foot set-back from the edge of the liner, ore had been stacked to the edge and acid leach solution had run off the pad in numerous places...The site records indicated the required monitoring of the leak detection systems had not been performed. At the time of the inspection, there was flow from one pad leak detection pipe of about 100 gallons per day. Site personnel were not aware of the flow and did not know how long it had been occurring." *(Information compiled by Doug Zimmerman, Nevada DEP)*

March 4, 1990   Western Mining, Western Hog Ranch Co., Nevada
"the barren pond was filled to capacity. Instead of flowing into the adjacent pond through the connecting channel, the cyanide solution overflowed the bank of the pond and flowed into stockpiled topsoil below the barren pond. Approximately 3500 gallons of fluid containing about 7.5 pounds of cyanide discharged from the pond." *(Notice of Non-Compliance from J. Anthony Danna, Surprise Resource Area Manager; March 14, 1990)*

May 30, 1989 - Feb. 26, 1990   Echo Bay Mines, McCoy/Cove Mine, Nevada
"Case: A series of solution and tailings releases.
Description: The following releases occurred:
15,000 gallons of pregnant solution with 31 lbs of cyanide (5/30/89)
20,000 gallons tailings with 41 lbs cyanide (6/29/89)
30,000 gallons solution with 100 lbs cyanide (10/8/89)
8,200 gallons solution with 45 lbs cyanide (11/5/89)
5,000 gallons solution with 12 lbs cyanide (11/14/89)
10,000 gallons solution with 41 lbs cyanide (12/7/89)
16,000 gallons with 579 lbs cyanide (2/15/90)
10,000 gallons with 32 lbs cyanide (2/26/90)"
(Mineral Policy Center, Mining Report Card: Echo Bay Mines)

July 31, 1989   Kennecott Alligator Ridge
"Free cyanide exceeding the permit limit of 2.0 mg/l was detected in ground water monitoring wells. The source was thought to be leaking leach pads and process ponds." *(Information compiled by Doug Zimmerman, Nevada DEP)*

June 30, 1989   Western States Minerals, Northumberland Mine
"Pipe break caused flow to overtop leach pad liner berm and form a pool on the ground surface next to the fence. Two cows pushed 1/2 way through the fence, drank the leach solution and were found dead in the fence." *(Information compiled by Doug Zimmerman, Nevada DEP)*

April - June 1989   Atlas Gold Bar Mine, Nevada
"I have had several discussions with you...regarding the need for groundwater monitoring wells at the Gold Bar Operation.... especially in light of the releases of process fluids from the mill building and leaks from the heap leach pad. However, I have received very little commitment and next to no action in the behalf of Atlas Gold...Two incidents of release of process fluid containing cyanide from the mill building were formally reported in April and June of this year. Our records show that another spill also occurred within this three month period. There is no documentation from you on file in this office that the cyanide-laced process solution was expeditiously removed from the basin and placed into the tailings impoundment." *(Nevada DEP, Letter from Tom Card to William Reich; Oct. 10, 1989)*

May 30, 1989   Alhambra Mines, Dayton Project
"Cyanide was detected in a monitoring well at the property boundary which is approximately 100 feet from the Carson River. Source of cyanide was the pond area in the vicinity of the 1986 release." *(Information compiled by Doug Zimmerman, Nevada DEP)*

March 10, 1989   Western Mining, Western Hog Ranch,
Western Goldfields, Nevada
"..on Friday, March 10, 1989, a temporary containment basin constructed to provide emergency storage of barren cyanide solution failed, discharging approximately 250,000 gallons downgrade. The solution was...at concentrations of 0.5 pounds of cyanide per ton of water...It was only after reading an article in the Reno Gazette Journal (March 16, 1989) six days after the incident occurred that the Susanville BLM District Office became aware of the problem." *(Notice of Non-Compliance; March 29, 1989; from Rex Cleary, Susanville BLM District Manager, to Western Mining, Western Goldfields, and Western Hog Ranch)*

February 3, 1989 Newmont Mining, Rain Project, Nevada
Finding of Alleged Violation "cyanide found in monitoring wells downgradient of the tailings impoundment." *(Mineral Policy Center, Mining Report Card: Newmont Mining Corporation)*

Nov. 1988 Newmont Gold, Elko, Nevada
"a cyanide waste pond sprung a leak" *(Dangers of Cyanide Gold Strip Mines, Wilderness Society; April 7, 1989)*

March 17, 1988 Alhambra Mines, Flowery Project,
Six Mile Canyon
"Groundwater contamination found in monitoring well in Six Mile Canyon. Leak detection system not installed at pad. Leakage from ponds exceeded permit limits. Company in bankruptcy and had inadequate staff. Monitoring reports not submitted." *(Information compiled by Doug Zimmerman, Nevada DEP)*

1983 - 1988 Carlin, Nevada
"One interesting point made by Mr. Van Drielen was that free cyanide occurs in detectable and measurable levels decades after release to the environment. He gave as an example a leak that occurred at a cyanide loading station near Carlin, Nevada. A significant volume of cyanide solution was lost. This solution did not intersect groundwater but remained in the aerated zone in contact with earth rich in iron. The cyanide is being extracted by wells installed for that purpose, a process that has been going on for about 5 years. Free cyanide is still present in the solutions." *(Gold/Silver Heap Leaching and Management Practices That Minimize the Potential for Cyanide Releases, PEI Associates, Inc., Cincinnati, Ohio; Prepared for EPA, Cincinnati, Jan. 88)*

December 27, 1987 Coeur Rochester
"Pregnant solution with WAD cyanide concentration of about 300 mg/l was released through a hole in the pregnant pond liner. breached the subbase and emerged at the north end of the plant site fill area. A sump was installed to collect the fluid, although it was estimated about 4,800 gallons escaped before the sump was completed." *(Information compiled by Doug Zimmerman, Nevada DEP)*

January 14, 1987 Atlas Gold Bar Mine, Nevada
"the carbon in leach tank return line froze causing tanks 5 and 6 to overflow. The tails should have been contained by the concrete pad that is under the tanks. However, extreme freezing complicated pumping and the tails overflowed and covered about two acres of sagebrush adjacent to the mill site. About 8,400 gallons of tails spilled onto the ground." *(Letter from John Wilbanks of Atlas to Harry Van Drielen, Nevada Environmental Protection; February 5, 1987)*

<u>Feb. 25, 1983 - 1987</u> B.P. Minerals, Alligator Ridge Mine, 40 miles N.W. of Ely, Nevada

"The NDEP file on Alligator Ridge contains documentation of four discharges of cyanide containing solutions in the last 6 years. The first took place on February 25th and 26th, 1983. It was an intentional discharge of 100,000-200,000 gallons with a cyanide concentration of 20-38 ppm. The discharge was allowed to occur so the company could install a bypass valve....Two discharges are documented as taking place in 1986. One of them, in August, was due to heavy rainfall and apparently caused process water to overflow from the collection pond to the overflow pond, and from the collection ditches into the stormwater ditches. There was cyanide detected in one monitoring well in September which the facility speculated was caused by this event. The second discharge documented in 1986 was also in August and consisted of 10,800 to 13,300 gallons of solution containing 365 ppm free cyanide. This discharge was from a tee in the pipe at the Southeast corner of leach pad number 2. In 1987 a flange in the line carrying solution to the No. 2 leach pad failed allowing 32,000-34,000 gallons of solution containing 365 ppm of free cyanide to discharge....Groundwater monitoring data in NDEP's file indicate contamination below the pregnant solution collection pond in 1985 and 1986 with cyanide levels as high as 10.4 mg/l as free cyanide." *(EPA Region 9 Water Management Division, NPDES Compliance Evaluation Inspection Report, prepared by Claire Elliot, EPA Environmental Engineer; September 30, 1989)*

<u>Nov., 1986</u> Dee Gold Mining, Carlin, Nevada

"pipe containing cyanide waste water ruptured. The safety system of ponds failed. Cyanide waste flowed through two ponds and into Boulder Creek. It contaminated water for about three miles. The damage to aquatic life is unknown." *(Dangers of Cyanide Gold Strip Mines, The Wilderness Society; April 7, 1989)*

<u>September 8, 1986</u> Nerco Minerals, Candelaria Mine

"A release of 25,000 gallons of leach solution occurred as a result of operator error. A by-pass valve was left open when a solution line was brought on-line. Solution flowed into a storm water control ditch." *(Information compiled by Doug Zimmerman, Nevada DEP)*

<u>February 22, 1986</u> Gold Bug Mining, Robert Craig

"On 2/22/86, a site inspection showed cyanide solution being pumped from lined ponds to an unlined pond. Solution then flowed into a drainage which discharged to Six Mile Canyon Creek and Carson River. A sample taken at Six Mile Canyon Creek at Highway 50 on 2/24/86 showed free cyanide at 0.14 mg/l." *(Information compiled by Doug Zimmerman, Nevada DEP)*

February 20-21, 1986   Alhambra Mines, Dayton Project
"Heavy rains and a power failure contributed to fluid management problems. The operator chose to discharge excess rainfall and leach solutions to Cardelli Ditch. About 150,000 gallons were discharged. The death of three or four sheep found near the ditch may have been from the cyanide and the company agreed to pay the owner." *(Information compiled by Doug Zimmerman, Nevada DEP)*

December 31, 1984   Pecos Resources, Inc., Tuscarora
"A discharge from one of the ponds has been observed to flow down the canyon into surface waters of the state." *(Finding of Alleged Violation, from Joseph S. Livak, Water Quality Enforcement Officer, State of Nevada, to Pecos Resources; December 31, 1984)*

February 1983   Kennecott, Alligator Ridge
"Due to precipitation events, pond capacity was exceeded. Between 100,000 and 200,000 gallons process solution containing free cyanide concentrations between 20 and 38 mg/l were discharged." *(Information compiled by Doug Zimmerman, Nevada DEP)*

