Model Remedies for Contaminated Mine Sites in Washington

Sampling and Cleaning Up Soil, Tailings, and Waste Rock Piles Contaminated with Mine Waste

Toxics Cleanup Program

Washington State Department of Ecology
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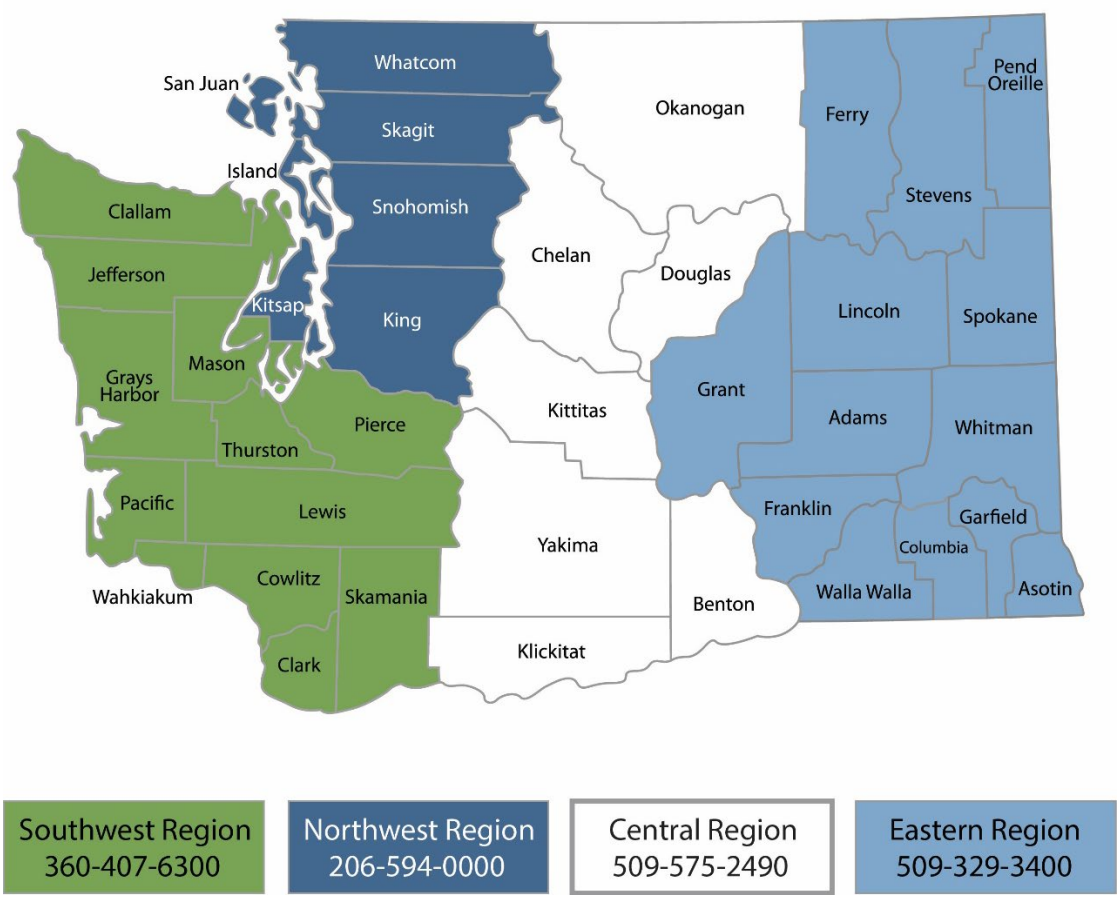
[1] www.ecology.wa.gov/contact

Department of Ecology's Regional Offices

Map of Counties Served



Region	Counties served	Mailing Address	Phone
Southwest	Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Mason, Lewis, Pacific, Pierce, Skamania, Thurston, Wahkiakum	P.O. Box 47775 Olympia, WA 98504	360-407-6300
Northwest	Island, King, Kitsap, San Juan, Skagit, Snohomish, Whatcom	P.O. Box 330316 Shoreline, WA 98133	206-594-0000
Central	Benton, Chelan, Douglas, Kittitas, Klickitat, Okanogan, Yakima	1250 West Alder Street Union Gap, WA 98903	509-575-2490
Eastern	Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman	4601 North Monroe Spokane, WA 99205	509-329-3400
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DEPARTMENT OF
ECOLOGY
State of Washington

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Executive Summary

To help streamline and accelerate the pace of cleanups, the Washington State Department of Ecology (Ecology) has developed standardized cleanup methods called "model remedies." Model remedies are most appropriate for routine cleanup projects at lower-risk sites.

If a site meets the criteria for a particular model remedy, you can use it to meet Washington state cleanup requirements under the Model Toxics Control Act (MTCA).[2] Model remedies may be used as part of an independent cleanup, Ecology-supervised cleanup, or Ecology-conducted cleanup.

Model remedies do not require a Feasibility Study, including a Disproportionate Cost Analysis. Ecology will not charge its usual fees to review independent cleanups under the Voluntary Cleanup Program if the cleanup uses model remedies.

Before using a model remedy, the site must be adequately characterized and consistent with Washington Administrative Code (WAC) 173-340-350.[3]

Ecology has established three model remedies for the cleanup of mine waste sites with metals-contaminated soils, tailings, and rock piles. These sites have common features and lower risk to human health and the environment under WAC 173-340-390.[4]

The three model remedies described in this document include:

- Excavation and off-site disposal;
- Cap in place; and
- Consolidation and capping.

Conditions

To use any of the three model remedies, the site must meet the following conditions:

- The site includes one or more mine waste piles consisting of contaminated soil, waste rock (rock containing target minerals in concentrations too low for economic recovery), and/or tailings (mined material remaining after processing removed the valuable minerals) from an abandoned mine;
- Each individual mine waste pile contains 2,000 cubic yards or less of material;
- Metals are the only suspected contaminants from the mine waste piles; and

[2] https://apps.leg.wa.gov/wac/default.aspx?cite=173-340
[3] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-350
[4] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-390

- The mine waste piles are located above the water table and have not contaminated groundwater, surface water, or sediment; or have the potential to do so in the future.

To use either the capping in place or the consolidation and capping model remedies, any mine waste piles must not include any contaminated material that classifies as dangerous waste under Chapter 173-303 WAC,[5] Dangerous Waste Regulations;

The best model remedy to use will depend on the specific conditions and proposed land use for each property. A combination of these options is acceptable if all contaminated areas are addressed.

No Further Action Determinations from Ecology

Ecology encourages independent cleanups of contaminated mine waste sites using model remedies to enroll in our Voluntary Cleanup Program (VCP) and request a no further action (NFA) determination. Local governments, lenders, or future buyers may request Ecology's written opinion that the model remedy implemented meets Ecology's cleanup standards. Ecology waives all fees for reviews, provided the model remedy used meets the criteria and follows the guidance outlined in this document.

More information is available on Ecology's VCP web pages.[6]

[5] https://app.leg.wa.gov/WAC/default.aspx?cite=173-303
[6] https://ecology.wa.gov/Spills-Cleanup/Contamination-cleanup/Voluntary-Cleanup-Program

Chapter 1: Introduction

Washington has a legacy of mining activity, leaving inactive, abandoned mines across the state. Many of these are ongoing sources of contamination that include high concentrations of metals in soil. The term "metals" is used in this document to describe both metals and metalloids.

