Site Investigation Work Plan

Santosh Landfill

Hogan Ranch Road
Scappoose, Oregon
ECSI No. 1383

Prepared for
Oregon Department of
Environmental Quality

March 27, 2020
150-002-020/Task 2

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Prepared by

Hart Crowser, Inc.

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Site Investigation Work Plan

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1.0 INTRODUCTION

This work plan presents the scope of work for completing site investigation (SI) activities at the Santosh Landfill (the "site") in Scappoose, Oregon (Figure 1). Planned activities include groundwater monitoring, site inspection, and site maintenance. This work plan was prepared for the Oregon Department of Environmental Quality (DEQ) under Task 2 of Task Order 72-18-20. The site is listed in DEQ's Environmental Cleanup Site Information (ECSI) database as ECSI No. 1383.

1.1 Purpose

The purpose of groundwater monitoring is to assess current groundwater conditions at the site, whether changes or trends in groundwater quality have occurred, and for potential unacceptable risks to human health or the environment from groundwater pathways. Besides analysis for landfill indicator parameters, samples will also be analyzed for per- and poly-fluoroalkyl substances (PFAS) to assess for the presence and/or extent of these emerging chemicals of concern. Site inspection and maintenance activities will allow DEQ to assess site conditions and take any steps necessary to ensure the landfill's environmental safeguards are functioning properly.

1.2 Scope of Work

To accomplish the above objectives, the scope of work described in this SI Work Plan will consist of the following general tasks:

- Conduct groundwater monitoring of 14 monitoring wells at the site, including water level and field parameter measurement and collection of groundwater samples.
- Analyze groundwater samples for landfill indicator parameters in all 14 site monitoring wells and PFAS in seven monitoring wells.
- Manage investigation-derived waste (IDW).
- Conduct site maintenance and wetland enhancement activities.
- Prepare an SI Report discussing the analytical results and assessing the data for groundwater quality changes and potential unacceptable risks to human and ecological receptors.

These activities are discussed in further detail within this work plan. A Sampling and Analysis Plan (SAP) and Site-Specific Health and Safety Plan (HASP) for the proposed field activities are included as appendices to this work plan.

1.3 Limitations

This SI Work plan has been prepared for DEQ. Work for this project will be performed in accordance with generally accepted professional practices relating to the nature of work completed at the same or similar localities. It is intended for the exclusive use of DEQ for specific application to the site. No other warranty, express or implied, is made.

2.0 BACKGROUND

This section presents a brief description of the site, its history, its physical setting, and results of previous environmental activities. Information about the site was gathered by previous site activities (conducted by Hart Crowser) and through a review of documentation provided by DEQ. References are provided in Section 5.

2.1 Site Location and Operational History

The Santosh Landfill is located approximately 1 mile north-northeast of the City of Scappoose, Oregon (Figure 1). The southern end of the landfill is approximately 1,500 to 2,000 feet north-northeast of the intersection of East Honeyman Road and Hogan Ranch Road along the western boundary of Hogan Ranch Road. The site is bounded to the north and west by undeveloped lowlands, to the south by Scappoose Creek, and to the east by Hogan Ranch Road.

From the early 1970s until September 1983, the Santosh Landfill was the primary municipal landfill for Columbia County during that time, receiving both municipal and industrial wastes. The landfill refuse is approximately 25 feet thick and surrounded by a perimeter berm. The landfill was covered with a soil cap upon cessation of operations in the early 1980s.

2.2 Previous Environmental Activities

In 2007, Hart Crowser designed and oversaw regrading and capping of the landfill's southern slope where leachate seeps had been observed. The low-permeable cap consisted of a crushed rock base layer, geosynthetic clay liner material, topsoil, and an erosion control blanket. In January 2008, 4-inch-minus rock was added to the base of the slope to address erosion issues associated with high rainfall and flooding events.

In 2008, Hart Crowser designed and oversaw construction of an impermeable cap over the entire landfill. The cap consists of the following components from bottom to top: re-graded pre-construction ground cover; imported crushed rock foundation layer; geocomposite gas distribution layer; low-permeable geosynthetic clay liner layer; geocomposite drainage layer; and an imported topsoil layer hydroseeded with grass vegetation. A gas ventilation system and stormwater drainage system were also installed as part of the low-permeable cap construction.

There are 14 groundwater monitoring wells at the site: nine wells along the landfill's perimeter berm, one well along Hogan Ranch Road south of the landfill, and four wells along Scappoose Creek. Figure 2 shows the monitoring well locations. Prior to the 2008 cap construction, groundwater monitoring had been completed at the landfill from April 2005 through March 2007 to determine whether observed leachate had affected groundwater quality. Groundwater monitoring since the construction of the low-permeable cap was only completed in January and August 2017. Results from these events are presented in Hart Crowser's Monitoring Report (2017).

3.0 SITE INVESTIGATION ACTIVITIES

Investigation activities will be performed to assess the current extent and magnitude of contamination on the site as well as assess the current wetland health and identify any future maintenance tasks.

3.1 Preparatory Activities

Prior to field work, several preparatory activities will be performed. These are discussed below.

Site-Specific HASP. We prepared a site-specific HASP for the proposed SI activities. The HASP was prepared in general accordance with the Occupational Safety and Health Act and the Oregon Administrative Rules. Hart Crowser personnel will have a copy of the HASP for their use during field activities. The HASP will be included under a separate cover.

Property Access. The DEQ has obtained an access agreement with the site owner to perform the SI activities on the site. Work is not anticipated to occur in public rights of way (ROW), thus a ROW permit or traffic control will not be necessary.

Subcontractors. The SI activities will include chemical analyses and disposal of IDW. Chemical analyses will be conducted by Pace Analytical National of Mt. Juliet, Tennessee, under Price Agreement #8903 with the State of Oregon. For the disposal of IDW, we will solicit bids from waste handlers. Where possible, at least three firms will be solicited for the service. Selection will be based on total unit or lump-sum pricing. The selected firm will be under subcontract to Hart Crowser.

3.2 Groundwater Monitoring

Groundwater monitoring will be conducted to assess current groundwater conditions at the site, whether changes or trends in groundwater quality have occurred, and for potential unacceptable risks to human health or the environment from groundwater pathways (i.e., groundwater use by people and groundwater emergence as surface water with ecological exposures). Monitoring will be conducted from the seven wells at the site: MW-3S, MW-3D, MW-4S, MW-4D, MW-6S, MW-8S, and MW-8D (Figure 2). The SAP in Appendix A presents a detailed discussion of the field monitoring activities and analytical program.

Depth to groundwater will be measured in all 14 site wells prior to sampling. The wells will first be opened and allowed to equilibrate. Groundwater levels will then be measured to the nearest 0.01 foot. Pairs of shallow and deep wells (e.g., MW-1S and MW-1D) will be measured concurrently to determine vertical gradient. Groundwater purging and sampling will then be completed using low-flow sampling techniques. During purging, groundwater field parameters (e.g., pH, temperature, specific conductance, dissolved oxygen, and oxygen-reduction potential) will be measured to assess the effectiveness of purging. When parameters stabilize, collection of the groundwater sample will be performed. Dissolved metals and hardness will be field filtered using a 0.45-micron filter. For quality control/quality assurance purposes, a trip blank and field duplicate will be collected Sample container requirements are included in Table 1 in the SAP. Purge water will be managed as IDW per Section 3.6.

Samples will be stored in a cooled ice chest and submitted under chain of custody documentation to Pace Analytical National for chemical analysis as outlined in the SAP. Analyses will include PFAS and landfill indicator parameters: various dissolved metals, ammonia, cyanide (both weak acid dissociable [WAD] and total), various anions, hardness (total and dissolved), chemical oxygen demand, total organic carbon, total dissolved solids, and total suspended solids.

3.3 Site Maintenance

During the groundwater monitoring site visit, staff will take notes and photographs of needed maintenance activities. Site maintenance generally includes managing fallen trees and repairing perimeter fences. Site maintenance activities will be conducted during a separate site visit to avoid possible cross-contamination with low-level PFAS analyses.

3.4 Wetland Enhancement Activities

An enhanced wetland was constructed during the landfill repair activities at the site in 2007. The wetland will be inspected to determine the overall wetland health and to identify if any future maintenance tasks are needed. In general, field staff will collect a detailed collection of photographs of the wetland following groundwater monitoring. A wetland biologist will review the photographs and provide recommendations for enhancing the wetland’s biodiversity. The wetland inspection and recommendations will use criteria identified in the U.S. Army Corps of Engineers and Oregon Department of State Lands permit issued during the construction of the enhanced wetland.

3.5 Decontamination

To prevent cross contamination between sampling locations, clean, dedicated sampling equipment (e.g., disposable gloves, groundwater sampling tubing) will be used when possible at each sampling location and discarded after use. Cleaning of non-disposable items will consist of washing in a non-phosphate detergent solution, rinsing with tap water, and rinsing with deionized water. Decontamination water will be collected and handled as IDW, as discussed below.

3.6 IDW Management

IDW will consist of purged groundwater from monitoring wells, decontamination water, disposable sampling equipment (e.g., tubing), and personal protective equipment (PPE). Disposable sampling equipment and PPE will be disposed of as solid waste. Water IDW will be placed into labeled, Department of Transportation-approved, 55-gallon steel drums.

4.0 REPORTING

After receipt of analytical results, we will prepare an SI Report to present our findings. The report will present information about the site; the SI activities; the chemical results; an assessment and risk screening of the chemical results; and recommended future maintenance activities. The risk screening will be performed by comparing detected chemical concentrations to DEQ Risk-Based Concentrations (DEQ 2018) and EPA Regional Screening Levels (EPA 2019) for human health for groundwater use and DEQ freshwater Screening Level Values for ecological receptors (DEQ 2001). The report will be prepared in general accordance with the following outline:

Executive Summary
1. Introduction
    a. Purpose
    b. Scope of Work
2. Limitations
3. Background
4. Site Investigation Activities
    a. Preparatory Activities
    b. Groundwater Monitoring
    c. Decontamination
    d. IDW Management
5. Chemical Analyses and Results
    a. Analyses Performed
    b. Chemical Results
6. Risk-Based Screening
7. Recommendations for Future Maintenance Activities
8. Conclusions
9. Appendices
    Photograph Log
    Field Methods and Sampling Procedures
    Analytical Laboratory Testing Program and Documentation, including a QA review

The report will initially be prepared as a draft for review by the DEQ. Upon receipt of DEQ's comments, we will issue the report in final form.

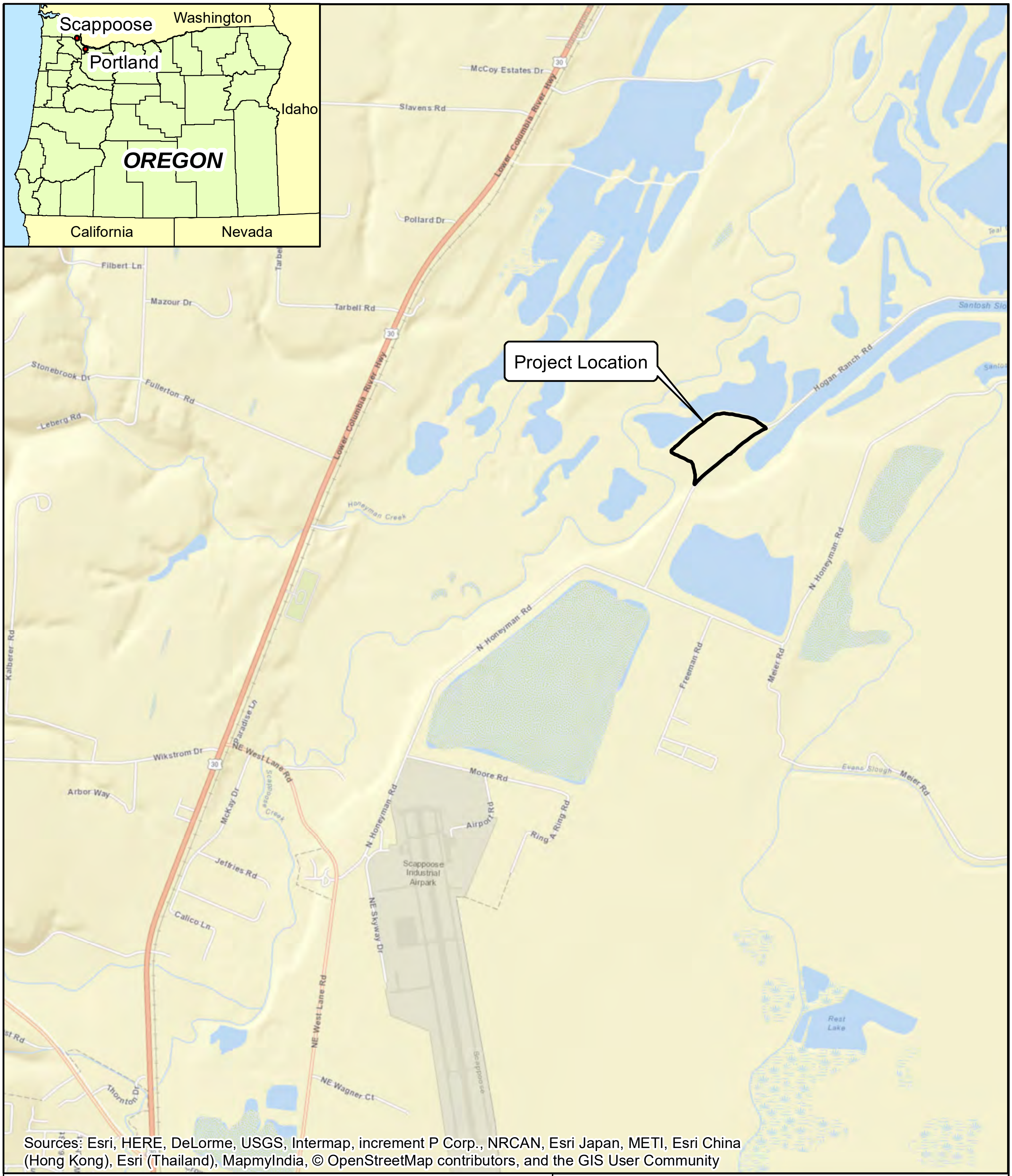
5.0 REFERENCES

DEQ 2001. Guidance for Ecological Risk Assessment: Levels I, II, III, IV. April 1998. Revised December 2001.

DEQ 2018. Excel® Spreadsheet for Risk Based Concentrations for Individual Chemicals. May 2018.

EPA 2019. Regional Screening Levels. November 2019.

Hart Crowser 2017. Groundwater Monitoring Report – January and August 2017, Santosh Landfill (ECSI #1383), Scappoose, Oregon. November 15, 2017.



Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Santosh Landfill
Scappoose, Oregon

Vicinity Map

150-001-053

12/16

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Figure

1

Document Path: F:\Notebooks\150001053_DEQ Santosh GW Monitoring\GIS\150001053_VMap.mxd Date: 12/21/2016 User Name: melissaschweitzer

Sources: Base map prepared from a survey prepared by David C. Smith & Associates, dated 6/05. Aerial photograph provided by Microsoft Bing, 2016.

LEGEND

MW-4S ⊕	Shallow Groundwater Monitoring Well
MW-4D ⊕	Deep Groundwater Monitoring Well

N

0 300 600

Scale in Feet

Note: Feature locations are approximate.

Santosh Landfill
Scappoose, Oregon

Site Plan

150-001-053 12/16

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Figure

2

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APPENDIX A
Sampling and Analysis Plan

Sampling and Analysis Plan

Santosh Landfill

Scappoose, Oregon

ECSI No. 1383

INTRODUCTION

This Sampling and Analysis Plan (SAP) presents the field activities, sample collection procedures, and analytical testing program that Hart Crowser will use to complete groundwater sampling at the Santosh Landfill site in Scappoose, Oregon (Figures 1 and 2). Field and laboratory quality assurance/quality controls (QA/QC) are also discussed.

Data quality objectives (DQOs) for this groundwater sampling event are: (1) to provide a current understanding of groundwater quality at the site by implementing sampling procedures and utilizing appropriate chemical analyses to obtain quality data; and (2) to screen the groundwater data against screening criteria to assess whether unacceptable risks to human health or the environment might be present. To accomplish these DQOs, the scope of work will consist of the following general tasks:

- Measure groundwater levels to determine gradient and flow directions and to compare with past monitoring events.
- Collect groundwater samples from seven monitoring wells at the site.
- Analyze groundwater samples for contaminants of interest (COIs; Section 4.1).
- Manage investigation-derived waste (IDW).
- Prepare a report discussing the field findings and analytical results and assessing data for groundwater quality changes and potential unacceptable risks at the site.

PROJECT TEAM

This section outlines the individuals directly involved with this project and their specific responsibilities.

Oregon DEQ Project Officer: Bob Schwarz, PE. Mr. Schwarz is the Oregon Department of Environmental Quality (DEQ) Project Officer and is responsible for obtaining access to the property, reviewing project deliverables, and providing assistance in problem resolution and technical matters.

Hart Crowser Program Manager: Rick Ernst, RG. Mr. Ernst is the Program Manager for Hart Crowser and will maintain primary responsibility for project quality, schedule, and budget; provide final review of all project deliverables; and serve as a technical resource throughout the project. Mr. Ernst will also monitor project QA procedures to ensure compliance with this SAP, and, if any problems or deficiencies are observed, he will facilitate appropriate corrective actions.

Hart Crowser Task Order Manager: Chris Martin, PE. Mr. Martin is the Task Order Manager for this project and will be the primary contact to the DEQ Project Manager. Mr. Martin will oversee field activities, prepare project deliverables, QA review of data, and manage and coordinate field staff.

Hart Crowser Field Manager: Kevin Woodhouse, RG. Mr. Woodhouse will be responsible for implementing the SAP, including preparing for field activities, implementing the field activities, and maintaining chain of custody with the analytical laboratory. He will also be a backup contact for the Hart Crowser Task Order Manager.

Subcontractors. A subcontractor will be needed to pick up and dispose of IDW generated during field activities. An IDW subcontractor will be solicited and procured in accordance with the terms of Price Agreement #72-18 and, to the extent applicable, state regulations. Solicitation documents will include descriptions of the scope of work and applicable subcontractor requirements. If a subcontractor does not meet the solicitation requirements, they will not be considered for award for the solicited service. The IDW subcontractor will report directly to the Hart Crowser Task Order Manager. Chemical analyses will be performed by Pace Analytical National (Pace) of Mt. Juliet, Tennessee, under State Price Agreement #8903 and billed directly to the DEQ.

FIELD AND SAMPLING PROCEDURES

Groundwater monitoring activities will be performed to assess the current groundwater conditions and quality at the site. Upon receiving analytical results, we will prepare a Groundwater Monitoring Report and coordinate and oversee IDW pick-up and disposal.

Groundwater Monitoring

Groundwater monitoring will be completed from seven site wells: MW-3S, MW-3D, MW-4S, MW-4D, MW-6S, MW-8S, and MW-8D (Figure 2). Groundwater samples will be collected using low-flow sampling techniques, as described below, and analyzed for the list of COIs outlined in Section 4.1. Sampling for per- and poly-fluoroalkyl substances (PFAS) also requires additional considerations and protocols as indicated in Section 3.3.

Groundwater Level Measurement. Depth to groundwater will be measured in 14 site wells prior to sampling. The wells will be first opened and allowed to equilibrate for about a half hour before measurements are collected. Groundwater levels will then be measured to the nearest 0.01 foot using an electronic probe. Pairs of shallow and deep wells (e.g., MW-1S and MW-1D) will be measured concurrently to determine vertical gradient.

Purging. After the groundwater levels are measured, each well will be purged at a low flow rate (less than 500 milliliters per minute) using a peristaltic pump connected to disposable tubing dedicated to each well. The tubing inlet will be placed approximately at the middle of the well screen or the middle of the water column, whichever is deeper. To assess the effectiveness of purging, field parameters including pH, electrical conductivity, temperature, specific conductance, dissolved oxygen, and oxidation-reduction potential will be measured by means of a flow-through cell for each liter that is purged. Purging will be considered complete when three casing volumes of water have been removed, the well purges dry, or field parameters stabilize to within 10 percent for three consecutive readings (whichever is less). If the well is purged dry, it will be allowed to recover to at least 50 percent of its original volume before sampling is performed. Results of these measurements will be included in the field notes. Purge water will be drummed and handled in accordance with Section 3.4.

Sampling. After purging of a well is complete, a groundwater sample will be collected using the same equipment used for purging. Sample container requirements are included in Table 1. For volatile organic compound (VOC) analysis, sample containers will be filled leaving no headspace. Dissolved metals and hardness will be field filtered using a 0.45-micron filter. PFAS will be sampled in accordance with the PFAS Sampling Guide provided by Pace (Attachment A). For QA/QC purposes, a field duplicate will be collected per Section 4.2 and as indicated in Table 2.

Documentation. Observations made during groundwater sampling activities will be documented in field notes. Observations recorded will include, but are not limited to, groundwater levels, purge water characteristics (e.g., color, turbidity, sheen), purge volumes, field parameter measurements, depth to water measurements, and sampling time.

Decontamination

To prevent cross contamination between sampling locations, clean dedicated sampling equipment (e.g., disposable gloves and groundwater sampling tubing) will be used at each sampling location and discarded after use. Cleaning of non-disposable items (e.g., water level meter, flow-through cell) will consist of washing in a non-phosphate detergent solution, rinsing with tap water, and rinsing with deionized water. Decontamination water will be collected and handled as IDW, as discussed below.

PFAS-Specific Sampling Considerations

PFAS are a widely used emerging group of chemicals that are suspected to have adverse health effects on people. PFAS will be analyzed during this sampling event. A PFAS-specific Field Sampling Guide is included as Attachment A. In general, the following will be employed during groundwater sampling to minimize the potential for cross-contamination of the groundwater samples.

- 100 percent cotton clothing (preferably not brand-new clothing).
- No makeup, lotions, hair products.
- Rubber boots instead of safety-toed boots due to potential water proofing.

IDW Management

IDW will consist of purged groundwater from monitoring wells, decontamination water, disposable sampling equipment (e.g., sample tubing) and personal protective equipment (PPE). Sampling equipment and PPE will be disposed of as solid waste. Water IDW generated during the activities will be added to a Department of Transportation-approved, 55-gallon steel drum pending disposal. IDW will be appropriately disposed of at a permitted disposal or treatment facility.

ANALYTICAL PROGRAM

Hart Crowser will submit groundwater samples to Pace of Mt. Juliet, Tennessee, for chemical analysis. Testing will be on a standard turnaround time, usually 10 business days.

Chemicals of Interest

COIs have been identified based on previous investigations and historical use of the site. In addition, PFAS has been identified as emerging COI for the site. COIs at the site and the analytical methods used to test for them are listed in Table 1 and are as follows:

- Weak acid dissociable cyanide by EPA Method 9012
- Total cyanide by EPA Method 9012
- dissolved metals (antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, strontium, thallium, titanium, vanadium, and zinc) by EPA Methods 6010B, 6020, and 7470A
- Ammonia as nitrogen by EPA Method 350.1
- Nitrate, nitrite, sulfate, and chloride by EPA Method 9056
- Hardness and dissolved hardness by EPA Method 310.1
- Chemical oxygen demand by EPA Method 410.4
- Total organic carbon by EPA Method 9060A
- Total dissolved solids by EPA Method 2540C-2011
- Total suspended solids by EPA Method 2540D-2011
- PFAS by Isotope Dilution

PFAS analysis includes the following 21 compounds: Perfluorobutanoic acid (PFBA), Perfluoropentanoic acid (PFPeA), Perfluorohexanoic acid (PFHxA), perfluoroheptanoic acid (PFHpA), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), perfluorobutanesulfonic acid (PFBS), perfluorohexanesulfonic acid (PFHxS), perfluorooctanesulfonic acid (PFOS), perfluorohexanoic acid (PFHxA), perfluorodecanoic acid (PFDA), perfluoroundecanoic acid (PFUnA or PFUdA), perfluorododecanoic acid (PFDoA), perfluorotridecanoic acid (PFTrDA), perfluorotetradecanoic acid (PFTeDA), 2-(N-Methylperfluorooctanesulfonamido) acetic acid (NMeFOSAA), and 2-(N-Ethylperfluorooctanesulfonamido) acetic acid (NEtFOSAA). Fluorotelomer sulphonic acid 4:2 (4:2FTS), Fluorotelomer sulphonic acid 6:2 (6:2FTS), Fluorotelomer sulphonic acid 8:2 (8:2FTS), Perfluorooctanesulfonamide (PFOSA), Perfluoroheptanesulfonic acid (PFHpS), Perfluoropentanesulfonic acid (PFPeS), and Perfluorononanesulfonic acid (PFNS).

Quality Assurance/Quality Control

The general QA objectives for this project are to develop and implement procedures for obtaining and evaluating data of a specified quality that can be used to determine current water quality conditions and evaluate risks posed to human health and the environment by contamination at the site. To collect such information, analytical data must have an appropriate degree of accuracy and reproducibility, samples collected must be representative of actual field conditions, and samples must be collected and analyzed using unbroken chain of custody procedures.

Field QA/QC. Disposable sampling equipment will be used to minimize or eliminate cross-contamination. All samples will be placed into laboratory-supplied sample containers including preservative, if required. Samples will be labeled with sample-specific identifying information. Chain of custody will be maintained at all times.

A duplicate groundwater sample will be collected from one of the monitoring wells with previous detections of relatively higher COIs. The duplicate will be analyzed for all COIs. Table 2 lists the QA sample associated with field collection. Equipment decontamination of the water level meter and flow-through cell (for field parameter measurement) will occur; however, no rinsate blank will be obtained as purging will be conducted after measuring with the water level meter and there is no contact of sampled water with the flow-through cell. A trip blank will not be analyzed as volatile organic compounds will not be analyzed.

Laboratory QA/QC. The laboratory will also perform QC analyses (e.g., matrix spikes and method blanks) per the requirements of the analytical method. Detection limits will be consistent with industry standards and, when practicable, below or comparable to promulgated regulatory standards, unless raised due to high analyte concentrations in the sample or matrix effects. Table 3 lists the reporting limit goals for the sample analyses.

REPORTING

After receipt of analytical results, Hart Crowser will prepare a report presenting general information about the site and nearby vicinity, the monitoring activities, groundwater levels and gradient, any changes in groundwater levels and gradient relative to previous monitoring events, the chemical results, any significant changes or trends in chemical results relative to previous monitoring events, and a risk screening of the chemical results to assess whether the site poses an unacceptable risk to human health or the environment. The report will initially be prepared as a draft for review by DEQ. Upon receipt of DEQ's comments, we will issue the report in final form.

