Health Consultation

LOWER BRIDGE MINE

TERREBONNE, OREGON

EPA FACILITY ID: ORD980837314

APRIL 8, 2009

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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HEALTH CONSULTATION

LOWER BRIDGE MINE

TERREBONNE, OREGON

EPA FACILITY ID: ORD980837314

Prepared By:

Oregon Public Health Division
Environmental Health Assessment Program
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry (ATSDR)

Foreword

The Environmental Health Assessment Program (EHAP) within the Oregon Public Health Division (PHD) has prepared this Health Consultation under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR is part of the U.S. Department of Health and Human Services, Public Health Service. The mission of ATSDR is to prevent or mitigate adverse human health effects and diminished quality of life resulting from exposure to hazardous substances in the environment. This Health Consultation was prepared in accordance with ATSDR methodology and guidelines.

ATSDR and its cooperative agreement partners review the available information about hazardous substances at a site, evaluate whether exposure to them might cause any harm to people, and provide the findings and recommendations to reduce harmful exposures in documents called Public Health Assessments and Health Consultations. ATSDR conducts a Public Health Assessment for every site on or proposed for the National Priorities List (the NPL, also known as the Superfund list). Health Consultations are similar to Public Health Assessments, but they usually are shorter, address one specific question, and address only one contaminant or one exposure pathway. Another difference is that Public Health Assessments are made available for public comment, while Health Consultations usually are not. Public Health Assessments and Health Consultations are not the same thing as a medical exam or a community health study.

Public Health Assessments and Health Consultations include conclusions that categorize environmental contaminants and conditions according to the likelihood that they will harm people. These categories are called "Hazard Categories." The five possible Hazard Categories are:

Urgent Public Health Hazard: This category is used for sites that have certain physical features or evidence of short-term (less than 1 year), site-related chemical exposure that could result in adverse health effects and require rapid intervention to stop people from being exposed.

Public Health Hazard: This category is used for sites that have certain physical features or evidence of chronic, site-related chemical exposure that could result in adverse health effects.

Indeterminate Public Health Hazard: This category is used for sites where important information is lacking (missing or has not yet been gathered) about site-related chemical exposures. In other words, this category is used when there is not enough information to decide whether or not a condition at a site poses a public health hazard.

No Apparent Public Health Hazard: This category is used for sites where exposure to site-related chemicals may have occurred in the past or is still occurring but the exposures are not at levels expected to cause adverse health effects.

No Public Health Hazard: This category is used for sites where there is evidence of an absence of exposure to site-related chemicals.

Final Release

This final Health Consultation is a follow-up to a previous public comment version titled "Lower Bridge Mine." Public comments were received from October 23 – December 8, 2008, and were incorporated into this final report. Details on how comments were incorporated or otherwise addressed can be found in Appendix A.

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Summary

The Oregon Office of Environmental Public Health's Environmental Health Assessment Program (EHAP) has prepared this Health Consultation (HC) regarding Lower Bridge Mine in Terrebonne, Oregon at the request of State Senator Ben Westlund (D-Bend). In this HC, EHAP has reviewed available environmental data, and addressed community concerns regarding the public health impact on current nearby residents from potential contaminants and dusts at the site.

Community members have expressed concerns about the potential public health implications of a proposed residential development on this site. EHAP did not have the information necessary to assess the health risks of the site for future residents, so the focus of this HC is on current land use conditions. Any health impacts that a proposed development may have on future residents will be addressed in a subsequent Public Health Assessment. This HC contains several recommendations for the collection of additional environmental sampling data that would be used in the subsequent Public Health Assessment, which could also result in updated conclusions about health risks to current nearby residents.

Lower Bridge Mine is a 576 acre diatomaceous earth (DE) strip mine located 5.5 miles west of Terrebonne, OR. Past activities at the site include DE mining and processing to form a type of crystalline silica (cristobalite) that is used in filtration systems and metal castings. The mine site has also been used for asphalt mixing, sand and gravel mining, and hazardous waste storage.

Community concerns related to current public health issues at the site include:

- Residual contaminants in soil and groundwater from historical hazardous and radiological waste storage onsite
- Physical safety hazards related to dilapidated buildings and piles of scrap metal and scrap wood onsite
- Inhalation of dust from the site and the possibility that dust contains cristobalite

EHAP developed the conclusions, recommendations, and public health action plan in this health consultation based on information gathered during a site visit on July 2, 2008, a meeting with community members on August 13, 2008, evaluation of existing environmental data, and review of medical and toxicological literature.

Contact with soil and groundwater potentially affected by former hazardous and radiological waste storage on the site poses ***no apparent public health hazard*** under current use conditions. This is because soil and groundwater samples showed no contaminant levels above health-based screening levels. Also, recent radiological surveys found radiation levels to be the same as local background.

Dilapidated buildings, piles of scrap metal and scrap wood pose a ***public health hazard*** to trespassers. Based on EHAP's observations, the existing physical barriers are inadequate to prevent teenagers, unsupervised children, or others from trespassing on the

site, EHAP recommends that site owners remove these buildings and scrap wood and metal piles or ensure that they are structurally sound. EHAP also recommends that adults keep away from these dilapidated structures, and that parents keep children and teenagers off of the site.

Airborne dust from any source can cause short-term respiratory irritation including sneezing, coughing, eye/nose/throat irritation, and difficulty breathing during dust storms. EHAP was unable to determine whether dust from the site could cause long-term health effects in nearby residents because existing air monitoring and crystalline silica (cristobalite) analysis data are insufficient. Therefore, EHAP has concluded that airborne dust from the site is an ***indeterminate public health hazard***. In order to fill this data gap, EHAP recommends that air monitoring be conducted near residences located downwind from the site to determine the particle size and concentration of dust in the air and to measure the amount of cristobalite in the dust.

Purpose and Health Issues

This health consultation (HC) was prepared by the Oregon Office of Environmental Public Health's Environmental Health Assessment Program (EHAP) in cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). In May 2008, State Senator Westlund (D-Bend) petitioned EHAP to assess the public health impacts of the Lower Bridge Mine on nearby residents. EHAP evaluated the potential health impacts of airborne dust composed of diatomaceous earth originating from the site, residual hazardous waste stored at the site, and physical safety hazards associated with dilapidated structures and alleged buried waste on the site.

It should be noted that the conclusions presented here are based on current uses and conditions on and around the site. However, on December 29, 2008, the Deschutes County Planning Commission voted to re-zone portions of the mine site for residential development. EHAP has made recommendations in this report to conduct further environmental sampling and evaluation in order to inform a future Public Health Assessment. Any health impacts that a proposed development may have on future residents will be addressed in the subsequent Public Health Assessment.

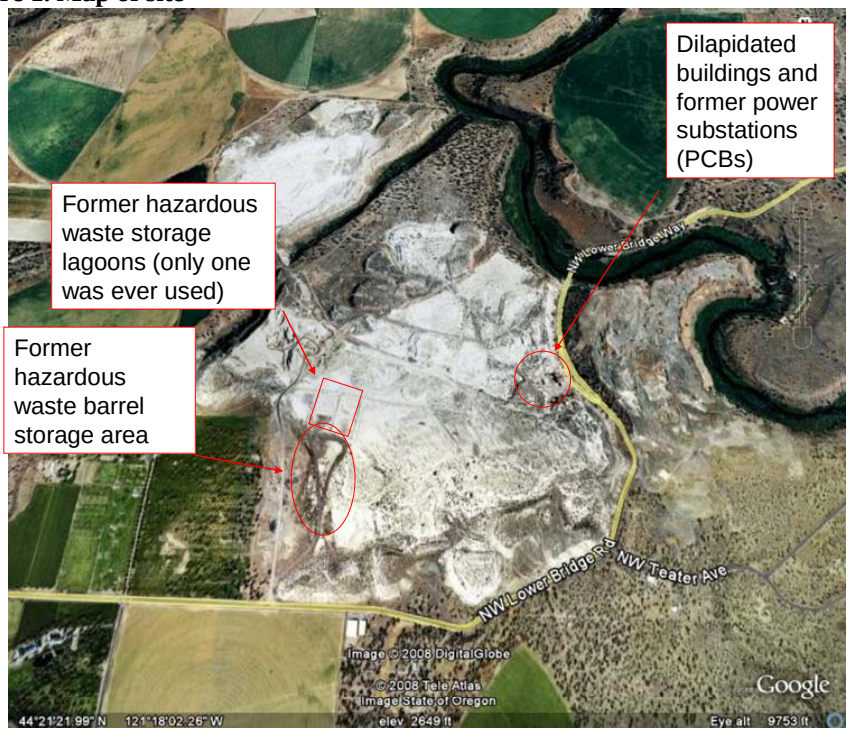
Background

Site Description and History

Lower Bridge Mine is located 5.5 miles west of Terrebonne, Oregon on Lower Bridge Road (10000 and 70420 NW Lower Bridge Rd., Terrebonne, Oregon). The surrounding land is agricultural and rural residential (Figure 1). The nearest residences are approximately 0.5 miles away. Prevailing winds at Redmond Municipal Airport (approximately 12.5 miles southeast of the site) are from the south from September through March and from the west/northwest from April through August. However, residents report that more locally, winds tend to come from the west and follow the course of the Deschutes River Basin.