South Carolina

<u>October 28, 1990</u> Brewer Gold Mine, South Carolina
"Approximately 10 million gallons of cyanide solution flooded a South Carolina river on 28 October 1990, after failure in an earthen dam at the Brewer Gold Mine near the city of Jefferson...the cyanide-contaminated stormwater raced down from a reservoir at the mine into a tributary of the Lynches River. As many as 10,000 fish were killed by the spill. Earlier in October, the same storm caused a 420,000-gallon spill of cyanide solution at the Brewer Mine when debris blocked a lined channel used to carry the pregnant solution from the leach pads to a processing plant. Although the flow of the pregnant solution was cut off almost instantaneously, it was seven hours before stormwater runoff containing 170 ppm of cyanide could be prevented from spilling into the river drainage. Brewer had been previously fined $25,000 by the EPA for failure to notify federal officials of a spill that occurred at the mine in 1988."
(Clementine, Winter 1990)

South Dakota

July 19, 1990 - September 13, 1991 Brohm Mining

"July 19, 1990....spill/release material: cyanide and nitrate
(Deadwood, S.D.) source: pad
July 31, 1990....spill/release material: cyanide, Cu, As
(Lead, S.D.) source: pad
June 20, 1991....spill/release material: cyanide
(Lead, S.D.) source: equipment
July 3, 1991.....spill/release material: cyanide solution
(Lead, S.D.) source: pad
Sept 13, 1991....spill/release material: cyanide solution
(Deadwood, S.D.) source: hose"
(Lawrence County Spill/Release List, Tips Newsletter; November 8,1991)

June 21, 1991 MinVen, Gilt Edge Mine, South Dakota

"Officials reported Wednesday that cyanide operations were shut down at Gilt Edge Mine because of a cyanide leak. Cyanide apparently leaked around a pipe that carried the solution out of the leaching pad to a processing facility where gold is removed." *(Mining firm faces cover-up charge, Argus Leader; Sioux Falls, S.D.; June 21,1991)* "The state Department of Environment and Natural Resources (DENR) says cyanide has contaminated surface and groundwater in the vicinity of the Gilt Edge Mine four miles southeast of Deadwood. The department said the Brohm operation contaminated Strawberry and Bear Butte creeks. An aquifer in the Strawberry Creek drainage area also was polluted, officials said." *(State cites Brohm for polluting water, Rapid City Journal; July 19, 1991)*

Dec 27, 1989 - May 13, 1991 Golden Reward Mining Company

"Dec 27, 1989....spill/release material: cyanide soln/400ppm
(Lead. S.D.) source: operator
Mar 30, 1990....spill/release material: cyanide soln
(Lead, S.D.) source: AST
May 14, 1990....spill/release material: cyanide soln/450ppm
(Lead, S.D.) source: piping
Dec 27, 1990....spill/release material: cyanide soln
(Lead, S.D.) source: sump
April 4, 1991...spill/release material: cyanide soln
(Lead, S.D.) source: pad
April 17, 1991..spill/release material: cyanide soln 20%
(Lead, S.D.) source: piping
May 3, 1991.....spill/release material: permeate soln
(Lead, S.D.) source: pump
May 13, 1991....spill/release material: cyanide soln permeate
(Lead, S.D.) source: sump"
(Lawrence County Spill/ Release List, Tips Newsletter; November 8, 1991)

Nov 22, 1983 - Oct 19, 1990   Wharf Resources

"Nov 22, 1983....spill/release material: sodium cyanide
(Lead, S.D.) source: ?
May 18, 1984....Spill/release material: sodium cyanide
(Lead, S.D.) source: handling
May 23, 1984....spill/release material: sodium cyanide
(Lead, S.D.) source: ?
June 12, 1984...spill/release material: cyanide
(Lead, S.D.) source: ?
June 13, 1984...spill/release material: sodium cyanide solution
(Lead, S.D.) source: pad
June 18, 1984...spill/release material: cyanide
(Trogan, S.D.) source: ?
June 18, 1984...spill/release material: sodium cyanide
(Lead, S.D.) source: ?
May 17, 1985....spill/release material: cyanide solution water
(Lead, S.D.) source: valve
May 31, 1985....spill/release material: cyanide solution
(Lead, S.D.) source: pipeline
Jan 3, 1986.....spill/release material: cyanide
(Deadwood, S.D.) source: unknown
Feb 18, 1986....spill/release material: cyanide?
(Lead, S.D.) source: handling
Nov 5, 1988.....spill/release material: cyanide
(Deadwood, S.D.) source: ?
Oct 19, 1990....spill/release material: cyanide solution
(Lead, S.D.) source: spill
Oct 19, 1990....spill/release material: dilute cyanide soln
(Lead, S.D.) source: equipment"

(Lawrence County Spill/Release List, Tips Newsletter; November 8, 1991)

May 1990   Golden Reward Mining Company; Lead, South Dakota
(owned by United Coin Mines and MinVen Gold Corp)

"Officials at the Golden Reward Mining Co. did not know Monday afternoon whether a 400-gallon cyanide solution spill at its open-pit gold mine near Terry Peak resulted from human error or faulty equipment...the accident happened when workers switched the flow of cyanide process solution, used to extract gold from ore, from one cell to another at the company's 12-celled heap-leach pad....a header valve opened on the north side of the pad about 9 a.m. and a gush of process solution blocked a 4 inch diameter culvert designed to carry solution from the pad to process ponds at the site. The blockage caused about 400 gallons of dilute sodium cyanide process solution to overflow the pad containment area and escape onto the ground." *(Golden Reward reports cyanide solution spill, The Rapid City Journal; May 15, 1990)*

July 29, 1982 - November 29, 1989   Homestake Mining

"July 29, 1982....spill/release material: tailing water
(Lead, S.D.) source: line
Jan 31, 1983.....spill/release material: cyanide in water
(Lead, S.D.) source: ?
Sept 19, 1983....spill/release material: mine tailings slurry
(Lead, S.D.) source: ?
Aug 28, 1984.....spill/release material: cyanate, thiocyanate
(Lead, S.D.) source: sump
Nov 5, 1984......spill/release material: cyanide and water
(Lead, S.D.) source: ?
Aug 30, 1985.....spill/release material: cyanide
(Lead, S.D.) source: pump
Sept 14, 1988....spill/release material: cyanide
(Lead, S.D.) source: mine
Mar 27, 1989.....spill/release material: cyanide
(Lead, S.D.) source: sump
June 11, 1989....spill/release material: cyanide return water
(Lead, S.D.) source: line
Nov 29, 1989.....spill/release material: cyanide
(Lead, S.D.) source: culvert
Jan 12, 1991.....spill/release material: cyanide
(Lead, S.D.) source: valve"

(Lawrence County Spill/Release List, Tips Newsletter; November 8, 1991)

October, 1989   Brohm Mining, South Dakota

"primary liner beneath a 14-acre heap leach pad was leaking more than 6,800 gallons of cyanide and other solutions per day. (The pad had been in operation only about one month when the leak was announced.) Although the primary liner is backed by polyethylene and 12 inches of low permeability soil, Don Pay of the Technical Information Project warns there is no way of knowing whether or not any solution escaped the lower liners. "There is no monitoring or detection beneath the second layer," says Pay."
(Going for the Gold by Peter Carrels; Outdoor America, Winter 89)

Jan 2, 1989   Bond Gold, Richmond Hill; Lead, S.D.

"Jan 2, 1989....spill/release material: cyanide dilute
source: error
Sept 14, 1990..spill/release material: cyanide solution
source: piping
Oct 5, 1990....spill release material: cyanide solution
source: line"

(Lawrence County Spill/Release List, Tips Newsletter; November 8, 1991)

<u>1987</u> Annie Creek Mine, Wharf Resources; Lead, S.D. "pad underlying one of its ore heaps that was leaking. For at least seven months, cyanide solution had escaped at a rate calculated as high as eleven gallons per hour." *(Going for the Gold by Peter Carrels; Outdoor America, Winter 1989)* Another reference: "A heap leach pad at Wharf Resources Inc.'s mine above Spearfish Creek in the northern Black Hills had been leaking cyanide solution since last October, according to state Department of Water and Natural Resources (DWNR) officials. Under questioning from mining opponents at the Board of Minerals and Environment meeting Thursday in Custer, state officials disclosed the didn't know how much of the poisonous liquid might be leaking, whether it was going into the groundwater, how many leaks there were, or where the leaks were. They said the cyanide solution already had gone through almost all the barriers that were supposed to prevent it from escaping, a fibrous geotextile liner, a plastic sheet, and eight inches of compact clay. Cyanide has been found in three different drainage pipes under the pad and there could be at least three leaks, said Mike Cepak of the DWNR." *(Wharf leaking cyanide, Rapid City Journal; May 22, 1987)*

<u>May, 1984</u> Annie Creek Mine, Wharf Resources; Lead S.D. " a holding pond leaked on the mine site. Wharf hauled contaminated water and clay from the pond and paid a $9,200 fine for permit violations." *(Going for the Gold, Peter Carrels; Outdoor America, Winter 1989)* Another reference: "The upper pregnant and barren ponds overflowed into the overflow pond which was only clay lined. The release water contained a concentration of approximately 100 mg/l total cyanide. The clay liner contained concentrations of approximately 2 - 3 mg/l total cyanide, with a maximum concentration of 14 mg/l cyanide. At about the same time, a tear was discovered in the barren pond below. The tear was repaired and the contaminated clay was removed." *(Heap Leach Technology and Potential Effects in the Black Hills, U.S. EPA; September 30, 1986)*

Oregon

<u>1986</u> Oregon
"The cyanide solution would not penetrate the ore but continually ran off the piles." *(Heap Leach Technology and Potential Effects in the Black Hills, U.S. EPA; September 30, 1986)*