Cleaning up contaminated mine sites presents unique challenges and opportunities. While there are some common characteristics (remote locations, heavy metals contamination, surface water pollution, etc.), the scope and scale of individual cleanups can vary dramatically. This guidance addresses mine sites:

- Contaminated by soil, waste rock (rock containing target minerals in concentrations too low for economic recovery), and/or tailings (mined material remaining after processing removed the valuable minerals), herein referred to as mine waste piles.
- Consisting of individual mine waste piles; each containing 2,000 cubic yards or less of material.
- Contaminated only by metals.
- With mine waste piles located above the water table and not contaminated with groundwater, surface water, and/or sediment.

Figure 1. Mine waste pile, Kaaba Texas Mine, Okanogan County

This guidance focuses on mine waste piles at mining sites, but it does not address chemical releases not associated with mine waste (for example, wastes from other commercial or industrial activities or illegally dumped hazardous waste). At many sites, physical hazards, such as open shafts, adits, unstable buildings, and unstable slopes, present a safety hazard. These safety hazards are not considered in this document.

The goals of this guidance document include:

- Encouraging the independent cleanup of contaminated mine sites;
- Providing consistency and clarity for property owners; and
- Providing simple sampling and cleanup guidance for mine waste piles.

Overview of mining operations

Since at least the early 1800s, miners have explored, mined, and processed valuable minerals in Washington. Traditional metals mining usually involves digging tunnels and pits to reach deposits of mineral-rich ore.

Ore is removed from the ground and processed to extract the desired minerals. When the ore is exhausted, miners move on, leaving behind finely ground tailings and waste rock piles above ground and in underground tunnels. Many of the environmental concerns about mine waste piles depend on the type of mining and ore-processing techniques used. The metal-rich material making up the mine waste piles, once underground, is now concentrated into piles that are exposed on the surface.

Health effects of mine wastes

Abandoned mines can cause environmental degradation and hazardous conditions that pose risks to human health and the environment. Mine wastes potentially contain metals in toxic concentrations.

Typical contaminants found in mine wastes include the following pollutants:

- Antimony
- Arsenic
- Beryllium
- Cadmium
- Chromium
- Copper
- Lead
- Mercury
- Nickel
- Selenium
- Silver
- Thallium
- Zinc

Exposure to these metals can increase the risk of certain health problems for humans and wildlife. Scientists have linked long-term exposure to these metals to a variety of health problems, including cancer of the bladder, lung, skin, kidney, liver, and prostate; heart disease; diabetes; and behavioral problems.

Whether someone is impacted depends on the amount of metal contaminants taken into their body over time (EPA 2021). People exposed to these contaminants on a regular basis may be affected.

Who is at highest risk?

Contaminated mine sites pose a risk to people's health, particularly to young children and pregnant women. Because many sites are in remote locations, people are most likely to be exposed to contamination while recreating in natural areas. Although these contaminants are not easily absorbed through the skin, exposure to mine waste will likely result in ingestion of contaminated soil and inhalation of dust.

Children are also more likely to be exposed because they typically play on the ground and tend to put their hands in their mouths. The small amount of metal contaminants they might swallow is more harmful because their bodies are still growing and developing.

Development in historic mining areas creates additional exposure scenarios that could include residential contact, groundwater, or surface water contamination.

Construction workers, gardeners, and landscapers can also be exposed to contaminated soil at a work site by accidentally ingesting soil or inhaling dust. Employers are responsible for meeting health and safety requirements at work sites to limit worker exposure.

Employers should contact the Washington Department of Labor and Industries (L&I)[7] for more information on exposure limits and other safety requirements at work sites.

As a result of the tendency of contaminated mine sites to be in remote locations, wildlife, and terrestrial and aquatic organisms are considered at high risk from mine waste exposure.

[7] https://www.lni.wa.gov/

Chapter 2: Meeting MTCA Requirements

This document provides information to establish model remedies for cleanup at sites with metals contamination due to historic mining activities, including the eligibility criteria each project must meet, and a discussion of how the model remedies comply with Model Toxics Control Act (MTCA) requirements.

Before considering a model remedy, the following steps in the remedial process must have already been completed:

- A release to the environment has been confirmed;
- Ecology has been notified of the release;
- Emergency/interim actions have been implemented (if appropriate); and
- An adequate site characterization has been completed under WAC 173-340-350.

Model remedies

The purpose of model remedies is to streamline and accelerate the selection of cleanup actions that protect human health and the environment, with a preference for permanent solutions to the maximum extent practicable. You do not need to conduct a feasibility study, including a disproportionate cost analysis, to select a model remedy.

Model remedies are most appropriate for routine cleanup projects at lower-risk sites and may be used as part of an independent, Ecology-supervised, or Ecology-conducted cleanup. Ecology encourages persons who independently clean up contaminated mine waste sites using model remedies to enroll in our Voluntary Cleanup Program (VCP) to request a no further action (NFA) determination.

Table 1 contains the three model remedy options found in this document. The best option will depend on the specific conditions and proposed land use for your site. A combination of these options is acceptable if all contaminated areas at the site are addressed.

Table 1: Model remedy options

Model Remedy		Action	Considerations
1	Excavate and Offsite Disposal (Chapter 3)	Excavate contaminated soils and properly dispose of them.	Compliance sampling of excavated areas is required. Careful sampling in advance provides an understanding of how much soil must be removed.
2	Cap in Place (Chapter 4)	Cover contaminated soils with a geotextile fabric and soil cap or hard cap.	Need to demonstrate there is no dangerous waste and no future potential impact on groundwater, surface water, or sediment. Requires long-term monitoring and maintenance. Institutional controls are required.
3	Consolidate and Cap (Chapter 5)	Excavate and consolidate contaminated soils into an area of the property and place under a cap.	Need to demonstrate there is no dangerous waste and no future potential impact on groundwater, surface water, or sediment. Compliance sampling of excavated areas is required. Requires long-term monitoring and maintenance. Institutional controls are required.

The premise of the model remedies presented in this document is the remedial action would be implemented as a final cleanup action, in accordance with WAC 173-340-390.[8] However, some or all the components of a model remedy could be implemented as an interim action under WAC 173-340-430.[9]

Eligibility criteria for all model remedies

The following criteria apply to all model remedies identified in this document.

Geographic area

The model remedies apply to contaminated mine sites in Washington.

[8] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-390
[9] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-430

Type of release

The model remedies apply to the release of metals from mine waste piles generated during historic mining operations consisting of the following:

- Contaminated soil;
- Waste rock (rock containing target minerals in concentrations too low for economic recovery); or
- Tailings (mined material remaining after processing removed the valuable minerals).

Amount of contaminated material

The model remedies apply to individual mine-waste piles containing 2,000 cubic yards or less of material.

Affected media

These model remedies apply to sites with contaminated soil, tailings, and waste rock above the water table.

These model remedies do not apply to sites where the mine waste piles have also contaminated groundwater, surface water, or sediment; and have no future potential to impact, groundwater, surface water, or sediment.