Starting in the early 1900s the site was strip-mined for diatomaceous earth (DE). For a 42-year period, the site was also used to process raw DE (composed mainly of amorphous silica) into a form of crystalline silica known as cristobalite. Two electrical power substations also existed on the site. Polychlorinated biphenyls (PCBs) were detected in the soil around one of the substations. In addition, hazardous and radiological waste was stored on the site for a period of approximately 8 years. In the mid-1980s, the Oregon Department of Environmental Quality (DEQ) oversaw the cleanup of the identified hazardous waste material. On December 29, 2008, the Deschutes County Planning Commission voted to re-zone portions of the mine site for residential development.

Figure 1. Map of site



Site Visit

On July 2, 2008, EHAP staff visited the mine site. The site visit included a walk-through tour of the former DE processing area and associated structures (Figure 2). EHAP noted that the former DE processing building appeared dilapidated and observed evidence of frequent trespassing (graffiti, bonfire remains, bullet holes, vandalism, etc.). In the immediate vicinity of the former DE processing building, EHAP staff saw a scrap metal pile composed mainly of sheet metal and some metal piping (Figure 3), two scrap wood piles (Figure 2 in front of building), and an area of large discarded machinery parts (Figure 4). The scrap metal pile and discarded machinery parts will be referred to collectively as “scrap metal” in this document.

EHAP staff noted that motor vehicle access to the site was restricted by partial perimeter fencing with locked gates at the main access roads and large boulders in strategic

locations. ”No Trespassing” signs surrounded the perimeter of the property; however, there were limited physical barriers to prevent pedestrians from entering the site.

During the site visit, EHAP staff also walked in some of the DE that covers the top-soil-stripped portion of the site. There was no wind during EHAP’s visit, but it was evident that the fine, dry, powdery DE would very easily become airborne in moderate to high winds. EHAP also observed a watering pivot covering a large area of the top-soil-stripped portion of the site. DEQ staff informed EHAP staff that this pivot had been put in place to suppress dust emissions from the site.

EHAP observed the four rectangular waste storage lagoons that had been constructed to receive hazardous waste. EHAP noted the area where hazardous and radiological waste storage barrels had been kept. No hazardous materials or barrels were observed by EHAP staff, and the lagoons appeared empty except for sparse vegetation growing on the bottoms.

Figure 2. Old mine process building onsite (July 2, 2008; EHAP)

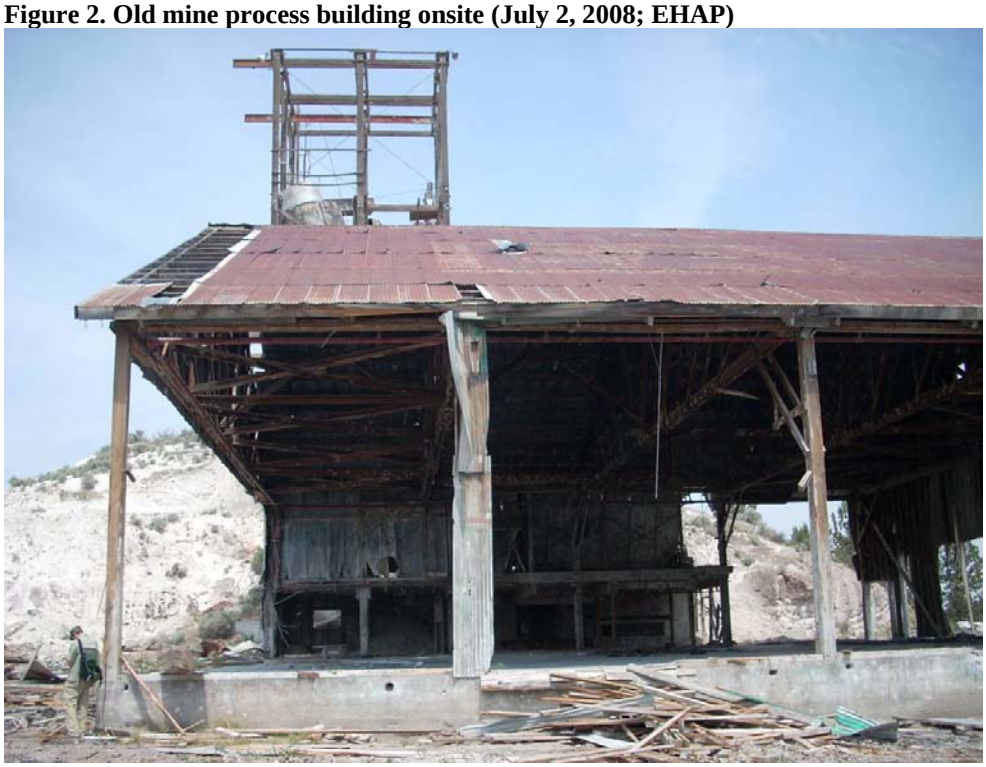
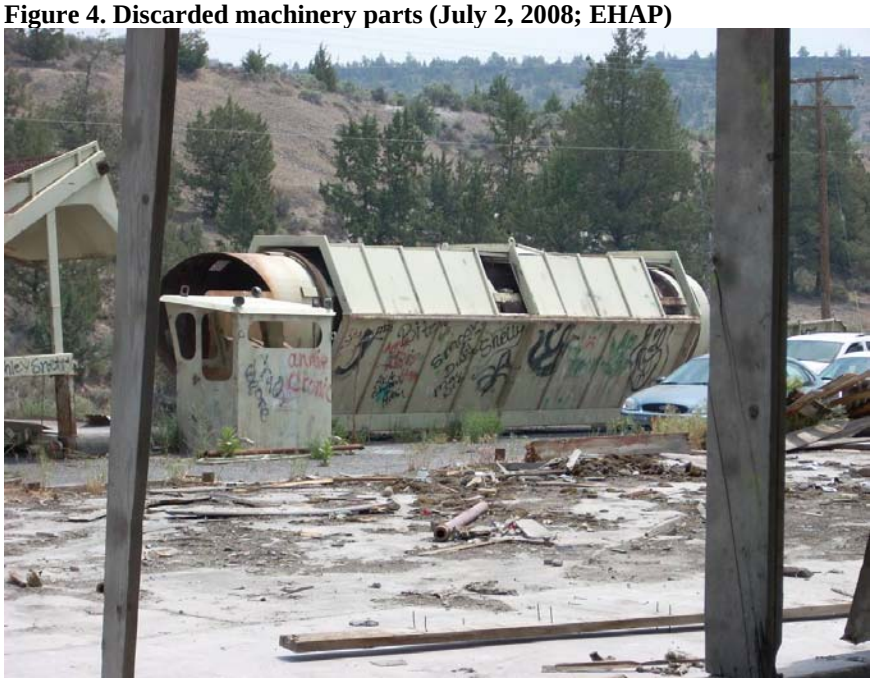


Figure 3. Scrap metal pile (July 2, 2008; EHAP)

Figure 4. Discarded machinery parts (July 2, 2008; EHAP)



Community Concerns

EHAP collects and documents community concerns as part of the health consultation process, in order to learn what is important to the affected communities, and gather information about local activity on or near the site. This section summarizes concerns that EHAP is able to address, as well as concerns that are beyond the scope/capacity of EHAP to address.

Concerns that are beyond EHAP's scope of work:

- Community members have voiced concerns that contaminants and activities at the mine site could degrade the surrounding natural wildlife habitat, including that of endangered fish species in the Deschutes River. We respectfully direct these questions to the appropriate agencies.
- EHAP has heard community members' desire for answers about land use and permitting issues, and we respectfully direct these questions to the appropriate agencies.
- Community members have expressed distrust of state agencies, site owners, and potential developers.
- Community members have expressed distrust of environmental sampling data. After a thorough review of the data collection and sampling methodologies, EHAP has found these data to be of adequate quality to support the findings presented in this report.
- Community members have alleged that there is additional, unidentified, buried waste on the site. One specific example is an allegation that copper waste has been buried or stored on the site. Neither DEQ nor EHAP have been able to identify any buried waste. In order for alleged buried waste to harm nearby residents, there would have to be a way for chemicals in the waste to move offsite to areas where people could be exposed to them. Buried waste cannot move in the wind, so migration into and through groundwater would be the pathway of most concern at the site. Because no contaminants were found at unsafe levels in either of the two groundwater aquifers underlying the site (See Discussion and Appendix C for more detail), it is unlikely that unsafe levels of chemical contaminants from alleged buried waste could move offsite to affect nearby residents. In addition, most of the current residents live south or east of the mine site. The general groundwater flow direction is north [1], meaning that potential contaminants from the mine would be carried away from the wells of current residents living south or east of the mine. Some private well owners nearby have had their water tested and have anecdotally reported that no contaminants were found above drinking water standards.
- Community members have also alleged that there was a discrepancy between the number of hazardous waste storage barrels brought onto the site and those removed from the site during the 1980's clean-up effort. EHAP has verified that 691 barrels were removed to a landfill near Arlington, OR, and 106 (those containing radioactive waste) were removed to Hanford, totaling 797 barrels removed from the site [2]. EHAP has found no discrepancy in the number of barrels accepted on site and those removed.

Community concerns EHAP is able to address:

EHAP is able to address many of the health concerns expressed by the community. These concerns are listed briefly here and discussed in detail in the next section (see Discussion).