<u>1880 - 1930</u> Cornucopia Mine, Oregon
"The Oregon DEQ plans to examine mill tailings from the defunct Cornucopia Mine after routine lab tests showed the waste may contain toxic material. The DEQ and the federal EPA were notified when the results indicated high levels of toxic mercury, lead, arsenic, cyanide and other heavy metals. The tailings in question were produced by the Baker Stamp Mill, which ceased operations in the 1930's." *(DEQ to check tailings from former gold mine, Bend Bulletin; August 7, 1990)*

Utah

<u>March 5 - March 6, 1991</u> Tenneco, Goldstrike Mine
"on Tuesday, March 5, 1991, mine operators had diverted 250,000 gallons of solution containing from 1,000 to 12,000 micrograms per liter of cyanide out of a holding pond to make way for the expected overflow stemming from another in-coming storm. Near noon on Wednesday, March 6, 1991, falling rock from a blasting operation perforated the synthetic HDPE liner of the pond. The liner was so badly damaged that the solution began percolating through to the ground." *(Letter from Lawson LeGate, Sierra Club Southwest Office, to Caroline Brown; February 26, 1992)*

<u>March 1 - March 3, 1991</u> Tenneco, Goldstrike Mine
"On February 28, 1991, heavy rain fell at the site of this heap-leach gold mine near St. George. Six inches of rain fell in a 24-hour period....The mine operators became worried about the quantity of precipitation and the inadequate capacity of their impoundment, so they began diverting cyanide solution onto the leaching pad. Unfortunately, the amount of solution diverted overwhelmed the limited storage capacity of the pad. So, from Friday, March 1, to Sunday, March 3, approximately 500,000 gallons of solution containing 20,000 micrograms per liter of cyanide was discharged into an unlined retention basin. From there the solution seeped into the area's aquifer and ran above ground down Beaver Dam Wash into the Virgin River.
(Letter from Lawson LeGate, Sierra Club Southwest Office, to Caroline Brown; February 26, 1992)

<u>Summer 1990</u> Barrick, Mercur Mine
"In the summer of 1990, the Mercur tailings pond liner ruptured, releasing 143,000 gallons of tailings containing 60 pounds of cyanide into a drainage. Tailings were captured in sedimentation ponds by Barrick. The state of Utah requested that Barrick submit water and soil samples but issued no fines." *(Mineral Policy Center, Mining Report Card, American Barrick Resources Corporation; April 1, 1992)*

<u>1986(?)</u> Mercur Mine, Utah
"...there is one large operation, the Mercur Mine, which has had a problem with their heap leach pads. The leak detection system detected 1 to 2 gallons per minute of leach solution containing up to 120 to 130 mg/l free cyanide. No impacts occurred because the leak was contained in the leak detection system. There are no groundwater monitoring wells because the bedrock is highly fractured." *(Heap Leach Technology and Potential Effects in the Black Hills, U.S. EPA; September 30, 1986)*

Washington

<u>September 13, 1991</u> Hecla Mining Company, Republic, Washington
"Hecla environmental technician Alana Scott says that 18,000 gallons of cyanide solution with about 53 pounds of cyanide escaped from a leach tank...The spill occurred because an employee left a valve open, forgot and went home. The tank overflowed and went down through the mill building and out the back on to a dirt road." *(Republic Mine reports cyanide spill, Boundary Community News, October 1, 1991, Grand Forks, B.C.)*

<u>Jan - March, 1991</u> Echo Bay Mines, Kettle River
"Echo Bay exceeded its permitted cyanide levels for the tailings pond in January, February, and March 1991." *(Mineral Policy Center, Mining Report Card, Echo Bay Mines, Ltd., December 18, 1991)*

Canada

<u>1990</u> Noranda, Hemlo Gold Mines; Marathon, Ontario
"At Hemlo Gold Mines near Marathon, Ontario, 600 cubic meters of tailings containing small amounts of cyanide leaked from a break in a tailings pipeline. Cleanup operations were initiated immediately and no cyanide was detected in downstream water systems, according to the report." *(Noranda Concerned about environmental image, The Lakeland Times; July 19, 1991)*

<u>June 10, 1989</u> Sumac Ventures, Burrell Creek, British Columbia
"Sumac Ventures has been slapped with a $1-million lawsuit by the provincial government, which is trying to recover the money it spent to have the company's former site near Burrell Creek cleaned up and reclaimed. Although Sumac had posted a $5,000 bond on the property, clean-up costs topped $1 million. The Environment Ministry declared an environmental emergency at the heap leach milling site on June 10, 1989, after cyanide leaked into nearby groundwater." *(Government sues Sumac for clean-up costs, Boundary Community News, Grand Forks British Columbia, September 10, 1991)*

<u>March 13, 1986</u> Lac Minerals
"March 13 of 1986 Lac Minerals spilled 11.8 ppm cyanide into Cigar Lake. The company drained reclaim water into a spill pond to enable the repairs to be made to the reclaim pipeline. Prior to release into the environment, this reclaim water was to be treated. Due to the time of day, it was decided that the water's treatment would be conducted the following day. March 14th, company personnel found the untreated reclaim water containing 11.8 ppm had drained into Cigar Lake. The valve on the spill pond had been left open." *(Northshield, a publication of Northshield, Inc.; Ely, Minnesota; Spring 1990)*

<u>1982</u> Mine name unknown
"In one case, cyanide-containing mine effluents from a Canadian tailings pond released into a nearby creek killed more than 20,000 steelhead (Oncorhynchus mykiss; Leduc et al 1982)" *Cyanide Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review, by Ronald Eisler; U.S. Department of Interior, Fish and Wildlife Service; December 1991)*

OREGON MINING COUNCIL

COMMENTS ON DEQ CHEMICAL MINING RULES AND PROPOSED AMENDMENTS
August 7, 1992

ISSUE I. LINERS:

(a) DEQ should expressly approve the alternate liner proposed by TRC, including variations;

(b) DEQ should replace the reference to 36" of clay and synthetic membranes in the bottom liner guidelines to simply 12" of clay; and

(c) The DEQ and TRC liner specifications should be deemed acceptable, not starting points.

Rationale:

(a) **TRC showed its alternative leach pad liner meets EQC policies with a high degree of certainty and prevents** leaks better than the DEQ triple liner. The DEQ triple liner encourages leaks, resulting in high operating costs.

(b) TRC found 12" of clay gives more than enough time after initial leak detection to remedy leaks. 36" is 4 times more than enough.

(c) DEQ calls its guidelines "minimum" criteria, implying that more may be required for specific projects. TRC found that the specified liners would meet EQC policies with a high degree of certainty. **If an applicant agrees to build the DEQ or TRC liner system rather than seek a variance, the application should be approved.**

PROPOSED AMENDMENTS:

340-43-065(4) [guidelines for heap leach pad liners]

(b) [last sentence] The leak detection system shall consist of appropriately sized collection piping placed within a minimum thickness of 12 inches of permeable material (minimum permeability of 10^{-2} cm/sec) or equivalent liquid conducting material of different thickness that is capable of withstanding the anticipated weight of the heap without loss of function.

(c) A secondary liner shall be placed below the leak detection system to provide assurance that any leakage through the primary liner during the operation of the heap and following closure of the heap is not released to the environment. The

12201/5

Secondary liner shall consist of~~be of a composite design with a continuous flexible membrane of suitable synthetic material in direct contact with~~ an engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 12~~36~~ inches, or materials providing protection against leaks for an equivalent period.

(d) [new] The following two heap leach pad liner designs are approved by the Department as satisfying the policies in 43-006(2) and these guidelines with a high degree of certainty. An applicant that elects to incorporate either of these designs into its facilities shall be deemed to have satisfied the requirements of these rules with respect to heap leach pad liners.

(i) <u>Alternate Liner I:</u> A triple liner with the following three layers: (a) an engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches; (b) continuous flexible-membrane middle and top liners of suitable synthetic material separated by a minimum of 12 inches of permeable material (minimum coefficient of permeability of 10^{-2} cm/sec); and (c) a leak detection piping system between the synthetic liners capable of detecting leakage of 400 gallons/day-acre within ten weeks of leak initiation.

(ii) <u>Alternate Liner II:</u> (As described in the final report of TRC Environmental Consultants, Inc. under ODEQ Contract No. 71-92) A triple liner system with the following three layers: (a) an engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 12 inches; (b) a top liner consisting of a continuous flexible-membrane of suitable synthetic material underlain by low permeability soil/clay (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 6 inches (or equivalent prefabricated composite liner consisting of a flexible membrane with attached bentonite layer of lesser thickness); and (c) a leak detection system between the top and bottom liners consisting of a minimum of 12 inches of permeable material (minimum coefficient of permeability of 10^{-2} cm/sec) and piping capable of detecting leakage of 400 gallons/day-acre within ten weeks of leak initiation.

<u>340-43-65(5)</u> [guidelines for Processing Chemical Pond Liners]

(b) [second sentence] The leak detection system shall consist of appropriately sized collection piping or equivalent liquid conducting materials ...

(c) A secondary liner shall be placed below the leak detection system to provide assurance that any leakage through the primary liner during the operation of the heap and following closure of the heap is not released to the environment. The Secondary liner shall consist of ~~be of a composite design with a continuous flexible membrane of suitable synthetic material in direct contact with~~ an engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 12~~36~~ inches, or materials providing protection against leaks for an equivalent period.

<u>ISSUE II. CYANIDE REMOVAL AND REUSE</u>:

> **(a) DEQ should delete cyanide reuse from its guideline requirements; cyanide destruction alone should be allowed; and**
>
> **(b) detoxification to 30 ppm WAD cyanide should be deemed sufficient.**

<u>Rationale</u>:

(a) TRC found cyanide <u>reuse</u> does <u>not</u> further the EQC policies of reducing toxicity or preventing long-term release of cyanide from the facilities. There is no evidence that one or two trucks per month bringing cyanide to a mine pose a material risk to the environment, justifying the expenditure of $2 to $5 million dollars on cyanide reuse technology.