Table 1 - Anticipated Sample Number and Analyses
Sampling and Analysis Plan
Santosh Landfill Groundwater Monitoring, Scappoose, Oregon

Sample Matrix and Analysis	Sample Locations	Sample Type	Analyses Requested	Sample Container and Volume	Sample Preservative	Holding Time	Estimated Number of Samples
Water Samples							
WAD Cyanide	Groundwater Monitoring Wells	Discrete	EPA Method 9012	250 mL HDPE Amber	Sodium Hydroxide	14 days	14
Total Cyanide	Groundwater Monitoring Wells	Discrete	D 7511-09e2 or EPA Method 9012	250 mL HDPE Amber	Sodium Hydroxide	14 days	14
Dissolved Metals* (Field Filtered)	Groundwater Monitoring Wells	Discrete	EPA Methods 6010B/6020/7470A	250 ml HDPE	Nitric Acid	180 days (Mercury 28 days)	14
Ammonia	Groundwater Monitoring Wells	Discrete	EPA Method 350.1	250 ml HDPE	Sulfuric Acid	28 days	14
Anions**	Groundwater Monitoring Wells	Discrete	EPA Method 9056	250 ml HDPE	None	48 hours	14
Hardness	Groundwater Monitoring Wells	Discrete	EPA Method 130.1	250 ml HDPE	Nitric Acid	180 days	14
Dissolved Hardness (Field Filtered)	Groundwater Monitoring Wells	Discrete	EPA Method 130.1	250 ml HDPE	Nitric Acid	180 days	14
COD	Groundwater Monitoring Wells	Discrete	EPA Method 410.4	250 ml HDPE	Sulfuric Acid	28 days	14
TOC	Groundwater Monitoring Wells	Discrete	EPA Method 9060A	250 mL Amber	Hydrochloric Acid	28 days	14
TDS	Groundwater Monitoring Wells	Discrete	EPA Method 2540C-2011	250 ml HDPE	None	7 days	14
TSS	Groundwater Monitoring Wells	Discrete	EPA Method 2540D-2011	1 liter HDPE	None	7 days	14
PFAS	Groundwater Monitoring Wells	Discrete	Isotope Dilution/EPA Method 537 Version 1.1	2 - 250 ml HDPE	None	14 days	14

Notes:

1. The number of required sample containers will be determined and supplied by the analytical laboratory.
2. The estimated number of samples does not include quality control samples (see Table 2).
3. * = Metals list includes; antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, strontium, thallium, titanium, vanadium, zinc.
4. ** = Anions list includes; nitrate, nitrite, sulfate, and chloride

Acronyms:

COD = Chemical Oxygen Demand
EPA = Environmental Protection Agency
HDPE = High-Density Polyethylene (Plastic Bottle)
ml = Milliliter
PFAS = Per- and Poly-fluoroalkyl Substances
TDS = Total Dissolved Solids
TOC = Total Organic Carbon
TSS = Total Suspended Solids
WAD = Weak Acid Dissociable

Table 2 - Quality Assurance Samples
Sampling and Analysis Plan
Santosh Landfill Groundwater Monitoring, Scappoose, Oregon

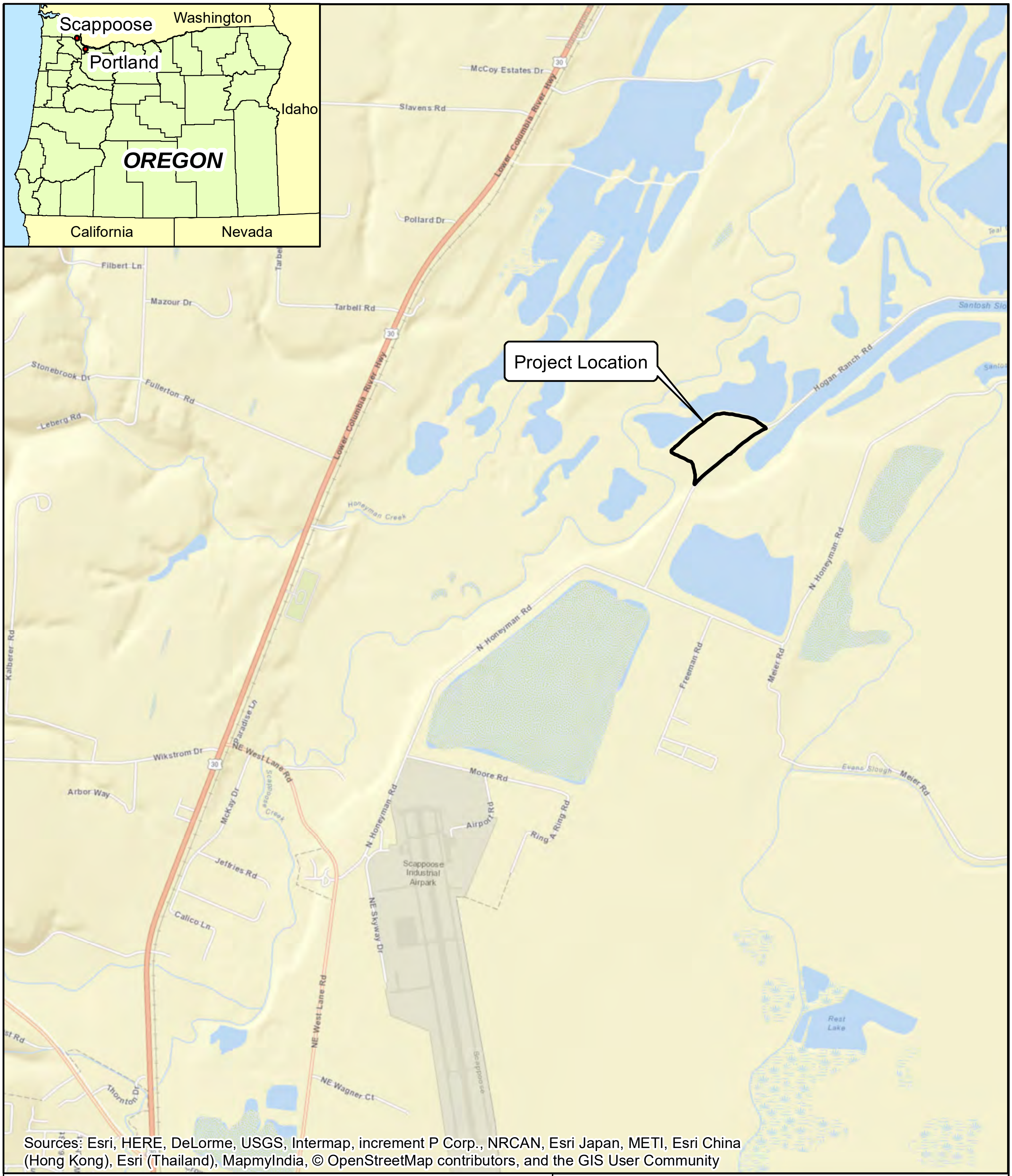
QA Sample Matrix	QA Sample Type	Analyses Requested	Anticipated Number of Samples
Site Collected Groundwater	Field Duplicate	All COPCs	1

Acronyms:
QA = Quality Assurance
COPCs = Contaminants of Potential Concern

Table 3 - Analytical Methods - Reporting Limit Goals
Sampling and Analysis Plan
Santosh Landfill Groundwater Monitoring, Scappoose, Oregon

Method	Analyte	Reporting Limit Goals Water [µg/L]
Cyanide (D 7511-09e2 or EPA Method 9012)	WAD cyanide	5.0
	Total Cyanide	5.0
Metals, Dissolved (EPA Method 6020)	Antimony	10
	Arsenic	10
	Barium	5.0
	Beryllium	2.0
	Boron	200
	Cadmium	2.0
	Calcium	1,000
	Chromium	10
	Cobalt	10
	Copper	10
	Iron	100
	Lead	5.0
	Magnesium	1,000
	Manganese	10
	Mercury	0.1
	Nickel	10
	Potassium	1,000
	Selenium	10
	Silver	5.0
	Sodium	1,000
	Strontium	10
	Thallium	10
	Titanium	50
	Vanadium	20
	Zinc	50
EPA Method 350.1	Ammonia	250
Anions (EPA Method 9056)	Nitrate	100
	Nitrite	100
	Sulfate	5,000
	Chloride	1,000
Hardness (EPA Method 130.1)	Total Hardness	1,250
	Dissolved Hardness	1,250
EPA Method 410.4	Chemical Oxygen Demand	10,000
EPA Method 9060A	Total Organic Carbon	1,000
Solids (EPA Method 2540C/D-2011)	Total Dissolved Solids	10,000
	Total Suspended Solids	2,500
PFAS (Isotope Dilution)	Perfluorobutanoic acid (PFBA)	0.002
	Perfluoropentanoic acid (PFPeA)	0.002
	Perfluorohexanoic acid (PFHxA)	0.002
	Perfluorobutanesulfonic acid (PFBS)	0.00177
	Perfluoroheptanoic acid (PFHpA)	0.002
	Perfluorohexanesulfonic acid (PFHxS)	0.00182
	Perfluorooctanoic acid (PFOA)	0.002
	Perfluorononanoic acid (PFNA)	0.002
	Perfluorooctanesulfonic acid (PFOS)	0.00185
	Perfluorodecanoic acid (PFDA)	0.002
	Perfluoroundecanoic acid (PFUnA or PFUdA)	0.002
	Perfluorodecanesulfonic acid (PFDS)	0.002
	Perfluorododecanoic acid (PFDoA)	0.002
	Perfluorotridecanoic acid (PFTrDA or PFTeDA)	0.002
	Perfluorotetradecanoic acid (PFTA, PFTreA, or PFTeDA)	0.002
	N-methyl perfluorooctane sulfonamidoacetic acid (NMeFOSAA)	0.002
	N-ethyl perfluorooctane sulfonamidoacetic acid (NEtFOSAA)	0.002
	Fluorotelomer sulphonic acid 4:2 (4:2FTS)	0.002
	Fluorotelomer sulphonic acid 6:2 (6:2FTS)	0.002
	Fluorotelomer sulphonic acid 8:2 (8:2FTS)	0.002
	Perfluorooctanesulfonamide (PFOSA)	0.002
	Perfluoroheptanesulfonic acid (PFHpS)	0.0019
	Perfluoropentanesulfonic acid (PFPeS)	0.00188
	Perfluorononanesulfonic acid (PFNS)	0.002

Acronyms:
µg/L = microgram per liter (ppb)
EPA = Environmental Protection Agency
WAD = Weak Acid Dissociable
PFAS = Per- and Poly-fluoroalkyl Substances



Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Santosh Landfill
Scappoose, Oregon

Vicinity Map

150-001-053

12/16

HARTCROWSER

Figure

1

Document Path: F:\Notebooks\150001053_DEQ Santosh GW Monitoring\GIS\150001053_VMap.mxd Date: 12/21/2016 User Name: melissaschweitzer

Sources: Base map prepared from a survey prepared by David C. Smith & Associates, dated 6/05. Aerial photograph provided by Microsoft Bing, 2016.

LEGEND

MW-4S ⊕	Shallow Groundwater Monitoring Well
MW-4D ⊕	Deep Groundwater Monitoring Well

N

0 300 600

Scale in Feet

Note: Feature locations are approximate.

Santosh Landfill
Scappoose, Oregon

Site Plan

150-001-053 12/16

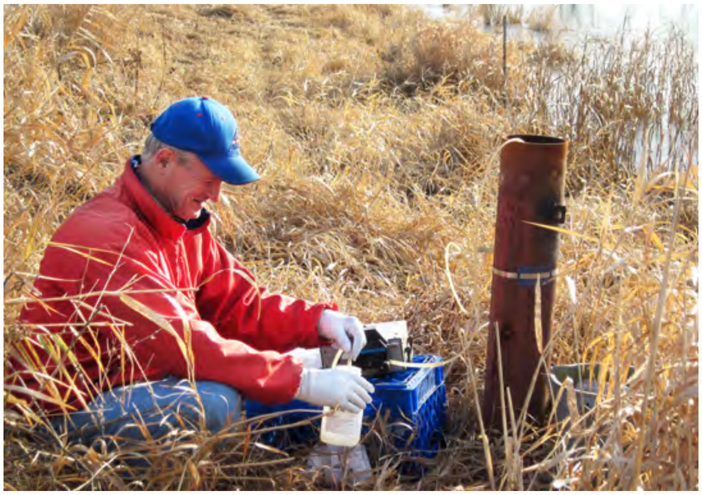
HARTCROWSER

Figure

2

File: F:\Notebooks\150001053_DEQ Santosh GW Monitoring\CAD\150001053_SP.dwg Layout:Layout1-8.5x11 - V Date: 12-21-2016 Author: melissaschweitzer

PFAS Field Sampling Guide



Due to the potential presence of Per- and Polyfluoroalkyl Substances (PFAS) in common consumer products and in equipment typically used to collect soil, groundwater, surface water, sediment, and drinking water samples, as well as the need for very low reporting limits, **special handling and care must be taken when collecting samples for PFAS** analysis to avoid sample contamination.

Best Practices

- Wash hands and use new nitrile gloves for each sample collected
- Groundwater, surface water, or drinking water samples should not be filtered as the glass fiber on the filter can potentially absorb PFAS
- Collect the PFAS sample first, prior to collecting samples for any other parameters into any other containers; this avoids contact with any other type of sample container, bottles or package materials
- Do not place the sample bottle cap on any surface when collecting the sample, and avoid all contact with the inside of the sample bottle or its cap
- When the **labeled** sample is collected, place the samples in an individual sealed plastic bag separate from all other sample parameter bottles
- Samples must be chilled during shipment and should arrive at the lab at <6 C +/-2

Field Reagent Blanks (FRB) - When sampling for PFAS, it is recommended that field reagent blanks be collected during sampling to check for residual PFAS during the sample collection process. The purpose of the FRB is to ensure that PFAS measured in the field samples were not inadvertently introduced into the sample during sample collection/handling.

Analysis of the FRB is required only if a field sample contains a method analyte or analytes at or above the MRL. The FRB is processed, extracted, and analyzed in exactly the same manner as a field sample. FRBs include a container filled with preserved water and an empty unpreserved container (per EPA methodology). To collect the FRB, simply pour the preserved water into the empty unpreserved container at the time a sample is collected in the field.

FRBs are required by EPA Method 537, but the number of FRBs to collect (for each site, for each representative sample, or not at all) is at the discretion of the customer and/or regulator overseeing the project.

SAMPLE COLLECTION

Matrix	Container	Preservative	Method	Notes
Drinking Water	2 x 250 ml HDPE or PP	Trizma	EPA Method 537 or EPA Method 537M	Trizma is a buffer and removes free chlorine.
Groundwater, surface water, waters	2 x 250 ml HDPE or PP	none	EPA Method 537M	
Effluent	2 x 250 ml HDPE or PP	Trizma	EPA Method 537M	Finished samples may require Trizma.
Soil, sediment, bio-solids	1 x 250 ml (or 4 ounce) HDPE or PP	none	EPA Method 537M	

Sample extraction = 14 days

Sample analysis = 28 days

✓ Best Practices	✗ What to Avoid
Sample Container Items	
• HDPE or Polypropylene (PP)	• No glass or LDPE containers
• Lined or unlined HDPE or polypropylene caps	• No Teflon™-lined caps
Field Equipment	
• High density polyethylene (HDPE) or polypropylene materials	• No Teflon™ containing materials
• Silcon tubing	• No Teflon™ tubing
• Loose paper (non-water resistent)	• No waterproof field books
• Aluminum field clipboards or Masonite	• No plastic clipboards, binders, or spiral notebooks
• Sharpies, pens	• No Post-It Notes
• Regular Ice	• No chemical (blue) ice packs
Field Clothing and Personal Protection Equipment	
• Well-laundered clothing, defined as clothing that has been washed six or more timesafter purchase, made of synthetic or natural fibers (preferable cotton)	• No new clothing or water resistant, waterproof, or stain-treated clothing, clothing containing Gore-Tex™
• No fabric softener	• No clothing laundered using fabric softener
• Cotton Clothing	• No Tyvek®
• Boots made with polyurethane and polyvinyl chloride (PVC)	• No boots containing Gore-Tex™
• Sunscreens – All Organic Natural Sunscreen, that are "free" or "natural" Check the label. Insect Repellents – Various natural one, DEET, check the label	• No cosmetics, moisturizers, hand cream, or other related products as part of personal cleaning/ showering routine on the morning of sampling
Field Equipment Deconamination Items	
• Alconox® and/or Liquinox®	• No Decon 90
Food Items	
• Bottled water and hydration drinks (i.e. Gatorade® and Powerade®) to be brought and consumed only in the staging area	• No food and drink, with exceptions hydrating items listed on the left

QUESTIONS?

PFAS@pacelabs.com
612.710.0151

1700 Elm Street SE
Minneapolis, MN 55414

APPENDIX B
Site-Specific Health and Safety Plan

Health and Safety Plan

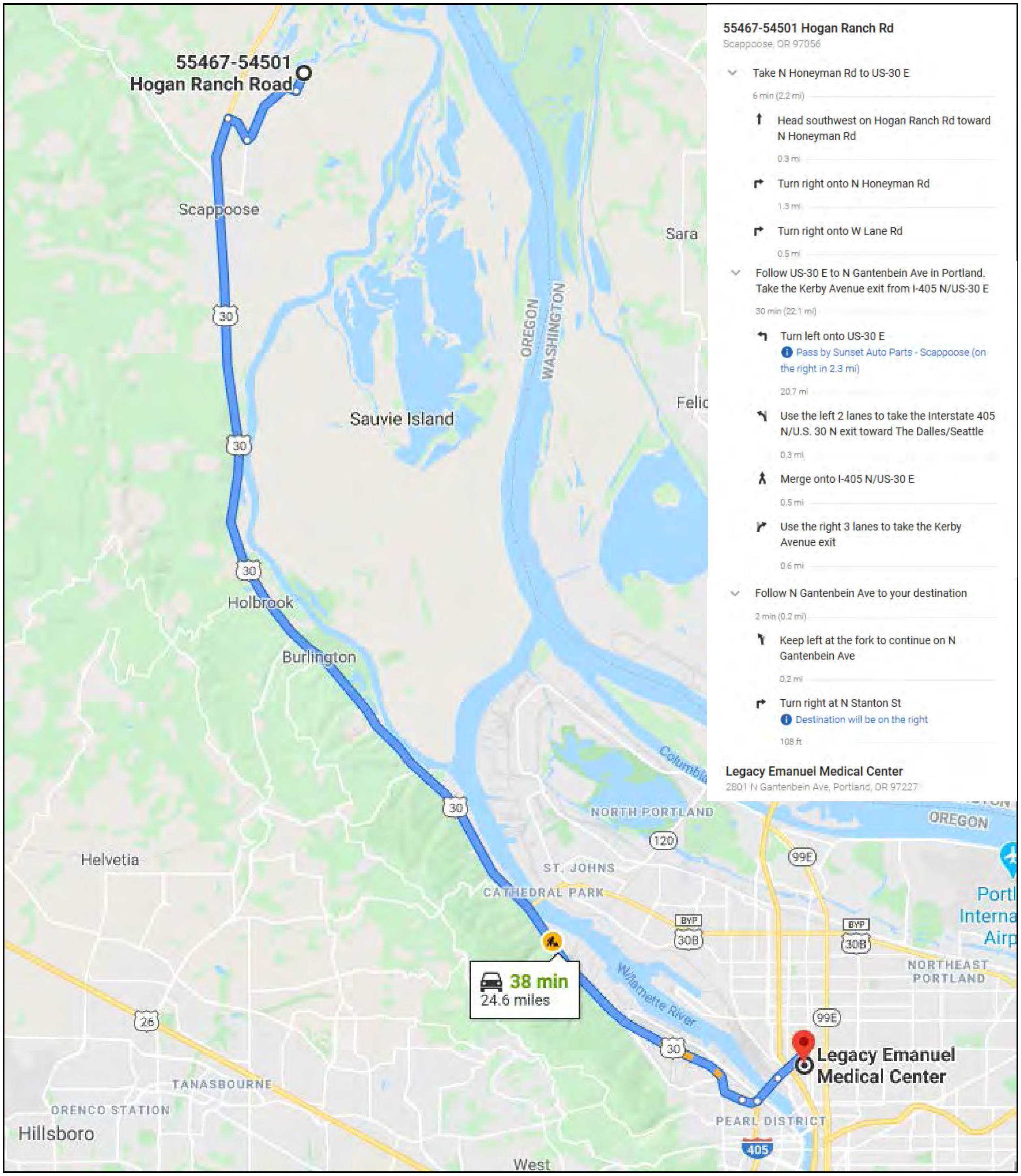
Santosh Landfill

Hogan Ranch Road
Scappoose, Oregon
Date Prepared: March 27, 2020

EMERGENCY INFORMATION

SITE LOCATION	Site Name: Santosh Landfill Site Address: Hogan Ranch Road
NEAREST HOSPITALS	Hospital Name: Legacy Emanuel Medical Center Hospital Address: 2801 N Gantenbein Ave, Portland, OR 97227 Hospital Phone Number: 503-413-2200 The route to the hospital is shown on Figure 1.
CONTACTS	**Hart Crowser** Portland Office.. (503) 620-7284 ►Project Manager, Chris Martin ....(503) 432-5979 (C) ►Portland Regional Health and Safety Officer, Kevin Woodhouse................ .... (530) 220-4012 (C) ►Corporate Health and Safety Director, Jeff Wagner ..... (206) 369-4772 (C) **Client** ►Bob Schwarz, DEQ Project Manager...............................(503) 229-5128 **Oregon Emergency Response System** **To report environmental problems or spills** .... (800) 452-0311 National Response Center... (800) 424-8802 Poison Control Center.. (800) 222-1222 Scappoose Police Non-Emergency Dispatch......................... (503)-397-1521
EMERGENCY RESPONDERS **Police, Fire, Ambulance**	**911**
IN EVENT OF EMERGENCY CONTACT 911 FOR HELP AS SOON AS POSSIBLE	Give the following information: ➔ **Where You Are** - address, cross streets, or landmarks ☎ **Phone Number** you are calling from ?? **What Happened** - type of injury, accident # **How many persons** need help ?? **What is being done** for the victim(s) !! **You hang up last** – let emergency dispatcher hang up first

Figure 1 -Hospital Route Map



55467-54501 Hogan Ranch Rd
Scappoose, OR 97056

Take N Honeyman Rd to US-30 E
6 min (2.2 mi)

- Head southwest on Hogan Ranch Rd toward N Honeyman Rd
  0.3 mi
- Turn right onto N Honeyman Rd
  1.3 mi
- Turn right onto W Lane Rd
  0.5 mi

Follow US-30 E to N Gantenbein Ave in Portland. Take the Kerby Avenue exit from I-405 N/US-30 E
30 min (22.1 mi)

- Turn left onto US-30 E
  Pass by Sunset Auto Parts - Scappoose (on the right in 2.3 mi)
  20.7 mi
- Use the left 2 lanes to take the Interstate 405 N/U.S. 30 N exit toward The Dalles/Seattle
  0.3 mi
- Merge onto I-405 N/US-30 E
  0.5 mi
- Use the right 3 lanes to take the Kerby Avenue exit
  0.6 mi

Follow N Gantenbein Ave to your destination
2 min (0.2 mi)

- Keep left at the fork to continue on N Gantenbein Ave
  0.2 mi
- Turn right at N Stanton St
  Destination will be on the right
  108 ft

Legacy Emanuel Medical Center
2801 N Gantenbein Ave, Portland, OR 97227

SITE HEALTH AND SAFETY PLAN SUMMARY

Location: Santosh Landfill on Hogan Ranch Road in Scappoose, Oregon.

Proposed dates of activities: Spring 2020.

Type of facility: Closed municipal landfill.

Land use of area surrounding facility: Wetlands to the north, west, and southeast. Active quarry and aggregate plant to the east.

Work activities to be performed: Groundwater sampling of monitoring wells and site maintenance.

Potential site contaminants: Heavy metals; total petroleum hydrocarbons (TPH) as diesel and oil; volatile organic compounds (VOCs); semi-volatile organic compounds (SVOCs); cyanide; hexavalent chromium; and ammonia.

Routes of entry: Skin contact with groundwater, inhalation of volatiles, and incidental ingestion of groundwater.

Other specific safety hazards: Driving to and from the site; cold and heat stress/illness; biological hazards; slips, trips, and falls; landfill gas exposure.

Protective measures: Safety glasses or goggles (if splash hazard exists); Class II high visibility safety vest; rubber or nitrile gloves when working with chemicals; work gloves for site maintenance tasks (as needed); long pants and shirt with minimum 4-inch sleeve; rain gear (as needed); foot protection (e.g., safety-toed boots or rubber boots).

Air monitoring equipment: A photoionization detector (PID) multi-meter, (e.g. MultiRAE) with a lamp appropriate for chemical contaminants and combustible gas indicator sensors for oxygen and lower explosive limit (LEL).

1.0 INTRODUCTION

1.1 Purpose and Regulatory Compliance

This site-specific Health and Safety Plan (HASP) provides information and procedures for protecting Hart Crowser personnel who will handle contaminated groundwater or may be exposed to other chemical and physical hazards while collecting groundwater samples and performing site maintenance at the Santosh Landfill site in Scappoose, Oregon. The HASP is to be used by Hart Crowser personnel and is written for the specific site conditions, purposes, dates, and personnel specified herein; it will be amended if conditions change.

This HASP is to be used in conjunction with Hart Crowser's Corporate Accident Prevention Program (APP) and field APP located on the Hart Crowser Intranet. Together the APP and this HASP constitute the health and safety plan for this site.

A field copy of this HASP is to be used by Hart Crowser personnel and must be available on site throughout the duration of the project. If site conditions, field activities, personnel, dates, or other conditions change over time, this HASP will be updated to address these changes as they occur. Hart Crowser personnel may make minor changes to the field copy by hand in ink (with date and initials). The signed HASP will be retained with the project files when the project is completed.

1.2 Distribution and Approval

This HASP will be made available to all Hart Crowser personnel working at the project site. Hart Crowser workers will read, sign, and return the form titled "Record of Health and Safety Communication" provided in Attachment A of this HASP to certify their agreement to comply with the minimum requirements of this HASP. The Hart Crowser project manager will route the signed Attachment A form to the project files upon completion of field activities covered under the HASP.

This HASP will be provided to subcontractors for informational purposes only. Subcontractors will sign the form titled "Record of Health and Safety Communication" and will be told clearly by the field health and safety manager that that this HASP represents minimum safety procedures for Hart Crowser workers and that subcontractors are responsible for their own safety while on the site. Nothing herein will be construed as granting rights to Hart Crowser subcontractors or any others working on this site to use or legally rely on this HASP.

This HASP has been approved by the Hart Crowser corporate health and safety director.

1.3 Chain of Command

The Hart Crowser chain of command for health and safety on this project includes the following individuals:

Corporate Health and Safety Director: Jeff Wagner

The Hart Crowser corporate health and safety director has overall responsibility for development and implementation of the corporate APP and company health and safety procedures. The corporate health and safety director will periodically review Hart Crowser policies and standards and provide updates as necessary. The corporate health and safety director will supervise incident and injury investigations to determine root causes and corrective actions. The corporate health and safety director will work with regional health and safety officers and project/field health and safety managers as needed to implement safe work practices on all projects.

Regional Health and Safety Officer: Kevin Woodhouse

The Hart Crowser regional health and safety officer has overall responsibility for preparation and modification of this HASP. If health and safety issues arise during site operations, the regional health and safety officer will attempt to resolve them with the appropriate members of the project team and the corporate health and safety director.

Project Manager: Chris Martin

The project manager has overall responsibility for the successful outcome of the project. In consultation with the corporate health and safety director, the project manager makes final decisions about implementing this site-specific HASP. The project manager may delegate this responsibility and the accompanying authority to another project worker as needed.

Project Health and Safety Manager: Kevin Woodhouse

The project health and safety manager has overall responsibility for health and safety on this project and will verify compliance with applicable requirements. This individual will communicate all relevant health and safety issues to Hart Crowser's workers.

Field Health and Safety Manager: To Be Determined

The field health and safety manager is responsible for implementing this HASP in the field and for maintaining it at the project site. This individual conducts safety briefings, observes workers to verify that they are following HASP procedures, and assures that proper personal protective equipment (PPE) is available and used correctly and that employees have knowledge of the local emergency response system. The field health and safety manager will see that the field HASP is updated as needed to address changes in field conditions or procedures.

1.4 Work Activities

Hart Crowser's work covered under this HASP includes gauging and sampling of up to 14 monitoring wells in accordance with the Site Investigation Work Plan and attached Sampling and Analysis Plan. Samples will be collected by a Hart Crowser employee(s) using a peristaltic pump and water quality meter. A preliminary wetlands inspection will be performed by a Hart Crowser ecologist and site maintenance activities will also be performed. Site maintenance activities may include the construction of "raptor perches" for rodent control; pruning and trimming of overgrown tree limbs, installation of gas vent covers, inspection and maintenance of well boxes, removal of trash and debris from the site, and management of investigation derived waste containers. Field activities are anticipated to be completed over several days in spring 2020.

1.5 Site Description

The Santosh Landfill is located approximately one mile north-northeast of the City of Scappoose, Oregon. The southern end of the landfill is approximately 1,500 to 2,000 feet north-northeast of the intersection of East Honeyman Road and Hogan Ranch Road along the western boundary of Hogan Ranch Road. The Site is bounded to the north and west by undeveloped lowlands, to the south by Scappoose Creek, and to the east by Hogan Ranch Road.

From the early 1970s until September 1983, the Santosh Landfill was the primary municipal landfill for Columbia County during that time, receiving both municipal and industrial wastes. The landfill refuse is approximately 25 feet thick and surrounded by a perimeter berm. The landfill was covered with a soil cap upon cessation of operations in the early 1980s.