The model remedies also do not apply to sites with contaminated soil, waste rock, or tailings below the water table.

Release confirmation and Ecology notification

These model remedies can be used if the release has been confirmed, and Ecology has been notified of the release.

Emergency/interim actions

These model remedies can be used if emergency or interim actions are not required due to the lower-risk nature of the site, or if the necessary emergency/interim action required by WAC 173-340-430[10] have already been implemented.

Adequate site characterization

An adequate site characterization has been completed under WAC 173-340-350.

[10] https://app.leg.wa.gov/wac/default.aspx?cite=173-340-430

Additional eligibility criteria for capping model remedies

No dangerous waste

To use either the capping in place or the consolidation and capping model remedies, any mine waste piles must not include any contaminated material that classifies as dangerous waste under Chapter 173-303 WAC, Dangerous Waste Regulations.[11] See Chapter 6 for guidance on how to make such a demonstration during a remedial investigation of the site.

How model remedies meet MTCA cleanup standards

The two primary components of cleanup standards are cleanup levels and points of compliance. Cleanup levels determine the concentration at which a substance does not threaten human health or the environment. A cleanup action addresses all media exceeding a cleanup level to prevent exposure to the contaminated material. Points of compliance represent the locations on the site where cleanup levels must be met.

The model remedies in this document eliminate direct contact with the contaminant source and contaminated soil by either:

1. Excavating and removing contaminated material exceeding soil cleanup levels at the point of compliance; or
2. Capping in place or consolidating and capping contaminated material exceeding soil cleanup levels at the point of compliance to minimize the potential for direct contact and migration of hazardous substances. Capping involves the use of engineered controls to contain contaminated material and institutional controls to limit or prohibit activities that may interfere with the integrity of the cap or result in exposure to the contaminated material remaining at the site. Institutional controls must comply with the requirements in WAC 173-340-440[12] and are typically implemented through an environmental covenant.

Soil cleanup levels

When defining cleanup levels at sites contaminated with several hazardous substances, Ecology can eliminate contaminants contributing a small percentage of the overall threat to human health and the environment. WAC 173-340-703[13] provides the criteria by which a substance can be eliminated from further consideration.

Ecology reviewed chemical analytical data from contaminated mine sites across Washington to identify indicator hazardous substances for mine waste piles. Past studies found other elements, but mostly in trace amounts. They include antimony, beryllium, chromium, copper, mercury, nickel, selenium, silver, and thallium.

[11] https://apps.leg.wa.gov/wac/default.aspx?cite=173-303
[12] https://apps.leg.wa.gov/wac/default.aspx?cite=173-340-440
[13] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-703

It is likely that, if any other trace metals exceed their respective cleanup levels, then the most abundant metals, i.e., arsenic, cadmium, lead, or zinc will exceed their respective cleanup levels. The model remedy assumes that cleanups driven by arsenic, cadmium, lead, and zinc will address all other hazardous metals from mine waste piles.

Cleanup levels for indicator hazardous substances are available in Table 2. Cleanup levels for the indicator hazardous substances meet MTCA requirements for human health and upland ecological receptors. See Appendix A for a discussion about developing contaminated mine site cleanup levels.

Table 2: State cleanup levels for indicator hazardous substances at contaminated mine sites

Contaminant	Cleanup Level in milligrams per kilograms (mg/kg)
Arsenic	20
Cadmium	4
Lead	250
Zinc	86

Terrestrial Ecological Evaluation

WAC 173-340-7490[14] through 173-340-7493[15] establish the process and procedures for completing a Terrestrial Ecological Evaluation (TEE). WAC 173-340-7491[16] establishes criteria for deciding whether a particular site can be excluded from the requirements for preparing a simplified or site-specific TEE. Most contaminated mine sites will not qualify for exclusion and require a site-specific TEE. Cleanup standards developed for the use of these model remedies meet the requirements of a site-specific TEE described in WAC 173-340-7493.[17]

How model remedies meet MTCA cleanup action requirements

The following discussion documents how the model remedies meet the minimum requirements found in WAC 173-340-360.[18]

Ecology recommends using an environmental consultant with experience remediating contaminated mine sites, and familiar with the information in Chapter 6, “Soil Sampling” of this document.

[14] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-7490
[15] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-7493
[16] https://apps.leg.wa.gov/WAC/default.aspx?cite=173-340-7491
[17] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-7493
[18] https://apps.leg.wa.gov/wac/default.aspx?cite=173-340-360

1. *Protect human health and the environment, including likely vulnerable populations and overburdened communities.*

   Removal and capping remedies will protect potential human and ecological receptors by eliminating exposure pathways.

2. *Comply with cleanup standards.*

   The model remedies identified in this document require compliance with the soil standards in MTCA. Adequate characterization must be completed to document that the site has not impacted, and has no future potential to impact, groundwater, surface water, or sediment.

   a. Model Remedy 1 is excavation and removal of the contamination (see Chapter 3). This remedy removes contaminated soil so cleanup standards are met at the point of compliance.

   b. Model Remedy 2 is capping in place (see Chapter 4). In this remedy, soils with hazardous substances above cleanup levels are contained. The cleanup action may be determined to comply with cleanup standards, provided the compliance monitoring program ensures the long-term integrity of the containment system, and other requirements for containment are met. This remedy requires an environmental covenant (see Chapter 10) and long-term operation and maintenance.

   c. Model Remedy 3 is consolidation and capping (see Chapter 5). In this remedy, contaminated soils are excavated, consolidated in one place, and covered with a soil or hard cap. The cleanup action may be determined to comply with cleanup standards, provided the compliance monitoring program is designed to ensure the long-term integrity of the containment system, and other requirements for containment are met. This remedy requires an environmental covenant (see Chapter 10) and long-term operation and maintenance.

3. *Comply with state and federal laws*.

   The model remedies must be implemented in accordance with applicable local, state, and federal laws and comply with any necessary permits. For example, the transport and disposal of contaminated materials must comply with the state's solid and dangerous waste regulations. Before implementing a model remedy at a site, identify which laws may apply. See Chapter 2 for guidance on the type of laws that may apply and the type of permits that may be necessary.

4. *Prevent or minimize current and future releases and migration of hazardous substances in the environment*.

   The model remedies meet this requirement by either eliminating (Model Remedy 1) or containing (Model Remedies 2 and 3) the source of contamination to prevent any migration of hazardous substances.

The containment model remedies require a demonstration that the remaining contamination under the cap will not cause an exceedance of a groundwater, surface water, or sediment cleanup level in the future.

5. *Provide resilience to climate change impacts*.

   The model remedies meet this requirement by either eliminating (Model Remedy 1) or appropriately containing (Model Remedies 2 and 3) the source of contamination to prevent any migration of hazardous substances.

6. *Provisions for compliance monitoring*.

   WAC 173-340-410[19] describes three types of compliance monitoring: 1) protection, 2) performance, and 3) confirmation monitoring. Protection monitoring includes preparing a health and safety plan, which should be completed before implementing any model remedy. Performance monitoring confirms that the applicable cleanup standards have been met. Confirmational monitoring confirms the long-term effectiveness of the cleanup action once cleanup standards have been attained.