Cyanide reuse technology requires the use of large quantities of fresh water, electrical power, sulfuric acid and caustics. Acid and caustics would have to be transported to the facility in lieu of cyanide. The reduction in cyanide transportation risk (which is minimal) would be offset by these other environmental costs.

(b) OAR 340-135-50(2)(f) [DEQ's toxic use reduction and hazardous waste reduction rule] expressly allows all other industries in Oregon to determine, on a site-specific basis, the technological and economic feasibility of reuse. DEQ has not justified treating the chemical mining industry differently than all other industries in Oregon by mandating cyanide reuse.

(c) TRC found no environmental risk basis for lowering cyanide residuals in tailings below 50 ppm. Industry would be willing to aim for 30 ppm, to add an additional margin of caution. Requiring expenditures for greater reductions without identifiable environmental benefits is unreasonable.

PROPOSED AMENDMENTS:

340-43-006(2)(b) [policy statement]

The toxicity of mill tailings and the potential for long-term cyanide and toxic metals release from mill tailings shall be reduced to the greatest degree practicable through removal, neutralization or destruction of cyanide and toxic metals compound~~s and reuse of chemical solutions~~ **prior to placement of tailings in the tailings disposal facility.** Reduction of residual WAD cyanide to 30 ppm or less shall be deemed sufficient.

340-65-070(1) [guidelines for disposal of mill tailings]

Mill tailings shall be treated by cyanide removal or destruction~~-and re-use~~ prior to disposal to reduce the amount of cyanide introduced into the tailings pond. Chemical oxidation or other means shall be additionally used, if necessary, prior to disposal to reduce the WAD cyanide level in the liquid fraction of the tailings. ~~The permittee shall conduct laboratory column tests on mill tailings to determine the lowest practicable concentration to which the WAD cyanide (weak acid dissociable cyanide as measured by ASTM Method D2036-82 C) can be reduced.~~ In no event~~,~~ shall the permitted **WAD cyanide concentration in the liquid fraction of the tailings be greater than 30 ppm.**

ISSUE III. COVERING HEAPS AND TAILINGS FACILITIES:

Hazardous waste covers should not be required unless the decommissioned heap or tailings contain toxic or acid-generating material. If the tailings are treated to be nontoxic and non-acid forming, a 12" composite liner is sufficient.

Rationale:

(a) TRC found that absent acid forming materials in the heap or tailings facility, a hazardous waste cover adds no material environmental protection. The cost of hazardous waste covers is very high (millions of dollars). Mining and transporting the clay for covers and burning fossil fuels to construct such covers would create negative environmental impacts while the covers would provide no benefits.

The proposed rule changes make cover requirements consistent with treatment of other solid or hazardous waste facilities in Oregon.

PROPOSED AMENDMENTS

340-43-080(4)(b) [guidelines for heap leach closure]

Following detoxification as defined in (a) above, if the spent ores are not state hazardous wastes as determined under existing rules and will not be acid generating, then the heap shall be reclaimed as required by the Department of Geology and Mineral Industries. If the tailings are state hazardous wastes or will be acid generating, then the heap shall be closed in place on the pad by covering the heap with a cover designed to prevent water and air infiltration. The cover should consist, at a minimum *** (continue with existing language).

340-43-080(5) [guidelines on covering tailings facility at closure]

[new first sentence] If the tailings, after all processing and treatments provided by the applicant, are not state hazardous wastes as determined under existing rules and will not be acid generating, then the tailings shall be reclaimed as required by the Department of Geology and Mineral Industries. If the tailings are state hazardous wastes or will be acid generating, then t~~T~~he tailings disposal facility shall be closed by covering with a composite cover designed to prevent water and air infiltration and be environmentally stable for an indefinite period of time. (continue with existing language)......

340-43-070(3) [guidelines for mill tailings liner]

If the tailings, after all processing and treatments to be provided by the applicant, will not be state hazardous wastes as determined under existing rules and will not be acid generating, then the tailings disposal facility shall be lined with a composite double liner consisting of a flexible-membrane synthetic top liner in tight contact with an engineered, stable, soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) having a minimum thickness of 12~~36~~ inches. If the tailings are state hazardous wastes or will be acid generating, then the minimum thickness of the clay liner shall be 36 inches.

ISSUE IV. ALTERNATIVE FACILITIES AND METHODS:

> **(a) DEQ should specify that alternative facilities that satisfy EQC policies with a high degree of certainty will be approved; and**
>
> **(b) the rules should provide for review of proposed alternative facilities by a qualified consultant, selected with DEQ approval, at the applicant's request and expense. The consultant's opinion should be given substantial weight by the DEQ.**

Rationale:

> The current rule on alternative facilities focuses on exceeding the performance of guideline technologies rather than satisfying EQC policies. Example: TRC found that 12" of clay (without a synthetic membrane) allows more than enough time to repair leaks, assuring compliance with EQC policy with a "high degree of certainty." DEQ rejects the TRC proposal on page 24 of DEQ's July 30 memo because DEQ believes 36" of clay (which allows four times longer to correct a leak) is more protective.
>
> Under the rules, DEQ dictates the schedule for correcting significant leaks. DEQ offers no explanation why it could not require leak correction within the time frame provided by the 12" liner.

PROPOSED AMENDMENTS

340-43-031(2) [provision for approval of alternative facility designs and methods]

Alternative facilities and methods of control of wastes and potential pollutants shall~~may~~ be approved by the Department if the permit applicant can demonstrate that the alternate facilities and methods will provide environmental protection that satisfies the policies set forth in 43-006(2) with a high degree of certainty.~~is fully equivalent or better than that achieved by the facilities specified in the guidelines in Sections 43-040 to 43-095 of these rules.~~ The burden of proof

~~of fully equivalent protection~~ lies with the permit applicant. Written approval of any alternative by the Department shall be evidence of acceptance as ~~equivalent or better level of~~ environmental protection that satisfies the policies set forth in 43-006(2) with a high degree of certainty. The applicant may provide for review of proposed alternative facilities and methods by an independent consultant, approved by the Department. The Department shall give substantial weight to the consultant's findings.

<u>340-43-040(1)</u> [statement of purposes for guidelines]

This Division establishes criteria for the design, construction, operation and closure of chemical mining operations and supplements the provisions of OAR 340-43-006 through OAR 340-43-035. **These criteria are intended to establish the minimum level of environmental protection that is necessary using a combination of performance standards and** ~~example~~**minimum** design criteria. Approval of alternative facilities or methods to satisfy the policies set forth in 43-006(2) with a high degree of certainty and to achieve an equivalent or better environmental result as the facilities and methods set forth in the following criteria is allowed as defined in OAR 340-43-031. To encourage innovation and technical advances, the Department shall evaluate alternative facilities and methods in terms of their overall ability to satisfy the policies in 43-006(2) and the following guidelines rather than requiring that each design element of a proposed alternative match the elements of the facilities and methods set forth below.

August 4, 1992

William W. Wessinger
121 S.W. Salmon, Suite 1100
Portland, Oregon 97204

Dear Chair Wessinger,

The Native Plant Society of Oregon (NPSO) strongly urges the Environmental Quality Commission to adopt the Department's chemical mining rules of December 13, 1991. In my letter dated December 10, 1991 to Fred Hansen and the members of the Environmental Quality Commission I stated that:

" NPSO is greatly concerned about any possibility of contamination by toxic chemicals, heavy metals, and acid-water accumulation to the soils or waters in the area of a mine. The quality of the water of our state must be protected from any contamination by the cyanide heap leach mining process. We hope that with high state standards protecting the environment we will avoid the potential damage this technology may inflict on Oregon's natural ecosystems."

The NPSO supports the draft rules of December 13, 1991 pertaining to the chemical mining rules. The department's chemical mining rules must set a high state standard to protect the environment and the public health in Oregon.

Thank you for considering these comments. I would greatly appreciate a copy of the final version of these rules as soon as they are available.

Sincerely,

Esther HG McEvoy.

Esther H.G. McEvoy
Legislative Chair
3290 SW Willamette
Corvallis, Oregon 97333

NATIONAL WILDLIFE FEDERATION
Suite 512 921 S.W. Morrison Portland, Oregon 97205
503-222-1429
Fax: 503-222-3203

August 6, 1992

William Wessinger
Chairman
Environmental Quality Commission
c/o Department of Environmental Quality
811 SW Sixth Ave.
Portland, OR 97204-1390

Dear Chairman Wessinger:

The National Wildlife Federation (NWF) is the nation's largest conservation organization, with over 5.3 million members and supporters. NWF represents 43,000 members in Oregon. One of our primary goals is the conservation of fish, wildlife and other natural resources.

NWF has been interested in chemical mining in Oregon since the last state legislative session when chemical mining operation legislation was passed. We have been watching with interest, and monitoring, the rulemaking process.

NWF strongly urges the Environmental Quality Commission to adopt rules regulating chemical mining in Oregon as they were written and proposed on December 13, 1991. We feel that this set of rules will best protect the resources NWF, and in particular our Oregon members, regard as a priority for protection.

Thank you for your consideration of our position on this critical issue of importance to the state of Oregon.

Sincerely,

Jacquelyn Bonomo

Jacquelyn Bonomo
Center Director

cc: Fred Hansen

OREGON
Natural Desert
ASSOCIATION

August 3, 1992

Fred Hanson
Director, Dept. of Environmental Quality
811 S.W. 6th Ave.
Portland OR 97204

Dear Mr. Hanson,

This letter represents our comments on the Proposed Rules for Chemical Process Mining.

Our members are very interested in the utmost protection for lands in Eastern Oregon. We feel that Oregonians will be better served in the long run if the tightest possible controls are enacted at the state level.

To save us both time, this letter acknowledges that we agree with and support the comments submitted by the Portland office of The Wilderness Society, regarding these proposed rules.

Sincerely,

Alice Elshoff, V.P.