In 2007, DEQ oversaw regrading and capping of the landfill's southern slope where leachate seeps had been observed. The low-permeable cap consisted of a crushed rock base layer, geosynthetic clay liner material, topsoil, and an erosion control blanket. In January 2008, 4-inch-minus rock was added to the base of the slope to address erosion issues associated with high rainfall and flooding events.

In 2008, DEQ oversaw construction of an impermeable cap over the entire landfill. The cap consists of the following components from bottom to top: re-graded pre-construction ground cover; imported crushed rock foundation layer; geocomposite gas distribution layer; low-permeable geosynthetic clay liner layer; geocomposite drainage layer; and an imported topsoil layer hydroseeded with grass vegetation. A gas ventilation system and stormwater drainage system were also installed as part of the low-permeable cap construction.

There are fourteen groundwater monitoring wells at the site: nine wells along the landfill's perimeter berm, one well along Hogan Ranch Road south of the landfill, and four wells along Scappoose Creek. Groundwater was last tested in 2017. DEQ is requesting that another groundwater monitoring event be completed, with the testing program including analysis for per- and poly-fluoroalkyl substances (PFAS), which are emerging chemicals of concern that potentially risks to human health and the environment.

2.0 HAZARD EVALUATION AND CONTROL MEASURES

The following sections describe the hazardous substances that are known or anticipated to be present.

2.1 Hazardous Substances

Chemicals of potential concern (COPCs) for the site have been identified based on previous investigations, groundwater sampling, and historical use of the site. The following COPCs have been identified.

- TPH
- VOCs including benzene, toluene, ethylbenzene, naphthalene, 1,2-dichlorobenzene, chloroform, and vinyl chloride
- SVOCs including polycyclic aromatic hydrocarbons, phthalates, and 1-methylnapthalene
- Cyanide

- Metals, including antimony, arsenic, barium, beryllium, boron, calcium, cadmium, chromium, hexavalent chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, selenium, silver, sodium, strontium, thallium, titanium, vanadium, and zinc)
- Ammonia
- PFAS

The potential health hazards of these hazardous substances are discussed in individual fact sheets (ToxFAQs) prepared by the Agency for Toxic Substances and Disease Registry and provided in Attachment B to this HASP. The fact sheets describe effects that might occur if acute (short-term) and/or chronic (occurring over a long period – more than 1 year) exposures were to happen. Inclusion of this information does not mean that these effects will occur during the work activities conducted by Hart Crowser. Fact sheets were not available for calcium, iron, sodium, and titanium. These chemicals do not have documented health effects that could come from exposure in groundwater at concentrations previously documented at the site. In dry form, these chemicals may be a respiratory tract irritant if inhaled.

In general, the hazardous substances that may be encountered during groundwater sampling at the Santosh Landfill site are not expected to be present at concentrations or in a form that could produce acute or significant adverse health effects. The types of work activities to be conducted and the use of PPE will limit potential exposure.

2.2 Potential Exposure Routes

Exposure to the hazardous substances listed above could occur by accidental inhalation of, direct contact with, or ingestion of potentially contaminated sediment and surface water. To prevent contact with potential contaminants, the Hart Crowser sampling team will wear the PPE specified in Section 3 while sampling and while decontaminating equipment.

Inhalation

Workers could be exposed by inhaling VOC vapors that have volatilized out of groundwater during purging and sampling of monitoring wells. VOCs will be monitored using a PID to monitor for VOCs during sampling activities. Air monitoring and control measures specified in this plan will minimize the possibility for inhalation of VOCs.

Direct Contact

Workers could be exposed if contaminated groundwater contacts the skin, eyes, or clothing. Wearing protective clothing and safety glasses, performing decontamination activities specified in this plan, and implementing safe handling and transferring of purge water will minimize the potential for skin and eye contact with hazardous substances.

Ingestion

Workers could be exposed if they eat, drink, or perform other hand-to-mouth activities while performing groundwater sampling activities. Personal hygiene measures will be implemented to prevent inadvertent ingestion of contaminants; for example, workers will remove their gloves and wash their hands and faces before eating, drinking, or using tobacco.

2.3 Air Monitoring

For activities in areas where VOCs and landfill gasses are known or suspected to be present, air quality will be monitored using a MultiRAE PID multi-meter to determine whether VOCs, carbon monoxide, or combustible gasses are present and to check the adequacy of PPE (specifically, respiratory protection). The monitoring results may trigger actions, as summarized in Table 1 and described in more detail below under "Action Levels."

Table 1 – Air Monitoring Action Levels

Monitoring Device	Sensor	PEL	Result	Action Required	Notes
PID	VOC	Benzene and Vinyl Chloride: 1 ppm, Naphthalene	0.5 ppm, <1/2 PEL for benzene and vinyl chloride 5 ppm naphthalene	Continue monitoring.	a
			0.5 to 1 ppm, 1/2 PEL to PEL	Implement additional control measures to reduce VOC concentration. Continue monitoring and prepare to stop work or upgrade PPE to include respirator use.	a, b, c
			>1 ppm, >PEL	Stop work; Contact project health and safety manager.	a, b
Combustible Gas Indictor/ Multi-Meter	Oxygen	<19.5% or > 22%	<19.5% or > 22%	Stop work; Contact corporate health and safety director.	a, b, d
	Hydrogen sulfide	10 ppm	> 5 ppm	Immediate evacuation; Contact project health and safety manager.	e
	Combustible gases	10% LEL	0 to 5% LEL	Continue monitoring.	f
			5 to <10% LEL	Use caution and continue monitoring. Implement additional control measures to reduce combustible gas concentration.	f
			≥ 10 % LEL	Immediate evacuation. Contact project health and safety manager and corporate health and safety director.	f
	Carbon monoxide	50 ppm TWA	< 25 ppm	Use caution and continue monitoring.	g
			25 to 50 ppm	Implement additional control measures to reduce combustible gas concentration. Be prepared to stop work or upgrade PPE to supplied air respirator use.	g

Monitoring Device	Sensor	PEL	Result	Action Required	Notes
			>50 ppm	Immediate evacuation. Contact project health and safety manager and corporate health and safety director.	

Notes:
a. Use appropriate lamp and calibrate unit.
b. Air-purifying respirators must be used only when use criteria are met and when appropriate cartridges are available.
c. Half-facepiece respirators generally acceptable up to 10 times the permissible exposure limit (PEL).
d. Oxygen deficiency requires confined space entry procedures.
e. A PEL for hydrogen sulfide has not been set by Occupational Safety and Health Administration (OSHA). The National Institute for Occupational Safety and Health Recommended Exposure Limit (REL) is used in place of a PEL.
f. LEL refers to Lower Explosive Limit. Use caution to prevent all sources of ignition.
g. TWA refers to the 8-hour time weighted average.
h. ppm = parts per million.

Air quality will be monitored at the discretion of the field health and safety manager by an individual trained to use the equipment. The project manager is responsible for ascertaining that each designated operator is properly trained in the use of the monitoring equipment. **Air monitoring measurements will be recorded on the "Air Monitoring Log" and actions taken based upon air monitoring results (e.g., changes to control measures or PPE) will be recorded on the project "Field Health and Safety Report." Both forms are provided in Attachment B to this HASP**. The results of air monitoring will be used to determine the need to upgrade PPE. The Air Monitoring Log" and "Field Health and Safety Report" forms will be filed with the project records.

The specific piece of monitoring equipment item(s) to be used on this project will be indicated by Hart Crowser unit number on the project "Field Equipment & Supplies" form, which is included in this plan by reference. The equipment technician will calibrate, maintain, and repair each air monitoring equipment item, or arrange for these activities, which will be conducted in accordance with and at the frequency specified by the manufacturer or more frequently, as required by use conditions. The equipment technician will maintain calibration/repair records in the equipment log books.

The following sections describe the equipment and procedures that will be used to monitor VOCs and combustible gases.

Volatile Organic Compounds. A MultiRAE or MiniRAE PID will be used at locations where VOCs may be present during site activities. **This detector is non-specific**, meaning that it does not identify the chemicals present. When using a PID to monitor for a specific chemical, the measurements taken are treated as being entirely for the chemical being monitored. If chemical-specific information is necessary, other types of sampling equipment (e.g. colorimetric tubes) must also be used.

When multiple VOCs are known to be present, the chemical with the lowest PEL can be used as it will be protective for the other chemicals. In addition, since it is calibrated using only a single reference chemical, **a correction factor must be applied to the result to give an accurate measurement for the chemical being monitored. Refer to the manufacturer's documentation for meter or device specific correction factors.** PID measurements can be recorded in one of two ways: 1) the PID has no correction factors programmed in and the displayed measurement has the correction factor applied before being recorded on field logs; or 2) the chemical-specific correction factor can be programmed into the PID and the displayed reading is directly recorded.

Monitoring Procedures. At the discretion of the field health and safety manager, air quality will be monitored using a PID with an appropriate lamp for the chemicals being monitored. A 10.6 eV lamp is generally used to measure organic vapor concentrations during work activities; however, the ionization potential of the chemical(s) being monitored should be checked to determine the correct eV lamp for use. The ionization potential of the chemical must be below the lamp rating otherwise the chemical will not be detected. The 10.6 eV lamp will be specified for general hydrocarbon survey measurements for chemicals having an ionization potential of up to 10.6 eV, such as benzene (9.24 eV).

The field health and safety manager or other designated project individual is responsible for verifying that the equipment is calibrated and working properly before on-site use. This will include zeroing and/or calibrating the instrument before work begins. Records of these activities will be maintained in the “Field Health and Safety Report” form. If there are any problems with the equipment, the item will be removed from use until repair or replacement can be performed.

Action Levels. PID monitoring will be conducted before work begins at each individual work area where volatile chemicals may be present and throughout the work shift. A safety factor of 2 has been used to determine action levels at 1/2 the PEL for VOCs. The following actions well be taken based on PID measurements.

- If PID measurements are **less than 1/2 the PEL**, no actions are needed, and monitoring will be continued.
- If PID measurements are **between 1/2 the PEL and the PEL**, work will stop, and additional control measures will be implemented to decrease VOC concentrations. After additional control measures have been implemented, work may resume with continued monitoring. If concentrations remain between 1/2 the PEL and the PEL, work may continue however crews will be prepared to stop work or upgrade PPE should concentrations reach the PEL.
- If PID measurements **exceed the PEL** in the worker's breathing zones, work will cease, and employees will evacuate the work area pending reevaluation of the situation by the project manager and corporate health and safety director. Action will be taken, including PPE upgrade or plan modification if required, to address any situations where such results are observed.

Combustible Gases and Vapors. It is unlikely that combustible gases will be present outside of subsurface conditions. However, the procedures described below address gas or vapor off gassing that could occur during opening of well boxes and purging/sampling of groundwater.

A combustible gas indicator meter or PID multi-meter will be used to monitor for combustible gases while sampling. All monitoring equipment will be properly calibrated and maintained as noted in the previous discussion of air monitoring procedures, and field monitoring results will be recorded on the "Air Monitoring Log" and “Field Health and Safety Report” form.

The following actions will be taken in response to air monitoring results:

- If monitoring indicates there is **no combustible gas or vapor hazard**, work will proceed and periodic testing at 1-hour intervals will be performed.
- If combustible vapors are **less than 5 percent of the LEL**, work will proceed, but monitoring will be repeated at 30-minute intervals, or sooner if any odors or signs of contamination are noted. Employees are never to continue to work in an area, even if LEL tests are acceptable, if they detect strange odors or experience symptoms of overexposure (such as nausea, dizziness, or tearing of the eyes). If this occurs, employees will stop work and leave the area pending further evaluation.
- If combustible vapors are **between 5 and 10 percent of the LEL**, workers may proceed with caution, but monitoring must be performed continuously, and fans or other means must be used to disperse vapors. Monitoring results will be recorded at 15-minute intervals, or more frequently if any odors or signs of contamination are noted. Workers should consult with the corporate health and safety director to determine whether other types of monitoring are required to check whether exposure levels are within acceptable limits.
- If combustible vapors are **greater than 10 percent of the LEL**, workers must assume an explosion hazard exists. Site work will cease pending reevaluation of the situation by the project health and safety manager. Action will be taken, including plan modification if required. In general, field ventilation attempts will be continued only if the ventilation equipment is non-sparking and approved for use in flammable atmospheres (intrinsically safe). Work will not be resumed until testing shows the hazard has been eliminated. In some cases, this may be accomplished by allowing the gas to dissipate by natural or fan-forced ventilation. It may also be necessary or useful to inert a well or boring by introducing nitrogen or carbon dioxide through a non-conductive line. Water or drilling mud may be used to replace air in some bore holes and thereby eliminate the explosion risk. Work will resume only when testing shows the explosion hazard has been removed. Monitoring will continue at least every 15 to 30 minutes to check whether the atmosphere remains inert.

Oxygen Meter. Monitoring for oxygen content will be conducted as part of combustible gas monitoring or whenever oxygen deficient or enriched conditions may be expected. A PID multi-meter, combustible gas indicator, or confined space meter entry meter will be used to monitor for oxygen.

The oxygen sensor must be set to 20.9 percent prior to use. The alarm must also be enabled before use, and the pump inlet filter must be checked and replaced as necessary. All monitoring equipment will be properly calibrated and maintained as noted in the previous discussion of air monitoring procedures, and field monitoring results will be recorded on the "Air Monitoring Log" and “Field Health and Safety Report” form.

- **If oxygen level is < 19.5 percent or > 23 percent**, immediately stop work, evacuate the area, and contact the project manager and/or corporate health and safety director. When employees are involved in activities where oxygen deficiency could occur, monitoring must be performed continuously during the initial phase of the job and results must be recorded on the “Air Monitoring Log ” form at a minimum frequency of 15 minutes.

- If the oxygen level is normal, combustible vapors are absent, and there is no indication these conditions may change, monitoring may be discontinued after a 1-hour period where all readings are at background levels. Otherwise, monitoring must be continued as described above. If any indications of changing conditions are noted, monitoring must be resumed immediately. Action will be taken, including plan modification, if required, to address any situations where such results are observed.

Hydrogen Sulfide. Monitoring for hydrogen sulfide (H_2S) content will be conducted where site conditions have the potential to generate H_2S. Records of these measurements will be recorded on the “Air Monitoring Log” and “Field Health and Safety Report” forms. As described below, the monitoring frequency will be determined by the results of the initial survey measurement. Action levels are shown in Table 1.

- **If hydrogen sulfide measurements are less than 5 ppm** in employee breathing zones, work can proceed without respiratory protection. In this case, monitoring will be repeated at 30-minute intervals, or sooner, if any odors or signs of respiratory irritation are noted. Monitoring may be discontinued when H_2S remains non-detectable for a 1-hour period.

- **If hydrogen sulfide measurements exceed 5 ppm** in employee breathing zones or if the rotten egg odor associated with H_2S is present, site work will cease, and employees will evacuate the work area pending reevaluation of the situation by the corporate health and safety director. Action will be taken, including plan modification, if required, to address any situations where such results are observed. Approved self-contained breathing apparatus or airline respirator with escape self-contained breathing apparatus (SCBA) are required when working in immediately dangerous to life or health environments. Hart Crowser personnel are not trained to wear this equipment and should not work in these environments for any period of time.

Carbon monoxide. Monitoring for carbon monoxide (CO) content will be conducted where site conditions are poorly ventilated and have the potential to trap CO. Records of these measurements will be recorded on the “Field Health and Safety Report” form and “Air Monitoring Log”. As described below, the monitoring frequency will be determined by the results of the initial survey measurement. Action levels are shown in Table 1.

- **If CO measurements are less than 25 ppm** in employee breathing zones, work can proceed without respiratory protection. In this case, monitoring will be repeated at 30-minute intervals, or sooner, if any odors or signs of respiratory irritation are noted. Monitoring may be discontinued when CO remains non-detectable for a 1-hour period.

- **If CO measurements are between 25 ppm and 50 ppm** in employee breathing zones, workers may proceed with caution, but monitoring must be performed continuously, and fans or other means must be used to disperse vapors. Monitoring results will be recorded at 15-minute intervals, or more frequently if any odors (CO exposure commonly occurs from inadequate ventilation of combustion engine exhaust) or signs of contamination are noted.

- **If CO measurements exceed 50 ppm** in employee breathing zones, site work will cease, and employees will evacuate the work area pending reevaluation of the situation by the corporate health and safety director. Action will be taken, including plan modification, if required, to address any situations where such results are observed. Approved self-contained breathing apparatus or airline respirator with escape SCBA are required when working in this environment. Hart Crowser personnel are not trained to wear this equipment and should not work in these environments for any period of time.

Calibration and Maintenance. The MultiRAE or MiniRAE PID will be calibrated and maintained according to the manufacturer instructions. If there are problems with the equipment, a completed "Notice of Returned Equipment" form or other notification indicating the equipment condition will accompany the Hart Crowser PIDs returned to the equipment room. The equipment technician will perform maintenance/repair as required. Rental PIDs will be returned to the rental facility for maintenance, repair, or replacement.

2.4 Physical Hazards

Potential physical hazards associated with the project include operating motor vehicles, doing heavy lifting, suffering from heat or cold-related illnesses, biological hazards (insects, blood-borne pathogens [BBPs]), or slips, trips, and falls.

Operating Motor Vehicles

Hart Crowser personnel who operate motor vehicles are legally licensed to do so, will wear seat belts at all times when driving, and will obey all rules of the road while engaged in company business.

Hart Crowser employees will comply with all federal, state, and local regulations on use of cellular devices while driving. Only hands-free cellular devices may be used during vehicle operation. Under no circumstances is text messaging or any use of a keyboard allowed while operating a vehicle.

Heavy Lifting

Field work on this project may require some amount of heavy lifting. Overexertion injuries to the back, shoulders, elbows, hands, or wrists can occur when a load is lifted or otherwise handled. Hands and wrists can be injured from grasping during lifting. Muscles in the forearm that are used for grasping attach to the elbow, so this joint can be injured when lifting. The shoulder can be injured by lifting any load and is especially at risk of injury from lifts done while reaching above the shoulder or away from the body. Frequent lifting and awkward lifting (i.e., above the shoulders, below the knees, at arms' length) can also result in injuries.

The best procedures for lifting vary depending on conditions and the size and shape of the object being lifted. A general rule for avoiding injuries is to assess the object and surrounding area before lifting, and never attempt to lift an object that is poorly packaged or too heavy. Before lifting, workers should make sure their path is dry and clear of obstacles that could cause a fall.

To lift heavy objects:

- Take a deep breath and relax your muscles.

- Approach the object, and in a slow, controlled movement, bend your knees (keeping your back straight) until you are squatting.
- Grip the object securely with both hands and, when ready, push up and extend your knees until reaching a standing position, with the object at chest level. Do not lift above your shoulders or below your knees.
- Do not twist your back or bend sideways.
- Walk slowly to the destination and put down the heavy object using the same slow, controlled movements, keeping your back relatively straight and bending your knees.
- Do not lift or lower with arms extended.
- Take a break between lifting each object if necessary.
- Never attempt to move any object that seems too heavy to manage alone. Get help from a co-worker as needed.

Workers who need to lift objects should be in good physical shape. Workers not accustomed to lifting or vigorous exercise should not be assigned difficult lifting or lowering tasks. Mechanical means (e.g., forklift, drum dolly, pallet jack, etc.) should be used whenever possible to reduce the potential for injury.

Heat-Related Illnesses

The sampling event is anticipated to be performed in spring 2020 where weather conditions are not inclined to produce heat stress. Future events or maintenance activities may be added to the scope of work and may be performed during the summer when weather conditions can induce heat stress.

At a minimum, personnel wearing non-breathable clothing (e.g. PPE like chemical-resistant suits) at temperatures greater than 70°F should take a break every 1 to 2 hours and drink plenty of fluids. An average of one quart of fluids per hour is recommended. When temperatures are over 70°F, water will be available at the site in a sufficient quantity for each worker to drink one quart per hour. A cool or shaded rest area should be used for breaks.

The body normally cools itself by sweating. People suffer heat-related illness when the body's temperature control system is overloaded. Several factors affect the body's ability to cool itself during extremely hot weather. For instance, sweat will not evaporate as quickly when humidity is high, and clothing type and amount can affect cooling. Impermeable clothing reduces the body's ability to cool with evaporating perspiration and may lead to heat stress. Outdoor work conducted in hot weather and direct sun also increases the risk of heat-related illness in exposed workers.

Heat related illnesses and their symptoms and first-aid measures are:

- ***Heat Rash***. Raised red vesicles on affected areas and decreased ability to tolerate heat; exacerbated by clothes that chafe. Maintain good personal hygiene and use drying powders or lotions.
- ***Heat Cramps***. Muscle spasms and pain in the extremities and abdomen. Rest in a cool area and drink plenty of fluids. If pain persists, seek medical attention.

- ***Heat Exhaustion***. Pale, cool, moist, clammy skin; profuse sweating; shallow breathing; dizziness; lassitude; and fainting. Rest in a cool area and drink plenty of fluids. Get medical attention before returning to work.
- ***Heat Stroke***: Red, hot, dry skin; no perspiration; nausea; dizziness; confusion; strong rapid pulse; and coma. Cool victim immediately with cool or cold water. **Seek immediate medical attention.**

Cold Stress

Work will be performed during the spring when temperatures can range from the 40s to 50s, and rainy weather is frequent.

Workers who are exposed to extreme cold or work outdoors in cold and wet environments may be at risk of cold stress, which can result when the core body temperature gets too low. The most common consequences of cold stress are hypothermia, frost bite, and trench foot; the latter two are not normally risks on Hart Crowser projects. Factors in cold stress include wetness, wind chill, tiredness, improper clothing, health conditions, and poor physical conditioning.

Near-freezing temperatures is a factor in cold stress. Project workers will dress appropriately for the weather conditions and pay attention to the signs and symptoms of hypothermia. When temperatures drop below normal and wind speed increases, heat can leave the body more rapidly. These weather-related conditions may lead to serious health problems.

Hypothermia

Causes. Hypothermia can result when the body loses heat faster than it can replace it, and temperature drops below 95°F. Wind chill and wetness can play a significant role in lowering core body temperature. It is important to understand that hypothermia can occur even when temperatures are not extremely cold, especially when water, wind, and/or pre-existing health conditions are involved.

Signs. Warning signs of hypothermia include shivering (only initially), confusion, loss of coordination, slurred speech, fumbling, inability to decide, disorientation, apathy, drowsiness, inability to stand or walk, dilated pupils, slowed pulse and breathing, and loss of consciousness. Confusion is a key symptom. With medium or advanced hypothermia, shivering is absent, and the person may not realize they have hypothermia. They may also be unwilling to call attention to themselves or seek help.

Treatment. Hypothermia victims should be immediately but not too rapidly re-warmed. Rewarming can involve the following treatments:

- Moving the victim into a sheltered area.
- Removing any wet clothing.
- Wrapping the victim loosely with blankets or sleeping bag.
- Applying heat packs or warm containers to armpits, groin, head, neck, and chest.
- If core body temperature falls below 90°F and heated shelter is not available, using skin-to-skin contact with another individual.

- Providing warm beverages if the person is conscious.
- Getting medical help as soon as possible.

Rescue breaths and cardiopulmonary resuscitation (CPR) for victims who are not breathing or who don't have a pulse are not covered in this HASP.

Power Tool Operation

Power tools may be used in the construction of "raptor perches" during site maintenance activities and may include chainsaw, power drill, circular saw, or reciprocating saw use. Prior to power tool use, all equipment will be inspected for defects and will be removed from service if any are identified. All tools will have all necessary guards and safety mechanisms attached or intact prior to use. Workers will keep hands and limbs away from the path of cutting blades and remove all loose clothing, jewelry, or accessories that may get caught or bound on rotating components. If drilling on uneven surfaces, workers will brace the item from rolling or tipping and will place hands far enough away to prevent injury in case of accidental slippage of the drill bit.

Biological Hazards

Biological hazards include vector-borne diseases, insects, spiders, rodents and other wild or stray animals, snakes, and poisonous plants. Vector-borne diseases may be spread to workers by insects such as mosquitoes and ticks. When a mosquito or tick bites a worker, it may transfer a disease-causing agent, such as a parasite, bacteria, or virus. Examples of mosquito-borne diseases are West Nile virus and encephalitis. Lyme disease and Rocky Mountain spotted fever are tick-borne diseases. People are exposed to biological hazards through contact with insects, soil, water, bird or bat droppings, rodent droppings, or poisonous plants.

Insects and Spiders

Wearing long pants, socks, and long-sleeved shirts provides protection from insects. Using insect repellents that contain DEET or picaridin also provides protection from insects. Insect bites and stings can be treated with over-the-counter products that relieve pain and prevent infection.

Stinging insects include bees, wasps, hornets, and fire ants. Personnel can avoid attracting stinging insects by wearing light-colored clothing and avoiding perfumes or colognes. If such an insect approaches, do not wave wildly and swat blindly; instead, use a gentle pushing or brushing motion to deter them.

Bee stings can produce life-threatening allergic reactions. Symptoms include pain, swelling of the throat, redness or discoloration of the wound, itching, hives, decreased consciousness, and labored or noisy breathing. Personnel who are allergic to insect stings should carry an anaphylactic shock kit prescribed by their physician.

Spiders may be present throughout the site and in well boxes. With the exception of the western black widow spider, most spiders likely to be encountered in Oregon are considered harmless. Spider bites are not common, but care should be taken when reaching into well boxes, rock crevices, or other places spiders may inhabit. Spider bites may range from painless to moderate pain but will generally subside over time and with the aid of topical pain ointments. Any spider bite wounds should be rinsed and cleaned with soap and water to minimize the chance for infection.

Blood-Borne Pathogens

Workers responding to a first-aid incident could be exposed to BBPs, which are infectious microorganisms in blood and other body fluids that can cause disease in humans. Examples of these pathogens include hepatitis B virus, hepatitis C virus, and HIV. Workers exposed to BBPs are at risk for serious or life-threatening illnesses.

Universal precautions will be followed if BBP exposure is a concern. Universal precautions involve treating all human blood and other potentially infectious materials as a BBP and protecting oneself from exposure. The easiest way to protect oneself from blood and body fluids is to have the injured person treat their own wound if they are conscious and capable of doing so. If injured people are unable to take care of themselves, or they need help, workers should use disposable gloves and eye protection if there is a splash hazard.

If disposable gloves are not available, a plastic bag (trash, shopping, or sandwich) can be used to create a barrier. If performing CPR, always use a pocket mask equipped with a one-way valve. After removing PPE, wash hands or other affected body parts. Place PPE in a plastic bag, seal the bag, and contact the corporate health and safety director for further instructions.

If you are exposed to BBPs or other potentially infectious materials (i.e. BBPs contact your eyes, mouth, nose, open wounds/sores, abrasions, sunburned areas, or acne), follow these steps:

- Flush the area of the body that was exposed with warm water, and then wash with soap and water. Vigorously scrub all areas. It is the abrasive action of scrubbing that removes the contamination from the skin.
- If you have an open cut, squeeze it gently to make it bleed, then wash with soap and water.
- Notify your project manager or the corporate health and safety director to document the incident; Identify the source of the exposure.
- Get medical counseling (i.e., get tested for BBPs, get vaccinated if needed).

Slips, Trips, and Falls

Hart Crowser workers will be careful to prevent slips on wet walking surfaces and will look for and avoid tripping hazards such as loose rock or debris. Wear safety-toed boots or rubber boots. Surfaces that could cause slips, trips, or falls can include slick rocks and muddy areas. If a worker gets stuck in the mud, they will roll their foot forward to break the suction and slowly pull their foot forward. If very muddy conditions are present, a walking stick is advised to probe the ground ahead when traversing to a new area of the site.

Be aware of your surroundings. Keep pathways and work areas free of debris and supplies to prevent unsafe walking and working conditions. Changes in elevation such as ruts or holes present a trip hazard and should be marked if possible. Avoid leaving tools on the ground.

Plan what you would do if you start to slip or fall. During a fall, do not try to catch yourself; try to avoid landing on your hands, elbows, or knees. Landing on the side of your body is much safer. If you are walking on a slope and know you are going to slide, lower your center of gravity by sitting down and sliding on your feet and/or bottom. If sliding while standing up, keep your weight over your feet and bend your knees; do not lean backward or forward.