7. *Not rely primarily on institutional controls*.

   The model remedies do not rely primarily on institutional controls. Model Remedy 1 does not require institutional controls. While Model Remedies 2 and 3 require the use of institutional controls as a component, they rely primarily on containment.

8. *Not rely primarily on dilution and dispersion*.

   The model remedies do not rely on dilution or dispersion.

9. *Provide for a reasonable restoration time frame*.

   The model remedies are based on soil being the only media impacted by the release. Implementation of a capping or soil removal remedy will provide similar restoration time frames that are considered reasonable considering the factors provided under WAC 173-340-360(4).[20]

10. *Use a permanent solution to the maximum extent practicable*.

    The model remedies use permanent solutions to the maximum extent practicable for the specified site conditions. A disproportionate cost analysis is used to determine whether a remedy uses permanent solutions to the maximum extent practicable. The analysis compares the costs and benefits of the cleanup action alternatives.

[19] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-410
[20] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-360

To establish model remedies that use "permanent solutions to the maximum extent practicable", Ecology conducted a review of information in its Integrated Site Information System (ISIS) database. The ISIS database includes over 200 contaminated mine sites. This review identified that at least 20 contaminated hard-rock mine sites have been cleaned up, or cleanup activities are ongoing. Selected remedies used at these sites include excavation and off-site disposal (5 sites), cap in place (2 sites), and consolidate and cap (13 sites).

This review included sites that were cleaned up under both MTCA and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) authorities.

Ecology considers the sites included in this evaluation to be appropriate for contaminated mine sites because they meet the criteria identified for the use of the model remedies, with the exception of contaminated mine-waste volumes. Several of the sites reviewed included mine-waste volumes greater than 2,000 cubic yards.

All of the model remedies require source removal to the maximum extent practicable. If site conditions preclude complete removal of all contaminated soil an environmental covenant must be used in conjunction with the remedy to reduce the overall risk and help ensure that the site remains protective over the long term.

Alternatives considered but not selected

Ecology considered the following alternative remedies but did not select them as a model remedy for mine waste piles:

- Soil mixing;
- Soil amendments; and
- In-situ treatment technologies.

The following provides a brief description of each alternative remedy. While these alternatives were not selected as model remedies, they can still be considered on a site-specific basis. To select one of these alternative remedies, a feasibility study must be conducted in accordance with WAC 173-340-351[21] to determine if it meets the cleanup action requirements in WAC 173-340-360.[22]

Soil mixing

Mixing contaminated soils with clean imported soils or clean soils underneath the contaminated surface soils was considered a cleanup alternative. However, mixing effectiveness depends on several measures including how deep you mix, how deep contamination goes, and the efficiency of mixing equipment.

[21] https://app.leg.wa.gov/wac/default.aspx?cite=173-340-351
[22] https://app.leg.wa.gov/wac/default.aspx?cite=173-340-360

It may also need a large volume of clean soils to achieve cleanup levels that can dramatically increase the total volume of remediated mine waste piles. Based on the typical dimensions of mine-waste piles, which can often extend several feet in depth or height, Ecology determined soil mixing is not an effective technique in remediating mine-waste piles.

Soil amendments

Soil amendments, such as mulch, biosolids, or biochar, are techniques used to potentially bind metals contamination in soil and promote vegetation growth. For these reasons, the use of soil amendments can be effective as part of a capping remedy and can be used as part of a soil cap.

However, as a standalone treatment alternative, soil amendment techniques may have long restoration time frames, which may be unreasonable for mine-waste pile sites based on factors in WAC 173-340-360(4).[23] Also, such alternatives are less likely to be effective over the long term without Ecology supervision given how difficult they are to implement and how long they need to be implemented. They also require rigorous characterization and ongoing operation, maintenance, and monitoring activities. Consequently, Ecology determined these technologies are not appropriate as model remedies at this time.

In-situ treatment technologies

In-situ treatment technologies (such as electrokinetics, phytoremediation, soil flushing, and solidification) were considered as a cleanup action alternative. However, experience with these technologies to treat mine waste is limited to bench and pilot-scale studies and so their long-term effectiveness is uncertain. Also, such treatment technologies are difficult to implement, and usually require rigorous characterization and ongoing operation, maintenance, and monitoring activities under Ecology supervision. Consequently, Ecology determined these technologies are not appropriate as model remedies at this time.

[23] https://app.leg.wa.gov/wac/default.aspx?cite=173-340-360

Chapter 3: Planning for Cleanup

Table 1 summarizes model remedies for soil, tailings, or waste rock. Ecology has also established conditions for using each of the model remedies. The conditions are specified in Chapter 1. Any combination of these remedies is acceptable. Sufficient information must be collected during the remedial investigation to demonstrate that a site meets the conditions established by Ecology (WAC 173-340-390(4)(a)[24] and 173-340-350(5)(g)(vii) and (6)(j)(ii)).[25]

Model remedy selection

This section will help you determine the best model remedy to use for the affected property. The best option will depend on the specific conditions and proposed land use for the site. Below are general considerations for each model remedy. Each remedy is discussed in more detail in Chapter 3, Chapter 4, through Chapter 5. The property location, accessibility, and features can make certain options less expensive.

Model Remedy 1 - Excavation and offsite disposal

Excavation and offsite disposal is often the most expensive option. It requires excavation of all contaminated soil from your property, and it requires disposal of this soil at a certified landfill. The benefit of excavation and disposal is that no further remedial action is necessary at the site where the release occurred.

Model Remedy 2 - Capping in place

Capping is often the least costly remedy, but it requires the greatest amount of long-term maintenance and monitoring. Capping requires a significant source of clean soil; however, other remedies typically require the import of topsoil, as well. In addition to long-term operation, maintenance, and monitoring (OM&M), institutional controls with an environmental covenant are required as part of this remedy.

Model Remedy 3 - Consolidation and capping

Consolidation and capping can be an excellent option for sites with multiple mine-waste piles. If your property has room to designate an area specifically for consolidation and capping, contaminated soil from across the property can be placed in that area. The remainder of the property would be clean and would not require any additional cleanup action. The consolidation area is the only area requiring capping. This is a particularly effective remedy when waste-rock piles are relatively small and numerous, and large amounts of excavation are not required. In addition to OM&M, institutional controls with environmental covenant are required as part of this remedy for the portion of the property where you have capped contaminated soil.

[24] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-390
[25] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-350

Model remedy options can be combined, as appropriate. For example, you can use model remedy 1 to clean up a highly contaminated area or volume of mine waste and use model remedy 2 to cap the rest of the area or volume.

Selection of alternative remedies

Alternative remedies may be considered on a site-specific basis. To select an alternative remedy, a feasibility study must be conducted in accordance with WAC 173-340-351[26] to determine if it meets the cleanup action requirements in WAC 173-340-360.[27] Ecology encourages persons considering alternate remedies to enroll in our VCP to request technical assistance.

Consideration of natural areas

In some cases, preserving a natural area is more valuable than destroying habitat just to clean up the soil. Contact Ecology to discuss approval to leave contamination in place to preserve natural areas.