Alice Elshoff

P.O. BOX 1005 BEND. OREGON 97709

Oregon Wildlife Federation
P.O. Box 67020 • Portland, OR 97267
(503) 659-9054

5 August 1992

Environmental Quality Commission
811 SW 6th
Portland, OR 97204

RE: Chemical Mining Rules

Dear Commission Members:

The Oregon Wildlife Federation (OWF) enjoys the support of over 1000 members and supporters statewide. OWF also is the state affiliate of the National Wildlife Federation, this nation's largest conservation organization.

OWF supports the 13 December 1992 draft Chemical Mining Rules. We ask that you include our support in the record and strongly urge the Commission to adopt this draft.

Sincerely,

Stu Sugarman

Stu Sugarman
President

Audubon Society of Portland
5151 N.W. Cornell Road
Portland, Oregon 97210
503-292-6855

August 5, 1992

Oregon Environmental Quality Commission
811 SW 6th
Portland, OR 97204

RE: *Rules Proposal: OAR Chapter 340, Division 43, Chemical Mining*

Dear Commissioners,

We recommend Commission adoption of the December 13, 1991 proposed rules governing chemical mining. We concur with testimony of The Wilderness Society supporting the December 13, 1991 rules proposal.

Thank you for your consideration of our views.

Sincerely,

Paul Ketcham

Paul Ketcham
Conservation Director

cc: Fred Hansen

OREGON NATURAL RESOURCES COUNCIL

MAIN OFFICE

YEON BUILDING, SUITE 1050
522 SOUTHWEST FIFTH AVENUE
PORTLAND, OREGON 97204
503-223-9001

Protecting Oregon's lands, waters and natural resources

August 5, 1992

Mr. William Wessinger, Chair
Environmental Quality Commission
811 SW Sixth Street
Portland, OR 97204

Dear Mr. Wessinger,

The Oregon Natural Resource supports the December 13, 1991, Draft Rules Proposal and urges your adoption of these rules at your special Meeting August 7.

Please make this letter part of the permanent record.

Sincerely,

Andy Kerr

Andy Kerr
Director of Conservation

printed on recycled paper

SIERRA CLUB

Oregon Chapter

July 31, 1992

Environmental Quality Commission
c/o Oregon Department of
  Environmental Quality
811 SW 6th
Portland, OR 97204

Re: Chemical Mining Rules

The Oregon Chapter Sierra Club supports the December 13th, 1991 draft Chemical Mining Rules. We ask that our support be made a part of the record and request that the Commission adopt this draft.

Sincerely,

(S)

Liz Frenkel, Legislative Coordinator
1413 SE Hawthorne
Portland, OR 97214

cc: The Wilderness Society

John Williams
12770 SW Foothill Dr.
Portland OR 97225
503-626-5736
(fax) 503-641-5507
August 3, 1992

And Attachments

Dear Ms. Kitchen:

Here is the letter I sent to Fred Hansen regarding the TRC report and the mine rulemaking. Harold Sawyer said that I may or may not be allowed to speak at the Friday meeting; he did not know. I would like to attend the meeting if for its educational value only. But I would also like to speak briefly on the issue outlined below. Unfortunately I have deadlines to submit comments on other mine permits that week, that would preclude my attendance.

Hopefully your group could call attention to the issues raised in my letter if I am unable to attend the meeting. I would greatly appreciate it. Of course I am not asking you to substitute my concerns for the issues you have so ably raised for many months now.

Thank you for your help and advice in this matter.

Yours,

John Williams

Dear Mr. Hansen:

I am a consultant for the TAME TIC Committee, a non-profit group funded by voluntary contributions from building trades unions to evaluate the environmental and economic implications of large construction projects. Pipefitters Local 290 in Portland, and other pipefitter locals with offices in Washington and Idaho, together represent thousands of skilled workers who live and work in Oregon. These unions are among the supporters of the TAME TIC program. The members of these unions will be working at any future chemical mines that will operate under the final version of the proposed DEQ rules.

Here are comments on the draft TRC report regarding prospective DEQ regulations for the chemical mining industry. Our remarks are narrowly limited to one issue; the reuse and recycling of cyanide. In your own July 2nd letter commenting on the TRC report, you state "Reuse (of cyanide) would reduce the quantity of chemicals transported ... and would ... reduce the potential for accidental release during transport, storage, handling, etc."

TAME TIC strongly supports your position on this issue, Mr. Hansen. Here is evidence that every handling and storage event regarding cyanide releases this highly toxic chemical into the environment.

Mine Safety and Health Administration (MSHA) records obtained under the Freedom of Information Act list many cases of worker injuries caused by cyanide releases during the handling of this substance. Here are examples:

> "After mixing chemicals ... operator ... received a cyanide dust exposure." (Druid Mine, CO., MSHA no. #05-4431, 11/8/91)
>
> "(Three workers) ... had just finished unloading cyanide from tractor trailer. (One worker) ...passed out ... and (was) taken to hospital." (Western States Minerals, NV., MSHA no. #27-1661, 7/27/89)

Finally, Mr. Hansen, the proposed air permit for the Echo Bay/McCoy mine in Nevada shows that the cyanide loading and unloading emission rates at this facility's cyanide storage silo are .16 and .12 lbs/hr., with 1095 hr/year of loading allowed, and 8760 hr/yr. of unloading allowed.

This permit and worker injury information clearly shows that any increased handling and storage of cyanide increases the emissions of cyanide to the environment. In the instance of the Echo Bay/McCoy facility, delivery, unloading and storage of cyanide potentially emits 1200 lb./yr. of this material.

Therefore recycling and reuse of cyanide, as opposed to increased delivery, storage and handling of this material, could reduce these emissions of cyanide.

Relevant portions of the quoted materials are enclosed. I regret that I may be ineligible to testify at the August 7 EQC hearing because of my inability to participate in earlier hearings on this rulemaking, but I hope this material is useful to you, and will be provided to the EQC for consideration.

DMIS-MSHA: AB060LA METAL/NONMETAL ACCIDENT AND INJURY ABSTRACT CYCLE: 91/077 DATE PREPARED: 03/17/92
(CONTRACTORS EXCLUDED) SELECTION PERIOD: 01/01/91 THRU 12/31/91 REPORT SEQUENCE: (MINE,SUBU,DATE) PAGE: 1

-MINE ID--	CTR	-----OCCUPATION TITLE-----	-ACCIDENT CLASSIFICATION-	
FOFC CNTY	CMP	---ACTIVITY OF INJURED---	----SOURCE OF INJURY-----	
---STATE---	SEX	--LOCATION OF ACCIDENT---	----NATURE OF INJURY-----	
---IDATE--	AGE	-CANVASS- COMMODITY-	--PART OF BODY INJURED---	---------NARRATIVE DESCRIPTION OF ACCIDENT AND INJURY---------
DOCUMENT#	DEG	-----MINING MACHINE-------	MANUFACTURER --MODEL #--	---------AS CONTAINED ON THE ACC/INJ FORM (FORM 7000-1)-----
CLOS DOC#	AT	-UG MNEMTH DAW DRSA CHGD	MN EXP JB EXP TO EXP PTB	
0301603		CRANE OPR/DRAGLINE/BACKHO	POISONING (TOXIC MATER)	EMPLOYEE WAS SEEN CONSCIOUS 15 MINTUES BEFORE END OF WORK
5871 111	YES	OPR SURFACE EQUIPMENT,NEC	NOXIOUS MINE GASES,NEC	SHIFT. AT END OF SHIT EMPLOYEE WAS FOUND UNCONSCIOUS.
ARKANSAS	M	STRIP/OPEN PIT	POISONING,SYSTEMIC	EMPLOYEE WAS TRANSPORTED BY AMBULANCE TO HOSPITAL AT THIS
03/14	44	SND+GRL-SAND & GRAVEL	BODY SYSTEM-POISON,NERVE	TIME NO DETERMINATION AS TO CAUSE HAS BEEN MADE.
210840181	7	************************	************ ***********	
310910020	36	********** 0007 0000 3109	5Y30W 17Y 0W 17Y 0W 13	
0401763		BELT/CONVEYOR MAN	POISONING (TOXIC MATER)	EMPLOYEES USING GAS WATER PUMP IN TUNNEL WAS OVERCOME WITH
7831 037	YES	OPR SURFACE EQUIPMENT,NEC	NOXIOUS MINE GASES,NEC	CARBON MONOXIDE, TAKING TO HOSPITAL FOR EXAMINATION AND WAS
CALIFORNI	M	STRIP/OPEN PIT	POISONING,SYSTEMIC	GIVEN OXYGEN.
12/09	27	SND+GRL-SAND & GRAVEL	BODY SYSTEM-POISON,NERVE	
213470003	7	PUMP	NOT ON LIST OP301TH	
313470023	36	********** 0000 0000 0000	1Y 0W 0Y28W 1Y28W 13	
0401880		BELT/CONVEYOR MAN	POISONING (TOXIC MATER)	EXPOSED TO RADIATION
7831 059	YES	UNKNOWN	RDIATNG SUBST OF EQIP,NEC	
CALIFORNI	M	STRIP/OPEN PIT	OTH RADIATION EFFECT,NEC	
09/11	41	SND+GRL-SAND & GRAVEL	MULTIPLE MAJOR BODY PARTS	
212730053	7	************************	************ ***********	
	38	********** 0000 0000 0000	2Y 0W 2Y 0W 13Y 0W 13	US ENERGY - LINCOLN MINE
0405038		MINER NEC	POISONING (TOXIC MATER)	MINER DID NOT PROPERLY VENTILATE WORK AREA AS INSTRUCTED.
7821 005	YES	WALKING/RUNNING	NOXIOUS MINE GASES,NEC	WHE HE ENTERED HIS WORK AREA HE ENCOUNTERED AIR WITH
CALIFORNI	M	SLOPE/INC SHAFT (UG)	POISONING,SYSTEMIC	POSSIBLY HIGH LEVELS OF OXIDES ON NITROGEN AND CO GAS. HE
08/05	39	METAL -GOLD (LODE AND PL	BODY SYSTEM-POISON,NERVE	EXPERIENCED SHORTNESS OF BREATH AND HEADACHE. HE WAS TAKEN
212250016	7	************************	************ ***********	TO THE AMADOR COUNTY HOPSITAL EMERGENCY ROOM. HE WAS
312250003	36	CONV/STOPE 0000 0000 0000	0Y 4W 15Y 0W 15Y 0W 13	EXAMINED, TESTED AND RELEASED TO RETURN TO WORK.
0405038		MINER NEC	POISONING (TOXIC MATER)	MINER DIDNT PROPERLY VENTILATE WORK AREA AS INSTRUCTED.WHEN
7821 005	YES	BAR DOWN FACE,RIB,SIDE,RF	NOXIOUS MINE GASES,NEC	HE ENTERED WORK AREA ENCOUNTERED AIR WITH POSSIBLY HIGH
CALIFORNI	M	SLOPE/INC SHAFT (UG)	POISONING,SYSTEMIC	LEVELS OF OXIDES OF NITROGEN & CO GAS.EXPERIENCED SHORTNESS
08/05	42	METAL -GOLD (LODE AND PL	BODY SYSTEM-POISON,NERVE	OF BREATH & HEAD ACHE.TAKEN TO EMERG RM,EXAMINED,TESTED &
212240274	7	************************	************ ***********	RELEASE
312240008	36	CONV/STOPE 0000 0000 0000	0Y 4W 18Y 0W 18Y 0W 13	DAVID
0504431		CINPLT/MED/BONEYOPR/CRSHR	POISONING (TOXIC MATER)	AFTER MIXING CHEMICALS WHEN OPERATOR REMOVED HIS RESPIRATOR
6642 047	YES	WORKING WITH CHEMICALS	CHEMICALS,CHEM COMP,NEC	HE RECIVED A CYANIDE DUST EXPOSURE-DUE TO HIGH WINDS AND THE
COLORADO	M	MILL/PREP PLANTS,ETC.	POISONING,SYSTEMIC	TYPE OF CYANIDE(GRANULAR NOT BRICKETTS).AFTER THE SHIFT THE
11/08		METAL -GOLD (LODE AND PL	BODY SYSTEM-POISON,NERVE	OPERATOR WE NT TO THE HOSPITAL FOR OBSERVATION-NO MEDICAL
213170041	7	************************	************ ***********	TREATMENT WAS RECEIVED.THIS TYPE OF CYANIDE WILL NOT BE
	36	********** 0000 0000 0000	1Y12W 1Y12W 1Y12W 13	UTILIZED ON THIS SITE AGAIN.