Hazards requiring fall protection are not expected at this site. A written Fall Protection Work Plan is required where fall hazards of 10 feet or more exist. Fall prevention or fall protection measures is required for any walking surface of 4 feet or higher, and when working within the affected area (the distance away from the edge of an excavation equal to the depth of the excavation up to a maximum distance of fifteen feet) of any excavation more than 10 feet deep. If there is a fall hazard of 4 feet or more on a hazardous slope (i.e., a slope where normal footing cannot be maintained without the use of devices because of the pitch of the surface, weather conditions, or surface material), a personal fall restraint system or positioning device system is required. Work will not be performed on slopes steeper than 75 percent or near vertical drop-offs without fall protection equipment.

Chemical Preservatives

Employees collecting environmental samples will often be required to collect samples into sample containers with chemical preservatives. The preservatives are used to stabilize sample media following collection and prior to analysis and can be acidic or alkaline chemicals. Commonly used preservatives include hydrochloric acid, nitric acid, sulfuric acid, and sodium hydroxide. Nitrile gloves should be worn when handling sample bottles and jars in case of leaks or accidental breakage of containers. If a chemical preservative is spilled onto exposed skin, the affected area should be immediately rinsed with water, or in the case of water reactive chemicals, neutralized with an appropriate agent (i.e. sodium bicarbonate [baking soda] for acids or vinegar for bases). Always check sample containers upon delivery or receipt for fractures, chips, or breaks.

2.5 Hazard Analysis and Applicable Safety Procedures by Task

Job hazard analysis (JHAs) have been prepared for planned work activities at Santosh Landfill to detail the task steps, potential hazards, and control measures. The JHAs listed below are included in Attachment D.

- General Site Activities
- Groundwater Sampling
- Site Maintenance and Raptor Perch Construction

3.0 PERSONEL PROTECTIVE EQUIPMENT

When fieldwork is performed in contaminated areas, the primary objective is to minimize worker exposure using engineering controls such as ventilating, working up-wind or away from contaminated materials, or wetting soil to reduce dust. If engineering controls are not feasible or may not provide adequate control, and before they are fully implemented, workers will wear specified PPE to minimize potential exposure to hazardous substances.

Contact with hazardous substances at harmful levels is not expected for this project; therefore, PPE is based on the lowest OSHA requirements, Level D. Conditions requiring Level A, B, or C protection are not anticipated for this project. If they do occur, work will stop, and the HASP will be amended as required before work is resumed.

Table 3 summarizes the minimum PPE requirements for Hart Crowser workers based on the potential routes of exposure and the potential hazardous substances.

Table 3 – Minimum Personal Protection Level Requirements

Potential Route of Contact: Type of Contaminant	Required Protection Level	Eye Protection[a]	Head Protection[b]	Foot Protection[c]	Hand Protection[d]
None anticipated	Level D (e)	X	X	X	
Minor skin contact possible	Level D (e)	X	X	X	X

Notes:
a. Safety glasses; safety goggles if there is a splash hazard.
b. Hard hat or equivalent where risk of falling objects (e.g., rock) exists or workers may strike overhead objects.
c. Safety-toed boots or rubber boots.
d. Nitrile or latex gloves and/or work gloves.
e. Level D protection is required when atmosphere contains no known hazard and work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals.

3.1 Level D Activities

Level D protection will be used when the atmosphere contains no known hazards and Hart Crowser workers will not perform activities where skin contact with free-phase product or contaminated materials is likely to occur. These workers will wear regular work clothes (long pants, shirt with minimum 4-inch sleeve), eye protection (safety glasses or goggles), hand protection (nitrile or latex gloves or neoprene-coated work gloves), and foot protection (safety-toed boots or shoes).

4.0 SAFETY SUPPLIES AND EQUIPMENT LIST

The following safety supplies and equipment must be available on site:

- Fire extinguisher – 3 to 4-pound ABC.
- First aid kit in a sturdy weatherproof carrying case; American National Standards Institute (ANSI)/ The International Safety Equipment Association (ISEA) Z308.1-2015.
- Bottled sterile hand-held eyewash solution.
- Mobile telephone.
- Class II high visibility safety vest or jacket; ANSI/ISEA 107-2015.
- Waterproof rain gear.
- Head protection – hard hat; ANSI Z89.1-2014.
- Foot protection – safety-toed boots or rubber boots (American Society for Testing and Materials [ASTM] F-2412-2005/F-2413-2005).

- Hand protection – nitrile outer gloves/nitrile inner gloves or neoprene-coated work gloves.
- Eye protection – safety glasses or safety goggles if a splash hazard is present; ANSI Z87.1-2015.

All non-disposable safety gear and PPE must be cleaned after use and stored securely to avoid damage. Avoid storing gear in direct sunlight or exposed to weather conditions. Safety equipment and PPE should be checked before use and damaged or worn-out gear should be disposed of and replaced.

5.0 SITE CONTROL

Field work for this project consists primarily of low-impact sampling activities that will not result in the migration of contaminants or increased exposure to human health or the environment. Additionally, the site is closed to the public and enclosed by fencing that is accessible through a gate off Hogan Ranch Road. The gate will be closed after entry and formal exclusion zones, contaminant reduction zones, and support zones are not necessary within the site for this field work.

Although a formal contaminant reduction zone is not necessary, project workers will use precautions during sampling activities. The amount of equipment and number of personnel allowed in sampling areas will be minimized and the number of samples collected should not exceed what is needed for laboratory analysis. Purge water will be stored in Department of Transportation (DOT)-approved 55-gallon drum(s) with the site and secured to prevent unauthorized access by trespassers.

6.0 DECONTAMINATION

Decontamination is not expected for this project as clean dedicated sampling equipment (e.g., disposable gloves and groundwater sampling tubing) will be used at each sampling location and discarded after use. However, if decontamination is needed, decontamination will be performed by using a phosphate free detergent to clean reusable sampling equipment (e.g., water level meter) and rinsed with tap water followed by rinsing with deionized water.

Hart Crowser workers will practice good hygiene by washing their hands and faces prior to taking rest breaks, drinking liquids, and so forth. They will also wash their hands and faces fully before eating, using tobacco, or as soon as possible upon leaving a work area.

7.0 SITE SECURITY

Security at the site will be the responsibility of the field health and safety manager. Any security problems will be reported to the appropriate authorities and to the client, as listed in the table at the beginning of this HASP.

8.0 SPILL CONTAINMENT PLAN

Sources of bulk chemical subject to spillage are not expected for this project. Accordingly, a spill containment plan is not required for this project.

9.0 EMERGENCY RESPONSE PLAN

This Emergency Response Plan outlines the steps necessary for appropriate response to emergency situations that could reasonably occur during Hart Crowser's work at Santosh Landfill. The following paragraphs summarize the key emergency responses for this project.

9.1 Plan Content and Review

The principal hazards addressed by this plan are fire, medical emergencies, and situations such as inadequate PPE for the hazards present. However, to help anticipate other potential emergency situations, field personnel will exercise caution and look for signs of potentially hazardous situations, including:

- General physical hazards (slippery or uneven surfaces)
- Inclement weather (heavy rains, high winds, flooding)
- Poisonous plants or dangerous animals

These and other potential conditions should be anticipated, and steps should be taken to prevent problems before they occur.

This emergency response plan will be reviewed and rehearsed, as necessary, during the on-site health and safety briefing so all personnel will know what their duties are if an emergency occurs.

9.2 Plan Implementation

The field health and safety manager will evaluate the situation and act as the lead if an emergency occurs. That individual will determine the need to implement the emergency response, in concert with other resource personnel including client representatives, the project manager, and the corporate health and safety director. Other on-site field personnel will assist the field health and safety manager as needed during an emergency.

If the plan is implemented, the field health and safety manager or designee is responsible for alerting all personnel at the affected area by use of a signal device (such as a hand-held air horn) or visual or shouted instructions, as appropriate.

The field health and safety manager will identify a safe assembly area for workers to gather if it is necessary to evacuate the area and will communicate this location to workers during the on-site health and safety briefing. The "buddy" system will be employed during evacuation to facilitate safe evacuation. The field health and safety manager is responsible for roll call at the assembly area to account for all personnel.

9.3 Emergency Response Contacts

Emergency contact information is provided in this HASP (Page 1). A copy of this HASP will be maintained at the project site. Emergency information includes:

- Emergency telephone numbers
- Route to nearest hospital (Figure 1)
- Site description (Section 1.4)

A significant environmental release of contaminants is not likely to occur from work activities subject to this HASP. If it does, the field health and safety manager will contact the project manager or corporate health and safety director to make any required notifications.

If an emergency situation occurs requiring implementation of the emergency response plan (fire, serious injury, or inadequate personal protection equipment for the hazards present, for instance), Hart Crowser staff will cease all work immediately, pending approval from the field health and safety manager to restart work. The general emergency actions described below will be followed.

9.4 Fires

Hart Crowser personnel may attempt to control only very small fires. If the fire expands, or an explosion appears likely, Hart Crowser field workers will evacuate the area immediately. If a fire occurs that cannot be controlled with a 3- to 4-pound ABC fire extinguisher, immediate intervention by the local fire department or other appropriate agency is imperative. Use these steps:

- Immediately call **911.**
- Evacuate to a safe area away from the danger to a previously agreed upon upwind location.
- Inform the project manager or field health and safety manager of the situation.

9.5 Medical Emergencies

Hart Crowser staff will call **911** immediately if a medical emergency (such as a serious injury or an unconscious worker) occurs. If workers are unsure about the severity of an accident or exposure, they will take a conservative approach and seek medical attention. The field health and safety manager will notify the project manager of the outcome of the medical incident as soon as possible.

No Hart Crowser employees are trained to perform rescue duties or medical duties beyond basic CPR and first aid. Hart Crowser employees certified in CPR and first aid may respond to work-related incidents requiring first aid services. First aid will be treatment for such things as minor cuts and bruises as needed. When rendering first aid, Hart Crowser workers will take necessary precautions to avoid exposure to BBPs. Section 2.4, Physical Hazards, provides information on BBPs and precautions for avoiding exposure.

9.6 Uncontrolled Contaminant Release

Work activities for this project do not present the potential for an uncontrolled contaminant release as defined by:

Oregon

- Oregon Administrative Rules (OAR), Chapter 437, Division 1, General Administrative Rules.
- OAR, Chapter 437, Division 2, General Occupational Safety and Health Rules.

Federal OSHA

- 29 Code of Federal Regulations (CFR) 1910, General Occupational Safety and Health Standards.
- 29 CFR 1904, Recording and Reporting Occupational Injuries and Illnesses.

Hart Crowser staff are not trained as emergency responders as defined by federal and state regulations; therefore, they are not qualified to respond to hazardous material emergencies.

9.7 Potentially High Chemical Exposure Situations

Work activities for this project do not present the potential for high chemical exposure situations.

10.0 NOTIFICATION AND REPORTING

The project manager will be informed immediately if an emergency, accident, or injury occurs at the project location. The project manager will notify the client immediately. The field health and safety manager will notify the corporate health and safety director as soon as possible after the situation has been stabilized. The project manager or corporate health and safety director will notify the appropriate client contacts and regulatory agencies, if applicable. If an individual is injured or suffers a work-related illness, the field health and safety manager or designee will complete an injury/accident report and submit it to human resources or the corporate health and safety director within 24 hours. A blank report is provided as Attachment C.

The project manager, the field health and safety manager, and the corporate health and safety director will evaluate emergency response following the incident. The results of the evaluation will be used in follow-up training exercises to improve the emergency response plan.

11.0 MEDICAL SURVEILLANCE

Hart Crowser employees working on this project participate in a medical surveillance program as described in Section 11 of Hart Crowser’s APP.

12.0 SAFETY TRAINING REQUIREMENTS

Hart Crowser employees who work at sites where there is potential for exposure to hazardous substances, health hazards, or safety hazards will have completed 40 hours of hazardous waste operations and emergency response (HAZWOPER) training and 3 days of supervised field experience. In addition, employees will have completed an 8-hour annual refresher training within the past 12 months or will possess equivalent documented training by experience. Site supervisors will have completed 8 hours of HAZWOPER supervisor training. The project manager will ensure that all employees working on this site have completed required HAZWOPER training. The Hart Crowser safety records coordinator maintains employee health and safety training records.

Employees performing some tasks will require additional safety training on performing the task safely (without injury or property damage) and in compliance with safety regulations. Examples of these tasks include entering confined spaces, wearing a respirator, operating equipment or machinery, working at heights, handling or using hazardous substances, and working in excessive outdoor heat. Safety training requirements are specified in Section 7.2 of the Hart Crowser APP. Hart Crowser personnel will complete hazard-specific safety training as needed based on the tasks to be performed.

Before each work day starts, the field health and safety manager will review applicable health and safety issues with Hart Crowser employees. At these briefings the work to be accomplished will be reviewed and there will be an opportunity for questions to be asked. The “Field Health and Safety Report” form (Attachment C) will be completed daily by the Hart Crowser field health and safety manager or designated individual.

13.0 REPORTING, REPORTS, AND DOCUMENTATION

All incidents (accidents, injuries, near-misses) that occur during field work on this project will be reported to the project manager immediately. The project manager will notify the client and the corporate health and safety director.

The field health and safety manager is responsible for maintaining records demonstrating that the provisions of this HASP are implemented throughout the course of this project.

ATTACHMENT A
Record of Health and Safety Communication

Record of Health and Safety Communication

PROJECT NAME: Santosh Landfill

PROJECT NUMBER: 150-002-020

SITE CONTAMINANTS:

PPE REQUIREMENTS (check all that apply):

______ Eye protection ______ Gloves (specify) ______________________

______ Foot protection ______ Clothing (specify) ______________________

______ Head protection ______ Respirator (specify) ______________________

______ Other (specify) ______________________

The following personnel have reviewed a copy of the site-specific HASP. By signing below, these personnel indicate they have read the plan, including all referenced information, and that they understand the requirements detailed for this project.

PRINTED NAME	SIGNATURE	PROJECT DUTIES	DATE

Project manager: please route a copy of this form to the job files when completed.

ATTACHMENT B
Hazardous Substance Fact Sheet

AGENCY FOR TOXIC SUBSTANCES
AND DISEASE REGISTRY

AMMONIA

CAS # 7664-41-7

Division of Toxicology ToxFAQs™ **September 2004**

This fact sheet answers the most frequently asked health questions (FAQs) about ammonia. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Ammonia is found throughout the environment in the air, soil, and water, and in plants and animals including humans. Exposure to high levels of ammonia can cause irritation and serious burns on the skin and in the mouth, throat, lungs, and eyes. At very high levels, ammonia can even cause death. Ammonia has been found in at least 137 of the 1,647 current or former National Priority Sites list identified by the Environmental Protection Agency (EPA).

What is ammonia?

Ammonia occurs naturally and is produced by human activity. It is an important source of nitrogen which is needed by plants and animals. Bacteria found in the intestines can produce ammonia.

Ammonia is a colorless gas with a very distinct odor. This odor is familiar to many people because ammonia is used in smelling salts, many household and industrial cleaners, and window-cleaning products.

Ammonia gas can be dissolved in water. This kind of ammonia is called liquid ammonia or aqueous ammonia. Once exposed to open air, liquid ammonia quickly turns into a gas.

Ammonia is applied directly into soil on farm fields, and is used to make fertilizers for farm crops, lawns, and plants. Many household and industrial cleaners contain ammonia.

What happens to ammonia when it enters the environment?

❏ Ammonia is found throughout the environment in air, water, soil, animals, and plants.
❏ Ammonia does not last very long in the environment. It is rapidly taken up by plants, bacteria, and animals.
❏ Ammonia does not build up in the food chain, but serves as a nutrient for plants and bacteria.

How might I be exposed to ammonia?

❏ Everyone is exposed to low levels of naturally-occurring ammonia in air, food, water, and soil.
❏ You may be exposed to higher levels during use of cleaning products containing ammonia.
❏ You may be exposed to higher levels if you apply ammonia fertilizers or live near farms where these fertilizers have been applied.
❏ You may be exposed to high levels if you go into enclosed buildings that contain lots of animals (such as on farms).

How can ammonia affect my health?

No health effects have been found in humans exposed to typical environmental concentrations of ammonia. Exposure to high levels of ammonia in air may be irritating to your skin, eyes, throat, and lungs and cause coughing and burns. Lung damage and death may occur after exposure to very high concentrations of ammonia. Some people with asthma may be more sensitive to breathing ammonia than others.

Swallowing concentrated solutions of ammonia can cause burns in your mouth, throat, and stomach. Splashing ammonia into your eyes can cause burns and even blindness.

How likely is ammonia to cause cancer?

There is no evidence that ammonia causes cancer. The The Department of Health and Human Services (DHHS), the EPA, and the InternationalAgency for Research on Cancer (IARC), have not classified ammonia for carcinogenicity.

How can ammonia affect children?

Children are less likely than adults to be exposed to concentrated levels of ammonia because most exposures occur at work. The effects on children are likely to be the same as for adults. We do not know if exposure to ammonia causes birth defects, or if it can pass to the fetus across the placenta or to infants via breast milk.

How can families reduce the risk of exposure to ammonia?

❏ Keep products that contain ammonia out of the reach of children.

❏ Make sure there is adequate ventilation when you use cleaners that contain ammonia, and wear proper clothing and eye protection.

❏ Never store cleaning solutions in containers that children might find attractive, like soda bottles.

❏ Avoid farm fields after they have been treated with ammonia or ammonia-containing fertilizers.

❏ Minimize exposure to ammonia in the workplace by wearing proper safety clothes and equipment, and by following safety rules.

Is there a medical test to show whether I've been exposed to ammonia?

There are tests to measure ammonia in blood and urine. These tests can not definitely determine whether you have been exposed because ammonia is normally found in our bodies.

Has the federal government made recommendations to protect human health?

The Food and Drug Administration (FDA) has determined that the levels of ammonia and ammonium salts typically found in foods do not pose a risk to human health.

The Occupational Safety and Health Administration (OSHA) has set an acceptable eight-hour exposure limit at 25 parts of ammonia per one million parts of air (ppm) and a short-term (15 minutes) exposure level at 35 ppm.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2004. Toxicological Profile for Ammonia. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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ANTIMONY
CAS # 7440-36-0

Agency for Toxic Substances and Disease Registry ToxFAQs **September 1995**

This fact sheet answers the most frequently asked health questions (FAQs) about antimony. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Exposure to antimony occurs in the workplace or from skin contact with soil at hazardous waste sites. Breathing high levels of antimony for a long time can irritate the eyes and lungs, and can cause problems with the lungs, heart, and stomach. This chemical has been found in at least 403 of 1,416 National Priorities List sites identified by the Environmental Protection Agency.

What is antimony?
(Pronounced ăn′tə-mō′nē)

Antimony is a silvery-white metal that is found in the earth's crust. Antimony ores are mined and then mixed with other metals to form antimony alloys or combined with oxygen to form antimony oxide.

Little antimony is currently mined in the United States. It is brought into this country from other countries for processing. However, there are companies in the United States that produce antimony as a by-product of smelting lead and other metals.

Antimony isn't used alone because it breaks easily, but when mixed into alloys, it is used in lead storage batteries, solder, sheet and pipe metal, bearings, castings, and pewter. Antimony oxide is added to textiles and plastics to prevent them from catching fire. It is also used in paints, ceramics, and fireworks, and as enamels for plastics, metal, and glass.

What happens to antimony when it enters the environment?

☐ Antimony is released to the environment from natural sources and from industry.

☐ In the air, antimony is attached to very small particles that may stay in the air for many days.

☐ Most antimony ends up in soil, where it attaches strongly to particles that contain iron, manganese, or aluminum.

☐ Antimony is found at low levels in some rivers, lakes, and streams.

How might I be exposed to antimony?

☐ Because antimony is found naturally in the environment, the general population is exposed to low levels of it every day, primarily in food, drinking water, and air.

☐ It may be found in air near industries that process or release it, such as smelters, coal-fired plants, and refuse incinerators.

☐ In polluted areas containing high levels of antimony, it may be found in the air, water, and soil.

☐ Workers in industries that process it or use antimony ore may be exposed to higher levels.

How can antimony affect my health?

Exposure to antimony at high levels can result in a variety of adverse health effects.

Breathing high levels for a long time can irritate your eyes and lungs and can cause heart and lung problems, stomach pain, diarrhea, vomiting, and stomach ulcers.

In short-term studies, animals that breathed very high levels of antimony died. Animals that breathed high levels had lung, heart, liver, and kidney damage. In long-term studies, animals that breathed very low levels of antimony had eye irritation, hair loss, lung damage, and heart problems. Problems with fertility were also noted. In animal studies, problems with fertility have been seen when rats breathed very high levels of antimony for a few months.

Ingesting large doses of antimony can cause vomiting. We don't know what other effects may be caused by ingesting it. Long-term animal studies have reported liver damage and blood changes when animals ingested antimony. Antimony can irritate the skin if it is left on it.

Antimony can have beneficial effects when used for medical reasons. It has been used as a medicine to treat people infected with parasites.

How likely is antimony to cause cancer?

The Department of Health and Human Services, the International Agency for Research on Cancer, and the Environmental Protection Agency (EPA) have not classified antimony as to its human carcinogenicity.

Lung cancer has been observed in some studies of rats that breathed high levels of antimony. No human studies are available. We don't know whether antimony will cause cancer in people.

Is there a medical test to show whether I've been exposed to antimony?

Tests are available to measure antimony levels in the body. Antimony can be measured in the urine, feces, and blood for several days after exposure. However, these tests cannot tell you how much antimony you have been exposed to or whether you will experience any health effects. Some tests are not usually performed in most doctors' offices and may require special equipment to conduct them.

Has the federal government made recommendations to protect human health?

The EPA allows 0.006 parts of antimony per million parts of drinking water (0.006 ppm). The EPA requires that discharges or spills into the environment of 5,000 pounds or more of antimony be reported.

The Occupational Safety and Health Administration (OSHA) has set an occupational exposure limit of 0.5 milligrams of antimony per cubic meter of air (0.5 mg/m^3) for an 8-hour workday, 40-hour workweek.

The American Conference of Governmental Industrial Hygienists (ACGIH) and the National Institute for Occupational Safety and Health (NIOSH) currently recommend the same guidelines for the workplace as OSHA.

Glossary

Carcinogenicity: Ability to cause cancer.
CAS: Chemical Abstracts Service.
Ingestion: Taking food or drink into your body.
Long-term: Lasting one year or more.
Milligram (mg): One thousandth of a gram.
Parasite: An organism living in or on another organism.
ppm: Parts per million.
Short-term: Lasting 14 days or less.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1992. Toxicological profile for antimony. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Arsenic - ToxFAQs™

CAS # 7440-38-2

This fact sheet answers the most frequently asked health questions (FAQs) about arsenic. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to higher than average levels of arsenic occur mostly in the workplace, near hazardous waste sites, or in areas with high natural levels. At high levels, inorganic arsenic can cause death. Exposure to lower levels for a long time can cause a discoloration of the skin and the appearance of small corns or warts. Arsenic has been found in at least 1,149 of the 1,684 National Priority List (NPL) sites identified by the Environmental Protection Agency (EPA).

What is arsenic?

Arsenic is a naturally occurring element widely distributed in the earth's crust. In the environment, arsenic is combined with oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Arsenic in animals and plants combines with carbon and hydrogen to form organic arsenic compounds.

Inorganic arsenic compounds are mainly used to preserve wood. Copper chromated arsenate (CCA) is used to make "pressure-treated" lumber. CCA is no longer used in the U.S. for residential uses; it is still used in industrial applications. Organic arsenic compounds are used as pesticides, primarily on cotton fields and orchards.

What happens to arsenic when it enters the environment?

- Arsenic occurs naturally in soil and minerals and may enter the air, water, and land from wind-blown dust and may get into water from runoff and leaching.
- Arsenic cannot be destroyed in the environment. It can only change its form.
- Rain and snow remove arsenic dust particles from the air.
- Many common arsenic compounds can dissolve in water. Most of the arsenic in water will ultimately end up in soil or sediment.
- Fish and shellfish can accumulate arsenic; most of this arsenic is in an organic form called arsenobetaine that is much less harmful.

How might I be exposed to arsenic?

- Ingesting small amounts present in your food and water or breathing air containing arsenic.
- Breathing sawdust or burning smoke from wood treated with arsenic.
- Living in areas with unusually high natural levels of arsenic in rock.
- Working in a job that involves arsenic production or use, such as copper or lead smelting, wood treating, or pesticide application.

How can arsenic affect my health?

Breathing high levels of inorganic arsenic can give you a sore throat or irritated lungs.

Ingesting very high levels of arsenic can result in death. Exposure to lower levels can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of "pins and needles" in hands and feet.

Ingesting or breathing low levels of inorganic arsenic for a long time can cause a darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso.

Skin contact with inorganic arsenic may cause redness and swelling.

Almost nothing is known regarding health effects of organic arsenic compounds in humans. Studies in animals show that some simple organic arsenic compounds are less toxic than inorganic forms. Ingestion of methyl and dimethyl compounds can cause diarrhea and damage to the kidneys.

How likely is arsenic to cause cancer?

Several studies have shown that ingestion of inorganic arsenic can increase the risk of skin cancer and cancer in the liver, bladder, and lungs. Inhalation of inorganic arsenic can cause increased risk of lung cancer. The Department of Health and Human Services (DHHS) and the EPA have determined that inorganic arsenic is a known human carcinogen. The International Agency for Research on Cancer (IARC) has determined that inorganic arsenic is carcinogenic to humans.

How can arsenic affect children?

There is some evidence that long-term exposure to arsenic in children may result in lower IQ scores. There is also some evidence that exposure to arsenic in the womb and early childhood may increase mortality in young adults.

There is some evidence that inhaled or ingested arsenic can injure pregnant women or their unborn babies, although the studies are not definitive. Studies in animals show that large doses of arsenic that cause illness in pregnant females, can also cause low birth weight, fetal malformations, and even fetal death. Arsenic can cross the placenta and has been found in fetal tissues. Arsenic is found at low levels in breast milk.

How can families reduce the risks of exposure to arsenic?

- If you use arsenic-treated wood in home projects, you should wear dust masks, gloves, and protective clothing to decrease exposure to sawdust.
- If you live in an area with high levels of arsenic in water or soil, you should use cleaner sources of water and limit contact with soil.
- If you work in a job that may expose you to arsenic, be aware that you may carry arsenic home on your clothing, skin, hair, or tools. Be sure to shower and change clothes before going home.

Is there a medical test to determine whether I've been exposed to arsenic?

There are tests available to measure arsenic in your blood, urine, hair, and fingernails. The urine test is the most reliable test for arsenic exposure within the last few days. Tests on hair and fingernails can measure exposure to high levels of arsenic over the past 6-12 months. These tests can determine if you have been exposed to above-average levels of arsenic. They cannot predict whether the arsenic levels in your body will affect your health.

Has the federal government made recommendations to protect human health?

The EPA has set limits on the amount of arsenic that industrial sources can release to the environment and has restricted or cancelled many of the uses of arsenic in pesticides. EPA has set a limit of 0.01 parts per million (ppm) for arsenic in drinking water.

The Occupational Safety and Health Administration (OSHA) has set a permissible exposure limit (PEL) of 10 micrograms of arsenic per cubic meter of workplace air ($10\ \mu g/m^3$) for 8 hour shifts and 40 hour work weeks.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological Profile for Arsenic (Update). Atlanta, GA: U.S. Department of Health and Human Services. Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636

ToxFAQs™ Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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BARIUM

CAS # 7440-39-3

Division of Toxicology and Human Health Sciences ToxFAQs™ **June 2013**

This fact sheet answers the most frequently asked health questions (FAQs) about barium and barium compounds. For more information, call the ATSDR Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because these substances may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to barium occurs mostly in the workplace or from drinking contaminated water. Ingesting drinking water containing levels of barium above the EPA drinking water guidelines for relatively short periods of time can cause gastrointestinal disturbances and muscle weakness. Ingesting high levels for a long time can damage the kidneys. Barium and barium compounds have been found in at least 798 of the 1,684 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is barium?