Additional sampling requirements

Model Remedy 1 (excavation and off-site disposal) and Model Remedy 3 (consolidation and capping) require compliance sampling (Chapter 7) to show the cleanup is complete in the excavated areas. Soil disposal might also require stockpile sampling (Chapter 8).

When importing soils, request sample results from the soil provider, complete soil sampling yourself prior to accepting the imported soil, or obtain approval from Ecology that the source of the fill should be sufficient to be considered clean fill (Chapter 9).

Follow other government requirements for your project

Model remedies are not exempt from local, state, or federal laws. Therefore, implementation must comply with all applicable procedural and substantive requirements, including any necessary permits. This section provides general guidelines but is by no means comprehensive. Additional information can be found at the Governor's Office for Regulatory Innovation and Assistance.[28]

The information below is provided for example purposes only. Some provisions might not apply to your cleanup action, while additional requirements to those below might apply. Therefore, anyone considering one of the model remedies in this document should consult Ecology and other government entities (city or county authorities) to ensure compliance with all required permits, notifications, and other requirements.

[26] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-351
[27] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-360
[28] https://apps.oria.wa.gov/opas/

State Environmental Policy Act (SEPA)

SEPA (RCW 43.21C, Chapter 197-11 WAC,[29] and the SEPA procedures found in Chapter 173-802 WAC[30]) are intended to ensure that state and local government officials consider environmental values when making decisions. The SEPA process is triggered whenever a local or state permit is required to conduct the cleanup. It begins by completing a SEPA Environmental Checklist and submitting it to the "lead agency" (usually the county or city where the property is located).

The lead agency will use the checklist to decide whether the cleanup action is likely to cause a significant adverse impact to the environment. The SEPA Environmental Checklist form can be found in WAC 197-11-960.[31] Information on how to use the checklist can be found in WAC 197-11-315[32] and 330.[33]

State waste and management laws

Local counties may require a solid waste (handling) permit for handling contaminated soil that has been removed from a cleanup site. RCW 70A.205,[34] Solid Waste Management – Reduction and Recycling establishes a statewide program for solid waste handling and assigns primary responsibility for adequate solid waste handling to local government. Prior to handling contaminated soil, contact the local city or county permitting department to determine if a permit is required.

Grade and fill permit

Most local governments require a grade and fill permit for larger excavations. Prior to conducting a cleanup, contact the city or county development permitting department with jurisdiction for the area to determine if a permit is required.

Demolition permit

If the cleanup requires demolishing a building or other structure, a permit will likely be needed from the local government. Contact the city or county development permitting department for additional information.

Construction stormwater general permit (CSWGP)

Construction site operators are required to obtain an NPDES general permit for construction activity from Ecology, known as CSWGP, if:

[29] https://apps.leg.wa.gov/wac/default.aspx?cite=197-11
[30] https://app.leg.wa.gov/WAC/default.aspx?cite=173-802
[31] https://apps.leg.wa.gov/wac/default.aspx?cite=197-11-960
[32] https://apps.leg.wa.gov/wac/default.aspx?cite=197-11-315
[33] https://apps.leg.wa.gov/wac/default.aspx?cite=197-11-330
[34] https://app.leg.wa.gov/RCW/default.aspx?cite=70A.205

1. Clearing, grading, and excavating activities are disturbing one or more acres; and
2. Stormwater will or may be discharged to surface waters of the state.

Ecology determined that construction activity is a significant contributor of pollutants to the waters of the state. Therefore, construction activity that has a reasonable potential to cause a violation of any water quality standards, requires a CSWGP. Further information on the CSWGP can be found on Ecology's Construction Stormwater General Permit[35] web pages.

Contaminated sites might not be eligible for a CSWGP if the stormwater or dewatering discharge from the construction site might violate water quality standards. In these situations, contact Ecology's Water Quality Program[36] for direction on the applicable permit submittal requirements and permitting options.

Air emissions

Excavation activities might trigger regulatory requirements related to equipment emissions and dust. Although using local construction equipment and dust controls (such as wetting or covering exposed soils during construction) should limit equipment emissions and airborne particulates, contact the local authority to determine if any additional requirements apply.

Dust control must take place during remedial activities that could result in soils with elevated metal concentrations being suspended in the air as dust.

Noise ordinance requirements

Construction activities must comply with the local and state environmental noise standards (Chapter 173-60 WAC).[37] Contact the city or county development permitting department for additional information.

Best management practices

Construction best management practices (BMPs) are practices and procedures that can be used to prevent contaminants from migrating off-site during construction. Some examples of BMPs include:

- Construction sequencing
- Dust control
- Silt fencing
- Storm drain inlet protection

[35] https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Stormwater-general-permits/Construction-stormwater-permit
[36] https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Stormwater-general-permits/Construction-stormwater-permit#contact
[37] https://apps.leg.wa.gov/WAC/default.aspx?cite=173-60

- Spill prevention and control measures
- Vehicle maintenance and washing areas

Ecology's stormwater manuals[38] provide guidance on implementing construction BMPs.

Minimum standards for constructing and maintaining wells

Groundwater monitoring wells that will be installed or removed as part of excavation activities must be constructed or decommissioned in accordance with Chapter 173-160 WAC.[39]

Location of underground utilities

Increasingly, many of the utility services provided to homeowners and businesses are buried underground. Damaging these utilities can result in fines and large damage claims. Under Washington State law (Chapter 19.122 RCW),[40] anyone who digs more than 12 inches below the ground surface is required to call to locate utilities two business days before digging. In general, you only have to make one call. Most owners of underground utilities, such as telephone, cable, water, sewer, electricity, and natural gas have cooperated in providing a one-call utility locate service. Simply call 811 or 1-800-424-555 two business days before you plan on digging.

Reporting to Ecology

Under MTCA, when contamination is discovered, it is considered a release of hazardous substances and must be reported to Ecology within 90 days of discovery.

MTCA allows for independent cleanup of contaminated sites (WAC 173-340-515).[41] Any site investigation, characterization, and/or cleanup work must be documented and included in a report and submitted to Ecology within 90 days. Any reports submitted must include adequate information documenting how the selected model remedy meets the substantive requirements of the state cleanup law.

For sites enrolled in the VCP, any report must follow the format and requirements in Chapter 5 of "Guidelines for Property Cleanups under the Voluntary Cleanup Program"[42] (Ecology 2015). In addition, electronic data must be submitted compatible with Ecology's EIM[43] data management system. Indicate in the cover letter transmitting a cleanup report that an Ecology-

[38] https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Stormwater-manuals
[39] https://apps.leg.wa.gov/WAC/default.aspx?cite=173-160
[40] https://app.leg.wa.gov/rcw/default.aspx?cite=19.122
[41] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-515
[42] https://apps.ecology.wa.gov/publications/summarypages/0809044.html
[43] https://ecology.wa.gov/Research-Data/Data-resources/Environmental-Information-Management-database/EIM-submit-data

approved model remedy was used so it is clear a feasibility study and disproportionate cost analysis are not required.