-MINE ID-	CTR	----OCCUPATION TITLE-----	-ACCIDENT CLASSIFICATION-	
FOFC CNTY	CMP	---ACTIVITY OF INJURED---	----SOURCE OF INJURY-----	
--STATE--	SEX	--LOCATION OF ACCIDENT---	----NATURE OF INJURY-----	
--IDATE--	AGE	-CANVASS- COMMODITY-	--PART OF BODY INJURED---	----------NARRATIVE DESCRIPTION OF ACCIDENT AND INJURY--------
DOCUMENT#	DEG	-----MINING MACHINE------	MANUFACTURER --MODEL #--	----------AS CONTAINED ON THE ACC/INJ FORM (FORM 7000-1)-----
CLOS DOC#	AT	-UG MNEMTH DAW DRSA CHGD	MN EXP JB EXP TO EXP PTB	
2000022		CLNPLT/MED/BONEYOPR/CRSHR	POISONING (TOXIC MATER)	HE ENTERED THE FEED END BUILDING AND WAS OVERCOME BY CARBON
4631 115	YES	WALKING/RUNNING	NOXIOUS MINE GASES,NEC	MONOXIDE FUMES.
MICHIGAN	M	MILL/PREP PLANTS,ETC.	POISONING,SYSTEMIC	
11/17	50	STONE -LIMESTONE (CRUSH	BODY SYSTEM-POISON,NERVE	
201430079	7	************************	************ ***********	
	36	********** 0000 0000 0000	15Y20W 3Y16W 15Y20W 13	
2002574		MINER NEC	POISONING (TOXIC MATER)	THE EMPLOYEE WAS WORKING ON THE 1600 LEVEL IN AN IMPROPERLY
4641 103	YES	OPR FRONT-END LOADER	NOXIOUS MINE GASES,NEC	VENTILATED AREA,WHILE RUNNING LOADER AND OTHER EQUIPMENT.
MICHIGAN	M	OTHER UNDERGROUND	POISONING,SYSTEMIC	
05/03	26	METAL -GOLD (LODE AND PL	BODY SYSTEM-POISON,NERVE	
291280080	7	FRONT-END LODR,TRACTR-SHV	NOT REPORTED ***********	
391280046	36	OTHER 0000 0000 0000	3Y16W 3Y 6W 3Y16W 13	western States Mineral - Northumberland
2601661		CLNPLT/MED/BONEYOPR/CRSHR	POISONING (TOXIC MATER)	I.NAME AND 2 OTHERS HAD JUST FINISHED UNLOADING CYANIDE
7851 023	YES	HANDL SUPLY,MTRL,LOAD/UNL	NOXIOUS MINE GASES,NEC	BOXES FROM TRACTOR TRAILER.I.NAME OPERATING BACKHOE USED TO
NEVADA	M	STRIP/OPEN PIT	POISONING,SYSTEMIC	UNLOAD BOXES.THE 3 WERE STANDING AT BACK OF TRAILER WHEN I.
07/27	18	METAL -GOLD (LODE AND PL	BODY SYSTEM-POISON,NERVE	NAME PASSED OUT.H ELP WAS SENT FOR AND I.NAME GIVEN OXYGEN
292190080	7	************************	************ ***********	AND TAKEN TO HOSPITAL.
	36	********** 0000 0000 0000	0Y 8W 0Y 8W 0Y 8W 13	
3000070		LABORER/UTILITY MN/PUMPER	POISONING (TOXIC MATER)	AFTER SHOVELING COAL COKE SPILL AT FEEDER #9 IN RECLAIM
2881 039	YES	HAND LOAD,SHOVEL/MUCKING	NOXIOUS MINE GASES,NEC	TUNNEL FOR APPROX. 5 HOURS, EMPLOYEE WENT TO CONTROL ROOM.
NEW YORK	M	MILL/PREP PLANTS,ETC.	POISONING,SYSTEMIC	WHEN DESCENDING STAIRS FROM CONTROL ROOM, HE ALLEGEDLY
01/27	27	STONE -CEMENT	BODY SYSTEM-POISON,NERVE	STARTED FEELING DIZZY. LATER HE FELT NAUSEOUS AND FELT LACK
290790143	7	HANDTOOL-NT POWERD,WRENCH	NOT REPORTED ***********	OF COORDINATION. DURING THE NEXT TWO DAYS THE SYMPTOMS
	36	********** 0000 0000 0000	1Y 5W 1Y 5W 1Y 5W 13	REMAINED.
3600100		TRUCK DRIVER	POISONING (TOXIC MATER)	EMPLOYEE WAS OPERATING A BACK DUMP TRUCK WHEN HE STARTED
2621 091	YES	OPR HAULAGE TRUCK	NOXIOUS MINE GASES,NEC	CAUGHING AND FEELING PAINS IN THE CHEST. AT THIS TIME HE
PENNSYLVA	M	STRIP/OPEN PIT	POISONING,SYSTEMIC	NOTICED EXHAUST FUMES IN TEH CAB OF THE TRUCK.
11/07	33	STONE -LIMESTONE (CRUSH	BODY SYSTEM-POISON,NERVE	
293330047	7	ORE HAULAGE/OFF HIWY TRUK	CATERPILLAR 769	
393330002	36	********** 0000 0000 0000	1Y 0W 1Y 0W 1Y 0W 13	

APPLICATION REVIEW

Echo Bay - McCoy Mine

Echo Bay Minerals Company of Battle Mountain, Nevada submitted a request to amend the following existing permits for modifications to existing hours of operation - (PC 1307, 2606, 2160, 1991, 2163; OP 1812, 1813, 1814). Echo Bay Minerals Company also submitted a request and applications for the addition of one new diatomaceous earth silo, one new Velmac lime silo, one new Cambelt cement/lime silo, a reduction in cyanide storage bins and for a temporary pilot plant. A summary of all equipment (both proposed and existing) is contained in Table I. The McCoy Mine is located approximately 56.3 kilometers (35 miles) south of Battle Mountain, Nevada in Hydrographic Area 59, Lower Reese River Valley. This area is designated non-attainment for particulate and unclassified for all other pollutants that have an ambient air quality standard and as such Echo Bay Minerals Company must provide for the Lowest Achievable Emission Rate (LAER) for all particulate emissions.

Modifications to existing permits:

PC 1307 ..... Echo Bay Minerals Company has requested the loading time be increased to 3 hours per day and 1095 hours per year, and the discharge time to be increased to 24 hours per day and 8760 hours per year, for the lime/cement silo.

PC 2606 ..... Echo Bay Minerals Company has requested to reduce from three (3) to two (2) calcium cyanide storage silos and to reduce the loading time to 3 hours per day and 1095 hours per year. One silo may also be used for the storage and discharge of lime.

PC 2160 ..... Echo Bay Minerals Company has requested the loading time be increased to 3 hours per day and 1095 hours per year for the diatomaceous earth silo.

PC 1991 ..... Echo Bay Minerals Company has requested the throughput be increased to 1100 short tons per hour for the pug mill.

PC 2163 ..... Echo Bay Minerals Company has requested the hours of operation be increased to 24 hours per day and 8760 hours per year for the two (2) bullion furnaces.