Barium is a silvery-white metal which exists in nature only in ores containing mixtures of elements. It combines with other chemicals such as sulfur or carbon and oxygen to form barium compounds.

Barium compounds are used by the oil and gas industries to make drilling muds. Drilling muds make it easier to drill through rock by keeping the drill bit lubricated. They are also used to make paint, bricks, ceramics, glass, and rubber.

Barium sulfate is sometimes used by doctors to perform medical tests and to take x-rays of the gastrointestinal tract.

What happens to barium when it enters the environment?

- Barium gets into the air during the mining, refining, and production of barium compounds, and from the burning of coal and oil.
- The length of time that barium will last in air, land, water, or sediments depends on the form of barium released.
- Barium compounds, such as barium sulfate and barium carbonate, which do not dissolve well in water, can last a long time in the environment.
- Barium compounds, such as barium chloride, barium nitrate, or barium hydroxide, that dissolve easily in water usually do not last in these forms for a long time in the environment. The barium in these compounds that is dissolved in water quickly combines with sulfate or carbonate that are naturally found in water and become the longer lasting forms (barium sulfate and barium carbonate).
- Fish and aquatic organisms can accumulate barium.

How might I be exposed to barium?

- Ingesting small amounts present in your food and water or breathing air containing very low levels of barium.
- Living in areas with unusually high natural levels of barium in the drinking water.
- Working in a job that involves barium production or use.
- Living or working near waste sites where barium has been disposed of.

How can barium affect my health?

The health effects of the different barium compounds depend on how well the compound dissolves in water or in the stomach contents. Barium compounds that do not dissolve well, such as barium sulfate, are not generally harmful.

Barium has been found to potentially cause gastrointestinal disturbances and muscular weakness when people are exposed to it at levels above the EPA drinking water standards for relatively short periods of time. Some people who eat or drink amounts of barium above background levels found in food and water for a short period may experience vomiting, abdominal cramps, diarrhea, difficulties in breathing, increased or decreased blood pressure, numbness around the face, and muscle weakness. Eating or drinking very large amounts of barium compounds that easily dissolve can cause changes in heart rhythm or paralysis and possibly death. Animals that drank barium over long periods had damage to the kidneys, decreases in body weight, and some died.

How likely is barium to cause cancer?

The Department of Health and Human Services (DHHS) and the International Agency for Research on Cancer (IARC) have not classified barium as to its carcinogenicity. The EPA has determined that barium is not likely to be carcinogenic to humans following ingestion and that there is insufficient information to determine whether it will be carcinogenic to humans following inhalation exposure.

How can barium affect children?

We do not know whether children will be more or less sensitive than adults to barium toxicity. A study in rats that swallowed barium found a decrease in newborn body weight; we do not know if a similar effect would be seen in humans.

How can families reduce the risk of exposure to barium?

- ☐ The greatest potential source of barium exposure is through food and drinking water. However, the amount of barium in foods and drinking water are typically too low to be of concern.

Is there a medical test to determine whether I’ve been exposed to barium?

There is no routine medical test to determine whether you have been exposed to barium. Doctors can measure barium in body tissues and fluids, such as bones, blood, urine, and feces, using very complex instruments. These tests cannot be used to predict the extent of the exposure or potential health effects.

The geometric mean barium level measured in the U.S. general population aged 6 and older is reported by the Centers for Disease Control and Prevention (CDC) as 1.56 µg/g creatinine (measured in urine).

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 2.0 milligrams of barium per liter of drinking water (2.0 mg/L), which is the same as 2 ppm.

The Occupational Safety and Health Administration (OSHA) has set Permissible Exposure Limits (PELs) of 0.5 milligrams of soluble barium compounds per cubic meter of workplace air (0.5 mg/m^3) for 8 hour shifts and 40 hour work weeks. The OSHA limits for barium sulfate dust are 15 mg/m^3 of total dust and 5 mg/m^3 for respirable fraction.

The National Institute for Occupational Safety and Health (NIOSH) has set Recommended Exposure Limits (RELs) of 0.5 mg/m^3 for soluble barium compounds. The NIOSH has set RELs of 10 mg/m^3 (total dust) for barium sulfate and 5 mg/m^3 (respirable fraction).

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological Profile for Barium and Compounds (*Update*). Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

http://www.cdc.gov/exposurereport/pdf/FourthReport_UpdatedTables_Sep2012.pdf

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30333. Phone: 1-800-232-4636, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Benzene - ToxFAQs™

CAS # 71-43-2

This fact sheet answers the most frequently asked health questions (FAQs) about benzene. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHTLIGHTS: Benzene is a widely used chemical formed from both natural processes and human activities. Breathing benzene can cause drowsiness, dizziness, and unconsciousness; long-term benzene exposure causes effects on the bone marrow and can cause anemia and leukemia. Benzene has been found in at least 1,000 of the 1,684 National Priority List (NPL) sites identified by the Environmental Protection Agency (EPA).

What is benzene?

Benzene is a colorless liquid with a sweet odor. It evaporates into the air very quickly and dissolves slightly in water. It is highly flammable and is formed from both natural processes and human activities.

Benzene is widely used in the United States; it ranks in the top 20 chemicals for production volume. Some industries use benzene to make other chemicals which are used to make plastics, resins, and nylon and other synthetic fibers. Benzene is also used to make some types of rubbers, lubricants, dyes, detergents, drugs, and pesticides. Natural sources of benzene include emissions from volcanoes and forest fires. Benzene is also a natural part of crude oil, gasoline, and cigarette smoke.

What happens to benzene when it enters the environment?

- Industrial processes are the main source of benzene in the environment.
- Benzene can pass into the air from water and soil.
- It reacts with other chemicals in the air and breaks down within a few days.
- Benzene in the air can attach to rain or snow and be carried back down to the ground.
- It breaks down more slowly in water and soil, and can pass through the soil into underground water.
- Benzene does not build up in plants or animals.

How might I be exposed to benzene?

- Outdoor air contains low levels of benzene from tobacco smoke, automobile service stations, exhaust from motor vehicles, and industrial emissions.
- Vapors (or gases) from products that contain benzene, such as glues, paints, furniture wax, and detergents, can also be a source of exposure.
- Air around hazardous waste sites or gas stations will contain higher levels of benzene.
- Working in industries that make or use benzene.

How can benzene affect my health?

Breathing very high levels of benzene can result in death, while high levels can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. Eating or drinking foods containing high levels of benzene can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate, and death.

The major effect of benzene from long-term exposure is on the blood. Benzene causes harmful effects on the bone marrow and can cause a decrease in red blood cells leading to anemia. It can also cause excessive bleeding and can affect the immune system, increasing the chance for infection. Some women who breathed high levels of benzene for many months had irregular menstrual periods and a decrease in the size of their ovaries, but we do not know for certain that benzene caused the effects. It is not known whether benzene will affect fertility in men.

Benzene

CAS # 71-43-2

How likely is benzene to cause cancer?

Long-term exposure to high levels of benzene in the air can cause leukemia, particularly acute myelogenous leukemia, often referred to as AML. This is a cancer of the bloodforming organs. The Department of Health and Human Services (DHHS) has determined that benzene is a known carcinogen. The International Agency for Research on Cancer (IARC) and the EPA have determined that benzene is carcinogenic to humans.

How can benzene affect children?

Children can be affected by benzene exposure in the same ways as adults. It is not known if children are more susceptible to benzene poisoning than adults.

Benzene can pass from the mother's blood to a fetus. Animal studies have shown low birth weights, delayed bone formation, and bone marrow damage when pregnant animals breathed benzene.

How can families reduce the risks of exposure to benzene?

Benzene exposure can be reduced by limiting contact with gasoline and cigarette smoke. Families are encouraged not to smoke in their house, in enclosed environments, or near their children.

Is there a medical test to determine whether I've been exposed to benzene?

Several tests can show if you have been exposed to benzene. There is a test for measuring benzene in the breath; this test must be done shortly after exposure. Benzene can also be measured in the blood; however, since benzene disappears rapidly from the blood, this test is only useful for recent exposures.

In the body, benzene is converted to products called metabolites. Certain metabolites can be measured in the urine. The metabolite S-phenylmercapturic acid in urine is a sensitive indicator of benzene exposure. However, this test must be done shortly after exposure and is not a reliable indicator of how much benzene you have been exposed to, since the metabolites may be present in urine from other sources.

Has the federal government made recommendations to protect human health?

The EPA has set the maximum permissible level of benzene in drinking water at 5 parts benzene per billion parts of water (5 ppb).

The Occupational Safety and Health Administration (OSHA) has set limits of 1 part benzene per million parts of workplace air (1 ppm) for 8 hour shifts and 40 hour work weeks.

References

Agency for Toxic Substances and Disease Registry (ATSDR) 2007. Toxicological Profile for Benzene (Update). Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636

ToxFAQs™ Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ToxFAQs - for Beryllium

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http://www.atsdr.cdc.gov/toxfaqs/tfacts4.pdf

Boron - ToxFAQs™

CAS # 7440-42-8

This fact sheet answers the most frequently asked health questions (FAQs) about boron. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to boron occurs in the workplace or from using certain consumer products. Breathing moderate levels of boron irritates the nose, throat, and eyes. Ingestion of large amounts of boron can result in damage to the testes, intestines, liver, kidney, and brain. Boron has been found in at least 164 of 1,689 National Priorities List (NPL) sites identified by the Environmental Protection Agency (EPA).

What is boron?

Boron is a compound that occurs in nature. It is often found combined with other substances to form compounds called borates. Common borate compounds include boric acid, salts of borates, and boron oxide.

Borates are used mostly to produce glass. They are also used in fire retardants, leather tanning industries, cosmetics, photographic materials, soaps and cleaners, and for high-energy fuel. Some pesticides used for cockroach control and some wood preservatives also contain borates.

What happens to boron when it enters the environment?

- Boron is released to the environment from natural sources such as oceans, volcanoes, and geothermal steam.
- Boron is also released from industries that use it.
- Boron cannot be destroyed in the environment. It can only change its form or become attached or separated from particles in soil, sediment, and water.

How might I be exposed to boron?

- You can be exposed to boron in food, mainly vegetables and fruits.
- Boron is widely distributed in surface water and groundwater.
- The general public is not likely to be exposed to air contaminated with boron.
- Working in borax mining and refining plants and at sites where boric acid is manufactured.
- Using consumer products that contain it, such as cosmetics and laundry products.

How can boron affect my health?

People working in dusty workplaces where borates are mined and processed have reported irritation of the nose, throat, and eyes. The irritation does not persist for long periods after leaving the dusty area.

Exposure to large amounts of boron (about 30 g of boric acid) over short periods of time can affect the stomach, intestines, liver, kidney, and brain and can eventually lead to death.

Studies in animals indicate that the male reproductive organs, especially the testes, are affected if large amounts of boron are ingested for short or long periods of time. The doses that produced these effects in animals are more than 1,800 times higher than the average daily intake of boron in food by adults in the U.S. population.

How likely is boron to cause cancer?

The Department of Health and Human Services, the International Agency for Research on Cancer, and the EPA have not classified boron as to its human carcinogenicity.

One animal study found no evidence of cancer after lifetime exposure to boric acid in food. No human studies are available.

CAS # 7440-42-8

How can boron affect children?

It is likely that children would show the same health effects as adults. We do not know whether children differ in their susceptibility to the effects of boron.

We do not know whether boron causes birth defects in people. Low birth weights, birth defects, and developmental delays have occurred in newborn animals whose mothers were orally exposed to high doses of boron (as boric acid) during pregnancy. The doses that produced these effects in pregnant animals are more than 800 times higher than the average daily intake of boron in food by adult women in the U.S. population

How can families reduce the risks of exposure to boron?

- Pesticides containing boron compounds should be used according to their directions and should be kept away from children.
- Always store household chemicals in their original labeled containers out of reach of young children to prevent accidental poisonings. Never store household chemicals in containers children would find attractive to eat or drink from, such as old soda bottles.
- Children living near waste sites containing boron and boron compounds are likely to be exposed to higher than normal environmental levels of boron through breathing in boron-containing dust, touching soil, and eating contaminated soil. Children should be encouraged to wash their hands frequently, especially before eating.

Is there a medical test to determine whether I've been exposed to boron?

Blood and urine can be examined to determine whether excessive exposure to boron has occurred.

These tests can show you were exposed to boron, but cannot predict the kind of health effects that might occur.

Has the federal government made recommendations to protect human health?

The EPA has determined that exposure to boron in drinking water at concentrations of 4 ppm for 1 day or 0.9 ppm for 10 days is not expected to cause any adverse effects in a child.

The EPA has determined that lifetime exposure to 1 ppm boron is not expected to cause any adverse effects.

The Occupational Health and Safety Administration (OSHA) has limited workers' exposure to an average of 15 mg/m^3 for boron oxide in air for an 8-hour workday, 40-hour workweek.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological Profile for Boron (Draft for Public Comment). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636

ToxFAQs^{TM} Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Cadmium- ToxFAQs™

CAS # 7440-43-9

This fact sheet answers the most frequently asked health questions (FAQs) about cadmium. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to cadmium happens mostly in the workplace where cadmium products are made. The general population is exposed from breathing cigarette smoke or eating cadmium contaminated foods. Cadmium damages the kidneys, lungs, and bones. Cadmium has been found in at least 1,014 of the 1,669 National Priorities List (NPL) sites identified by the Environmental Protection Agency (EPA).

What is cadmium?

Cadmium is a natural element in the earth's crust. It is usually found as a mineral combined with other elements such as oxygen (cadmium oxide), chlorine (cadmium chloride), or sulfur (cadmium sulfate, cadmium sulfide).

All soils and rocks, including coal and mineral fertilizers, contain some cadmium. Most cadmium used in the United States is extracted during the production of other metals like zinc, lead, and copper. Cadmium does not corrode easily and has many uses, including batteries, pigments, metal coatings, and plastics.

What happens to cadmium when it enters the environment?

- Cadmium enters soil, water, and air from mining, industry, and burning coal and household wastes.
- Cadmium does not break down in the environment, but can change forms.
- Cadmium particles in air can travel long distances before falling to the ground or water.
- Some forms of cadmium dissolve in water.
- Cadmium binds strongly to soil particles.
- Fish, plants, and animals take up cadmium from the environment.

How might I be exposed to cadmium?

- Eating foods containing cadmium; low levels are found in all foods (highest levels are found in leafy vegetables, grains, legumes, and kidney meat).
- Smoking cigarettes or breathing cigarette smoke.
- Breathing contaminated workplace air.
- Drinking contaminated water.
- Living near industrial facilities which release cadmium into the air.

How can cadmium affect my health?

Breathing high levels of cadmium can severely damage the lungs. Eating food or drinking water with very high levels severely irritates the stomach, leading to vomiting and diarrhea.

Long-term exposure to lower levels of cadmium in air, food, or water leads to a buildup of cadmium in the kidneys and possible kidney disease. Other long-term effects are lung damage and fragile bones.

How likely is cadmium to cause cancer?

The Department of Health and Human Services (DHHS) and the International Agency for Research on Cancer (IARC) have determined that cadmium and cadmium compounds are human carcinogens. The EPA determined that cadmium is a probable human carcinogen (group B1).

Cadmium

CAS # 7440-43-9

How can cadmium affect children?

The health effects in children are expected to be similar to the effects seen in adults (kidney and lung damage depending on the route of exposure).

A few studies in animals indicate that younger animals absorb more cadmium than adults. Animal studies also indicate that the young are more susceptible than adults to a loss of bone and decreased bone strength from exposure to cadmium.

We don't know if cadmium causes birth defects in people. Studies in animals exposed to high levels of cadmium during pregnancy have resulted in harmful effects to the young. Young animals exposed to cadmium before birth have shown effects on behavior and learning. There is also some information from animal studies that high enough exposures to cadmium before birth can reduce body weights and affect the skeleton in the developing young.

How can families reduce the risk of exposure to cadmium?

- Do not allow children to play with batteries. Dispose of nickel-cadmium batteries properly.
- Cadmium is a component of tobacco smoke. Avoid smoking and smoking in enclosed spaces like inside the home or car in order to limit exposure to children and other family members.
- If you work with cadmium, use all safety precautions to avoid carrying cadmium-containing dust home from work on your clothing, skin, hair, or tools.
- A balanced diet can reduce the amount of cadmium taken into the body from food and drink.

Is there a medical test to determine whether I've been exposed to cadmium?

Cadmium can be measured in blood, urine, hair, or nails. Urinary cadmium has been shown to accurately reflect the amount of cadmium in the body.

The amount of cadmium in your blood shows your recent exposure to cadmium. The amount of cadmium in your urine shows both your recent and your past exposure.

Has the federal government made recommendations to protect human health?

The EPA has determined that exposure to cadmium in drinking water at concentrations of 0.04 milligrams per liter (0.04 mg/L) for up to 10 days is not expected to cause any adverse effects in a child.

The EPA has determined that lifetime exposure to 0.005 mg/L cadmium is not expected to cause any adverse effects.

The Food and Drug Administration (FDA) has determined that the cadmium concentration in bottled drinking water should not exceed 0.005 mg/L.

The Occupational Health and Safety Administration (OSHA) has limited workers' exposure to an average of 5 μg/m^3 for an 8-hour workday, 40-hour workweek.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2012. Toxicological Profile for Cadmium. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636

ToxFAQs™ Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Chloroform - ToxFAQs™

CAS # 67-66-3

This fact sheet answers the most frequently asked health questions (FAQs) about chloroform. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to chloroform can occur when breathing contaminated air or when drinking or touching the substance or water containing it. Breathing chloroform can cause dizziness, fatigue, and headaches. Breathing chloroform or ingesting chloroform over long periods of time may damage your liver and kidneys. It can cause sores if large amounts touch your skin. This substance has been found in at least 717 of the 1,430 National Priorities List (NPL) sites identified by the Environmental Protection Agency (EPA).

What is chloroform?

(Pronounced klôr′ə-fôrm′)

Chloroform is a colorless liquid with a pleasant, nonirritating odor and a slightly sweet taste. It will burn only when it reaches very high temperatures.

In the past, chloroform was used as an inhaled anesthetic during surgery, but it isn't used that way today. Today, chloroform is used to make other chemicals and can also be formed in small amounts when chlorine is added to water.

Other names for chloroform are trichloromethane and methyl trichloride.

What happens to chloroform when it enters the environment?

- Chloroform evaporates easily into the air.
- Most of the chloroform in air breaks down eventually, but it is a slow process.
- The breakdown products in air include phosgene and hydrogen chloride, which are both toxic.
- It doesn't stick to soil very well and can travel through soil to groundwater.
- Chloroform dissolves easily in water and some of it may break down to other chemicals.
- Chloroform lasts a long time in groundwater.
- Chloroform doesn't appear to build up in great amounts in plants and animals.

How might I be exposed to chloroform?

- Drinking water or beverages made using water containing chloroform.
- Breathing indoor or outdoor air containing it, especially in the workplace.
- Eating food that contains it.
- Skin contact with chloroform or water that contains it, such as in swimming pools.

How can chloroform affect my health?

Breathing about 900 parts of chloroform per million parts air (900 ppm) for a short time can cause dizziness, fatigue, and headache. Breathing air, eating food, or drinking water containing high levels of chloroform for long periods of time may damage your liver and kidneys. Large amounts of chloroform can cause sores when chloroform touches your skin.

It isn't known whether chloroform causes reproductive effects or birth defects in people.

Animal studies have shown that miscarriages occurred in rats and mice that breathed air containing 30 to 300 ppm chloroform during pregnancy and also in rats that ate chloroform during pregnancy. Offspring of rats and mice that breathed chloroform during pregnancy had birth defects. Abnormal sperm were found in mice that breathed air containing 400 ppm chloroform for a few days.

Chloroform

CAS # 67-66-3

How likely is chloroform to cause cancer?

The Department of Health and Human Services (DHHS) has determined that chloroform may reasonably be anticipated to be a carcinogen.

Rats and mice that ate food or drank water with chloroform developed cancer of the liver and kidneys.

Is there a medical test to show whether I've been exposed to chloroform?

Although the amounts of chloroform in the air that you exhale and in blood, urine, and body tissues can be measured, there is no reliable test to determine how much chloroform you have been exposed to or whether you will experience any harmful effects.

The measurement of chloroform in body fluids and tissues may help to determine if you have come into contact with large amounts of chloroform, but these tests are useful for only a short time after you are exposed. Chloroform in your body might also indicate that you have come into contact with other chemicals.

Has the federal government made recommendations to protect human health?

The current EPA drinking water limit for total trihalomethanes, a class of chemicals that includes chloroform, is 80 micrograms per liter of water (80µg/L).

The EPA requires that spills or accidental releases of 10 pounds or more of chloroform into the environment be reported to the EPA.

The Occupational Safety and Health Administration (OSHA) has set the maximum allowable concentration of chloroform in workroom air during an 8-hour workday in a 40-hour workweek at 50 ppm.

Glossary

Carcinogenicity: A substance with the ability to cause cancer.

CAS: Chemical Abstracts Service.

Ingesting: Taking food or drink into your body.

Microgram (µg): One millionth of a gram.

Miscarriage: Pregnancy loss.

ppm: Parts per million.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1997. Toxicological Profile for Chloroform. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636

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Chromium - ToxFAQs™

CAS # 7440-47-3

This fact sheet answers the most frequently asked health questions (FAQs) about chromium. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to chromium occurs from ingesting contaminated food or drinking water or breathing contaminated workplace air. Chromium(VI) at high levels can damage the nose and cause cancer. Ingesting high levels of chromium(VI) may result in anemia or damage to the stomach or intestines. Chromium(III) is an essential nutrient. Chromium has been found in at least 1,127 of the 1,669 National Priorities List (NPL) sites identified by the Environmental Protection Agency (EPA).

What is chromium?

Chromium is a naturally occurring element found in rocks, animals, plants, and soil. It can exist in several different forms. Depending on the form it takes, it can be a liquid, solid, or gas. The most common forms are chromium(0), chromium(III), and chromium(VI). No taste or odor is associated with chromium compounds.

The metal chromium, which is the chromium(0) form, is used for making steel. Chromium(VI) and chromium(III) are used for chrome plating, dyes and pigments, leather tanning, and wood preserving.

What happens to chromium when it enters the environment?

- Chromium can be found in air, soil, and water after release from the manufacture, use, and disposal of chromium-based products, and during the manufacturing process.
- Chromium does not usually remain in the atmosphere, but is deposited into the soil and water.
- Chromium can easily change from one form to another in water and soil, depending on the conditions present.
- Fish do not accumulate much chromium in their bodies from water.

How might I be exposed to chromium?

- Eating food containing chromium(III).
- Breathing contaminated workplace air or skin contact during use in the workplace.
- Drinking contaminated well water.
- Living near uncontrolled hazardous waste sites containing chromium or industries that use chromium.

How can chromium affect my health?

Chromium(III) is an essential nutrient that helps the body use sugar, protein, and fat.

Breathing high levels of chromium(VI) can cause irritation to the lining of the nose, nose ulcers, runny nose, and breathing problems, such as asthma, cough, shortness of breath, or wheezing. The concentrations of chromium in air that can cause these effects may be different for different types of chromium compounds, with effects occurring at much lower concentrations for chromium(VI) compared to chromium(III).

The main health problems seen in animals following ingestion of chromium(VI) compounds are irritation and ulcers in the stomach and small intestine and anemia. Chromium(III) compounds are much less toxic and do not appear to cause these problems.

Sperm damage and damage to the male reproductive system have also been seen in laboratory animals exposed to chromium(VI).

Skin contact with certain chromium(VI) compounds can cause skin ulcers. Some people are extremely sensitive tochromium(VI) or chromium(III). Allergic reactions consisting of severe redness and swelling of the skin have been noted.

CAS # 7440-47-3

How likely is chromium to cause cancer?

The Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and the EPA have determined that chromium(VI) compounds are known human carcinogens.

In workers, inhalation of chromium(VI) has been shown to cause lung cancer. Chromium(VI) also causes lung cancer in animals. An increase in stomach tumors was observed in humans and animals exposed to chromium(VI) in drinking water.

How can chromium affect children?

It is likely that health effects seen in children exposed to high amounts of chromium will be similar to the effects seen in adults.

We do not know if exposure to chromium will result in birth defects or other developmental effects in people. Some developmental effects have been observed in animals exposed to chromium(VI).

How can families reduce the risk of exposure to chromium?

- Children should avoid playing in soils near uncontrolled hazardous waste sites where chromium may have been discarded.
- Chromium is a component of tobacco smoke. Avoid smoking in enclosed spaces like inside the home or car in order to limit exposure to children and other family members.
- Although chromium(III) is an essential nutrient, you should avoid excessive use of dietary supplements containing chromium.

Is there a medical test to determine whether I've been exposed to chromium?

Since chromium(III) is an essential element and naturally occurs in food, there will always be some level of chromium in your body. Chromium can be measured in hair, urine, and blood.

Higher than normal levels of chromium in blood or urine may indicate that a person has been exposed to chromium. However, increases in blood and urine chromium levels cannot be used to predict the kind of health effects that might develop from that exposure.

Has the federal government made recommendations to protect human health?

The EPA has established a maximum contaminant level of 0.1 mg/L for total chromium in drinking water.

The FDA has determined that the chromium concentration in bottled drinking water should not exceed 0.1 mg/L.

The Occupational Health and Safety Administration (OSHA) has limited workers' exposure to an average of 0.005 mg/m^3 chromium(VI), 0.5 mg/m^3 chromium(III), and 1.0 mg/m^3 chromium(0) for an 8-hour workday, 40-hour workweek.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2012. Toxicological Profile for Chromium. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636

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COBALT
CAS #7440-48-4

Division of Toxicology ToxFAQs™ **April 2004**

This fact sheet answers the most frequently asked health questions (FAQs) about cobalt. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: The general population is exposed to low levels of cobalt in air, water, and food. Cobalt has both beneficial and harmful effects on health. At low levels, it is part of vitamin B12, which is essential for good health. At high levels, it may harm the lungs and heart. This chemical has been found in at least 426 of the 1,636 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is cobalt?

Cobalt is a naturally occurring element found in rocks, soil, water, plants, and animals. Cobalt is used to produce alloys used in the manufacture of aircraft engines, magnets, grinding and cutting tools, artificial hip and knee joints. Cobalt compounds are also used to color glass, ceramics and paints, and used as a drier for porcelain enamel and paints.

Radioactive cobalt is used for commercial and medical purposes. ^{60}Co (read as cobalt sixty) is used for sterilizing medical equipment and consumer products, radiation therapy for treating cancer patients, manufacturing plastics, and irradiating food. ^{57}Co is used in medical and scientific research. It takes about 5.27 years for half of ^{60}Co to give off its radiation and about 272 days for ^{57}Co; this is called the half-life.

What happens to cobalt when it enters the environment?

❑ Cobalt enters the environment from natural sources and the burning of coal or oil or the production of cobalt alloys.
❑ In the air, cobalt will be associated with particles that settle to the ground within a few days.
❑ Cobalt released into water or soil will stick to particles. Some cobalt compounds may dissolve.
❑ Cobalt cannot be destroyed. It can change form or attach to or separate from particles. Radioactive decay is a way of decreasing the amount of radioactive cobalt in the environment.

How might I be exposed to cobalt?

❑ You can be exposed to low levels of cobalt by breathing air, eating food, or drinking water. Food and drinking water are the largest sources of exposure to cobalt for the general population.
❑ Working in industries that make or use cutting or grinding tools; mine, smelt, refine, or process cobalt metal or ores; or that produce cobalt alloys or use cobalt.
❑ The general population is rarely exposed to radioactive cobalt unless a person is undergoing radiation therapy. However, workers at nuclear facilities, irradiation facilities, or nuclear waste storage sites may be exposed to radiation from these sources.

How can cobalt affect my health?

Cobalt can benefit or harm human health. Cobalt is beneficial for humans because it is part of vitamin B12.

Exposure to high levels of cobalt can result in lung and heart effects and dermatitis. Liver and kidney effects have also been observed in animals exposed to high levels of cobalt.

Exposure to large amounts of radiation from radioactive cobalt can damage cells in your body from the radiation.

You might also experience acute radiation syndrome that includes nausea, vomiting, diarrhea, bleeding, coma, and even death. This would be a rare event.