Based on the selected model remedy, environmental covenants or other institutional controls might be necessary to help ensure the remedy remains protective of human health and the environment over the long term. If an environmental covenant is used, it must be filed with the Register of Deeds in the county where the site is located. The environmental covenant must meet all applicable requirements in WAC 173-340-440,[44] and follow Procedure 440A: Establishing Environmental Covenants under the Model Toxics Control Act."[45] Institutional controls are discussed further in Chapter 10.

Option to pursue a No Further Action determination

Property owners following the independent cleanup process interested in pursuing an NFA determination have two options.

NFA through initial investigation

If you can complete your cleanup within 90 days of discovering contamination (based on initial sampling) and submit a report documenting your work to Ecology, you may be eligible for an NFA determination through Ecology's initial investigation process. Ecology will issue an NFA determination if the site meets applicable cleanup standards and other substantive requirements of the state cleanup law. Ecology does not charge a fee for this service.

NFA through VCP review

Persons planning or conducting independent remedial action may also request technical assistance from Ecology under the VCP,[46] including advice on how to investigate and clean up a site and written opinions on whether a planned or completed remedial action meets the substantive requirements of the state cleanup law. See RCW 70A.305.170[47] and WAC 173-340-515(5).

Ecology waives fees for participation in the VCP when reviewing cleanups using model remedies. Ecology encourages persons who independently clean up contaminated mine waste sites using model remedies to enroll in our Voluntary Cleanup Program (VCP) to seek a no further action (NFA) determination. Local governments, lenders, or future buyers may request Ecology's written opinion on the sufficiency of the cleanup.

[44] https://apps.leg.wa.gov/WAC/default.aspx?cite=173-340-440
[45] https://apps.ecology.wa.gov/publications/SummaryPages/1509054.html
[46] https://ecology.wa.gov/spills-cleanup/contamination-cleanup/voluntary-cleanup-program
[47] https://app.leg.wa.gov/RCW/default.aspx?cite=70A.305.170

On our website, you can find instructions on how to apply (including application and agreement), how to report independent remedial actions (including checklists),[48] and how to request our assistance or opinions.[49]

Chapter 4: Model Remedy 1 – Excavation and Offsite Disposal

The purpose of Model Remedy 1 is to clean up any mine-waste pile by excavating contaminated waste rock, tailings, and soils; properly disposing of them at a landfill; and backfilling with uncontaminated soils if necessary. This is considered a more permanent solution than keeping waste in place. Following excavation, performance testing must be completed to verify soil cleanup levels have been met at the limits of the excavation, such that no environmental covenants are necessary.

Excavation and offsite disposal do not require institutional controls or long-term monitoring and maintenance.

Considerations

The up-front costs are typically higher for excavation and offsite disposal. However, there are no long-term costs for maintenance and monitoring because there is no waste remaining above cleanup levels.

Excavation and disposal process

A worksheet to help plan the excavation and removal process is in Appendix C (Worksheet 1: Planning for Excavation and Removal) and a form to document the excavation and offsite disposal process is in Appendix B (Form 3: Excavation and Removal). The general steps are as follows:

1. Develop a site-specific cleanup design that includes delineating your excavation area. Make sure you have sufficiently narrowed down your excavation area. Collecting samples prior to excavation will help you eliminate areas that already meet state cleanup levels.

2. Prevent contaminated soils and dust from leaving the site. Control dust on the worksite during dry months by watering down the soil.

   If you are storing soil until it can be disposed of, cover it to prevent runoff. Install proper erosion-control devices to prevent contaminated soil from leaving the project area.

[48] https://ecology.wa.gov/spills-cleanup/contamination-cleanup/voluntary-cleanup-program/working-with-vcp
[49] https://ecology.wa.gov/spills-cleanup/contamination-cleanup/voluntary-cleanup-program/working-with-vcp

a) You will need to apply for coverage under the Construction Stormwater General Permit[50] if you disturb one or more acres. There may be additional local stormwater control requirements. Check with your local government.

b) Trucks should avoid driving through contaminated soils. Tightly cover truck beds transporting contaminated soil and rinse their wheels to prevent contaminated soil from leaving the worksite. Use the quarry spall at the entrance.

3. Plan to protect workers. L&I regulates health and safety at worksites. Employers must comply with all workplace safety rules on toxic exposures, including:

   - Arsenic, WAC 296-848[51]
   - General Occupational Health Standards, WAC 296-62[52]
   - Hazardous Waste Operations, WAC 296-843[53]

4. Excavate and test soils before disposal. For properties or mine waste piles with contamination above cleanup levels, all mine waste must be disposed of at a permitted and regulated landfill.

   a) Use stockpile sampling (Chapter 8) to determine your contaminant levels. This information or a "Toxicity Characteristic Leaching Procedure" (TCLP) laboratory method may be required for a Waste Disposal Authorization or to dispose of soils in a private landfill.

   b) If you are loading material directly into transport for disposal, you may also be able to use characterization sampling results. The highest sample concentrations from the area to be excavated should be used for disposal determination.

   c) For more information about waste disposal, contact your local health authority.

5. Take compliance samples after excavation is complete. Soils from 0–6 inches below the excavated surface should have contaminated mine site indicator hazardous substances concentrations at or below cleanup levels. If not, excavate further. Chapter 7 describes how to take performance samples.

6. Backfill the excavated areas with clean soil if needed. Before you purchase soil, check with the supplier to ensure the soil does not contain contaminants at concentrations greater than MTCA cleanup levels.

[50] https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Stormwater-general-permits/Construction-stormwater-permit
[51] https://app.leg.wa.gov/wac/default.aspx?cite=296-848
[52] https://app.leg.wa.gov/WAC/default.aspx?cite=296-62
[53] https://app.leg.wa.gov/WAC/default.aspx?cite=296-843

Some questions to ask your supplier include:

a) Where does this soil come from?

b) Is it blended with compost or additives? If so, where do they come from?

c) Has it been tested for chemical contamination?

d) Will the soil support sod, vegetation, etc.?

e) If you are unsure of whether these soils meet MTCA cleanup levels, use imported soils sampling (Chapter 9) or ask the supplier to sample. If you are planning to use onsite soils to backfill, do stockpile sampling (Chapter 8) to make sure they won't contaminate the excavated area.

Chapter 5: Model Remedy 2 – Capping in Place

The purpose of Model Remedy 2 is to cover mine waste piles in place with a soil or hard cap. The cap prevents exposure to contaminated soils on the property.

A hard cap may be a building, parking lot, pavement, or driveway. A soil cap is a minimum depth of clean soil over a geotextile. Part of the soil cap can be landscaping material.

Remember to follow proper engineering practices and local, state, and federal regulations when installing soil and hard caps.

Considerations

Caps are effective if they are maintained. The up-front costs of capping in place can be lower. However, there will be long-term monitoring and maintenance costs.

Soil caps

Soil caps must be a minimum settled thickness of 12 inches and include:

- Geotextile;
- Eight inches of mechanically compacted clean soil;
- Four inches of loose topsoil; and
- Seeding to establish native vegetation or landscaping material to mitigate surface erosion.

Soil cap materials must meet MTCA cleanup levels for contaminants. Otherwise, you could re-contaminate the property. Review imported soils sampling (Chapter 9) or ask the supplier to sample. Meaningful questions should include inquiring where the soil came from if it has additives, and if it will support vegetation.