- Residual contaminants in soil and groundwater from historical hazardous and radiological onsite waste storage and from two former onsite power substations

- Physical safety hazards related to dilapidated buildings and scrap metal and scrap wood piles
- Inhalation of dust from the site and the possibility that the dust contains cristobalite

Concern about dust inhalation is the most commonly expressed concern among local residents. The community is concerned that dust from the site may contain crystalline silica (cristobalite) and that inhalation of this dust could lead to long-term health effects such as cancer and/or silicosis. Another concern expressed by the community in a public meeting on August 13, 2008 is that dust from the site may accumulate in their homes, prolonging exposure to cristobalite in the dust. Each of these concerns is discussed in more detail in the following section.

Discussion

This discussion is divided into subsections based on the various site concerns expressed by community members near Lower Bridge Mine. Each subsection describes the sources of environmental sampling data relevant to the specific concern it addresses, evaluates the quality of those data, and identifies important data gaps. Finally, each subsection contains an analysis and explanation of the public health implications of each concern.

Hazardous and radiological waste storage and polychlorinated biphenyls (PCBs)

For an 8-year period ending with a clean-up action in 1983, hazardous waste (including radiological waste) was stored at the Lower Bridge Mine site. The majority of the waste was stored in barrels on the surface; however, one of the four lagoons that were dug in the DE to store sludge did receive one shipment of hazardous ink sludge waste. In 1983, the responsible party removed the hazardous sludge waste and sampled the soil underlying the former waste storage areas.

The community has expressed concern that the two former onsite power substations could have been a source of PCB contamination. In April and May 2008, the areas around the two substations were sampled for PCBs. Pacific Corp., the responsible party, subsequently removed the contaminated soil and conducted confirmatory sampling to ensure no PCBs were left in the area.

<u>Soil sampling from former hazardous waste storage areas</u>

EHAP reviewed confirmatory sampling data collected in the mid-1980s during the hazardous waste clean-up. Surface soil samples were taken from under the area where barrels containing chromium, lead, PCBs, cyanide, and radioactive sand-casting sludges had been stored. A composite surface soil sample was also taken from the bottom of the one lagoon that had been used to store hazardous ink sludge waste.

While these samples are limited in number, the sample locations represent the “worst-case scenario.” In other words, if any of the hazardous waste that was stored above ground or in the lagoons remained after the clean-up occurred, these were the most likely locations to find evidence of these contaminants. Samples were analyzed for the

contaminants listed in Table 1 in Appendix B. This list of chemicals includes all of the contaminants known or suspected to have been in the hazardous waste stored on the site.

EHAP compared the highest concentration of each contaminant found in the soil from both locations against ATSDR health-based comparison values for soil. These values assume daily exposure to contaminants over an entire lifetime. None of the contaminants exceeded ATSDR comparison values (See Appendix B Table 1), which means that the contaminants were not found at high enough levels to present a health risk. Based on these findings, EHAP concluded that contact with soil from the former hazardous waste storage areas poses ***no apparent public health hazard*** to surrounding residents under current land use conditions.

Radiological concerns

Some of the hazardous materials historically stored at the mine site contained radiological materials, so EHAP reviewed radiological survey data collected in March 2008 conducted by a third party contractor[3]. Radiation readings were taken at 13 locations in and around the former hazardous waste storage areas including the lagoons and former barrel storage pad. None of the gamma radiation readings exceeded local background levels. In addition to surveys onsite, EHAP staff surveyed the yards of two private residences for gamma radiation levels where fill taken from the mine site had been used for landscaping. EHAP found no radiological readings above local background levels at either of the residences during this July 2, 2008 survey. EHAP concluded that ***no apparent public health hazard*** associated with historical radiological waste exists at the Lower Bridge Mine site.

Polychlorinated Biphenyls (PCBs)

EHAP evaluated PCB concentrations in ten soil samples that were taken in April and May of 2008[4] from around the two former onsite power substations. Two out of the ten samples had PCB concentrations above health-based screening values. Pacific Corp. removed the contaminated soil and took thirteen confirmatory soil samples[5]. EHAP evaluated the thirteen confirmatory soil samples and determined that PCB concentrations no longer exceeded ATSDR's health-based soil screening values [5]. Given the localized nature and small area affected by PCB contamination prior to removal, it is unlikely that PCBs could have migrated offsite in sufficient quantities to affect the health of local residents in the past or under current land use conditions. EHAP concluded that soil around the former power substations on the site poses ***no apparent public health hazard*** to nearby residents.

Potential Groundwater Contamination

Residents expressed concern that hazardous wastes could contaminate groundwater under the site and migrate into domestic wells used by nearby residents. EHAP evaluated groundwater sampling data that was collected and analyzed in March 2008 by third party, state-certified contractors and laboratories (Appendix C Tables 2 and Table 3). The samples were collected from two aquifers (sampled via an irrigation well and a spring) at different depths under the site (one sample from each aquifer). Data in Tables 2 and 3 in Appendix C show the chemical and radionuclide concentrations from the deeper aquifer;

these concentrations are representative of both aquifers, which had very similar concentrations. Hydrological data for the area indicate that these are the only two aquifers under the mine site.

The groundwater samples were tested for chemicals that represent a complete suite of contaminants commonly found at hazardous waste sites. The general categories of chemicals in this list include: metals, nitrates, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), pesticides, radionuclides, and PCBs. None of the contaminants measured exceeded drinking water screening comparison values, and most were not detectable. A few chemicals had detection limits that were slightly higher than comparison values. However, these detection limits are close to comparison values, and comparison values are set 10 to 1000 times lower than levels that have been shown to cause health effects. Based on these findings, EHAP concluded that drinking groundwater from the site poses ***no apparent public health hazard***.

Because none of the contaminants detected in the groundwater directly under the mine exceeded safe levels, EHAP concluded that any contaminants migrating through groundwater would not be found at unsafe levels off of the mine site. In addition, most of the current nearby residents live upgradient from the mine [1], meaning that the general direction of groundwater flow is away from current residential wells. However, these groundwater samples represent a snap-shot in time, so additional rounds of groundwater sampling would be useful in ruling out any potential trends towards contamination. Additional sampling of groundwater on the mine site is also important to ensure the safety of future residents who will be drinking groundwater from under the site.

Physical safety hazards

During a site visit to Lower Bridge Mine, EHAP staff observed dilapidated buildings that appeared structurally unsound (Figure 2). EHAP staff noted that this area appeared to be frequented by trespassers, as evidenced by graffiti, residual fire pits, and garbage. EHAP staff also observed piles of scrap metal and scrap wood (Figures 3 and 4). There were locked gates on access roads, large rock barriers, partial perimeter fencing, and "No Trespassing" signs posted around the perimeters of the site. These barriers appeared effective in barring entry to motorized vehicles; however no physical barriers existed to effectively restrict access to trespassing pedestrians. People climbing on or around structures or scrap piles could be at risk of injury by falling, getting cut on sharp edges, or puncture wounds. EHAP concluded that these conditions pose a ***public health hazard*** to trespassers.

Airborne dust

The arid, windy conditions surrounding Lower Bridge Mine create a potential for airborne dust to be generated from this open strip mine. The formerly mined areas have no topsoil and sparse vegetative cover, allowing raw DE to easily become airborne and migrate in dust clouds offsite, as illustrated in Figure 5. Dust of any size and from any

source, when inhaled, can cause respiratory irritation. Health effects of such exposure can include sneezing, coughing, difficulty breathing, and eye/nose/throat irritation. These symptoms are usually short-term and resolve on their own once exposure to the airborne dust has stopped. Because DE is very absorbent, it may be especially irritating because of its ability to dry out the moist membranes inside the nose, throat, and eyes. Airborne dust generated from the mine or from the Deschutes River valley in general could cause these kinds of short-term respiratory irritation in residents, particularly during dust-storm events.

Figure 5. Dust storm at Lower Bridge Mine site (April 4, 2008; David Jenkins)

Cristobalite

Inhaled crystalline silica (cristobalite) can cause a debilitating respiratory disease called silicosis and also increase the risk for lung cancer [6, 7]. Cristobalite is considered a health hazard only under occupational conditions where people are exposed to more than 0.05 mg/m^3 for a full work week over 15-20 years [6, 7]. The community surrounding the mine site has expressed concern about residual cristobalite at the Lower Bridge Mine site related to the DE processing that occurred there for 42 years. Some have expressed concern that the dust may get into the air in sufficient concentrations to cause silicosis and increase the risk for lung cancer in nearby residents.

After evaluating the scientific literature on the subject [6-20] and observing current conditions at the site, EHAP concluded that an increased incidence of silica-related lung diseases in residents near the mine site is unlikely. This is because the exposure to dust during periodic, even frequent, dust storms is quantitatively very different from sustained exposures averaging 40 hours/week over 15-20 years (the conditions under which silicosis and silica-related lung cancer typically develop) [6, 7]. Based on current epidemiological studies of silicosis, EHAP found that it is unlikely that sufficient quantities of respirable size crystalline silica particulate could become airborne and reach residents for sufficient periods of time to induce silicosis or silica-related lung cancer.

In order to determine if there is residual cristobalite in the soil, DEQ collected and analyzed a soil sample from the mine site in May of 2006. This sample contained 0.2% cristobalite, a concentration EHAP considers very safe. However, data from this sample have significant limitations. First, there has been no additional sampling of the exposed surface soils at the site, so this sample represents an inadequate surface area. Second, a soil sample is very different from an air sample and may not reflect what actually gets into the air. Additional surface soil samples could be used to determine whether the mine could serve as a source of crystalline silica in air. In October of 2006, DEQ collected six air samples from two residences located downwind from the mine site. Analysis found no detectable crystalline silica in any of the six air samples. However, these data also have significant limitations. First, these samples represent only one snapshot in time and may not be representative of typical conditions at the site. Second, the analysis used did not measure the size of particles captured from the air. Therefore, EHAP concluded that cristobalite exposure poses an ***indeterminate public health hazard*** because the existing sampling data for cristobalite content in the soil and air at and around the mine are insufficient. EHAP has made recommendations to fill these data gaps (see recommendations on page 13).