How likely is cobalt to cause cancer?

Nonradioactive cobalt has not been found to cause cancer in humans or animals following exposure in food or water. Cancer has been shown, however, in animals that breathed cobalt or when cobalt was placed directly into the muscle or under the skin. Based on the laboratory animal data, the International Agency for Research on Cancer (IARC) has determined that cobalt and cobalt compounds are possibly carcinogenic to humans.

Exposure to high levels of cobalt radiation can cause changes in the genetic materials within cells and may result in the development of some types of cancer.

How can cobalt affect children?

We do not know whether children differ from adults in their susceptibility to cobalt. However, it is likely that health effects in children would be similar those in adults. Studies in animals suggest that children may absorb more cobalt than adults from foods and liquids containing cobalt.

We do not know if exposure to cobalt will result in birth defects or other developmental effects in people. Birth defects have been observed in animals exposed to nonradioactive cobalt. Exposure to cobalt radiation can also result in developmental effects.

How can families reduce the risk of exposure to cobalt?

Children should avoid playing in soils near hazardous waste sites where cobalt may be present.

Is there a medical test to show whether I've been exposed to cobalt?

Cobalt levels can be tested in the urine and blood within a couple of days of exposure. Your doctor can take samples, but must send them to a laboratory to be tested. The amount of cobalt in your blood or urine can be used to estimate how much cobalt you were exposed to. However, these tests cannot predict whether you will experience any health effects.

Two types of tests are available for radioactive cobalt. One is to see if you have been exposed to a large dose of radiation, and the other is to see if radioactive cobalt is in your body. The first looks for changes in blood cell counts or in your chromosomes that occur at 3 to 5 times the annual occupational dose limit. It cannot tell if the radiation came from cobalt. The second type of test involves examining your blood, feces, saliva, urine, and even your entire body. It is to see if cobalt is being excreted from or remains inside your body. Either the doctor's office collects and sends the samples to a special lab for testing, or you must go to the lab for testing.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) has set a limit of 0.1 milligrams of nonradioactive cobalt per cubic meter of workplace air (0.1 mg/m^3) for an 8-hour workday and 40-hour work week.

The Nuclear Regulatory Commission limits radioactive cobalt in workplace air to 1×10^{-5} microcurie per milliliter (μCi/mL) for ^{57}Co and 7×10^{-8} μCi/mL for ^{60}Co. EPA has set an average annual drinking water limit of 1000 picocurie per liter (pCi/L) for ^{57}Co or 100 pCi/L for ^{60}Co so the public radiation dose will not exceed 4 millirem.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2004. Toxicological Profile for Cobalt Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES
AND DISEASE REGISTRY

COPPER

CAS # 7440-50-8

Division of Toxicology ToxFAQs™ **September 2004**

This fact sheet answers the most frequently asked health questions (FAQs) about copper. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Copper is a metal that occurs naturally in the environment, and also in plants and animals. Low levels of copper are essential for maintaining good health. High levels can cause harmful effects such as irritation of the nose, mouth and eyes, vomiting, diarrhea, stomach cramps, nausea, and even death. Copper has been found in at least 906 of the 1,647 National Priority Sites identified by the Environmental Protection Agency (EPA).

What is copper?

Copper is a metal that occurs naturally throughout the environment, in rocks, soil, water, and air. Copper is an essential element in plants and animals (including humans), which means it is necessary for us to live. Therefore, plants and animals must absorb some copper from eating, drinking, and breathing.

Copper is used to make many different kinds of products like wire, plumbing pipes, and sheet metal. U.S. pennies made before 1982 are made of copper, while those made after 1982 are only coated with copper. Copper is also combined with other metals to make brass and bronze pipes and faucets.

Copper compounds are commonly used in agriculture to treat plant diseases like mildew, for water treatment and, as preservatives for wood, leather, and fabrics.

What happens to copper when it enters the environment?

❑ Copper is released into the environment by mining, farming, and manufacturing operations and through waste water releases into rivers and lakes. Copper is also released from natural sources, like volcanoes, windblown dusts, decaying vegetation, and forest fires.
❑ Copper released into the environment usually attaches to particles made of organic matter, clay, soil, or sand.
❑ Copper does not break down in the environment. Copper compounds can break down and release free copper into the air, water, and foods.

How might I be exposed to copper?

❑ You may be exposed to copper from breathing air, drinking water, eating foods, or having skin contact with copper, particulates attached to copper, or copper-containing compounds.
❑ Drinking water may have high levels of copper if your house has copper pipes and acidic water.
❑ Lakes and rivers that have been treated with copper compounds to control algae, or that receive cooling water from power plants, can have high levels of copper. Soils can also contain high levels of copper, especially if they are near copper smelting plants.
❑ You may be exposed to copper by ingesting copper-containing fungicides, or if you live near a copper mine or where copper is processed into bronze or brass.
❑ You may be exposed to copper if you work in copper mines or if you grind metals containing copper.

How can copper affect my health?

Everyone must absorb small amounts of copper every day because copper is essential for good health. High levels of copper can be harmful. Breathing high levels of copper can cause irritation of your nose and throat. Ingesting high levels of copper can cause nausea, vomiting, and diarrhea. Very-high doses of copper can cause damage to your liver and kidneys, and can even cause death.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, Public Health Service
Agency for Toxic Substances and Disease Registry

How likely is copper to cause cancer?

We do not know whether copper can cause cancer in humans. The EPA has determined that copper is not classifiable as to human carcinogenicity.

How can copper affect children?

Exposure to high levels of copper will result in the same type of effects in children and adults. We do not know if these effects would occur at the same dose level in children and adults. Studies in animals suggest that the young children may have more severe effects than adults, but we don't know if this would also be true in humans. There is a very small percentage of infants and children who are unusually sensitive to copper.

We do not know if copper can cause birth defects or other developmental effects in humans. Studies in animals suggest that high levels of copper may cause a decrease in fetal growth.

How can families reduce the risk of exposure to copper?

The most likely place to be exposed to copper is through drinking water, especially if your water is corrosive and you have copper pipes in your house. The best way to lower the level of copper in your drinking water is to let the water run for at least 15 seconds first thing in the morning before drinking or using it. This reduces the levels of copper in tap water dramatically.

If you work with copper, wear the necessary protective clothing and equipment, and always follow safety procedures. Shower and change your clothes before going home each day.

Is there a medical test to show whether I've been exposed to copper?

Copper is found throughout the body; in hair, nails, blood, urine, and other tissues. High levels of copper in these samples can show that you have been exposed to higher-than normal levels of copper. These tests cannot tell whether you will experience harmful effects. Tests to measure copper levels in the body are not usually available at a doctor's office because they require special equipment, but the doctor can send samples to a specialty laboratory.

Has the federal government made recommendations to protect human health?

The EPA requires that levels of copper in drinking water be less than 1.3 mg of copper per one liter of drinking water (1.3 mg/L).

The U.S. Department of Agriculture has set the recommended daily allowance for copper at 900 micrograms of copper per day (µg/day) for people older than eight years old.

The Occupational Safety and Health Administration (OSHA) requires that levels of copper in the air in workplaces not exceed 0.1 mg of copper fumes per cubic meter of air (0.1 mg/m^3) and 1.0 mg/m^3 for copper dusts.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2004. Toxicological Profile for Copper. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES
AND DISEASE REGISTRY

CYANIDE

CAS# 74-90-8, 143-33-9, 151-50-8, 592-01-8, 544-92-3, 506-61-6, 460-19-5, 506-77-4

Division of Toxicology and Environmental Medicine ToxFAQs™ **July 2006**

This fact sheet answers the most frequently asked health questions (FAQs) about cyanide. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to high levels of cyanide harms the brain and heart, and may cause coma and death. Exposure to lower levels may result in breathing difficulties, heart pains, vomiting, blood changes, headaches, and enlargement of the thyroid gland. Cyanide has been found in at least 471 of the 1,662 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is cyanide?

Cyanide is usually found joined with other chemicals to form compounds. Examples of simple cyanide compounds are hydrogen cyanide, sodium cyanide and potassium cyanide. Certain bacteria, fungi, and algae can produce cyanide, and cyanide is found in a number of foods and plants. In certain plant foods, including almonds, millet sprouts, lima beans, soy, spinach, bamboo shoots, and cassava roots (which are a major source of food in tropical countries), cyanides occur naturally as part of sugars or other naturally-occurring compounds. However, the edible parts of plants that are eaten in the United States, including tapioca which is made from cassava roots, contain relatively low amounts of cyanide.

Hydrogen cyanide is a colorless gas with a faint, bitter, almond-like odor. Sodium cyanide and potassium cyanide are both white solids with a bitter, almond-like odor in damp air. Cyanide and hydrogen cyanide are used in electroplating, metallurgy, organic chemicals production, photographic developing, manufacture of plastics, fumigation of ships, and some mining processes.

What happens to cyanide when it enters the environment?

❏ Cyanide enters air, water, and soil from both natural processes and industrial activities.

❏ In air, cyanide is mainly found as gaseous hydrogen cyanide; a small amount is present as fine dust particles.

❏ The half-life (the time needed for half of the material to be removed) of hydrogen cyanide in the atmosphere is about 1–3 years.

❏ Most cyanide in surface water will form hydrogen cyanide and evaporate.

❏ Cyanide in water does not build up in the bodies of fish.

❏ Cyanides are fairly mobile in soil. Once in soil, cyanide can be removed through several processes. Some cyanide compounds in soil can form hydrogen cyanide and evaporate, whereas some cyanide compounds will be transformed into other chemical forms by microorganisms in soil. At the high concentrations, cyanide becomes toxic to soil microorganisms. Because these microorganisms can no longer change cyanide to other chemical forms, cyanide is able to passes through soil into underground water.

How might I be exposed to cyanide?

❏ Breathing air, drinking water, touching soil, or eating foods that contain cyanide.

❏ Smoking cigarettes and breathing smoke-filled air during fires are major sources of cyanide exposure.

❏ Breathing air near a hazardous waste site containing cyanide.

❏ Eating foods naturally containing cyanide compounds, such as tapioca (made from cassava roots), lima beans, and almonds. However, the portions of these plants that are eaten in the United States contain relatively low amounts of cyanide.

How can cyanide affect my health?

You are not likely to be exposed to large enough amounts of cyanide in the environment to cause adverse health effects. The severity of the harmful effects following cyanide exposure

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, Public Health Service
Agency for Toxic Substances and Disease Registry

depends in part on the form of cyanide, such as hydrogen cyanide gas or cyanide salts. Exposure to high levels of cyanide for a short time harms the brain and heart and can even cause coma and death. Workers who inhaled low levels of hydrogen cyanide over a period of years had breathing difficulties, chest pain, vomiting, blood changes, headaches, and enlargement of the thyroid gland.

Some of the first indications of cyanide poisoning are rapid, deep breathing and shortness of breath, followed by convulsions (seizures) and loss of consciousness. These symptoms can occur rapidly, depending on the amount eaten. The health effects of large amounts of cyanide are similar, whether you eat, drink, or breathe it; cyanide uptake into the body through the skin is slower than these other means of exposure. Skin contact with hydrogen cyanide or cyanide salts can irritate and produce sores.

How likely is cyanide to cause cancer?

There are no reports that cyanide can cause cancer in people or animals. EPA has determined that cyanide is not classifiable as to its human carcinogenicity.

How can cyanide affect children?

Effects reported in exposed children are like those seen in exposed adults. Children who ate large quantities of apricot pits, which naturally contain cyanide as part of complex sugars, had rapid breathing, low blood pressure, headaches, and coma, and some died. Cyanide has not been reported to directly cause birth defects in people. However, among people in the tropics who eat cassava root, children have been born with thyroid disease because of the mothers' exposure to cyanide and thiocyanate during pregnancy. Birth defects occurred in rats that ate cassava root diets, and harmful effects on the reproductive system occurred in rats and mice that drank water containing sodium cyanide.

How can families reduce the risk of exposure to cyanide?

Families can reduce their exposure to cyanide by not breathing in tobacco smoke, which is the most common source of cyanide exposure for the general population. In the event of a building fire, families should evacuate the building immediately, because smoke from burning plastics contains cyanide (and carbon monoxide). Breathing this smoke can lead to unconsciousness or death. Cyanide in smoke can arise from the combustion of certain plastics (e.g., polyacrylamines, polyacrylics, polyurethane, etc.).

Compounds that release cyanide are naturally present in plants. The amounts are usually low in the edible portion but are higher in cassava. Pits and seeds of common fruits, such as apricots, apples, and peaches, may have substantial amounts of cyanide-releasing chemicals, so people should avoid eating these pits and seeds to prevent accidental cyanide poisoning.

Is there a medical test to show whether I've been exposed to cyanide?

There are medical tests to measure blood and urine levels of cyanide; however, small amounts of cyanide are always detectable in blood and urine. Tissue levels of cyanide can be measured if cyanide poisoning is suspected, but cyanide is rapidly cleared from the body, so the tests must be done soon after the exposure. An almond-like odor in the breath may alert a physician that a person was exposed to cyanide.

Has the federal government made recommendations to protect human health?

EPA regulates the levels of cyanide that are allowable in drinking water. The highest level of cyanide allowed in drinking water is 0.2 parts cyanide per 1 million parts of water (0.2 ppm).

The Occupational Safety and Health Administration (OSHA) has set a limit for hydrogen cyanide and most cyanide salts of 10 parts cyanide per 1 million parts of air (10 ppm) in the workplace.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2006. Toxicological Profile for Cyanide (Update). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Environmental Medicine, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ToxFAQs - for Dichlorobenzenes

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http://www.atsdr.cdc.gov/toxfaqs/tfacts10.pdf

Lead - ToxFAQs™

What is lead?

Lead is a naturally occurring metal found in small amounts in the earth's crust. Lead can be found in all parts of our environment, including air, water and soil. Lead can exist in many different chemical forms.

Lead is used in the production of batteries, ammunition, and metal products (solder and pipes). Because of health concerns, use of lead in paints, ceramic products, caulking, and pipe solder has been dramatically reduced. The use of lead as an additive to automobile gasoline was banned in 1996 in the United States.

What happens to lead in the environment?

- Lead is an element and, therefore, it does not break down.
- When lead is released to the air, it may be transported long distances before it deposits onto the ground.
- Once deposited, lead often adheres to soil particles.
- Lead in soil can be transported into groundwater, but the amount of lead that moves into groundwater will depend on the chemical form of lead and soil type.

How can I be exposed to lead?

- Eating food or drinking water that contains lead. Water pipes in some older homes may contain lead solder which can leach into the water.
- Spending time in areas where lead-based paints have been used and are deteriorating. Deteriorating lead paint can form lead dust which can be ingested.
- Spending time in areas where the soil is contaminated with lead.
- Working in a job where lead is used or participating in certain hobbies in which lead is used, such as making stained glass.
- Using health-care products or folk remedies that contain lead.

> Lead can affect almost every organ and system in your body

How can lead affect my health?

The effects of lead are the same whether it enters the body through inhalation or ingestion. Lead can affect almost every organ and system in your body. The nervous system is the main target for lead toxicity in adults and children. Long-term exposure can result in decreased learning, memory, and attention and weakness in fingers, wrists, or ankles. Lead exposure can cause anemia and damage to kidneys. It can also cause increases in blood pressure, particularly in middle-aged and older individuals. Exposure to high lead levels can severely damage the brain and kidneys and can cause death. In pregnant women, exposure to high levels of lead may cause a miscarriage. High-level exposure in men can damage reproductive organs.

Lead

How can lead affect children?

Children are more vulnerable to lead poisoning than adults because their nervous system is still developing. Children can be exposed to lead in their environment and prior to birth from lead in their mother's body. At lower levels of exposure, lead can decrease mental development, with effects on learning, intelligence and behavior. Physical growth may also be decreased. A child who swallows large amounts of lead may develop anemia, severe stomachache, muscle weakness, and brain damage. Exposure to lead during pregnancy can result in premature births. Some effects of lead may persist into adulthood.

Can lead cause cancer?

There have been several agencies and organizations both in the United States and internationally that have reviewed studies and made an assessment about whether lead can cause cancer.

- The Department of Health and Human Services (HHS) has determined that lead and lead compounds are reasonably anticipated to be human carcinogens
- The U.S. Environmental Protection Agency (EPA) has classified lead as a probable human carcinogen.
- The International Agency for Research on Cancer (IARC) has determined that inorganic lead is probably carcinogenic to humans, and that there is insufficient information to determine whether organic lead compounds will cause cancer in humans.

Can I get a medical test to check for lead?

A blood test is available to measure the amount of lead in your blood. Blood tests are commonly used to screen children for lead poisoning. Your doctor can draw blood samples and send them to appropriate laboratories for analysis.

How can I protect my family from lead exposure?

- Avoid exposure to sources of lead.
- Do not allow children to chew or mouth surfaces that may have been painted with lead-based paint.
- If your home contains lead-based paint or you live in an area contaminated with lead, wash children's hands and faces often to remove lead dusts and soil, and regularly clean the house of dust and tracked in soil.

Want more information?

Go to ATSDR's Toxicological Profile for Lead

CDC Lead Poisoning Prevention Program https://www.cdc.gov/nceh/lead/default.htm

Environmental Protection Agency https://www.epa.gov/lead/protect-your-family-exposures-lead

Call **CDC-INFO** at 1-800-232-4636, or submit your question online at https://wwwn.cdc.gov/dcs/ContactUs/Form

Go to ATSDR's Toxic Substances Portal: http://www.atsdr.cdc.gov/substances/index.asp

If you have any more questions or concerns, you can also find & contact your ATSDR Regional Representative at http://www.atsdr.cdc.gov/DRO/dro_org.html

Manganese - ToxFAQs™

CAS # 7439-96-5

This fact sheet answers the most frequently asked health questions (FAQs) about manganese. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Manganese is a trace element and eating a small amount from food or water is needed to stay healthy. Exposure to excess levels of manganese may occur from breathing air, particularly where manganese is used in manufacturing, and from drinking water and eating food. At high levels, it can cause damage to the brain. Manganese has been found in at least 869 of the 1,669 National Priorities List (NPL) sites identified by the Environmental Protection Agency (EPA).

What is manganese?

Manganese is a naturally occurring metal that is found in many types of rocks. Pure manganese is silver-colored, but does not occur naturally. It combines with other substances such as oxygen, sulfur, or chlorine. Manganese occurs naturally in most foods and may be added to some foods.

Manganese is used principally in steel production to improve hardness, stiffness, and strength. It may also be used as an additive in gasoline to improve the octane rating of the gas.

What happens to manganese when it enters the environment?

- Manganese can be released to the air, soil, and water from the manufacture, use, and disposal of manganese-based products.
- Manganese cannot break down in the environment. It can only change its form or become attached to or separated from particles.
- In water, manganese tends to attach to particles in the water or settle into the sediment.
- The chemical state of manganese and the type of soil determine how fast it moves through the soil and how much is retained in the soil.
- The manganese-containing gasoline additive may degrade in the environment quickly when exposed to sunlight, releasing manganese.

How might I be exposed to manganese?

- The primary way you can be exposed to manganese is by eating food or manganese-containing nutritional supplements. Vegetarians, who consume foods rich in manganese such as grains, beans and nuts, as well as heavy tea drinkers, may have a higher intake of manganese than the average person.
- Certain occupations like welding or working in a factory where steel is made may increase your chances of being exposed to high levels of manganese.
- Manganese is routinely contained in groundwater, drinking water, and soil at low levels. Drinking water containing manganese or swimming or bathing in water containing manganese may expose you to low levels of this chemical.

How can manganese affect my health?

Manganese is an essential nutrient, and eating a small amount of it each day is important to stay healthy.

The most common health problems in workers exposed to high levels of manganese involve the nervous system. These health effects include behavioral changes and other nervous system effects, which include movements that may become slow and clumsy. This combination of symptoms when sufficiently severe is referred to as "manganism". Other less severe nervous system effects such as slowed hand movements have been observed in some workers exposed to lower concentrations in the work place.

Manganese

CAS # 7439-96-5

Exposure to high levels of manganese in air can cause lung irritation and reproductive effects.

Nervous system and reproductive effects have been observed in animals after high oral doses of manganese.

How likely is manganese to cause cancer?

The EPA concluded that existing scientific information cannot determine whether or not excess manganese can cause cancer.

How can manganese affect children?

Studies in children have suggested that extremely high levels of manganese exposure may produce undesirable effects on brain development, including changes in behavior and decreases in the ability to learn and remember. We do not know for certain that these changes were caused by manganese alone. We do not know if these changes are temporary or permanent. We do not know whether children are more sensitive than adults to the effects of manganese, but there is some indication from experiments in laboratory animals that they may be.

Studies of manganese workers have not found increases in birth defects or low birth weight in their offspring. No birth defects were observed in animals exposed to manganese.

How can families reduce the risk of exposure to manganese?

- Children are not likely to be exposed to harmful amounts of manganese in the diet. However, higher-than-usual amounts of manganese may be absorbed if their diet is low in iron. It is important to provide your child with a well-balanced diet.
- Workers exposed to high levels of airborne manganese in certain occupational settings may accumulate manganese dust on their work clothes. Manganese-contaminated work clothing should be removed before getting into your car or entering your home to help reduce the exposure hazard for yourself and your family.

Is there a medical test to determine whether I've been exposed to manganese?

Several tests are available to measure manganese in blood, urine, hair, or feces. Because manganese is normally present in our body, some is always found in tissues or fluids.

Because excess manganese is usually removed from the body within a few days, past exposures are difficult to measure with common laboratory tests.

Has the federal government made recommendations to protect human health?

The EPA has determined that exposure to manganese in drinking water at concentrations of 1 mg/L for up to 10 days is not expected to cause any adverse effects in a child.

The EPA has established that lifetime exposure to 0.3 mg/L manganese is not expected to cause any adverse effects.

The Food and Drug Administration (FDA) has determined that the manganese concentration in bottled drinking water should not exceed 0.05 mg/L.

The Occupational Health and Safety Administration (OSHA) has established a ceiling limit (concentration that should not be exceeded at any time during exposure) of 5 mg/m^3 for manganese in workplace air.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2012. Toxicological Profile for Manganese. Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636.

ToxFAQs™ Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Mercury - ToxFAQs™

CAS # 7439-97-6

This fact sheet answers the most frequently asked health questions (FAQs) about mercury. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to mercury occurs from breathing contaminated air, ingesting contaminated water and food, and having dental and medical treatments. Mercury, at high levels, may damage the brain, kidneys, and developing fetus. This chemical has been found in at least 714 of 1,467 National Priorities List (NPL) sites identified by the Environmental Protection Agency (EPA).

What is mercury?

Mercury is a naturally occurring metal which has several forms. The metallic mercury is a shiny, silver-white, odorless liquid. If heated, it is a colorless, odorless gas.

Mercury combines with other elements, such as chlorine, sulfur, or oxygen, to form inorganic mercury compounds or "salts," which are usually white powders or crystals. Mercury also combines with carbon to make organic mercury compounds. The most common one, methylmercury, is produced mainly by microscopic organisms in the water and soil. More mercury in the environment can increase the amounts of methylmercury that these small organisms make.

Metallic mercury is used to produce chlorine gas and caustic soda, and is also used in thermometers, some dental fillings, and batteries. Mercury salts are sometimes used in skin lightening creams and as antiseptic creams and ointments.

What happens to mercury when it enters the environment?

- Inorganic mercury (metallic mercury and inorganic mercury compounds) enters the air from mining ore deposits, burning coal and waste, and from manufacturing plants.
- It enters the water or soil from natural deposits, disposal of wastes, and volcanic activity.
- Methylmercury may be formed in water and soil by small organisms called bacteria.
- Methylmercury builds up in the tissues of fish. Larger and older fish tend to have the highest levels of mercury.

How might I be exposed to mercury?

- Eating fish or shellfish contaminated with methylmercury.
- Breathing vapors in air from spills, incinerators, and industries that burn mercury-containing fossil fuels.
- Release of mercury from dental work and medical treatments.
- Breathing contaminated workplace air or skin contact during use in the workplace.
- Practicing rituals that include mercury.

How can mercury affect my health?

The nervous system is very sensitive to all forms of mercury. Methylmercury and metallic mercury vapors are more harmful than other forms, because more mercury in these forms reaches the brain. Exposure to high levels of metallic, inorganic, or organic mercury can permanently damage the brain, kidneys, and developing fetus. Effects on brain functioning may result in irritability, shyness, tremors, changes in vision or hearing, and memory problems.

Short-term exposure to high levels of metallic mercury vapors may cause effects including lung damage, nausea, vomiting, diarrhea, increases in blood pressure or heart rate, skin rashes, and eye irritation.

Mercury

CAS # 7439-97-6

How likely is mercury to cause cancer?

There are inadequate human cancer data available for all forms of mercury. Mercuric chloride has caused increases in several types of tumors in rats and mice, and methylmercury has caused kidney tumors in male mice. The EPA has determined that mercuric chloride and methylmercury are possible human carcinogens.

How can mercury affect children?

Very young children are more sensitive to mercury than adults. Mercury in the mother's body passes to the fetus and may accumulate there, possibly causing damage to the developing nervous system. It can also pass to a nursing infant through breast milk. However, the benefits of breast feeding may be greater than the possible adverse effects of mercury in breast milk.

Mercury's harmful effects that may affect the fetus include brain damage, mental retardation, incoordination, blindness, seizures, and inability to speak. Children poisoned by mercury may develop problems of their nervous and digestive systems, and kidney damage.

How can families reduce the risk of exposure to mercury?

Carefully handle and dispose of products that contain mercury, such as thermometers or fluorescent light bulbs. Do not vacuum up spilled mercury, because it will vaporize and increase exposure. If a large amount of mercury has been spilled, contact your health department. Teach children not to play with shiny, silver liquids.

Properly dispose of older medicines that contain mercury. Keep all mercury-containing medicines away from children.

Pregnant women and children should keep away from rooms where liquid mercury has been used.

Learn about wildlife and fish advisories in your area from your public health or natural resources department.

Is there a medical test to determine whether I've been exposed to mercury?

Tests are available to measure mercury levels in the body. Blood or urine samples are used to test for exposure to metallic mercury and to inorganic forms of mercury. Mercury in whole blood or in scalp hair is measured to determine exposure to methylmercury. Your doctor can take samples and send them to a testing laboratory.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 2 parts of mercury per billion parts of drinking water (2 ppb).

The Food and Drug Administration (FDA) has set a maximum permissible level of 1 part of methylmercury in a million parts of seafood (1 ppm).

The Occupational Safety and Health Administration (OSHA) has set limits of 0.1 milligram of organic mercury per cubic meter of workplace air (0.1 mg/m^3) and 0.05 mg/m^3 of metallic mercury vapor for 8-hour shifts and 40-hour work weeks.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for mercury. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636.

ToxFAQs™ Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ToxFAQs - for Naphthalene, 1-Methylnaphthalene, and 2-Methylnaphthalene

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http://www.atsdr.cdc.gov/toxfaqs/tfacts67.pdf

ToxFAQs - for Nickel

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http://www.atsdr.cdc.gov/toxfaqs/tfacts15.pdf

Polycyclic Aromatic Hydrocarbons (PAHs) - ToxFAQs™

This fact sheet answers the most frequently asked health questions (FAQs) about polycyclic aromatic hydrocarbons (PAHs). For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to polycyclic aromatic hydrocarbons usually occurs by breathing air contaminated by wild fires or coal tar, or by eating foods that have been grilled. PAHs have been found in at least 600 of the 1,430 National Priorities List (NPL) sites identified by the Environmental Protection Agency (EPA).

What are polycyclic aromatic hydrocarbons?

(Pronounced pŏl′ĭ-sī′klĭk ăr′ə-măt′ĭk hī′drə-kar′bənz)

Polycyclic aromatic hydrocarbons (PAHs) are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs are usually found as a mixture containing two or more of these compounds, such as soot.

Some PAHs are manufactured. These pure PAHs usually exist as colorless, white, or pale yellow-green solids. PAHs are found in coal tar, crude oil, creosote, and roofing tar, but a few are used in medicines or to make dyes, plastics, and pesticides.

What happens to PAHs when they enter the environment?