Modifications requiring new permits to construct:

OP 1812 ..... Echo Bay Minerals Company has requested the hours of operation be increased to 24 hours per day and 8760 hours per year for the mercury retort.

OP 1813 ..... Echo Bay Minerals Company has requested the hours of operation be increased to 24 hours per day and 8760 hours per year for the carbon kiln.

OP 1814 ..... Echo Bay Minerals Company has requested the hours of operation be increased to 24 hours per day and 8760 hours per year for the T-Thermal solution heater.

EMISSIONS

An emission summary of the proposed equipment and the existing permitted equipment is contained in Table II.

PSD EMISSION DETERMINATION

Since this area is defined as non-attainment for particulate, PSD regulations are not appropriate for this pollutant. However, PSD regulations do apply for all other pollutants. The only other criteria (listed in the Clean Air Act) pollutant emitted from the mine is sulfur dioxide. Sulfur dioxide emissions are contributed from the solution heating boiler. The yearly emission impact of sulfur dioxide is 95.0 ST/yr, which is less than the 250 ST/yr emission rate necessary required for a source to trigger PSD review. Also, this source is exempt from PSD/NSR review because of a requirement that operation is limited to the operating hours specified in Table I. Any relaxation of the emission limits or operating hours that increases the potential to emit above the applicable PSD/NSR threshold will require a full PSD/NSR review of the source as though construction had not yet commenced.

TABLE I

Source	Operating Rate	Operating Hours (Day/Annual)	Proposed Controls
New Equipment			
Cambelt Lime/Cement Silo - (loading)	38.50 ST/hr.	3/1095	Baghouse
Cambelt Lime/Cement Silo - (discharge lime)	0.7 ST/hr	24/8760	Uncontrolled
Cambelt Lime/Cement Silo - (discharge cement)	5.0 ST/hr	24/8760	Uncontrolled
Diatomaceous Earth Silo - (loading)	37.5 ST/hr	3/1095	Baghouse
Diatomaceous Earth Silo - (discharge)	1.5 ST/hr	24/8760	Uncontrolled
Velmac Lime Silo - (loading)	50.0 ST/hr	2/730	Baghouse
Velmac Lime Silo - (discharge)	2.4 ST/hr	24/8760	Uncontrolled
Pilot Plant Jaw Crusher and Screen	10.0 ST/hr	8/2920	Pneumatic Fogging Water Sprays
Pilot Plant 3 Belt Conveyor Transfers	2.0 ST/hr	8/2920	Pneumatic Fogging Water Sprays
Pilot Plant Roll Crusher	1.0 ST/hr	8/2920	Uncontrolled
Pilot Plant Bucket Elevator	2.0 ST/hr	8/2920	Pneumatic Fogging Water Sprays
Modifications Requiring Amendments			
PC 1307 - Lime/Cement Silo - (loading)	38.5 ST/hr	3/1095	Baghouse
PC 1307 - Lime/Cement Silo - (discharge lime)	0.7 ST/hr	24/8760	Uncontrolled
PC 1307 - Lime/Cement Silo - (discharge cement)	5.0 ST/hr	24/8760	Uncontrolled
PC 2606 - (2) Calcium Cyanide Storage Bins - (loading)	30.0 ST (each)	3/1095	Baghouse
PC 2606 - (2) Calcium Cyanide Storage Bins - (discharge)	1.5 ST/hr (each)	24/8760	Uncontrolled
PC 2160 - Diatomaceous Earth Silo - (loading)	37.5 ST/hr	3/1095	Baghouse
PC 2160 - Diatomaceous Earth Silo - (discharge)	1.5 ST/hr	24/8760	Uncontrolled
PC 1991 - Pug Mill	1100 ST/hr	24/8760	Wet Process
PC 2163 - (2) Bullion Furnaces	1.0 ST/hr (combined)	24/8760	Venturi Scrubber/Separator
Modifications Requiring A New Permit To Construct			
OP 1812 - Mercury Retort	0.5 ST/hr	24/8760	Closed System
OP 1813 - Carbon Kiln	0.15 St/hr	24/8760	Uncontrolled
OP 1814 - T-Thermal Solution Heater	220 Gal/hr	24/8760	Water Quench/Mist Eliminator
Existing Equipment			
PC 1970 - Transfer To Crusher	750 ST/hr	24/8760	Fogging Water Sprays W/Surf.
PC 1970 - Mill Crushing Circuit	750 ST/hr	24/8760	Baghouse
PC 1970 - Transfer To Stacker Conveyor	750 ST/hr	24/8760	Baghouse
PC 1970 - Transfer To Radial Stacker	750 ST/hr	24/8760	Fogging Water Sprays W/Surf. & Enclosure
PC 1970 - Transfer Stacker To Stockpile	750 ST/hr	24/8760	Fogging water Sprays W/Surf. & Enclosure
PC 1970 - Mill Reclaim System	750 ST/hr	24/8760	Baghouse
PC 2625 - Transfer To Wobbler Feeder	1100 ST/hr	24/8760	Pneumatic Fogging Water Sprays
PC 2625 - Transfer Feeder To Crusher	1100 ST/hr	24/8760	Pneumatic Fogging Water Sprays
PC 2625 - Heapleach Primary Crusher	1100 ST/hr	24/8760	Pneumatic Fogging Water Sprays
PC 2625 - Transfer To Radial Stacker	1100 ST/hr	24/8760	Pneumatic Fogging Water Sprays
PC 2625 - Transfer Stacker To Stockpile	1100 ST/hr	24/8760	Pneumatic Fogging Water Sprays
PC 2626 - Heapleach Secondary Crushing	1100 ST/hr	24/8760	Baghouse
PC 2626 - 2 Conveyor Transfers	1100 ST/hr	24/8760	Baghouse
PC 2627 - Heapleach Secondary Screening	1100 ST/hr	24/8760	Baghouse
PC 2628 - Heapleach Tertiary Crusher	1100 ST/hr	24/8760	Baghouse
PC 2629 - Heapleach Tertiary Screening	1100 ST/hr	24/8760	Baghouse
PC 2629 - Transfer To Silos	1100 ST/hr	24/8760	Pneumatic Fogging Water Sprays
PC 2629 - Transfer To Stacker	1100 ST/hr	24/8760	Pneumatic Fogging Water Sprays
PC 2629 - 15 Conveyor Transfers Past Pug Mill	1100 ST/hr	24/8760	Controlled By Moisture Content Of Material
PC 2159 - Velmac Lime Silo - (loading)	50 ST/hr	2/730	Baghouse
PC 2159 - Velmac Lime Silo - (discharge)	3 ST/hr	24/8760	Uncontrolled
PC 1858 - Assay Lab Equipment	various	24/8760	Baghouse,
PC 2161 - Slag Handling System	0.2 ST/hr	24/8760	Baghouse
PC 2162 - Flux Handling System	2.5 St/yr	24/8760	HEPA/ULPA Filter System

OFFSET DETERMINATION

The highest particulate emission impact is 138.61 ST/yr as summarized in Table III. The latest total offset requirement, which has been fulfilled, was determined to be 142.12 ST/yr (125% of the predicted emission level at the time of previous review, 143.04 ST/yr). The latest emission inventory includes consideration for the actual controlled emission rates from the source tested processes. Since Echo Bay has complied with the 143.04 ST/yr offset requirement previously determined, and since the calculated facility emissions have decreased to 138.61 ST/yr, a decrease of 3.51 ST/yr, no offset will be required for the stationary source emissions inventory.