Other Respirable Dust

Inhaled airborne dust, regardless of source or cristobalite content, can cause long-term health effects such as asthma, chronic bronchitis, chronic obstructive pulmonary disorder (COPD), and heart problems [21-39]. The ability of airborne dust to cause these long-term health effects depends on whether the dust particles are small enough, concentrations are high enough, and people are exposed for a long enough period of time. Generally, most of the dust particles that are visible in the air during high-wind conditions are not small enough to go deep into the lungs and cause these long-term health effects [40]. For healthy individuals, the amount of respirable particles (particles small enough to go deep into the lungs and cause long-term health effects) generated during dust storms is not sufficient to cause long-term health effects. However, people with pre-existing conditions, such as asthma, COPD, heart problems, and other respiratory diseases, may be sensitive to lower concentrations of respirable particles[28]. Children also may be more sensitive to respirable particles because they breathe more air per body size than adults and because their lungs are still developing[28]. Because the concentration and size of dust particles in the air surrounding the site are unknown, EHAP concluded that airborne dust from the mine or poses an ***indeterminate public health hazard*** for increasing risk for long-term health effects**.**

Children's Health Considerations

EHAP and ATSDR recognize that infants and children may be more vulnerable to exposures than adults in communities faced with contamination of their air, water, soil, or food. This vulnerability is a result of the following factors:

- Children are more likely to play outdoors and bring food into contaminated areas.
- Children are shorter, resulting in a greater likelihood to breathe dust, soil, and heavy vapors close to the ground.

- Children are smaller, resulting in higher doses of chemical exposure per body weight.
- The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages.

Because children depend on adults for risk identification and management decisions, ATSDR is committed to evaluating their special interests at sites such as Lower Bridge Mine where their behaviors or sensitivity to contaminants could put them at greater risk. Because children's lungs are still developing and because they inhale a larger volume of air per body size than adults, children could potentially be more sensitive to contaminants in the air.

Older children and teenagers are attracted to dilapidated buildings and piles of scrap metal and scrap wood as places to play and congregate. Old structures on the mine property could be dangerous for children playing on, in, or around them. Children and teenagers are the population most susceptible to physical injury and harm from the dilapidated structures on the site. Also, teens and children entering the site will have much greater exposure to dust. Parents and mine owners should take special care to prevent teens and unsupervised children from entering the site.

Conclusions

Soil and groundwater from Lower Bridge Mine currently pose ***no apparent public health hazard*** to nearby residents under current land use conditions. This is because none of the contaminants measured in areas where hazardous waste was stored or where PCB contamination occurred exceed ATSDR comparison values for soil or groundwater. Radiological surveys found no readings above local background levels.

Dilapidated buildings and piles of scrap metal and scrap wood pose a ***public health hazard (physical hazard)*** to trespassers. While "No Trespassing" signs are posted around the perimeter and barriers block access to motorized vehicles onto the site, there currently are insufficient physical barriers in place to restrict pedestrian access. There is sufficient evidence that people do trespass onto these dangerous areas and therefore could be at risk for injury.

EHAP does not expect that cristobalite in inhaled dust from Lower Bridge Mine can cause silicosis or lung cancer because the concentration of crystalline silica in the air is not likely to be at sufficient levels to cause these health effects in nearby residents. However, because existing data are insufficient, EHAP is unable to conclude whether inhalation of dust from Lower Bridge Mine could cause silicosis or lung cancer (***indeterminate public health hazard***).

EHAP is unable to determine whether other long-term health effects of airborne dust from the site are likely (***indeterminate public health hazard***). This is because data about the size and concentration of dust particles in the air that residents breathe are insufficient. However, airborne dust from any source ***may cause short-term respiratory***

irritation such as sneezing, coughing, eye/nose/throat irritation, bloody noses, and difficulty breathing. Raw DE may be especially irritating because it is extremely absorbent, and larger particles trapped in the nose and throat could dry out membranes.

Recommendations

Although this Health Consultation reports on current land use conditions, and the public health implications to nearby residences, the Deschutes County Planning Commission recently voted to re-zone portions of the mine site for residential development. Therefore, in order to ensure the public health and safety of current and future residents at and near the mine site, EHAP recommends that site owners take the following actions:

- Join DEQ's voluntary cleanup program
- Consult with EHAP in developing a comprehensive site sampling plan that will fill current data gaps. This sampling plan should be approved by EHAP and should include the following components:
    - Additional rounds of groundwater sampling from aquifers under the mine to ensure that there is not a trend towards contamination over time
    - Additional surface soil sampling on the site with analysis for crystalline silica, ensuring that an adequate surface area is covered to determine whether the mine could serve as a significant source of crystalline silica to the air
    - Air monitoring for respirable particulate matter (PM10). This monitoring scheme should provide for:
        - Air monitoring stations near some affected homes and in more distant locations for background comparison
        - Analysis appropriate to determine the concentration of particles of respirable size and the percentage of respirable particulate composed of crystalline silica (cristobalite)
        - Sufficient time coverage to capture seasonal trends
- Continue dust suppression efforts, and include short- and long-term dust suppression in planning any future activity at the site
- Remove dilapidated structures from the site or take measures to ensure that they are structurally sound
- Remove scrap metal and scrap wood from site

Nearby residents can take steps to protect themselves and their families from potential health impacts. Specifically:

- Stay off of mine property and away from dilapidated structures and scrap metal piles
- Keep children and teenagers off of the mine site and away from dilapidated structures and scrap metal piles
- Take care to close doors and windows when visible dust clouds approach homes
- Remove shoes before entering homes to reduce the amount of dust brought into the house from outdoors

- Remove outer-wear such as coats and jackets or outdoor work clothes to avoid carrying additional dust into the house
- Clean with wet methods or vacuum with HEPA filtered units

Public Health Action Plan

The Public Health Action Plan ensures that this HC identifies public health risks and provides a plan of action designed to reduce and prevent adverse health effects from exposure to hazardous substances in the environment. This plan includes a description of actions that will be taken by EHAP in collaboration with other agencies to pursue the implementation of the recommendations outlined in this document.

Public health actions that have been implemented to date:

- EHAP conducted a site visit on July 2, 2008 which included a walk-through of the site itself and a meeting with local residents to collect community concerns.
- On July 2, 2008, EHAP took gamma radiation readings in homeowners' yards where fill originating from the mine site had been used for landscaping purposes.
- EHAP hosted a public meeting on August 13, 2008 to collect additional community concerns and share initial ideas about existing data.
- EHAP released this Health Consultation for public comment on October 23, 2008.
- EHAP hosted a second public meeting on November 3, 2008 to present the findings of this report and answer the public's questions regarding the findings.
- EHAP incorporated public comments into this final release of the Health Consultation.

Public health actions that will be implemented in the future:

- EHAP will be available to provide input on future air monitoring and sampling plans generated by mine owners, and potential developers to ensure that data collected from such sampling will be useful in making subsequent public health determinations.
- EHAP will be available to evaluate the public health implications of any new environmental sampling data as it becomes available.
- The "indeterminate public health hazard" designation for air particulate will be revised based on the new sampling data (mentioned above) as it becomes available.
- EHAP will be available to write additional health consultations/assessments based on future data as the need arises.

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Certification

This Lower Bridge Mine Health Consultation was prepared by the Oregon Department of Human Services under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with approved methodologies and a procedures existing at the time the health consultation was initiated. Editorial review was completed by the Cooperative Agreement partner.

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The Division of Health Assessment and Consultation (DHAC) ATSDR, has reviewed this health consultation and concurs with the findings.