- PAHs enter the air mostly as releases from volcanoes, forest fires, burning coal, and automobile exhaust.
- PAHs can occur in air attached to dust particles.
- Some PAH particles can readily evaporate into the air from soil or surface waters.
- PAHs can break down by reacting with sunlight and other chemicals in the air, over a period of days to weeks.
- PAHs enter water through discharges from industrial and wastewater treatment plants.
- Most PAHs do not dissolve easily in water. They stick to solid particles and settle to the bottoms of lakes or rivers.
- Microorganisms can break down PAHs in soil or water after a period of weeks to months.
- In soils, PAHs are most likely to stick tightly to particles; certain PAHs move through soil to contaminate underground water.
- PAH contents of plants and animals may be much higher than PAH contents of soil or water in which they live.

How might I be exposed to PAHs?

- Breathing air containing PAHs in the workplace of coking, coal-tar, and asphalt production plants; smokehouses; and municipal trash incineration facilities.
- Breathing air containing PAHs from cigarette smoke, wood smoke, vehicle exhausts, asphalt roads, or agricultural burn smoke.
- Coming in contact with air, water, or soil near hazardous waste sites.
- Eating grilled or charred meats; contaminated cereals, flour, bread, vegetables, fruits, meats; and processed or pickled foods.
- Drinking contaminated water or cow's milk.
- Nursing infants of mothers living near hazardous waste sites may be exposed to PAHs through their mother's milk.

How can PAHs affect my health?

Mice that were fed high levels of one PAH during pregnancy had difficulty reproducing and so did their offspring. These offspring also had higher rates of birth defects and lower body weights. It is not known whether these effects occur in people.

Animal studies have also shown that PAHs can cause harmful effects on the skin, body fluids, and ability to fight disease after both short- and long-term exposure. But these effects have not been seen in people.

How likely are PAHs to cause cancer?

The Department of Health and Human Services (DHHS) has determined that some PAHs may reasonably be expected to be carcinogens.

Some people who have breathed or touched mixtures of PAHs and other chemicals for long periods of time have developed cancer. Some PAHs have caused cancer in laboratory animals when they breathed air containing them (lung cancer), ingested them in food (stomach cancer), or had them applied to their skin (skin cancer).

Is there a medical test to show whether I've been exposed to PAHs?

In the body, PAHs are changed into chemicals that can attach to substances within the body. There are special tests that can detect PAHs attached to these substances in body tissues or blood. However, these tests cannot tell whether any health effects will occur or find out the extent or source of your exposure to the PAHs. The tests aren't usually available in your doctor's office because special equipment is needed to conduct them.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) has set a limit of 0.2 milligrams of PAHs per cubic meter of air (0.2 mg/m^3). The OSHA Permissible Exposure Limit (PEL) for mineral oil mist that contains PAHs is 5 mg/m^3 averaged over an 8-hour exposure period.

The National Institute for Occupational Safety and Health (NIOSH) recommends that the average workplace air levels for coal tar products not exceed 0.1 mg/m^3 for a 10-hour workday, within a 40-hour workweek. There are other limits for workplace exposure for things that contain PAHs, such as coal, coal tar, and mineral oil.

Glossary

Carcinogen: A substance that can cause cancer.

Ingest: Take food or drink into your body.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for polycyclic aromatic hydrocarbons. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636.

ToxFAQs™ Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Perfluoroalkyls - ToxFAQs™

What are perfluoroalkyls (PFAs)?

Perfluoroalkyls (PFAs) are a group of man-made chemicals that are not found naturally in the environment. Some chemicals that are in this group PFAs include:

- perfluorooctanoic acid (PFOA)
- perfluorooctane sulfonic acid (PFOS)
- perfluorononanoic acid (PFNA)
- perfluorohexane sulfonic acid (PFHxS)
- perfluordecanoic acid (PFDeA)

These PFAs were used to protect products like carpet and fabric, and as a coating for paper and cardboard packaging. They can also be found in some fire-fighting foams.

- The two PFAs made in the largest amounts in the United States were PFOA and PFOS. However, most companies have stopped making these two chemicals.

Where are PFAs found in the environment?

- PFAs can be found in air, soil, and water.
- They break down very slowly in air within days or weeks, but then fall to the ground where they can enter water or soil.
- PFAs do not break down in water or soil and may be carried over great distances by wind or rain.

How can I be exposed to PFAs?

- You may be exposed to PFAs in the air; in indoor dust, food, and water; and in some home products. However, the main sources of exposure to PFAs, such as PFOA and PFOS, are usually from eating food and drinking water that has these chemicals.
- Breast feeding infants may be exposed to PFAs since these chemicals have been found in breast milk. The benefits of breastfeeding are well known and almost always outweigh any potential risk, but you can talk with your doctor about concerns.
- Children can be exposed to PFAs in carpet since they are closer to the ground and play on the floor.
- Workers in facilities that make or use PFAs can be exposed to higher amounts of these chemicals and have higher levels in their blood.
- Some communities near factories that made or used PFOA and PFOS or in areas that used certain types of firefighting foam that spread into the environment may have been exposed to high levels of these substances in their drinking water.

How can PFAs affect my health?

A large number of studies have examined possible relationships between levels of PFAs in blood and harmful health effects in people. However, most of these studies analyzed only a small number of chemicals, and not all PFAs have the same health effects. Research suggests that high levels of certain PFAs **may**:

- increase cholesterol levels;
- decrease how well the body responds to vaccines;
- increase the risk of thyroid disease;
- decrease fertility in women;
- increase the risk of serious conditions like high blood pressure or pre-eclampsia in pregnant women;
- lower infant birth weights; however, the decrease in birth weight is small and may not affect the infant's health.

At this time, scientists are still learning about the health effects of exposures to mixtures of PFAs.

One way to learn about whether PFAs will harm people is to conduct studies in lab animals. Most of these studies have tested doses of PFOA and PFOS that are higher than levels found in the environment.

- These animal studies have found that PFOA and PFOS can cause damage to the liver and the immune system.
- PFOA and PFOS have also caused birth defects, delayed development, and newborn deaths in lab animals.

Humans and animals react differently to PFAs, and not all effects observed in animals may occur in humans.

- Scientists have ways to estimate how the exposure and effects in animals compare to what they would be in humans.
- What they learn from this process helps them decide how to protect people from harm caused by chemical exposure.

Can PFAs cause cancer?

Studies do not clearly show whether PFAs cause cancer in people. People exposed to high levels may have increased risk of kidney cancer or testicular cancer. However, these studies are not consistent and may not have looked at other factors like smoking.

Studies in animals have shown that PFOA and PFOS can cause cancer in the liver, testes, pancreas, and thyroid. However, some scientists believe that humans may not develop the same cancers as animals.

The International Agency for Research on Cancer has classified PFOA as possibly carcinogenic (causing cancer) to humans, but it has not evaluated whether other PFAs may also cause cancer. The Department of Health and Human Services has not yet evaluated whether PFOA and other PFAs can cause cancer. The Environmental Protection (EPA) suggest that there is evidence that PFAs may have the potential to cause cancer.

How can I protect my family from exposure to PFAs?

- If you do not know about PFAs levels in your water, ask your local health department.
- If your drinking water contains PFAs above the EPA Lifetime Health Advisory, consider using an alternative or treated water source for any activity in which you might swallow water. Check for fish advisories for water bodies where you fish. Follow fish advisories that tell people to stop or limit eating fish from waters contaminated with PFAs or other compounds.

Can a medical test show whether I've been exposed to PFAs?

A blood test can measure individual PFAs compounds in your blood, but this is not a test routinely done in a doctor's office.

If you have PFAs in your blood, you have been exposed to these chemicals and absorbed them into your body at some time. However, having PFAs in your blood does not necessarily mean that you will become ill from PFAs.

Has the federal government made recommendations to protect human health?

The EPA has set drinking water levels for PFOA and PFOS of 70 parts per trillion. You can learn more by visiting: https://www.epa.gov/ground-water-and-drinking-water/drinking-water-health-advisories-pfoa-and-pfos.

Where can I get more information?

For more information, call CDC-INFO at 1-800-232-4636.

You can also get information on ATSDR's PFAS website: https://www.atsdr.cdc.gov/pfas/index.html.

You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES
AND DISEASE REGISTRY

SELENIUM

CAS # 7782-49-2

Division of Toxicology ToxFAQs™ **September 2003**

This fact sheet answers the most frequently asked health questions (FAQs) about selenium. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: People may be exposed to low levels of selenium daily through food and water. Selenium is a trace mineral needed in small amounts for good health, but exposure to much higher levels can result in neurological effects and brittle hair and deformed nails. Occupational inhalation exposure to selenium vapors may cause dizziness, fatigue, irritation of mucous membranes, and respiratory effects. This substance has been found in at least 508 of the 1,636 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is selenium?

Selenium is a naturally occurring mineral element that is distributed widely in nature in most rocks and soils. In its pure form, it exists as metallic gray to black hexagonal crystals, but in nature it is usually combined with sulfide or with silver, copper, lead, and nickel minerals. Most processed selenium is used in the electronics industry, but it is also used: as a nutritional supplement; in the glass industry; as a component of pigments in plastics, paints, enamels, inks, and rubber; in the preparation of pharmaceuticals; as a nutritional feed additive for poultry and livestock; in pesticide formulations; in rubber production; as an ingredient in antidandruff shampoos; and as a constituent of fungicides. Radioactive selenium is used in diagnostic medicine.

What happens to selenium when it enters the environment?

- ❏ Selenium occurs naturally in the environment and can be released by both natural and manufacturing processes.
- ❏ Selenium dust can enter the air from burning coal and oil. This selenium dust will eventually settle over the land and water.
- ❏ It also enters water from rocks and soil, and from agricultural and industrial waste. Some selenium compounds will dissolve in water, and some will settle to the bottom as particles.
- ❏ Insoluble forms of selenium will remain in soil, but soluble forms are very mobile and may enter surface water from soils.
- ❏ Selenium may accumulate up the food chain.

How might I be exposed to selenium?

- ❏ The general population is exposed to very low levels of selenium in air, food, and water. The majority of the daily intake comes from food.
- ❏ People working in or living near industries where selenium is produced, processed, or converted into commercial products may be exposed to higher levels of selenium in the air.
- ❏ People living in the vicinity of hazardous waste sites or coal burning plants may also be exposed to higher levels of selenium.

How can selenium affect my health?

Selenium has both beneficial and harmful effects. Low doses of selenium are needed to maintain good health. However, exposure to high levels can cause adverse health effects. Short-term oral exposure to high concentrations of selenium may cause nausea, vomiting, and diarrhea. Chronic oral exposure to high concentrations of selenium compounds can produce a disease called selenosis. The major signs of selenosis are hair loss, nail brittleness, and neurological abnormalities (such as numbness and other odd sensations in the extremities).

Brief exposures to high levels of elemental selenium or selenium dioxide in air can result in respiratory tract irritation, bronchitis, difficulty breathing, and stomach pains. Longer-term exposure to either of these air-borne forms can cause respiratory irritation, bronchial spasms, and coughing.

Levels of these forms of selenium that would be necessary to produce such effects are normally not seen outside of the workplace.

Animal studies have shown that very high amounts of selenium can affect sperm production and the female reproductive cycle. We do not know if similar effects would occur in humans.

How likely is selenium to cause cancer?

Studies of laboratory animals and people show that most selenium compounds probably do not cause cancer. In fact, studies in humans suggest that lower-than-normal selenium levels in the diet might increase the risk of cancer.

The International Agency for Research on Cancer (IARC) has determined that selenium and selenium compounds are not classifiable as to their carcinogenicity to humans.

The EPA has determined that one specific form of selenium, selenium sulfide, is a probable human carcinogen. Selenium sulfide is not present in foods and is a very different chemical from the organic and inorganic selenium compounds found in foods and in the environment.

How can selenium affect children?

It is likely that the health effects seen in children exposed to selenium will be similar to the effects seen in adults. However, one study found that children may be less susceptible to the health effects of selenium than adults.

Selenium compounds have not been shown to cause birth defects in humans or in other mammals.

How can families reduce the risk of exposure to selenium?

❑ Certain dietary supplements and shampoos contain selenium; these should be used according to the manufacturer's directions.

❑ Children living near waste sites that contain selenium or coal burning plants should be encouraged to wash their hands before eating and to avoid putting their unwashed hands in their mouths.

Is there a medical test to show whether I've been exposed to selenium?

Low levels of selenium are normally found in body tissues and urine. Blood and urine tests for selenium are most useful for people who have recently been exposed to high levels. Toenail clippings can be used to determine longer-term exposure. These tests are not usually available at your doctor's office, but your doctor can send the samples to a laboratory that can perform the tests. None of these tests, however, can predict whether you will experience any health effects.

Has the federal government made recommendations to protect human health?

The EPA restricts the amount of selenium allowed in public water supplies to 50 parts total selenium per billion parts of water (50 ppb).

The Occupational Safety and Health Administration (OSHA) sets a limit of 0.2 mg selenium/m^3 of workroom air for an 8-hour work shift.

ATSDR and the EPA have determined that 5 micrograms of selenium per kilogram of body weight taken daily would not be expected to cause any adverse health effects over a lifetime of such intake.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2003. Toxicological Profile for Selenium (Update) Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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SILVER
CAS # 7440-22-4

Agency for Toxic Substances and Disease Registry ToxFAQs **July 1999**

This fact sheet answers the most frequently asked health questions (FAQs) about silver. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Silver is an element found naturally in the environment. At very high levels, it may cause argyria, a blue-gray discoloration of the skin and other organs. This chemical has been found in at least 27 of the 1,177 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is silver?
(Pronounced sĭl′vər)

Silver is a naturally occurring element. It is found in the environment combined with other elements such as sulfide, chloride, and nitrate. Pure silver is "silver" colored, but silver nitrate and silver chloride are powdery white and silver sulfide and silver oxide are dark-gray to black. Silver is often found as a by-product during the retrieval of copper, lead, zinc, and gold ores.

Silver is used to make jewelry, silverware, electronic equipment, and dental fillings. It is also used to make photographs, in brazing alloys and solders, to disinfect drinking water and water in swimming pools, and as an antibacterial agent. Silver has also been used in lozenges and chewing gum to help people stop smoking.

What happens to silver when is enters the environment?

☐ Silver may be released into the air and water through natural processes such as the weathering of rocks.

☐ Human activities such as the processing of ores, cement manufacture, and the burning of fossil fuel may release silver into the air.

☐ It may be released into water from photographic processing.

☐ Rain may wash silver out of soil into the groundwater.

☐ Silver does not appear to concentrate to a significant extent in aquatic animals.

How might I be exposed to silver?

☐ Breathing low levels in air.

☐ Swallowing it in food or drinking water.

☐ Carrying out activities such as jewelry-making, soldering, and photography.

☐ Using anti-smoking lozenges or other medicines containing it.

How can silver affect my health?

Exposure to high levels of silver for a long period of time may result in a condition called arygria, a blue-gray discoloration of the skin and other body tissues. Lower-level exposures to silver may also cause silver to be deposited in the skin and other parts of the body; however, this is not known to be harmful. Argyria is a permanent effect, but it appears to be a cosmetic problem that may not be otherwise harmful to health.

Exposure to high levels of silver in the air has resulted in breathing problems, lung and throat irritation, and stomach pains. Skin contact with silver can cause mild allergic reactions such as rash, swelling, and inflammation in some people.

Animal studies have shown that swallowing silver results in the deposit of silver in the skin. One study in mice found that the animals exposed to silver in drinking water were less active than unexposed animals.

No studies are available on whether silver affects reproduction or causes developmental problems in people.

How likely is silver to cause cancer?

No studies are available on whether silver may cause cancer in people. The only available animal studies showed both positive and negative results when silver was implanted under the skin.

The EPA has determined that silver is not classifiable as to human carcinogenicity.

Is there a medical test to show whether I’ve been exposed to silver?

Silver can be measured in the blood, urine, feces, and body tissues of exposed people. Silver builds up in the body, and the best way to learn if past exposure has occurred is to look for silver in samples of skin. Tests for silver are not commonly done at a doctor’s office because they require special equipment. Although doctors can find out if a person has been exposed to silver by doing these tests, they cannot tell whether any health effects will occur.

Has the federal government made recommendations to protect human health?

The EPA recommends that the concentration of silver in drinking water not exceed 0.10 milligrams per liter of water (0.10 mg/L) because of the skin discoloration that may occur.

The EPA requires that spills or accidental releases of 1,000 pounds or more of silver be reported to the EPA.

The Occupational Safety and Health Administration (OSHA) limits silver in workplace air to 0.01 milligrams per cubic meter (0.01 mg/m^3) for an 8-hour workday, 40-hour workweek. The National Institute of Occupational Safety and Health (NIOSH) also recommends that workplace air contain no more that 0.01 mg/m^3 silver.

The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that workplace air contain no more than 0.1 mg/m^3 silver metal and 0.01 mg/m^3 soluble silver compounds.

The federal recommendations have been updated as of July 1999.

Glossary

Carcinogenicity: Ability to cause cancer.

CAS: Chemcial Abstracts Service.

Milligram (mg): One thousandth of a gram.

National Priorities List: A list of the nation's worst hazardous waste sites.

Soluble: Capable of being dissolved in water.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1990. Toxicological profile for silver. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone:1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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STRONTIUM

CAS #7440-24-6

Division of Toxicology ToxFAQs™ **April 2004**

This fact sheet answers the most frequently asked health questions (FAQs) about strontium. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to stable or radioactive strontium occurs from ingesting contaminated food or drinking water or breathing contaminated air. In children, high levels of stable strontium can impair bone growth. High levels of radioactive strontium can cause anemia or cancer. Strontium has been found in at least 102 of the 1,636 National Priority List sites identified by the Environmental Protection Agency.

What is strontium?

Strontium is a naturally occurring element found in rocks, soil, dust, coal, and oil. Naturally occurring strontium is not radioactive and is either referred to as stable strontium or strontium. Strontium in the environment exists in four stable isotopes, ^{84}Sr (read as strontium eighty-four), ^{86}Sr, ^{87}Sr, ^{88}Sr.

Strontium compounds are used in making ceramics and glass products, pyrotechnics, paint pigments, fluorescent lights, and medicines.

Strontium can also exist as several radioactive isotopes; the most common is ^{90}Sr. ^{90}Sr is formed in nuclear reactors or during the explosion of nuclear weapons. Radioactive strontium generates beta particles as it decays. One of the radioactive properties of strontium is half-life, or the time it takes for half of the isotope to give off its radiation and change into another substance. The half-life of ^{90}Sr is 29 years.

What happens to strontium when it enters the environment?

❑ In air, strontium is present as dust, which eventually settles over land and water.
❑ Some strontium compounds dissolve in water.
❑ Some strontium compounds in soil can dissolve in water and move deeper in the soil to underground water.
❑ Radioactive decay and decontamination are the only ways of decreasing the amount of ^{90}Sr in the environment.

How might I be exposed to strontium?

❑ You can be exposed to low levels of stable strontium and radioactive strontium by breathing air, eating food, or drinking water.
❑ Food and drinking water are the largest sources of exposure to strontium.
❑ You can be exposed to radioactive strontium if you eat food that was grown in contaminated soil, or if you come near a source of radioactive strontium.

How can strontium affect my health?

Exposure to low levels of stable strontium has not been shown to affect adult health, but may harm children (see following section).

Breathing or ingesting low levels of radioactive strontium have not been shown to affect health. High levels of radioactive strontium can damage bone marrow and cause anemia and prevent the blood from clotting properly.

How likely is strontium to cause cancer?

The only stable strontium compound that may cause cancer is strontium chromate, but this is due to chromium not strontium.

Exposure to high levels of radioactive strontium may cause cancer. Leukemia has been seen in humans exposed to relatively large amounts of radioactive strontium. Leukemia and cancers of the bone, nose, lung, and skin have also been seen in laboratory animals.

The International Agency for Research on Cancer (IARC) has determined that radioactive strontium is a human carcinogen.

How can strontium affect children?

We do not know if exposure to strontium will result in birth defects or other developmental effects in people. Birth defects have been observed in animals exposed to radioactive strontium.

Exposure to high levels of stable strontium can result in impaired bone growth in children.

Children may be more susceptible than adults to the harmful effects of radioactive strontium.

How can families reduce the risk of exposure to strontium?

Having a balanced diet with sufficient amounts of vitamin D, calcium, and protein will reduce the amount of strontium that is absorbed.

Is there a medical test to show whether I've been exposed to strontium?

All people have small amounts of stable strontium in their bodies. There are tests to measure the level of strontium in blood, hair, feces, and urine. These tests are most useful for people exposed to high levels. These tests cannot determine the exact levels of strontium you may have been exposed to or predict how the levels in your tissues will affect your health.

Two types of tests are available for radioactive strontium. One is to see if you have been exposed to a large dose of radiation, and the other is to see if strontium is in your body. The first looks for changes in blood cell counts or in your chromosomes that occur at 3 to 5 times the annual occupational dose limit. It cannot tell if the radiation came from strontium. The second type of test involves examining your blood, feces, saliva, urine, teeth, and even your entire body. It is to see if strontium is being excreted from your body, is in your teeth, or remains inside your body at levels that are higher than normal. The doctor's office collects and sends samples to a special lab for testing, or you must go to the lab for testing.

Has the federal government made recommendations to protect human health?

EPA has set a limit of 4000 micrograms strontium per liter of drinking water (4000 µg/L).

EPA has set a limit of 8 picocurie ^{90}Sr per liter of drinking water.

The Nuclear Regulatory Commission has set limits for radioactive strontium in workplace air for a 40-hour work week of 6×10^{-8} microcurie per milliliter (µCi/mL) for ^{89}Sr and 8×10^{-9} µCi/mL for ^{90}Sr. EPA has set an average annual drinking water limit of 20 picocuries per liter (pCi/L) for ^{89}Sr and 8 pCi/L for ^{90}Sr so the public radiation dose will not exceed 4 millirem.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2004. Toxicological Profile for Strontium. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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THALLIUM

CAS # 7440-28-0

Division of Toxicology and Human Health Sciences ToxFAQs™ June 2013

This fact sheet answers the most frequently asked health questions about thallium. For more information, you may call the ATSDR Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

Summary: Exposure to thallium occurs mainly from eating food. Exposure to higher levels of thallium may occur in the workplace. Breathing high levels of thallium may result in effects on the nervous system, while ingesting high levels of it results in vomiting, diarrhea, temporary hair loss, and other effects. This chemical has been found in at least 210 of 1,416 National Priorities List sites identified by the Environmental Protection Agency.

What is thallium?

Pure thallium is a bluish-white metal that is found in trace amounts in the earth's crust. In the past, thallium was obtained as a by-product from smelting other metals; however, it has not been produced in the United States since 1984. Currently, all the thallium is obtained from imports and from thallium reserves.

In its pure form, thallium is odorless and tasteless. It can also be found combined with other substances such as bromine, chlorine, fluorine, and iodine. When it's combined, it appears colorless-to-white or yellow.

Thallium is used mostly in manufacturing electronic devices, switches, and closures, primarily for the semiconductor industry. It also has limited use in the manufacture of special glass and for certain medical procedures.

What happens to thallium when it enters the environment?

- Thallium enters the environment primarily from coal-burning and smelting, in which it is a trace contaminant of the raw materials.
- It stays in the air, water, and soil for a long time and is not broken down.
- Some thallium compounds are removed from the atmosphere in rain and snow.
- It's absorbed by plants and enters the food chain.
- It builds up in fish and shellfish.

How might I be exposed to thallium?

- Eating food contaminated with thallium may be a major source of exposure for most people.
- Breathing workplace air in industries that use thallium.
- Smoking cigarettes.
- Living near hazardous waste sites containing thallium (may result in higher than normal exposures).
- Touching or, for children, eating soil contaminated with thallium.
- Breathing low levels in air and water.

How can thallium affect my health?

Exposure to high levels of thallium can result in harmful health effects. A study on workers exposed on the job over several years reported nervous system effects, such as numbness of fingers and toes, from breathing thallium.

Studies in people who ingested large amounts of thallium over a short time have reported vomiting, diarrhea, temporary hair loss, and effects on the nervous system, lungs, heart, liver, and kidneys. It has caused death. It is not known what the effects are from ingesting low levels of thallium over a long time.

Birth defects were not reported in the children of mothers exposed to low levels from eating vegetables and fruits contaminated with thallium. Studies in rats, however, exposed to high levels of thallium, showed adverse developmental effects.

It is not known if breathing or ingesting thallium affects human reproduction. Studies showed that rats that ingested thallium for several weeks had some adverse reproductive effects. Animal data suggest that the male reproductive system may be susceptible to damage by low levels of thallium.

There is no information available on the health effects of skin contact with thallium in people or animals.

How likely is thallium to cause cancer?

The Department of Health and Human Services, the International Agency for Research on Cancer, and the Environmental Protection Agency (EPA) have not classified thallium as to its human carcinogenicity.

No studies are available in people or animals on the carcinogenic effects of breathing, ingesting, or touching thallium.

Is there a medical test to determine whether I've been exposed to thallium?

There are medical tests available to measure levels of thallium in urine and hair. In addition, thallium can also be measured in blood; however, this is not a good indicator of exposure since thallium only stays in blood a very short time.

These tests require special equipment that is not usually available in most doctor's offices. In addition, these tests cannot determine if adverse health effects will occur from the exposure to thallium.

The geometric mean thallium level measured in the U.S. general population aged 6 and older is reported by the Centers for Disease Control and Prevention as 0.153 µg/g creatinine (measured in urine).

Has the federal government made recommendations to protect human health?

The EPA requires that discharges or accidental spills into the environment of 1,000 pounds or more of thallium be reported.

The Occupational Safety and Health Administration (OSHA) has set an exposure limit of 0.1 milligrams per cubic meter (0.1 mg/m³) for thallium in workplace air. The American Conference of Governmental Industrial Hygienists (ACGIH) has established the same guidelines as OSHA for the workplace.

The National Institute for Occupational Safety and Health (NIOSH) has recommended that 15 mg/m³ of thallium be considered immediately dangerous to life and health. This is the exposure level of a chemical that is likely to cause permanent health problems or death.

Glossary

Carcinogenicity: Ability to cause cancer.

Ingesting: Taking food or drink into your body.

Milligram (mg): One thousandth of a gram.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1992. Toxicological Profile for thallium. Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

http://www.cdc.gov/exposurereport/pdf/FourthReport_UpdatedTables_Sep2012.pdf

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30333. Phone: 1-800-232-4636, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Toluene - ToxFAQs™

CAS # 108-88-3

This fact sheet answers the most frequently asked health related questions (FAQs) regarding exposure to toluene. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important that you understand this information because this substance may harm you, or your family. The health effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to toluene occurs from breathing contaminated workplace air, automobile exhaust, or by using products such as paints, paint thinners, fingernail polish, lacquers, and adhesives. Toluene affects the nervous system. Toluene has been found in at least 1,012 of the 1,699 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is toluene?

Toluene is a clear, colorless liquid with a distinctive smell. It is a good solvent (a substance that can dissolve other substances). Toluene occurs naturally in crude oil and in the tolú tree. It is produced in the process of making gasoline and other fuels from crude oil and in making coke from coal.

Toluene is used in making paints, paint thinners, fingernail polish, lacquers, adhesives, and rubber and in some printing and leather tanning processes. Toluene is also used in the manufacture of other chemicals, nylon, and plastics. It is also added to gasoline along with benzene and xylene to improve octane ratings.

What happens to toluene when it enters the environment?

- Toluene enters the environment when you use materials that contain it. It can also enter surface water and ground water from spills of solvents and petroleum products as well as leaking underground storage tanks at gasoline stations and other facilities.
- When toluene-containing products are placed in landfills or waste disposal sites, toluene can enter the soil or water near the waste site.
- Toluene in subsurface water can be degraded by anaerobic microorganisms.
- Toluene in surface water or soil will readily evaporate to the air or be degraded by bacteria.
- Toluene does not usually stay in the environment long.

How might I be exposed to toluene?

- Breathing contaminated workplace air or automobile exhaust.
- Individuals who work with gasoline, paint, lacquer, or dyes have greater exposures to toluene, as do individuals who smoke or intentionally inhale products containing toluene for its euphoric effects or to get high.
- Living near uncontrolled hazardous waste sites containing toluene products.
- Toluene is not frequently detected in drinking water or food.