A geotextile is necessary to indicate soil beneath it is still contaminated and it needs maintenance when it becomes exposed. The marker also reduces the chance of animals bringing capped soils to the surface. Check with your supplier to make sure the marker material is not bio-degradable and durable enough to last underground. Consult with Ecology to confirm your choice of material is acceptable.

Hard caps

Hard caps are most cost-effective when they are part of the original development plan, such as a building or driveway.

Hard caps include building footprints, asphalt, or any other permanent surface Ecology approves. Asphalt and concrete hard caps must have a minimum thickness of three inches.

Remember to follow proper engineering practices and local, state, and federal regulations when installing both soft and hard caps.

Capping process

A worksheet to help plan the capping-in-place process is in Appendix C (Worksheet 2: Planning for Capping in Place), and a form to document the capping-in-place process can be found in Appendix B (Form 4: Capping in Place). These are the general steps:

1. Determine the capping area. Use more sampling to narrow down the area.

2. Pick a cap type.

3. Prevent contaminated soils and dust from leaving the site. Control dust on the worksite during dry months by watering down the soil during construction. Install proper erosion-control devices to prevent dirty water from leaving the project area.

   You will need to apply for coverage under the Construction Stormwater General Permit[54] if you disturb one or more acres. There might also be additional local stormwater control requirements.

4. Plan to protect workers. L&I regulates health and safety at worksites. For guidance, visit their Safety and Health web page.[55]

5. Regrade mine waste as necessary. Soil caps should have a maximum slope of 2 feet horizontal to 1 foot vertical except where steeper slopes are necessary to control drainage.

6. Build the cap. Use enough materials to create the necessary cap depth. Make sure it covers the contaminated area.

7. Revegetate soil caps. Revegetation involves promoting plant growth, performing grading activities, and adding soil amendments and nutrients to promote vegetative growth.

8. File an environmental covenant documenting any institutional or engineered controls with the appropriate county recording office. This warns future property owners that contamination remains on the property. It also restricts uses that would damage the cap and sets an inspection schedule and cap maintenance instructions. See Chapter 10 for more information.

[54] https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Stormwater-general-permits/Construction-stormwater-permit
[55] https://lni.wa.gov/

Chapter 6: Model Remedy 3 – Consolidation and Capping

The purpose of Model Remedy 3 is to excavate mine-waste piles, consolidate them in one place, and cover them with a soil or hard cap. Detailed capping information is available in Chapter 4.

Consolidation reduces the footprint of contamination on the property, and the cap prevents exposure.

Considerations

The up-front costs of consolidation and capping might be lower than excavation and disposal at a regulated landfill; however, there are long-term monitoring and maintenance costs. Consolidating mine waste confines contamination to a smaller footprint on your property and requires an environmental covenant.

Process for consolidation and capping

A worksheet to help plan the consolidation and capping process is in Appendix C (Worksheet 3: Planning for Consolidation and Capping), and a form to document the consolidation and capping process is in Appendix B (Form 5: Consolidation and Capping). These are the general steps:

1. Determine the capping area. Use additional sampling to narrow down the area that needs to be capped. The consolidation area should be located as far upland from any water body as feasible. Contaminated soil cannot be consolidated where concentrated stormwater infiltration will occur.

2. Pick a cap type.

3. Prevent contaminated soils and dust from leaving the site. Control dust on the worksite during dry months by watering down the soil during construction. Install proper erosion-control devices to prevent dirty water from leaving the project area. You will need to apply for coverage under the Construction Stormwater General Permit[56] if you disturb one or more acres. There might also be additional local stormwater control requirements.

4. Plan to protect workers. L&I regulates health and safety at worksites. For guidance, visit their Safety and Health web page.[57]

[56] https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Stormwater-general-permits/Construction-stormwater-permit
[57] https://lni.wa.gov/

5. Remove contaminated soils from removal areas. Use the worksheet in this chapter to help determine your excavation depth.

6. Take compliance samples after excavation is complete. Soils from 0–6 inches below the excavated surface should have contaminated mine site indicator hazardous substances concentrations at levels less than MTCA cleanup levels. Chapter 7 describes how to take performance samples.

7. Consolidate the mine waste. Carefully transport excavated soils to the area where they will be capped. These soils can contaminate other parts of the property if they escape during transport.

8. Regrade mine waste as necessary. Soil caps should have a maximum slope of 2 feet horizontal to 1 foot vertical except where steeper slopes are necessary to control drainage.

9. Build the cap. Use enough materials to create the required 12-inch cap depth as described in Chapter 4. Make sure it covers the contaminated area. Sample any imported soils as described in Chapter 9, to make sure the cap material is not contaminated.

10. File an environmental covenant documenting any institutional or engineered controls with the appropriate county recording office. This warns future property owners that contamination remains on the property. It also restricts uses that would damage the cap and sets an inspection schedule and cap maintenance instructions. See Chapter 10 for more information.

Chapter 7: Soil Sampling

This chapter provides guidance on sampling mine waste on your property. WAC 173-340-350[58] describes remedial investigations required to adequately characterize your site prior to using a model remedy.

Why sample mine wastes?

Ecology requires initial sampling when mine waste is suspected to be on a property (Chapter 173-340 WAC)[59]. At some sites, the extent of mining and mine waste might not be visually apparent, and it would be necessary to consult published reference material.

Useful publicly available data sources on contaminated mine sites include the following:

- State of Washington, Department of Natural Resources, Inactive and Abandoned Mine Land Reports Index.[60]
- State of Washington, Department of Natural Resources, Washington Geologic Information Portal.[61]
- State of Washington, Department of Ecology, What's in My Neighborhood[62] map-based search tool of Washington cleanup sites.

Ecology requires sampling because there is a very strong correlation between elevated metal concentrations and mine waste. The United States Environmental Protection Agency's (EPA) Abandoned Mine Site Characterization and Cleanup Handbook[63] (USEPA 2000) provides an overview of the environmental impacts of mine waste. As a result, properties containing mine waste are suspected to be contaminated, and sampling is required by state law (Chapter 173-340 WAC).[64]

Even if your property is a former mine land, you might not have elevated levels of metal in your soil. Metal concentrations depend on several factors, including local geology and past mining processes, and are highly variable from property to property. Initial sampling verifies whether your property contains concentrations of metals exceeding applicable MTCA soil cleanup levels. Once you know if contamination is present and where contamination is located, you can take actions to manage potential exposure on your property.

[58] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-350
[59] https://apps.leg.wa.gov/wac/default.aspx?cite=173-340
[60] https://file.dnr.wa.gov/publications/ger_contaminated mine site_reports.pdf
[61] https://geologyportal.dnr.wa.gov/
[62] https://apps.ecology.wa.gov/neighborhood/
[63] https://www.epa.gov/sites/default/files/2015-09/documents/2000_08_pdfs_amscch.pdf
[64] https://apps.leg.wa.gov/wac/default.aspx?cite=173-340

If the initial sampling shows metals contamination above cleanup levels, this means you have a confirmed release. The release must be reported to Ecology.

Estimate mine waste volume

Mine waste pile dimensions can be estimated using field measurements, approximations, and GPS data. Estimated height of piles can be made through visual observation.