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References

1. Caldwell, R.R., *Chemical Study of Regional Ground-Water Flow and Ground-Water/Surface-Water Interaction in the Upper Deschutes Basin, Oregon Ground-Water and Water-Chemistry Data for the Upper Deschutes Basin, Oregon* 1998, USGS: Portland, OR.
2. ODEQ, *Preliminary Assessment (PA) Deschutes Valley Sanitation (Attachment 15)*, R.A. Section, Editor. 1987, Oregon Department of Environmental Quality: Portland, OR.
3. Arana, J., *Environmental Radiological Survey Report: Property Associated with the Former Deschutes Valley Sanitation (DVS) Waste Disposal Site; 10000 & 70420 NW Lower Bridge Road, Deschutes County, Oregon*. 2008: Richland, WA.
4. Scott, T., *Shallow Soil Sampling - Oremite Substations NW Lower Bridge Road, Terrebonne, Oregon*. 2008, PBS Engineering + Environmental
5. Scott, T. and U. Cooley, *Soil Characterization and Removal Report*. 2008, PBS Engineering + Environmental.
6. Greenberg, M.I., J. Waksman, and J. Curtis, *Silicosis: a review.* Dis Mon, 2007. **53**(8): p. 394-416.
7. NIOSH, *Health Effects of Occupational Exposure to Respirable Crystalline Silica*, D.o.H.a.H. Services, Editor. 2002, Centers for Disease Control: Cincinnati, OH.
8. Berry, G., A. Rogers, and P. Yeung, *Silicosis and lung cancer: a mortality study of compensated men with silicosis in New South Wales, Australia.* Occup Med (Lond), 2004. **54**(6): p. 387-94.
9. Cocco, P., et al., *Lung cancer risk, silica exposure, and silicosis in Chinese mines and pottery factories: the modifying role of other workplace lung carcinogens.* Am J Ind Med, 2001. **40**(6): p. 674-82.
10. Hessel, P.A., et al., *Silica, silicosis, and lung cancer: a response to a recent working group report.* J Occup Environ Med, 2000. **42**(7): p. 704-20.
11. Huaux, F., *New developments in the understanding of immunology in silicosis.* Curr Opin Allergy Clin Immunol, 2007. **7**(2): p. 168-73.
12. Lacasse, Y., et al., *Meta-analysis of silicosis and lung cancer.* Scand J Work Environ Health, 2005. **31**(6): p. 450-8.
13. Marinaccio, A., et al., *Retrospective mortality cohort study of Italian workers compensated for silicosis.* Occup Environ Med, 2006. **63**(11): p. 762-5.
14. Park, R., et al., *Exposure to crystalline silica, silicosis, and lung disease other than cancer in diatomaceous earth industry workers: a quantitative risk assessment.* Occup Environ Med, 2002. **59**(1): p. 36-43.
15. Peretz, A., et al., *Silica, silicosis, and lung cancer.* Isr Med Assoc J, 2006. **8**(2): p. 114-8.
16. Saffiotti, U., *Silicosis and lung cancer: a fifty-year perspective.* Acta Biomed, 2005. **76 Suppl 2**: p. 30-7.
17. Spigno, F., et al., *Lung cancer in subjects suffering from silicosis in the Province of Genoa from 1979 to 2004.* G Ital Med Lav Ergon, 2007. **29**(4): p. 898-902.
18. Tjoe Nij, E. and D. Heederik, *Risk assessment of silicosis and lung cancer among construction workers exposed to respirable quartz.* Scand J Work Environ Health, 2005. **31 Suppl 2**: p. 49-56.

19. Ulm, K., et al., *Silica, silicosis and lung-cancer: results from a cohort study in the stone and quarry industry.* Int Arch Occup Environ Health, 2004. **77**(5): p. 313-8.
20. Yu, I.T. and L.A. Tse, *Exploring the joint effects of silicosis and smoking on lung cancer risks.* Int J Cancer, 2007. **120**(1): p. 133-9.
21. Chow, J.C., et al., *Health effects of fine particulate air pollution: lines that connect.* J Air Waste Manag Assoc, 2006. **56**(10): p. 1368-80.
22. Gong, H., et al., *Exposures of elderly volunteers with and without chronic obstructive pulmonary disease (COPD) to concentrated ambient fine particulate pollution.* Inhal Toxicol, 2004. **16**(11-12): p. 731-44.
23. Johnson, P.R. and J.J. Graham, *Fine particulate matter national ambient air quality standards: public health impact on populations in the northeastern United States.* Environ Health Perspect, 2005. **113**(9): p. 1140-7.
24. Joseph, P.M., *Can fine particulate matter explain the paradoxical ozone associations?* Environ Int, 2008.
25. Nawrot, T.S., et al., *Lung cancer mortality and fine particulate air pollution in Europe.* Int J Cancer, 2007. **120**(8): p. 1825-6; author reply 1827.
26. Oberdorster, G., et al., *Association of particulate air pollution and acute mortality: involvement of ultrafine particles?* Inhal Toxicol, 1995. **7**(1): p. 111-24.
27. Ostro, B., et al., *The Impact of Components of Fine Particulate Matter on Cardiovascular Mortality in Susceptible Subpopulations.* Occup Environ Med, 2008.
28. Pope, C.A., 3rd, *Epidemiology of fine particulate air pollution and human health: biologic mechanisms and who's at risk?* Environ Health Perspect, 2000. **108 Suppl 4**: p. 713-23.
29. Pope, C.A., 3rd, *Mortality effects of longer term exposures to fine particulate air pollution: review of recent epidemiological evidence.* Inhal Toxicol, 2007. **19 Suppl 1**: p. 33-8.
30. Pope, C.A., 3rd, et al., *Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution.* JAMA, 2002. **287**(9): p. 1132-41.
31. Riediker, M., *Cardiovascular effects of fine particulate matter components in highway patrol officers.* Inhal Toxicol, 2007. **19 Suppl 1**: p. 99-105.
32. Rivero, D.H., et al., *Acute cardiopulmonary alterations induced by fine particulate matter of Sao Paulo, Brazil.* Toxicol Sci, 2005. **85**(2): p. 898-905.
33. Rundell, K.W. and R. Caviston, *Ultrafine and fine particulate matter inhalation decreases exercise performance in healthy subjects.* J Strength Cond Res, 2008. **22**(1): p. 2-5.
34. Schlesinger, R.B., *The health impact of common inorganic components of fine particulate matter (PM2.5) in ambient air: a critical review.* Inhal Toxicol, 2007. **19**(10): p. 811-32.
35. Tainio, M., et al., *Health effects caused by primary fine particulate matter (PM2.5) emitted from buses in the Helsinki metropolitan area, Finland.* Risk Anal, 2005. **25**(1): p. 151-60.
36. Tiittanen, P., et al., *Fine particulate air pollution, resuspended road dust and respiratory health among symptomatic children.* Eur Respir J, 1999. **13**(2): p. 266-73.

37. Alfaro-Moreno, E., et al., *Particulate matter in the environment: pulmonary and cardiovascular effects.* Curr Opin Pulm Med, 2007. **13**(2): p. 98-106.
38. Bai, N., et al., *The pharmacology of particulate matter air pollution-induced cardiovascular dysfunction.* Pharmacol Ther, 2007. **113**(1): p. 16-29.
39. van Eeden, S.F., et al., *Systemic response to ambient particulate matter: relevance to chronic obstructive pulmonary disease.* Proc Am Thorac Soc, 2005. **2**(1): p. 61-7.
40. Willis, H.H., et al., *Protecting Emergency Responders*. Protecting Emergency Responders. Vol. 4. 2006: Rand Corporation.

Appendix A. Response to Public Comments

There were several comments submitted during the public comment period. Because of the volume of comments, EHAP combined and paraphrased comments of similar theme and content. Where a quoted comment was representative of those submitted in multiple documents, EHAP responded to only one. Many of the comments submitted were addressed to DHS and DEQ. Comments that were addressed to DEQ were not included in this report.

Comment 1: "…Lower Bridge Mine is 576 acres, not 550 acres."

Response: This has been corrected in the report.

Comment 2: "Amorphous diatomaceous earth was cooked and processed …at the site from 1921-1963. This time period spans 42 years (not 30 years)."

Response: This has been corrected in the report.

Comment 3: "In 2008,… DHS never obtained historical site documents from DEQ, EPA, and DOGAMI…."

Response: Before and while writing this report, EHAP consulted with staff at DEQ, EPA, and DOGAMI regarding the history and background of the site. These consultations included discussions about which of the many historical documents available were relevant to the scope of this report. The historical documents EHAP considered relevant to human health impacts to current nearby residents at the site are cited in this report (See References).

Comment 4: "DHS report makes no mention of inspection and removal of Solid Waste. This is unacceptable. This waste… represents a public health hazard."

Response: In order for contaminants associated with alleged buried/partially buried waste to affect the health of nearby residents, there has to be a way for these contaminants to migrate off of the site to a place where nearby residents could come into contact with them. Groundwater is the most likely route of migration in this case because of the vertically fractured DE. Groundwater samples from two aquifers under the site were analyzed for an extensive list of potential contaminants (see Tables 2 and 3 in Appendix C). Analysis showed that these samples did not contain harmful levels of any of the contaminants measured. This initial round of sampling indicated that if there are any remaining contaminants on the site, they are not present in groundwater, and not likely to be migrating offsite. Therefore, there is no apparent public health hazard to nearby residents who may be drinking water from the same aquifer.

However, EHAP recommends in this final version of the report that additional rounds of confirmatory groundwater samples be collected and analyzed to ensure that the groundwater is still clean. Also, since the property has been re-zoned for residential use

and planned residences would be drinking groundwater from directly under the mine, EHAP recommends that a future sampling plan include regular monitoring of groundwater prior to developing the land. EHAP will also advocate for exploration of the site to identify and remove any alleged buried waste as part of the recommendation that the site be re-evaluated for residential use.

Comment 5: Buried toxic lagoon lines and buried fuel lines not addressed in this report

Response: See response to 4

Comment 6: EHAP's recommendations to conduct additional sampling do not specify a sampling method or sampling timeline.

Response: ATSDR-funded Public Health Assessments and Health Consultations like this one do not typically specify sampling methods and time-lines. Health agencies depend on environmental agencies, in this case DEQ, or contractors to do the actual sampling. Also, as a health agency, EHAP has neither the expertise nor authority to mandate what sampling methods should be used or when sampling should be done. Rather, EHAP explains what kinds of environmental data are needed to make health risk determinations and relies on sampling experts at partner agencies to determine the best method to produce the needed data.

Comment 7: "Residents with pre-existing health conditions (asthma, heart problems, etc.) and children live near site."

Response: All Health Assessments and Health Consultations consider children and susceptible populations. The screening values used to determine health risks, and the recommendations in this report, are very protective of vulnerable populations.

Comment 8: "The community demands that DHS clearly state why a hillside scraping of DE may be submitted and considered as a clear indicator of respirable cristobalite and crystalline silica."