How can toluene affect my health?

Toluene may affect the nervous system. Low to moderate levels can cause tiredness, confusion, weakness, drunken-type actions, memory loss, nausea, and loss of appetite. These symptoms usually disappear when exposure stops.

Long-term daily inhalation exposure to toluene in the workplace may cause some hearing and color vision loss. Repeatedly breathing toluene from glue or paint thinners may permanently damage the brain.

The effects of toluene in animals are similar to those seen in humans.

How likely is toluene to cause cancer?

Studies in workers and animals exposed to toluene generally indicate that toluene is not carcinogenic

The International Agency for Research on Cancer (IARC) determined that toluene is not classifiable as to its carcinogenicity in humans. The EPA determined there is inadequate information to assess the carcinogenic potential of toluene. The National Toxicology Program (NTP) has not considered the carcinogenic potential of toluene.

How can toluene affect children?

The effects of toluene on children have not been studied very much, but toluene seems to produce the same types of effects in children as it does in adults.

Some older children and adolescents who have repeatedly breathed large amounts of toluene to get high have developed loss of muscle control, loss of memory, poor balance, and decreased mental abilities. Some of these changes may last for a long time after toluene has left the body.

Some mothers who breathed large amounts of toluene during pregnancy to get high have had children with birth defects, including retardation of mental abilities and growth.

How can families reduce the risk of exposure to toluene?

- Families can reduce their risk of exposure to toluene by using consumer products containing the chemical (such as paints, glues, inks, and stain removers) in well-ventilated areas and reading the labels of the products.
- When not in use, toluene-containing products should be tightly covered to prevent evaporation into the air.
- Household chemicals should be stored out of the reach of young children to prevent accidental poisonings.
- Always store household chemicals in their original labeled containers. Never store household chemicals in containers that children would find attractive to eat or drink from, such as old soda bottles.
- Use bottled water if you have concerns about the presence of toluene in your tap water.
- Prevent children from eating or playing in the dirt if you live near a waste site that has been contaminated with toluene.
- Talk with children about the dangers of sniffing chemicals.

Is there a medical test to show whether I've been exposed to toluene?

Toluene and its breakdown products (metabolites) can be measured in blood and urine. However, the detection of toluene or its metabolites cannot predict the kind of health effects that might develop from that exposure. Because toluene and its metabolites leave the body fairly rapidly, the tests need to be conducted within days after exposure. The tests are not routinely available at the doctor's office because they require special equipment.

Has the federal government made recommendations to protect human health?

The EPA has recommended a drinking water limit of 1 mg/L for toluene.

The Occupational Safety and Health Administration (OSHA) has set a legal limit for workers of 200 ppm for toluene in air averaged over an 8 hour workday.

The National Institute for Occupational Safety and Health (NIOSH) has set a recommended limit of 100 ppm for toluene in air averaged over a 10-hour workday.

References

This ToxFAQs™ information is taken from the 2015 Toxicological Profile for Toluene (Draft for Public Comment) produced by the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services, Public Health Service in Atlanta, GA.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636.

ToxFAQs™ on the web: www.atsdr.cdc.gov/toxFAQs

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES
AND DISEASE REGISTRY

TOTAL PETROLEUM HYDROCARBONS (TPH)

Agency for Toxic Substances and Disease Registry ToxFAQs **August 1999**

This fact sheet answers the most frequently asked health questions (FAQs) about total petroleum hydrocarbons (TPH). For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: TPH is a mixture of many different compounds. Everyone is exposed to TPH from many sources, including gasoline pumps, spilled oil on pavement, and chemicals used at home or work. Some TPH compounds can affect your nervous system, causing headaches and dizziness. TPH has been found in at least 23 of the 1,467 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are total petroleum hydrocarbons?

(Pronounced tōt′l pə-trō′lē-əm hī′drə-kär′bənz)

Total petroleum hydrocarbons (TPH) is a term used to describe a large family of several hundred chemical compounds that originally come from crude oil. Crude oil is used to make petroleum products, which can contaminate the environment. Because there are so many different chemicals in crude oil and in other petroleum products, it is not practical to measure each one separately. However, it is useful to measure the total amount of TPH at a site.

TPH is a mixture of chemicals, but they are all made mainly from hydrogen and carbon, called hydrocarbons. Scientists divide TPH into groups of petroleum hydrocarbons that act alike in soil or water. These groups are called petroleum hydrocarbon fractions. Each fraction contains many individual chemicals.

Some chemicals that may be found in TPH are hexane, jet fuels, mineral oils, benzene, toluene, xylenes, naphthalene, and fluorene, as well as other petroleum products and gasoline components. However, it is likely that samples of TPH will contain only some, or a mixture, of these chemicals.

What happens to TPH when it enters the environment?

- ☐ TPH may enter the environment through accidents, from industrial releases, or as byproducts from commercial or private uses.
- ☐ TPH may be released directly into water through spills or leaks.
- ☐ Some TPH fractions will float on the water and form surface films.
- ☐ Other TPH fractions will sink to the bottom sediments.
- ☐ Bacteria and microorganisms in the water may break down some of the TPH fractions.
- ☐ Some TPH fractions will move into the soil where they may stay for a long time.

How might I be exposed to TPH?

- ☐ Everyone is exposed to TPH from many sources.
- ☐ Breathing air at gasoline stations, using chemicals at home or work, or using certain pesticides.
- ☐ Drinking water contaminated with TPH.
- ☐ Working in occupations that use petroleum products.
- ☐ Living in an area near a spill or leak of petroleum products.
- ☐ Touching soil contaminated with TPH.

How can TPH affect my health?

Some of the TPH compounds can affect your central nervous system. One compound can cause headaches and dizziness at high levels in the air. Another compound can cause a nerve disorder called "peripheral neuropathy," consisting of numbness in the feet and legs. Other TPH compounds can cause effects on the blood, immune system, lungs, skin, and eyes.

Animal studies have shown effects on the lungs, central nervous system, liver, and kidney from exposure to TPH compounds. Some TPH compounds have also been shown to affect reproduction and the developing fetus in animals.

How likely is TPH to cause cancer?

The International Agency for Research on Cancer (IARC) has determined that one TPH compound (benzene) is carcinogenic to humans. IARC has determined that other TPH compounds (benzo[a]pyrene and gasoline) are probably and possibly carcinogenic to humans. Most of the other TPH compounds are considered not to be classifiable by IARC.

Is there a medical test to show whether I've been exposed to TPH?

There is no medical test that shows if you have been exposed to TPH. However, there are methods to determine if you have been exposed to some TPH compounds. Exposure to kerosene can be determined by its smell on the breath or clothing. Benzene can be measured in exhaled air and a breakdown product of benzene can be measured in urine. Other TPH compounds can be measured in blood, urine, breath, and some body tissues.

Has the federal government made recommendations to protect human health?

There are no regulations or advisories specific to TPH. The following are recommendations for some of the TPH fractions and compounds:

The EPA requires that spills or accidental releases into the environment of 10 pounds or more of benzene be reported to the EPA.

The Occupational Safety and Health Administration has set an exposure limit of 500 parts of petroleum distillates per million parts of air (500 ppm) for an 8-hour workday, 40-hour workweek.

Glossary

Carcinogenicity: Ability to cause cancer.

CAS: Chemical Abstracts Service.

Immune system: Body organs and cells that fight disease.

Pesticides: Chemicals used to kill pests.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for total petroleum hydrocarbons (TPH). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Vanadium - ToxFAQs™

CAS # 7440-62-2

This fact sheet answers the most frequently asked health questions (FAQs) about vanadium. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Everyone is exposed to low levels of vanadium in air, water, and food; however, most people are exposed mainly from food. Breathing high levels of vanadium pentoxide may cause lung damage. Ingesting vanadium can cause nausea and vomiting. In animals, ingesting vanadium can cause decreased red blood cells and increased blood pressure. Vanadium has been found in at least 319 of 1,699 National Priorities List (NPL) sites identified by the Environmental Protection Agency (EPA).

What is vanadium?

Vanadium is an element that occurs in nature as a white-to-gray metal compounds, and is often found as crystals. Pure vanadium has no smell. It usually combines with other elements such as oxygen, sodium, sulfur, or chloride. Vanadium and vanadium compounds can be found in the earth's crust and in rocks, some iron ores, and crude petroleum deposits.

Vanadium is used in producing rust-resistant, spring, and high-speed tool steels.

Vanadium pentoxide is used in ceramics, as a catalyst, and in the production of superconductive magnets.

Vanadyl sulfate and sodium metavanadate have been used as dietary supplements.

What happens to vanadium when it enters the environment?

- Vanadium mainly enters the environment from natural sources and from the burning of fuel oils.
- It does not dissolve well in water.
- It combines with other elements and particles.
- Vanadium binds strongly to soil and sediments.
- Low levels have been found in plants, but it is not likely to build up in the tissues of animals.

How might I be exposed to vanadium?

- Eating foods containing vanadium, higher levels are found in seafoods. Vanadium is found in some nutritional supplements.
- Breathing air near an industry that burns fuel oil or coal; these industries release vanadium oxide into the air.
- Working in industries that process vanadium or make products containing vanadium.
- Breathing contaminated air or drinking contaminated water near waste sites or landfills containing vanadium.
- Breathing cigarette smoke.
- Vanadium is not readily absorbed by the body from the stomach, gut, or contact with the skin.

How can vanadium affect my health?

Exposure to high levels of vanadium pentoxide in air can result in lung damage.

Nausea, mild diarrhea, and stomach cramps have been reported in people some vanadium compounds. A number of effects have been found in animals ingesting vanadium compounds including decreases in the number of red blood cells, increased blood pressure, and mild neurological effects. The amounts of vanadium given in these animal studies that resulted in harmful effects are much higher than those likely to occur in the environment.

Vanadium

CAS # 7440-62-2

How likely is vanadium to cause cancer?

The International Agency for Research on Cancer (IARC) has classified vanadium pentoxide as possibly carcinogenic to humans based on evidence of lung cancer in exposed mice.

The Department of Health and Human Services (DHHS) and EPA have not classified vanadium as to its human carcinogenicity.

How can vanadium affect children?

The health effects in children are expected to be similar to the effects seen in adults.

Studies in animals exposed during pregnancy have shown that vanadium can cause decreases in growth and increases in the occurrence of birth defects. These effects are usually observed at levels which cause effects in the mother. Effects have also been observed at vanadium doses which did not cause effects in the mother.

How can families reduce the risk of exposure to vanadium?

- Vanadium is present in some supplements. Consult with your doctor before taking supplements containing vanadium to determine if they are appropriate for you. Supplements should be kept out of reach of children.
- Vanadium is a component of tobacco smoke. Avoid smoking in enclosed spaces like inside the home or car in order to limit exposure to children and other family members.

Is there a medical test to determine whether I've been exposed to vanadium?

Vanadium can be measured in blood and urine. These tests cannot determine if harmful health effects will occur from the exposure to vanadium.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) has set a legal limit of 0.5 milligrams per cubic meter (0.5 mg/m^3) for vanadium pentoxide dust as a ceiling limit not to be exceeded during the workday. A ceiling limit of 0.1 mg/m^3 for vanadium pentoxide fumes has also been established.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2012. Toxicological Profile for Vanadium. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636.

ToxFAQs^{TM} Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Vinyl Chloride - ToxFAQs™

CAS # 75-01-4

This fact sheet answers the most frequently asked health questions (FAQs) about vinyl chloride. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to vinyl chloride occurs mainly in the workplace. Breathing high levels of vinyl chloride for short periods of time can cause dizziness, sleepiness, unconsciousness, and at extremely high levels can cause death. Breathing vinyl chloride for long periods of time can result in permanent liver damage, immune reactions, nerve damage, and liver cancer. This substance has been found in at least 616 of the 1,662 National Priority List (NPL) sites identified by the Environmental Protection Agency (EPA).

What is vinyl chloride?

Vinyl chloride is a colorless gas. It burns easily and it is not stable at high temperatures. It has a mild, sweet odor. It is a manufactured substance that does not occur naturally. It can be formed when other substances such as trichloroethane, trichloroethylene, and tetrachloroethylene are broken down. Vinyl chloride is used to make polyvinyl chloride (PVC). PVC is used to make a variety of plastic products, including pipes, wire and cable coatings, and packaging materials.

Vinyl chloride is also known as chloroethene, chloroethylene, and ethylene monochloride.

What happens to vinyl chloride when it enters the environment?

- Liquid vinyl chloride evaporates easily. Vinyl chloride in water or soil evaporates rapidly if it is near the surface.
- Vinyl chloride in the air breaks down in a few days to other substances, some of which can be harmful.
- Small amounts of vinyl chloride can dissolve in water.
- Vinyl chloride is unlikely to build up in plants or animals that you might eat.

How might I be exposed to vinyl chloride?

- Breathing vinyl chloride that has been released from plastics industries, hazardous waste sites, and landfills.
- Breathing vinyl chloride in air or during contact with your skin or eyes in the workplace.
- Drinking water from contaminated wells.

How can vinyl chloride affect my health?

Breathing high levels of vinyl chloride can cause you to feel dizzy or sleepy. Breathing very high levels can cause you to pass out, and breathing extremely high levels can cause death.

Some people who have breathed vinyl chloride for several years have changes in the structure of their livers. People are more likely to develop these changes if they breathe high levels of vinyl chloride. Some people who work with vinyl chloride have nerve damage and develop immune reactions. The lowest levels that produce liver changes, nerve damage, and immune reaction in people are not known. Some workers exposed to very high levels of vinyl chloride have problems with the blood flow in their hands. Their fingers turn white and hurt when they go into the cold.

The effects of drinking high levels of vinyl chloride are unknown. If you spill vinyl chloride on your skin, it will cause numbness, redness, and blisters.

Animal studies have shown that long-term exposure to vinyl chloride can damage the sperm and testes.

CS265956-A

Vinyl Chloride

CAS # 75-01-4

How likely is vinyl chloride to cause cancer?

The U.S. Department of Health and Human Services (DHHS) has determined that vinyl chloride is a known carcinogen. Studies in workers who have breathed vinyl chloride over many years showed an increased risk of liver, brain, lung cancer, and some cancers of the blood have also been observed in workers.

How can vinyl chloride affect children?

It has not been proven that vinyl chloride causes birth defects in humans, but studies in animals suggest that vinyl chloride might affect growth and development. Animal studies also suggest that infants and young children might be more susceptible than adults to vinyl chloride-induced cancer.

How can families reduce the risk of exposure to vinyl chloride?

Tobacco smoke contains low levels of vinyl chloride, so limiting your family's exposure to cigarette or cigar smoke may help reduce their exposure to vinyl chloride.

Is there a medical test to determine whether I've been exposed to vinyl chloride?

The results of several tests can sometimes show if you have been exposed to vinyl chloride. Vinyl chloride can be measured in your breath, but the test must be done shortly after exposure. This is not helpful for measuring very low levels of vinyl chloride.

The amount of the major breakdown product of vinyl chloride, thiodiglycolic acid, in the urine may give some information about exposure. However, this test must be done shortly after exposure and does not reliably indicate the level of exposure.

Has the federal government made recommendations to protect human health?

Vinyl chloride is regulated in drinking water, food, and air. The EPA requires that the amount of vinyl chloride in drinking water not exceed 0.002 milligrams per liter (mg/L) of water.

The Occupational Safety and Health Administration (OSHA) has set a limit of 1 part vinyl chloride per 1 million parts of air (1 ppm) in the workplace.

The Food and Drug Administration (FDA) regulates the vinyl chloride content of various plastics. These include plastics that carry liquids and plastics that contact food. The limits for vinyl chloride content vary depending on the nature of the plastic and its use.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2006. Toxicological Profile for Vinyl Chloride (Update). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636.

ToxFAQs™ Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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AGENCY FOR TOXIC SUBSTANCES
AND DISEASE REGISTRY

ZINC

CAS # 7440-66-6

Division of Toxicology ToxFAQs™ **August 2005**

This fact sheet answers the most frequently asked health questions (FAQs) about zinc. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Zinc is a naturally occurring element. Exposure to high levels of zinc occurs mostly from eating food, drinking water, or breathing workplace air that is contaminated. Low levels of zinc are essential for maintaining good health. Exposure to large amounts of zinc can be harmful. It can cause stomach cramps, anemia, and changes in cholesterol levels. Zinc has been found in at least 985 of the 1,662 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is zinc?

Zinc is one of the most common elements in the earth's crust. It is found in air, soil, and water, and is present in all foods. Pure zinc is a bluish-white shiny metal.

Zinc has many commercial uses as coatings to prevent rust, in dry cell batteries, and mixed with other metals to make alloys like brass, and bronze. A zinc and copper alloy is used to make pennies in the United States.

Zinc combines with other elements to form zinc compounds. Common zinc compounds found at hazardous waste sites include zinc chloride, zinc oxide, zinc sulfate, and zinc sulfide. Zinc compounds are widely used in industry to make paint, rubber, dyes, wood preservatives, and ointments.

What happens to zinc when it enters the environment?

❑ Some is released into the environment by natural processes, but most comes from human activities like mining, steel production, coal burning, and burning of waste.
❑ It attaches to soil, sediments, and dust particles in the air.
❑ Rain and snow remove zinc dust particles from the air.
❑ Depending on the type of soil, some zinc compounds can move into the groundwater and into lakes, streams, and rivers.
❑ Most of the zinc in soil stays bound to soil particles and does not dissolve in water.
❑ It builds up in fish and other organisms, but it does not build up in plants.

How might I be exposed to zinc?

❑ Ingesting small amounts present in your food and water.
❑ Drinking contaminated water or a beverage that has been stored in metal containers or flows through pipes that have been coated with zinc to resist rust.
❑ Eating too many dietary supplements that contain zinc.
❑ Working on any of the following jobs: construction, painting, automobile mechanics, mining, smelting, and welding; manufacture of brass, bronze, or other zinc-containing alloys; manufacture of galvanized metals; and manufacture of machine parts, rubber, paint, linoleum, oilcloths, batteries, some kind of glass, ceramics, and dyes.

How can zinc affect my health?

Zinc is an essential element in our diet. Too little zinc can cause problems, but too much zinc is also harmful.

Harmful effects generally begin at levels 10-15 times higher than the amount needed for good health. Large doses taken by mouth even for a short time can cause stomach cramps, nausea, and vomiting. Taken longer, it can cause anemia and decrease the levels of your good cholesterol. We do not know if high levels of zinc affect reproduction in humans. Rats that were fed large amounts of zinc became infertile.

Inhaling large amounts of zinc (as dusts or fumes) can cause a specific short-term disease called metal fume fever. We do not know the long-term effects of breathing high levels of zinc.

Putting low levels of zinc acetate and zinc chloride on the skin of rabbits, guinea pigs, and mice caused skin irritation. Skin irritation will probably occur in people.

How likely is zinc to cause cancer?

The Department of Health and Human Services (DHHS) and the International Agency for Research on Cancer (IARC) have not classified zinc for carcinogenicity. Based on incomplete information from human and animal studies, the EPA has determined that zinc is not classifiable as to its human carcinogenicity.

How can zinc affect children?

Zinc is essential for proper growth and development of young children. It is likely that children exposed to very high levels of zinc will have similar effects as adults. We do not know whether children are more susceptible to the effects of excessive intake of zinc than the adults.

We do not know if excess zinc can cause developmental effects in humans. Animal studies have found decreased weight in the offspring of animals that ingested very high amounts of zinc.

How can families reduce the risks of exposure to zinc?

❏ Children living near waste sites that contain zinc may be exposed to higher levels of zinc through breathing contaminated air, drinking contaminated drinking water, touching or eating contaminated soil.
❏ Discourage your children from eating soil or putting their hands in their mouths and teach them to wash their hands frequently and before eating.
❏ If you use medicines or vitamin supplements containing zinc, make sure you use them appropriately and keep them out of the reach of children.

Is there a medical test to determine whether I've been exposed to zinc?

There are tests available to measure zinc in your blood, urine, hair, saliva, and feces. These tests are not usually done in the doctor's office because they require special equipment. High levels of zinc in the feces can mean high recent zinc exposure. High levels of zinc in the blood can mean high zinc consumption and/or high exposure. Tests to measure zinc in hair may provide information on long-term zinc exposure; however, the relationship between levels in your hair and the amount of zinc you were exposed to is not clear.

Has the federal government made recommendations to protect human health?

The EPA recommends that drinking water should contain no more than 5 milligrams per liter of water (5 mg/L) because of taste. The EPA requires that any release of 1,000 pounds (or in some cases 5,000 pounds) into the environment be reported to the agency.

To protect workers, the Occupational Safety and Health Administration (OSHA) has set an average limit of 1 mg/m^3 for zinc chloride fumes and 5 mg/m^3 for zinc oxide (dusts and fumes) in workplace air during an 8-hour workday, 40-hour workweek.

Similarly, the National Institute for Occupational Safety and Health (NIOSH) has set the same standards for up to a 10-hour workday over a 40-hour workweek.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2005. Toxicological Profile for Zinc (Update). Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATTACHMENT C

Field Health & Safety Report

Street Address City, State	
Field Health & Safety Report 00000-00 Date	
HARTCROWSER	Appendix **C**

Job No. 150-002-202

Date

S M T W Th F S

Arrival time:

Departure time:

Job Santosh Landfill

Location

Client

Field representative

Project manager

Field H&S manager

Project H&S manager

Names of personnel on site

Site activities

Potential hazards

Hazard control used

Protective measures taken

Comments or observations

Sketch position of equipment relative to exploration (attach separate diagram if needed); indicate monitoring point(s) and prevailing wind direction.

Exploration No. ______________________

Air Monitoring Log

Meter Number 1, Type ____________ Calibrated ____________ Checked ____________

Meter Number 2, Type ____________ Calibrated ____________ Checked ____________

Background Reading: Meter 1 ______________________ Meter 2 ______________________

Time	Meter 1	Meter 2	Comments

ATTACHMENT D
Job Hazard Analyses

Job Hazard Analysis: General Site Activities

Work Task	Potential Hazards	Protective Measures
General site activities	Slips, trips, and falls from: • Uneven surfaces • Wet and slick surfaces • Obstacles in travel path	• Always watch where you are walking and take note of any obstacles before starting work, get the lay of the land. • Plant foot straight up and down when walking on wet surfaces, shoes may slip on surface with lateral force on shoe when planting foot • Practice good housekeeping and don't leave tools or equipment lying around.
General site activities	Lifting heavy objects	• Use proper lifting techniques when handling objects. • Do not lift more than 50 pounds per person. Seek assistance for heavier objects. • Use mechanical means when possible. • Pick up loads using your legs and not your back. • Carry loads directly in front of you and do not twist your body while carrying a load.
General site activities	Weather and cold stress	• Check the weather forecast prior to mobilization and plan accordingly for cold or inclement weather. • Layer up or down as necessary to stay warm. Avoid sweating in cold temperatures as it can wick heat away from the body. • Have waterproof rain gear available during the rainy season.
General site activities	Exposure to blood borne pathogens (BBP)	• Survey the site for biohazards objects such as used hypodermic needles, medical waste, or biological waste. • Do not handle potentially infectious items. Isolate the item if possible or use a tool to move it out of the way (i.e. use a shovel to pick up and move a needle). • In the event CPR is performed, use a pocket mask with a one-way valve.

Job Hazard Analysis: Groundwater Sampling

Work Task	Potential Hazards	Protective Measures
Handling sample glassware	Cuts from broken glass	• Inspect all glassware prior to use for signs of damage. • Do not overtighten containers as they may break under excessive pressure. • Wear cut resistant gloves when handling broken glassware.
Collecting groundwater samples	Contact with contaminated media • Direct contact • Inhalation	• Wear nitrile gloves when handling environmental media. • Immediately wash off any groundwater that comes into contact with bare skin. • Wash hands before eating, drinking, or performing other hand to face or mouth activities. • Use PID multi-meter or PID and combustible gas indicator meter to monitor for VOCs and flammable gasses.
Sample handling	Exposure to chemical preservatives	• Inspect all sample containers upon receipt for breaks, cracks, or fractures. • Wear nitrile or chemical resistant gloves when handling sample containers with preservatives

Job Hazard Analysis: Site Maintenance and Raptor Perch Construction

Work Task	Potential Hazards	Protective Measures
Power tool operation • Chainsaw • Power drill • Circular saw • Reciprocating saw	Cuts, lacerations, and punctures from blades and drill bits	• Inspect all tools prior to use. Repair or remove from service any tool with deficiencies. • Verify that all guards and safety devices on the tool are present and functioning as intended. • Wear gloves appropriate to the task and tool being used. • Stabilize item prior to cutting or drilling to avoid movement that could throw. • Do not wear and loose clothing that could get caught around auger if using a powered auger. • Additional PPE for chainsaw use includes cut resistant chaps, hearing protection, and faceshield
Pruning tree limbs	Strike from branch, limbs under tension	• Chainsaw use and pruning operations will be performed be an experienced technician • Assess branches and tree stalks for signs of stored tension (e.g. branch held down by fence wiring). Release tension if safe to do so. • Make small cuts no more than half-way through branch at several intervals along limb to release tension. • All non-essential personal to trimming operation will maintain distance from pruning activities and not be in the line of direction for any potential limb breaks and releases of tension energy
Post-hole digging	Muscle strain	• Use tool (powered auger or post-hole digger) per the manufacturer's instruction. • Periodically switch performance of task between workers to potential for fatigue and muscle strain.
Cementing post in place	Exposure to caustic material	• Cement is caustic to bare skin with prolonged exposure. Immediately wash off any spilled cement with water. • Wear appropriate gloves when mixing or handling wet cement. • Do not inhale cement dust. Stand upwind when mixing.

Job Hazard Analysis: Site Maintenance and Raptor Perch Construction

Work Task	Potential Hazards	Protective Measures
Installing post in ground	Post tip-over/ falling	• Post can be long and top heavy. Use multiple people (as needed) to place post in ground. Use tag lines for maneuvering and support struts to hold post in place, as needed.
Generator use	Fire	• Fuel generator offsite prior to use. If fueling in the field, allow to cool before refueling. • Do not point exhaust towards combustible fuels (e.g. dry grass) that could be ignited by exhaust heat or contact with exhaust pipe. • Have fire extinguisher available for use if a fire should start. • Only attempt to extinguish incipient stage fires. Evacuate site if fire can't be immediately extinguished.

ATTACHMENT E

Hart Crowser Incident/Accident Investigation Report

Hart Crowser Incident/Accident Investigation Report*

Hart Crowser Office: ____________________ Incident/Accident Site Location: ____________________ Address: ____________________ State: County:	Project number: 150-002-020 Date/time of occurrence: ___AM ___PM

Name(s) of Hart Crowser personnel involved in the incident/accident:

Name(s) and Affiliation of any other personnel involved in the incident/accident:

What happened? Describe cause and nature of incident, injury or illness.

Was the incident/accident caused by actions of another individual: __Yes __No If yes, provide name, address, phone and details:

Describe any unsafe action, equipment, conditions that contributed to the incident/accident:

Was first aid given? **__Yes __No __ Unknown**	Was person referred to medical evaluation/treatment? **___Yes ___No ___ Unknown** If yes, indicate date, where and to whom:

Did the employee(s) receive medical treatment beyond first aid __Yes __No __ Unknown If yes, describe medical treatment given:

Will lost time be involved? **__Yes __No __N/A**	Will restricted work days be involved? **__Yes __No __N/A**

If yes to either lost time or restricted work, complete the following:

____________ Last normal work date

____________ Date of return to normal work

____________ Number of days lost time involved or expected

____________ Number of days restricted work involved or expected

What actions will be taken to prevent recurrence? Give responsibilities and expected completion dates for each action.

Witnesses (Provide name, company, address, and phone number):

Reported By: Date:	Reviewed by: Corporate health and safety director: Date: Employee(s) manager or supervisor: Date: Human resources: Date:
Will the work-related injury/illness result in a Workers' Compensation claim? __Yes __No ____N/A	If yes, provide claim number and date claim filed:

*The supervisor of the employee(s) involved in the incident/accident must ensure that this form is filled out within 24 hours of the incident/or accident and forwarded to corporate health and safety director. Attach additional sheets if necessary. If the incident is a recordable work-related injury or illness, OSHA Form 301 must be completed in addition to this form.