TABLE II

Source	Operating Rate	Uncontrld Emission Factor (lb/ST)	Uncontrolled Emissions (lb/hr)	Contrld (Actual) Emissions (lb/hr)	NAC Allow. Emissions[4] (lb/hr)
New Equipment					
Cambelt Lime/Cement Silo - (loading)	38.5 ST/hr	0.27[2]	10.40	0.10	25.3
Cambelt Lime/Cement Silo - (discharge lime)	0.7 ST/hr	0.04[2]	0.03	0.03	3.8
Cambelt Lime/Cement Silo - (discharge cement)	5.0 ST/hr	0.04[2]	0.2	0.02	9.3
Diatomaceous Earth Silo - (loading)	37.5 ST/hr	0.27[2]	10.13	0.01	25.2
Diatomaceous Earth Silo - (discharge)	1.5 ST/hr	0.04[2]	0.06	0.06	5.4
Velmac Lime Silo - (loading)	50.0 ST/hr	0.27[2]	13.50	0.14	26.7
Velmac Lime Silo - (discharge)	2.4 ST/hr	0.04[2]	0.10	0.10	6.7
Pilot Plant Crusher and Screen	10.0 ST/hr	0.05[1]	0.50	0.03	12.6
Pilot Plant 3 Conveyor Transfers	2.0 ST/hr	0.18[1]	0.36	0.02	6.1
Pilot Plant Roll Crusher	1.0 ST/hr	0.05[1]	0.05	0.05	4.5
Pilot Plant Bucket Elevator	2.0 ST/hr	0.06[1]	0.06	0.01	6.1
Modifications Requiring Amendments					
PC 1307 - Lime/Cement Silo - (loading)	38.5 St/hr	0.27[2]	10.4	0.10	25.3
PC 1307 - Lime/Cement Silo - (discharge lime)	0.7 ST/hr	0.04[2]	0.03	0.03	3.8
PC 1307 - Lime/Cement Silo - (discharge cement)	5.0 ST/hr	0.04[2]	0.20	0.20	9.3
PC 2606 - (2) Calcium Cyanide Storage - (loading)	30.0 ST/hr (each)	0.27[2]	16.2	0.16	48.0
PC 2606 - (2) Calcium Cyanide Storage - (discharge)	1.50 ST/hr (each)	0.04[2]	0.12	0.12	10.8
PC 2160 - Diatomaceous Earth Silo - (loading)	37.5 ST/hr[5]	0.27[2]	10.13	0.10	25.2
PC 2160 - Diatomaceous Earth Silo - (discharge)	1.5 ST/hr	0.04[2]	0.06	0.06	5.4
PC 1991 - Pug Mill	1100 ST/hr	N/A	N/A	N/A	N/A
PC 2163 - Bullion Furnaces (2)	1.0 ST/hr (comb)	22.0[3]	22.0	0.22	4.1[6]
Modifications Requiring A New Permit To Construct					
OP 1812 - Mercury Retort	0.5 ST/hr	N/A	N/A	N/A	N/A
OP 1813 - Carbon Kiln	0.15 ST/hr	3.3[8]	0.049	0.0083	0.0083[9]
OP 1814 - T-Thermal Solution Heater	220 Gal/hr	2.10[10]	0.44	0.0357	0.0357[11]
Existing Equipment					
PC 1970 - Transfer To Crusher	750 ST/hr	0.06[1]	44.4	2.25	44.4
PC 1970 - Mill Crushing Circuit	750 ST/hr	0.05[1]	37.5	See Note 7	37.5
PC 1970 - Transfer To Stack Conveyor	750 ST/hr	0.06[1]	45.0	See Note 7	45.0
PC 1970 - Transfer To Radial Stacker	750 ST/hr	0.06[1]	45.0	1.13	45.0
PC 1970 - Transfer Stacker To Stockpile	750 ST/hr	0.06[1]	44.4	1.13	44.4
PC 1970 - Mill Reclaim System	750 ST/hr	0.06[1]	44.4	See Note 15	44.4
PC 2625 - Transfer To Wobbler Feeder	1100 ST/hr	0.06[1]	47.3	3.30	47.3
PC 2625 - Transfer Feeder To Crusher	1100 ST/hr	0.06[1]	47.3	3.30	47.3
PC 2625 - Heapleach Primary Crusher	1100 ST/hr	0.05[12]	55.0	2.75	47.3
PC 2625 - Transfer To Radial Stacker	1100 ST/hr	0.06[1]	47.3	1.65	47.3
PC 2625 - Transfer Stacker To Stockpile	1100 ST/hr	0.06[1]	47.3	1.65	47.3
PC 2626-27 - Heapleach Secondary Crushing & Screening	1100 ST/hr	0.16[1]	176.0	See Note 13	47.3
PC 2628 - 2 Conveyor Transfers	1100 ST/hr	0.06[1]	66.0	See Note 13	66.0
PC 2628-29 - Heapleach Tertiary Crushing & Screening	1100 ST/hr	0.16[1]	176.0	See Note 13	47.3
PC 2629 - Transfer To Silos	1100 ST/hr	0.06[1]	66.0	See Note 13	47.3
PC 2629 - Transfer To Stacker	1100 ST/hr	0.06[1]	66.0	See Note 13	47.3
PC 2629 - 15 Conveyor Transfers Past Pug Mill	1100 ST/hr	0.00033[14]	47.3	5.40	47.3
PC 2159 - Velmac Lime Silo (loading)	50.0 ST/hr	0.27[2]	13.5	0.14	26.7
PC 2159 - Velmac Lime Silo (discharge)	3.0 ST/hr	0.04[2]	0.12	0.12	7.4
PC 1858 - Assay Lab Equipment	Various	N/A	N/A	N/A	N/A
PC 2161 - Slag Handling System	0.2 ST/hr	N/A[1]	1.4	1.4	1.4
PC 2162 - Flux Handling System	2.5 ST/hr	N/A[1]	0.003	0.003	N/A

[1] Obtained from Table 8.23-1 of AP-42.
[2] Obtained from Table 8.10-1 of AP-42.
[3] Obtained from Table 8.16-1
[4] Based on NAC 445.732 allowable emission equation, unless otherwise specified.
[5] Based on a density of 15 lb/ft³ (dry), from Scott at Eagle Picher-Clark Station.
[6] Based on emission test conducted December, 1989. Emissions are calculated from the 3 test average concentration of 0.0041 gr/dscf and volume flow rate of 3898.0 dscfm.
[7] Based on emission test conducted January, 1990. Individual total emissions are 0.87 lb/hr for the primary crusher baghouse.
[8] Emission factor is based on the highest rate emitted from a compilation of various carbon kiln tests required by DEP.
[9] Based on emission test conducted October, 1989. Emissions are calculated from the 3 test average concentration of 0.0038 gr/dscf and volume flow rate of 254.67 dscfm.
[10] Obtained from Table 1.3-1 of AP-42. Units are "lb/1000 gallons" of fuel burned. This unit is permitted to burn a maximum of 220 gallons of #2 fuel oil per hour. Sulfur emissions are obtained from NAC 445.745.2 and are based on the 31 mmBtu/hr heat input. The allowable sulfur emission is 21.7 lb/hr.
[11] Based on emission test conducted October, 1989. Emissions are calculated from the 3 test average concentration of 0.0034 gr/dscf and volume flow rate of 1213.3 dscfm.
[12] Obtained from Table 8.23-1 of AP-42. Factor is for primary crusher only (no screen).
[13] Based on emission test conducted October, 1989. Emissions are calculated from the 3 test average concentration of 0.0101 gr/dscf and volume flow rate of 14600.3 dscfm total emissions equal 1.89 lb/hr.
[14] Based on equation and table from section 11.2.3.2; AP-42.
[15] Based on emission test conducted January, 1990. Individual total emissions are 0.46 lb/hr for the mill reclaim baghouse.

TABLE III

Source	Emission Rate (lb/hr)	Operating Hours (Annual)	Annual Emission Rate (ST/yr)
New Equipment			
Cambelt Lime/Cement Silo - (loading)	0.10	3.0/1095	0.06
Cambelt Lime/Cement Silo - (discharge lime)	0.03	24/8760	0.12*
Cambelt Lime/Cement Silo - (discharge cement)	0.20	24/8760	0.88
Diatomaceous Earth Silo - (loading)	0.10	3.0/1095	0.06
Diatomaceous Earth Silo - (discharge)	0.06	24/8760	0.26
Velmac Lime Silo - (loading)	0.14	2/730	0.05
Velmac Lime Silo - (discharge)	0.10	24/8760	0.42
Pilot Plant Jaw Crusher and Screen	0.03	8/2920	0.04
Pilot Plant 3 Conveyor Transfers	0.02	8/2920	0.03
Pilot Plant Roll Crusher	0.05	8/2920	0.07
Pilot Plant Bucket Elevator	0.01	8/2920	0.01
Modifications Requiring Amendments			
PC 1307 - Lime/Cement Silo - (loading)	10.4	3/1095	0.06
PC 1307 - Lime/Cement Silo - (discharge lime)	0.03	24/8760	0.12*
PC 1307 - Lime/Cement Silo - (discharge cement)	0.20	24/8760	0.88
PC 2606 - (2) Calcium Cyanide Storage - (loading)	16.2	3/1095	0.08
PC 2606 - (2) Calcium cyanide Storage - (discharge)	0.12	24/8760	0.52
PC 2160 - Diatomaceous Earth Silo - (loading)	10.13	3/1095	0.06
PC 2160 - Diatomaceous Earth Silo - (discharge)	0.06	24/8760	0.26
PC 1991 - Pug Mill	N/A	N/A	N/A
PC 2163 - Bullion Furnaces (2)	4.10	24/8760	14.96
Modifications Requiring A New Permit To Construct			
OP 1812 - Mercury Retort	N/A	N/A	N/A
OP 1813 - Carbon Kiln	1.15	24/8760	0.01
OP 1814 - T-Thermal Solution Heater	0.03	24/8760	0.14
Existing Equipment			
PC 1970 - Transfer To Crusher	45.0	24/8760	9.86
PC 1970 - Mill Crushing Circuit	37.5	24/8760	See Note 1
PC 1970 - Transfer To Stacker Conveyor	45.0	24/8760	See Note 1
PC 1970 - Transfer To Radial Stacker	45.0	24/8760	4.93
PC 1970 - Transfer Stacker To Stockpile	45.0	24/8760	4.93
PC 1970 - Mill Reclaim System	135.0	24/8760	See Note 3
PC 2625 - Transfer To Wobbler Feeder	66.0	24/8760	14.45
PC 2625 - Transfer Feeder To Crusher	66.0	24/8760	14.45
PC 2625 - Heapleach Primary Crusher	55.0	24/8760	12.05
PC 2625 - Transfer To Radial Stacker	66.0	24/8760	7.23
PC 2625 - Transfer Stacker To Stockpile	66.0	24/8760	7.23
PC 2626-27 - Heapleach Secondary Crushing	176.0	24/8760	See Note 2
PC 2626 - 2 Conveyor Transfers	132.0	24/8760	See Note 2
PC 2628-29 - Heapleach Tertiary Crushing	176.0	24/8760	See Note 2
PC 2629 - Transfer To Silos	66.0	24/8760	See Note 2
PC 2629 - Transfer To Stacker	66.0	24/8760	See Note 2
PC 2629 - 15 Conveyor Transfers Past Pug Mill	5.4	24/8760	23.85
PC 2159 - Lime Silo - (loading)	13.5	2/730	0.05
PC 2159 - Lime Silo - (discharge)	3.0	24/8760	0.53
PC 1858 - Assay Lab Equipment	Various	Various	N/A
PC 2161 - Slag handling System	1.4	24/8760	6.14
PC 2162 - Flux Handling System	0.003	24/8760	0.013
		TOTAL:	138.61

* 0.12 ST/yr from lime discharge is not included for total annual emissions, discharge rate of 0.88 ST/yr from cement has been determined to be worst case.

Note 1 - Total annual emission rate is equal to 3.81 ST/yr, based on January 1990 source tested emission rate of 0.87 pounds per hour.

Note 2 - Total annual emission rate is equal to 8.23 ST/yr, based on October 1988 source tested emission rate of 1.88 pounds per hour.

Note 3 - Total annual emission rate is equal to 2.01 ST/yr, based on October 1988 source tested emission rate of 0.46 pounds per hour.