Response: It was not EHAP's intent to present these data as a "clear indicator" of respirable cristobalite. Language has been added to the report to more explicitly identify and explain the limitations of these data. EHAP used these limitations as justification for recommending additional soil and air sampling for crystalline silica. Because airborne dust starts out as soil, soil data, when sufficient in number and surface area coverage, can provide an idea of what could potentially end up in the air. For example, if we had extensive surface soil samples covering a large percentage of the mine surface area, and none of the samples showed significant levels of cristobalite, this would indicate that the mine cannot serve as a significant source of cristobalite in air.

Also, EHAP strives to maintain a spirit of transparency with the community at all sites. In contrast to a court of law where some evidence may be considered "irrelevant" or "inadmissible," a Health Consultation is an opportunity for EHAP to share all available

data with the community in a spirit of full disclosure. If there are limitations that result in data being inadequate to evaluate health risks, EHAP clearly states those limitations, as was done in this report.

Comment 9: "DEQ 2006 analytical air test sample is irrelevant and is not a test for respirable particulate matter."

Response: EHAP is aware of the limitations of these data and has added language to the report to identify them more explicitly. Also, see second paragraph in response to comment 8.

Comment 10: "DHS… overlooked dumped barrels at site."

Response: See response to comment 4.

Comment 11: "Soil and diatomaceous earth at this site is vertically fractured and provides migration pathways for toxins…The community demands that DHS state why irrigation was approved before this site with fractured DE that has never been inspected."

Response: While migration pathways may exist, the available groundwater data indicate that no migration has occurred even after decades of normal precipitation. However, EHAP has recommended additional rounds of groundwater monitoring to ensure that there is no trend towards contamination.

DHS has no oversight of water rights and water use decisions and defers questions regarding irrigation approval to the Water Resources Department.

Comment 12: "Area drinking wells tap same aquifer that is under this 97-year-old mine site."

Response: This is true. Recent groundwater monitoring data indicate that the aquifer is clean. Also, most current residences are up gradient of the mine, meaning that the general direction of groundwater flow would tend to carry potential contaminants from the mine away from current drinking water wells. With the re-zone to residential use, the groundwater under the mine will need more regular monitoring to ensure that it is safe for residents that are on top of or down gradient from it.

Comment 13: "DHS has not been able to verify dumped copper waste."

Response: See response to comment 4.

Comment 14: "Physical safety hazards…Owners do not maintain fences, barriers and no trespassing signs. Trespassing is frequent."

Response: EHAP has made recommendations to owners that, if followed, should eliminate the hazard.

Comment 15: "…The community demands that both departments cease giving tips to residents about protecting their own health and act quickly to do their jobs to protect public health."

Response: Providing information to communities about what they can do to protect themselves and their families is part of our mandate established by law. Providing this information to the community is part of our job. We may also identify potential health risks that are not site-specific. While DEQ's work might end at the boundaries of a site, ours doesn't necessarily. EHAP cannot in good conscience withhold information from the community that may be useful to protect their health.

Comment 16: Community members are not more concerned about airborne dust than other issues at the site.

Response: This comment was received by only one member of the community. During the initial community meeting on August 13, 2008, several community members communicated directly with EHAP staff affirming that dust was, indeed, the issue of most concern to them. Therefore, this comment has been noted, but was not used as a basis to alter wording in the document.

Comment 17: "…I do not believe there has been adequate investigation of this site to determine that… 1) contact with soil and groundwater potentially affected by former hazardous radiological waste storage on the site poses 'no apparent public health hazard under the current use conditions'…"

Response: EHAP has taken this comment under advisement.

Comment 18: "…I do not believe there has been adequate investigation of this site to determine that… 2) airborne dust from the site is an 'indeterminate public health hazard.'"

Response: The "indeterminate public health hazard" designation is used when EHAP determines that there aren't enough data to decide whether or not conditions at a site pose a hazard to public health. So, EHAP agrees with this comment in that there has not been adequate investigation to determine whether or not public health is negatively impacted by dust from the site. EHAP has made recommendations to collect additional data so that this question can be answered in subsequent assessments.

Comment 19: "I remain concerned and unclear about your investigation and reporting process and the expenditure of State resources and funds to perform your health consultation…"

Response: EHAP is a federally funded program, and no State resources were used in the production of this report. The Federal agency funding this work is the Agency for Toxic Substances and Disease Registry (ATSDR). Under a cooperative agreement with ATSDR,

EHAP performs the work of ATSDR on sites located in Oregon. Any citizen, citizen group, agency, or government official can request EHAP's involvement at a site. EHAP internally evaluates requests and moves forward with clearance from local management and ATSDR. Although Senator Westlund was the petitioner in the case of this report, EHAP would likely have accepted the petition regardless of who had made the request. EHAP follows guidelines set by ATSDR when investigating and reporting on a site.

Comment 20: "…the study should not only have addressed the current use conditions but covered the proposed land-use zone change which Deschutes County is considering and all parties know is the objective of this report."

Response: EHAP focused this report on current use conditions because 1) the outcome of the re-zone decision was unknown at the time we were petitioned and 2) because we wanted to provide available information to the public in a timely manner. The production of this report does not preclude EHAP from doing subsequent assessments at the site. Since the Deschutes County Planning Commission voted on December 29, 2008 to re-zone portions of the mine site for residential development, EHAP has revised the recommendations in this report. These revisions request collection of additional environmental sampling that will inform a future Public Health Assessment primarily focused on the health of future residents of the proposed housing development. These recommendations are useful in guiding and prioritizing future environmental sampling to ensure that new data will be useful in making sound public health decisions in the future.

Comment 21: "I submit your report does not assure the local citizens there are no public health issues and does nothing to address the potential health concerns for people who may live in the proposed development."

Response: EHAP found that exposure to soil and groundwater from the site poses "no apparent public health hazard" to nearby residents. We have supported this conclusion with environmental sampling data and scientific analysis. While some citizens may not be assured by these data, they are the only data that are available, and EHAP found them to be of adequate quality to make the conclusions that we did.

EHAP was unable to determine whether airborne dust from the site poses a health hazard to nearby residents. EHAP has made recommendations to collect more information to resolve this issue.

As discussed in the response to comment 20, currently there is insufficient information to make a health determination for future residents of the proposed housing development, and this can be done in a subsequent assessment when more data are available.

Comment 22: "Further, this State report is incomplete in not addressing or directing a study on the impact to the Deschutes River either currently or in the event of development."

Response: EHAP acknowledged this concern in the community concerns section on page 6. It would be very unusual for a public health agency to direct a study of the ecological health of a river. Such a study would be far outside the scope of EHAP's expertise. The Department of Environmental Quality and/or the Department of Fish and Wildlife are much better equipped to do an ecological assessment of the Deschutes River.

Appendix B. Soil sampling data

Legend for Table 1
ppm = Parts per million
COPC = Contaminant of potential concern
EMEG = Environmental Media Evaluation Guide (ATSDR)
RMEG = Reference dose Media environmental Guide (ATSDR)
SSL = soil screening level (EPA)
CREG = Cancer risk evaluation guide (ATSDR)
PRG = Preliminary remediation goal (EPA)
'<' = Indicates contaminant was not detected. Number indicates lower detection limit.
'---' = Indicates that no comparison value has been established for contaminant
CV = Comparison value

Table 1. Soil sampling from under hazardous waste storage lagoon (1984)

Chemical	Concentration (ppm)	Comparison Value (ppm)	Comparison Value Source	COPC?	Explanation
Chromium	67	200	RMEG	No	Concentration is below CV
Lead	160	400	SSL	No	Concentration is below CV
Total PCB	0.68	1	EMEG	No	Concentration is below CV
Chloromethane	<0.01	1.7	PRG	No	Concentration is below CV
Bromomethane	<0.01	70	RMEG	No	Concentration is below CV
Vinyl Chloride	<0.01	0.5	CREG	No	Concentration is below CV
Chloroethane	<0.01	220	PRG	No	Concentration is below CV
Methylene Chloride	<0.01	90	CREG	No	Concentration is below CV
Trichlorofluoromethane	<0.01	20000	RMEG	No	Concentration is below CV
1,1-Dichloroethylene	<0.01	500	EMEG	No	Concentration is below CV
1,1-Dichloroethane	<0.01	16000	PRG	No	Concentration is below CV
Trans-Dichloroethylene	<0.01	1000	RMEG	No	Concentration is below CV
Chloroform	<0.01	500	EMEG	No	Concentration is below CV

Chemical	Concentration (ppm)	Comparison Value (ppm)	Comparison Value Source	COPC?	Explanation
1,2-Dichloroethane	<0.01	8	CREG	No	Concentration is below CV
1,1,1-Trichlorethane	<0.01	100000	RMEG	No	Concentration is below CV
Carbon Tetrachloride	<0.01	5	CREG	No	Concentration is below CV
Bromodichloromethane	<0.01	10	CREG	No	Concentration is below CV
1,2-dichloropropane	<0.01	5000	EMEG	No	Concentration is below CV
cis-1,3-Dichloropropene	<0.01	7	CREG	No	Concentration is below CV
Trichloroethylene	<0.01	1.6	PRG	No	Concentration is below CV
Benzene	<0.01	10	CREG	No	Concentration is below CV
Dibromochloromethane	<0.01	8	CREG	No	Concentration is below CV
1,1,2-Trichloroethane	<0.01	10	CREG	No	Concentration is below CV
trans-1,3-Dichloropropene	<0.01	7	CREG	No	Concentration is below CV
2-Chloroethyl Vinyl Ether	<0.01	---	---	No	Not detected
Bromoform	<0.01	90	CREG	No	Concentration is below CV
1,1,2,2-Tetrachloroethane	<0.01	4	CREG	No	Concentration is below CV
1,1,2,2-Tetrachloroethylene	<0.01	500	RMEG	No	Concentration is below CV
Toluene	<0.01	1000	EMEG	No	Concentration is below CV
Chorobenzene	<0.01	1000	RMEG	No	Concentration is below CV
Ethyl Benzene	<0.01	5000	RMEG	No	Concentration is below CV
1,3-Dichlorobenzene	<0.01	1000	EMEG	No	Concentration is below CV
1,2-Dichlorobenzene/1,4-Dichlorobenzene	<0.01	4000	EMEG	No	Concentration is below CV

Appendix C. Groundwater sampling

Legend for Table 2

ppb = Parts per billion
COPC = Contaminant of potential concern
EMEG = Environmental Media Evaluation Guide (ATSDR)
RMEG = Reference Dose Media Evaluation Guide (ATSDR)
CREG = Cancer Risk Evaluation Guide (ATSDR)
PRG = Preliminary Remediation Goal (EPA)
LTHA = Lifetime Health Advisory for drinking water (EPA)
MCL = Maximum Contaminant Level for drinking water (EPA)
'<' = Indicates that contaminant was not detected. Number is the lower detection limit.
'---' = No comparison value exists for contaminant
CV = Comparison value

Table 2. Groundwater sampling from well at Lower Bridge Mine (2008)

Chemical	Concentration (ppb)	Comparison Value (ppb)	Comparison Value Source	COPC?	Explanation
Nitrate	630	20,000	RMEG	No	Concentration is below CV
Sulfate	3710	250000	MCL	No	Concentration is below CV
Cyanide	<20	200	RMEG	No	Concentration is below CV
Mercury	<1	2	MCL	No	Concentration is below CV
Iron	70	26000	PRG	No	Concentration is below CV
Silver	<10	50	RMEG	No	Concentration is below CV
Sodium	12600	---		No	Non-toxic
Zinc	<20	3000	EMEG	No	Concentration is below CV
Aluminum	<200	10,000	EMEG	No	Concentration is below CV
Calcium	9790	---		No	Non-toxic
Antimony	<3	4	EMEG	No	Concentration is below CV
Arsenic	<5	3	EMEG	No	Concentration within margin of safety with CV
Barium	<100	2000	EMEG	No	Concentration is below CV

Chemical	Concentration (ppb)	Comparison Value (ppb)	Comparison Value Source	COPC?	Explanation
Beryllium	<0.2	20	EMEG	No	Concentration is below CV
Cadmium	<1	2	EMEG	No	Concentration is below CV
Chromium	<20	100	MCL	No	Concentration is below CV
Copper	<10	100	RMEG	No	Concentration is below CV
Lead	<2	15	MCL	No	Concentration is below CV
Manganese	<10	500	RMEG	No	Concentration is below CV
Nickel	<20	200	RMEG	No	Concentration is below CV
Selenium	<3	50	EMEG	No	Concentration is below CV
Thallium	<1	2	MCL	No	Concentration is below CV
Uranium	<1	30	MCL	No	Concentration is below CV
Dibromochloropropane	<0.02	0.2	MCL	No	Concentration is below CV
Ethylene dibromide	<0.01	0.02	CREG	No	Concentration is below CV
Chlordane	<0.04	0.1	CREG	No	Concentration is below CV
Toxaphene	<0.1	10	EMEG	No	Concentration is below CV
Aroclor-1016 (PCB)	<0.02	0.7	RMEG	No	Concentration is below CV
Aroclor-1221 (PCB)	<0.02	0.2	EMEG	No	Concentration is below CV
Aroclor-1232 (PCB)	<0.02	0.2	EMEG	No	Concentration is below CV
Aroclor-1242 (PCB)	<0.02	0.2	EMEG	No	Concentration is below CV
Aroclor-1248 (PCB)	<0.02	0.2	EMEG	No	Concentration is below CV
Aroclor-1254 (PCB)	<0.02	0.2	EMEG	No	Concentration is below CV

Chemical	Concentration (ppb)	Comparison Value (ppb)	Comparison Value Source	COPC?	Explanation
Aroclor-1260 (PCB)	<0.02	0.2	EMEG	No	Concentration is below CV
2,4-D	<0.2	100	RMEG	No	Concentration is below CV
2,4,5-TP	<0.4	80	RMEG	No	Concentration is below CV
Dinoseb	<0.4	10	RMEG	No	Concentration is below CV
Pentachlorophenol	<0.08	0.3	CREG	No	Concentration is below CV
Picloram	<0.2	2600	PRG	No	Concentration is below CV
Dalapon	<2	1100	PRG	No	Concentration is below CV
Alachlor	<0.4	100	RMEG	No	Concentration is below CV
Atrazine	<0.2	30	EMEG	No	Concentration is below CV
Benzo(a)pyrene	<0.04	0.2	MCL	No	Concentration is below CV
gamma-BHC (Lindane)	<0.02	0.1	EMEG	No	Concentration is below CV
Bis-(2-ethylexyl) adipate	<1	30	CREG	No	Concentration is below CV
Bis(2-ethylhexyl) pthalate	<1	4.8	PRG	No	Concentration is below CV
Endrin	<0.02	3	EMEG	No	Concentration is below CV
Heptachlor	<0.04	1	EMEG	No	Concentration is below CV
Heptachlor epoxide	<0.02	0.1	RMEG	No	Concentration is below CV
Hexachlorobenzene	<0.1	0.5	EMEG	No	Concentration is below CV
Hexachlorocyclopentadiene	<0.2	60	RMEG	No	Concentration is below CV
Methoxychlor	<0.2	50	RMEG	No	Concentration is below CV
Simazine	<0.1	50	RMEG	No	Concentration is below CV

Chemical	Concentration (ppb)	Comparison Value (ppb)	Comparison Value Source	COPC?	Explanation
Carbofuran	<1	50	RMEG	No	Concentration is below CV
Oxamyl	<2	300	RMEG	No	Concentration is below CV
Glyphosate	<10	1000	RMEG	No	Concentration is below CV
Endothall	<10	200	RMEG	No	Concentration is below CV
Diquat Dibromide	<0.4	20	MCL	No	Concentration is below CV
Dicamba	<0.5	300	RMEG	No	Concentration is below CV
Aldrin	<0.1	0.3	EMEG	No	Concentration is below CV
Butachlor	<0.1	---		No	Not detected
Dieldrin	<0.1	0.5	EMEG	No	Concentration is below CV
Metolachlor	<0.2	2000	RMEG	No	Concentration is below CV
Metribuzin	<0.1	300	RMEG	No	Concentration is below CV
Propachlor	<0.1	100	RMEG	No	Concentration is below CV
Aldicarb	<2	10	RMEG	No	Concentration is below CV
Aldicarb sulfone	<1	10	RMEG	No	Concentration is below CV
Aldicarb sulfoxide	<3	4	MCL	No	Concentration is below CV
Carbaryl	<4	1000	RMEG	No	Concentration is below CV
3-Hydroxycarbofuran	<4	---		No	Not detected
Methomyl	<4	300	RMEG	No	Concentration is below CV
1,1,1-Trichloroethane	<0.5	20000	RMEG	No	Concentration is below CV
1,1,2-Trichloroethane	<0.5	0.6	CREG	No	Concentration is below CV

Chemical	Concentration (ppb)	Comparison Value (ppb)	Comparison Value Source	COPC?	Explanation
1,1-Dichloroethylene	<0.5	90	EMEG	No	Concentration is below CV
1,2,4-Trichlorobenzene	<0.5	100	RMEG	No	Concentration is below CV
1,2-Dichlorobenzene	<0.5	3000	EMEG	No	Concentration is below CV
1,2-Dichloroethane	<0.5	0.4	CREG	No	Concentration within margin of safety with CV
1,2-Dichloropropane	<0.5	900	EMEG	No	Concentration is below CV
1,4-Dichlorobenzene	<0.5	700	RMEG	No	Concentration is below CV
Benzene	<0.5	0.6	CREG	No	Concentration is below CV
Carbon Tetrachloride	<0.5	0.3	CREG	No	Concentration within margin of safety with CV
Chlorobenzene	<0.5	200	RMEG	No	Concentration is below CV
cis-1,2-Dichloroethylene	<0.5	3000	EMEG	No	Concentration is below CV
Ethyl Benzene	<0.5	1000	RMEG	No	Concentration is below CV
Methylene Chloride	<0.5	5	CREG	No	Concentration is below CV
Styrene	<0.5	2000	RMEG	No	Concentration is below CV
Tetrachloroethylene	<0.5	100	RMEG	No	Concentration is below CV
Toluene	<0.5	200	EMEG	No	Concentration is below CV
trans-1,2-Dichloroethylene	<0.5	200	RMEG	No	Concentration is below CV
Trichloroethylene	<0.5	1.7	PRG	No	Concentration is below CV
Vinyl Chloride	<0.5	30	EMEG	No	Concentration is below CV

Chemical	Concentration (ppb)	Comparison Value (ppb)	Comparison Value Source	COPC?	Explanation
Xylenes	<1.5	2000	EMEG	No	Concentration is below CV
1,1,1,2-Tetrachloroethane	<0.5	1	CREG	No	Concentration is below CV
1,1,2,2-Tetrachloroethane	<0.5	0.2	CREG	No	Concentration within margin of safety with CV
1,1-Dichloroethane	<0.5	2.4	PRG	No	Concentration is below CV
1,2,3-Trichloropropane	<0.5	60	RMEG	No	Concentration is below CV
1,3-Dichlorobenzene	<0.5	200	EMEG	No	Concentration is below CV
1,3-Dichloropropane	<0.5	730	PRG	No	Concentration is below CV
2,2-Dichloropropane	<0.5	900	EMEG-for 1,2-Dichloropropane	No	Concentration is below CV
2-Chlorotoluene	<0.5	200	RMEG	No	Concentration is below CV
4-Chlorotoluene	<0.5	100	LTHA	No	Concentration is below CV
Bromobenzene	<0.5	23	PRG	No	Concentration is below CV
Bromodichloromethane	<0.5	0.6	CREG	No	Concentration is below CV
Bromoform	<0.5	4	CREG	No	Concentration is below CV
Bromomethane	<0.5	10	RMEG	No	Concentration is below CV
Chloroethane	<0.5	21000	PRG	No	Concentration is below CV
Chloroform	<0.5	100	EMEG	No	Concentration is below CV
Chloromethane	<0.5	30	LTHA	No	Concentration is below CV
cis-1,3-Dichloropropene	<0.5	0.4	CREG	No	Concentration within margin of safety with CV

Chemical	Concentration (ppb)	Comparison Value (ppb)	Comparison Value Source	COPC?	Explanation
Dibromochloromethane	<0.5	0.4	CREG	No	Concentration within margin of safety with CV
Dibromomethane	<0.5	370	PRG	No	Concentration is below CV
trans-1,3-Dichloropropene	<0.5	0.4	CREG	No	Concentration within margin of safety with CV

Table 3. Groundwater sampling radionuclide results (2008)

Radionuclides	Radiation (pCi/L)	MCL pCi/L
Gross Alpha	2.4	15
Gross Beta	0.54	50
Radium 226	<0.07	---
Radium 228	1.3	---
Radium 226+228	1.2	5
Uranium activity	<0.7	20

MCL = Maximum contaminant level (EPA standard)
pCi/L = Pico Curies per liter
'<' = Indicates that no activity was detected. Number indicates detection limit.
'---' = No MCL exists for the two Radium isotopes alone

Appendix D. Glossary

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR serves the public by using the best science to take responsive public health actions and provides trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health.

This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-888-42-ATSDR (1-888-422-8737).

Absorption
For a person or animal, absorption is the process through which a substance enters the body through the eyes, skin, stomach, intestines, or lungs.

Acute
Occurring over a short time [compare with **chronic**].

Acute exposure
Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with **intermediate duration exposure** and **chronic exposure]**.

Adverse health effect
A change in body function or cell structure that might lead to disease or health problems.

AML
Acute Myeloid Leukemia: A grouping of specific cancers of the blood.

Background level
An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Biologic uptake
The transfer of substances from the environment to plants, animals, and humans.

Cancer
Any one of a group of diseases that occurs when cells in the body become abnormal and grow or multiply out of control.

Cancer risk
A theoretical risk for developing cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen
A substance that causes cancer.

Chronic
Occurring over a long time (more than 1 year) [compare with **acute**].

Chronic exposure
Contact with a substance that occurs over a long time (more than 1 year) [compare with **acute exposure** and **intermediate duration exposure**].

Completed exposure pathway [see **exposure pathway**].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)
CERCLA, also known as **Superfund**, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances.

Concentration
The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant
A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Dermal
Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact
Contact with (touching) the skin [see **route of exposure**].

Detection limit
The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Disease prevention
Measures used to prevent a disease or reduce its severity.

Disease registry
A system of ongoing registration of all cases of a particular disease or health condition in a defined population.

DOD
United States Department of Defense.

Dose (for chemicals that are not radioactive)
The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An Aexposure dose@ is how much of a substance is encountered in the environment. An Aabsorbed dose@ is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose-response relationship
The relationship between the amount of exposure [**dose**] to a substance and the resulting changes in body function or health (response).

Environmental media
Soil, water, air, **biota** (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism
Environmental media include water, air, soil, and **biota** (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The **environmental media and transport mechanism** is the second part of an **exposure pathway**.

EPA
United States Environmental Protection Agency.

Epidemiologic surveillance
The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.

Epidemiology
The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

Exposure
Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [**acute exposure**], of intermediate duration, or long-term [**chronic exposure**].

Exposure assessment
The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure-dose reconstruction
A method of estimating the amount of people's past exposure to hazardous substances. Computer and approximation methods are used when past information is limited, not available, or missing.

Exposure investigation
The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

Exposure pathway
The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a **source of contamination** (such as an abandoned business); an **environmental media and transport mechanism** (such as movement through groundwater); a **point of exposure** (such as a private well); a **route of exposure** (eating, drinking, breathing, or touching); and a **receptor population** (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a **completed exposure pathway**.

Exposure registry
A systematic collection of information on persons exposed to a specific substance within a specified population.

Groundwater
Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with **surface water**].

Hazard
A source of potential harm from past, current, or future exposures.

Hazardous waste
Potentially harmful substances that have been released or discarded into the environment.

Health consultation
A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with **public health assessment**].

Health education
Programs designed with a community to help it know about health risks and how to reduce these risks.

Health investigation
The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to estimate the possible association between the occurrence and exposure to hazardous substances.

Health promotion
The process of enabling people to increase control over, and to improve, their health.

Indeterminate public health hazard
The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Incidence
The number of new cases of disease in a defined population over a specific time period [contrast with **prevalence**].

Ingestion
The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see **route of exposure**].

Inhalation
The act of breathing. A hazardous substance can enter the body this way [see **route of exposure**].

Intermediate duration exposure
Contact with a substance that occurs over a time period between 15 and 364 days in length [compare with **acute exposure** and **chronic exposure**].

Lowest-observed-adverse-effect level (LOAEL)
The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

mg/kg
Milligram per kilogram.

mg/cm^2
Milligram per square centimeter (of a surface).

mg/m^3
Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

$\mu g/m^3$
Micrograms per cubic meter: a measure of a concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Migration
Moving from one location to another.

MRL
Minimum Risk Level; An estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse no-cancer health effects over a specified duration of exposure.

No apparent public health hazard
A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No-observed-adverse-effect level (NOAEL)
The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

No public health hazard
A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

Oxidation
The combination of a substance with oxygen or a reaction in which the atoms in an element lose electrons and the valence of the element is correspondingly increased.

Plume
A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

Point of exposure
The place where someone can come into contact with a substance present in the environment [see **exposure pathway**].

Population
A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

ppb
Parts per billion.

ppm
Parts per million.

Prevalence
The number of existing disease cases in a defined population during a specific period [contrast with **incidence**].

Prevalence survey
The measure of the current level of disease(s) or symptoms and exposures through a questionnaire that collects self-reported information from a defined population.

Prevention
Actions that reduce exposure or other risks, keep people from getting sick, or keep disease from getting worse.

Public comment period
An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public availability session
An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public health action
A list of steps to protect public health.

Public health advisory
A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

Public health assessment (PHA)
An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with **health consultation**].

Public health hazard
A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or **radionuclides** that could result in harmful health effects.

Public health hazard categories
Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are **no public health hazard**, **no apparent public health hazard**, **indeterminate public health hazard**, **public health hazard**, and **urgent public health hazard**.

Public health statement
The first chapter of an ATSDR **toxicological profile**. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.

Public meeting
A public forum with community members for communication about a site.

Reference Concentration (RfC)
The concentration of a chemical in air that is very unlikely to have adverse effects if inhaled continuously over a lifetime.

Reference dose (RfD)
An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Registry
A systematic collection of information on persons exposed to a specific substance or having specific diseases [see **exposure registry** and **disease registry**].

RFA
RCRA Facility Assessment. An assessment required by RCRA to identify potential and actual releases of hazardous chemicals.

RfC
See **reference concentration.**

RfD
See **reference dose**.

Risk
The probability that something will cause injury or harm.

Risk reduction
Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.

Risk communication
The exchange of information to increase understanding of health risks.

Route of exposure
The way people come into contact with a hazardous substance. Three routes of exposure are breathing [**inhalation**], eating or drinking [**ingestion**], or contact with the skin [**dermal contact**].

Safety factor [see **uncertainty factor]**

Sample
A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see **population**]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Source of contamination
The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an **exposure pathway**.

Special populations
People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Substance
A chemical.

Superfund Amendments and Reauthorization Act (SARA)
In 1986, SARA amended CERCLA and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.

Surface water
Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with **groundwater**].

Toxic agent
Chemical or physical (for example, radiation, heat, cold, microwaves) agents that, under certain circumstances of exposure, can cause harmful effects to living organisms.

Toxicology
The study of the harmful effects of substances on humans or animals.

Tumor
An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

Uncertainty factor
Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a **safety factor**].

Urgent public health hazard
A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

Volatile organic compounds (VOCs)
Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

Other Glossaries and Dictionaries
Environmental Protection Agency
http://www.epa.gov/OCEPAterms/

National Center for Environmental Health (CDC)
http://www.cdc.gov/nceh/dls/report/glossary.htm

National Library of Medicine (NIH)
http://www.nlm.nih.gov/medlineplus/mplusdictionary.html