Mine waste pile dimensions can generally be characterized as uniform in depth, cone shape, or pyramid shape. Mine waste volume for these configurations can be estimated using the following general formulas.

- **Uniform Depth**: Volume (cubic feet) = Surface Area (square feet) x Depth (feet)
- **Cone**: Volume (cubic feet) = 1/3 x π x (Radius of Base [feet])^2 x Depth (feet)
- **Pyramid**: Volume (cubic feet) = 1/3 x Surface Area of Base (square feet) x Depth (feet)
- **Conversion Factor**: 1 cubic yard = 27 cubic feet

The volume of mine waste piles can also be calculated with great accuracy using remote sensing, such as unmanned aerial vehicles (UAVs or drones), and surveying techniques.

Background levels

At certain sites, background sampling can provide a useful tool to determine whether contamination represents conditions caused by past mining activities. Natural background is defined as the concentration of a hazardous substance consistently present in the environment that has not been influenced by localized human activities (WAC 173-340-200).[65] Often, mining activities occur in areas of naturally occurring elevated metal concentrations. In these instances, an investigation of the natural background condition can assist to determine site-specific cleanup levels.

Contact Ecology if you suspect metals contaminants naturally occur at concentrations greater than cleanup levels at your property.

Dangerous waste

Washington State Dangerous Waste Regulations (DWRs) (WAC 173-303)[66] govern the generation, management, and disposal of dangerous waste. Highly contaminated mine waste might designate as dangerous waste if the waste exhibits the characteristics of toxicity, using the TCLP laboratory method. Soil samples may need to undergo a TCLP analysis to determine if they designate as dangerous waste. Table 3 lists soil concentrations for contaminated mine site indicator hazardous substances requiring TCLP analysis.

[65] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-200
[66] https://app.leg.wa.gov/wac/default.aspx?cite=173-303

Table 3: Dangerous waste concentration levels

Contaminant	Soil concentration requiring TCLP analysis (mg/kg)
Arsenic	≥ 100
Cadmium	≥ 20
Lead	≥ 100

mg/kg = milligrams per kilogram
TCLP = Toxicity Characteristic Leaching Procedure

Contact Ecology if mine waste located on your property designates as dangerous waste to confirm if model remedies are appropriate for your site.

Sampling mine waste

The following sections provide guidance for sampling soil and mine waste at a site. WAC 173-340-350[67] describes remedial investigations required to adequately characterize your site prior to using a model remedy. There are three stages of mine waste sampling that might be required during the cleanup process. They include:

1. Initial sampling
2. Site characterization sampling
3. Compliance sampling

Initial sampling will show whether a property or a portion of it is clean or contaminated. Ecology requires initial sampling on properties that contain mine waste. If the property is identified as clean during initial sampling, no other action is required.

If indicator hazardous substances (Table 2) are detected at concentrations above state cleanup levels, site characterization sampling is required to determine which remedy is appropriate for your property. Compliance sampling will still be necessary to make sure the full extent of contamination has been removed.

Site characterization sampling is required if initial sampling shows the property is contaminated. Site characterization sampling will determine the extent and magnitude of contamination, and determine what remedial options are appropriate (WAC 173-340-350).[68]

Compliance sampling is required if you use a remedy that includes excavation. Compliance sampling will demonstrate whether you have successfully excavated all contaminated soil.

[67] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-350
[68] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-350

Compliance sampling is discussed further with the excavation and offsite disposal model remedy (Chapter 3) and the consolidate and cap model remedy (Chapter 5). Additional details are provided in Chapter 7.

Site condition map

You will need to prepare an existing site condition map illustrating relevant current site features such as property boundaries, extent of mine waste and impacted soils, process-related operation areas, haul routes surface topography, surface water, well locations, and other pertinent information.

Individual mine waste piles distributed throughout the property should be identified as separate piles.

Initial sampling

As stated in the introduction, Ecology *requires* initial sampling when mine waste is on a property. Initial sampling will follow the procedure described in "Sampling Strategy for the Rapid Screening Assessment of Mine-Waste Dumps on Abandoned Mine Lands" (Smith et. al., 2000) developed by the United States Geological Survey (USGS). This procedure consists of collecting 30 subsamples within a targeted mine waste pile and then combining the subsamples into one composite sample for chemical analysis.

Site characterization sampling

Site characterization sampling is used to understand how metal contaminants are distributed throughout your property. Site characterization must be completed in accordance with WAC 173-340-350.[69] Appendix B (Form 1: Characterization Sampling) will help you document your planning for this process.

Site characterization requires taking samples at multiple depths to identify the maximum depth of contaminated soil. Collecting characterization samples from multiple depths might require the use of mechanical equipment such as a backhoe or drill rig. The sample locations selected for depth profile samples should be equally distributed across the mine waste pile. For sample locations selected for depth analysis, samples should be taken at 1-foot depth intervals until clean soil is encountered. This process is much quicker when using an X-ray fluorescence (XRF) detector rather than laboratory analysis. See the discussion of XRF use later in this chapter. Use Table 4 to find the number of sample locations you need for an excavation remedy.

[69] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-350

Table 4: Minimum number of soil sample locations per mine waste pile

Cubic yards of mine waste	Number of samples for chemical analysis	Number of sample locations with depth profile samples
0–100	4	2
101–500	6	3
501–1,000	8	4
1,001–2,000	10	5

Where to sample

You will be required to attach a site cleanup map to your final cleanup report showing the property dimensions and extent of mine waste. For each mine waste pile, lay out sampling points in an evenly spaced grid.

Initial samples are composite samples, which means the soils from multiple locations are combined into a single sample. When conducting initial sampling, lay out 30 sampling points to collect subsamples for compositing.

All characterization samples are discrete, which means the soils for one sample come from a single sample location. Use the number of locations from Table 4 for site characterization sampling. Grid points should cover as much area as possible. Adjust the grid or add locations to make it fit.

Collecting samples

At a minimum, you will need the following equipment to collect soil samples for laboratory analysis:

- Stainless-steel tools to dig holes and remove soil (trowel and small shovel),
- Stainless-steel bowl to mix (composite) samples, if performing initial sampling,
- Lab-provided glass sample containers,
- Permanent marker to record sample locations on the container labels,
- Wash bucket, non-phosphate detergent, scrub brush, and rinse water (tap water and distilled or deionized water),
- Nitrile gloves,
- Property diagrams with sampling grids,
- Cooler with ice to keep the samples cool, and
- Chain-of-custody forms.

Sample collection steps

Before taking any samples, contact an Ecology accredited lab (see Help Desk). The lab might have special instructions about labeling and delivering the samples.

The following sections describe procedures to collect samples for laboratory analysis.

Initial sampling procedure

Figure 2: Collecting mine waste subsamples for compositing.

1. Remove any large debris at each subsample location. This includes rocks, pebbles, leaves, vegetation, and roots. For each mine waste pile, there will be 30 subsample locations.
2. Excavate a 2- by 2-inch square to a depth of about 6 inches with a clean (see Decontamination section below) spade or trowel.
3. Screen material to remove any pebbles, gravel, roots, or other debris.
4. Place excavated soil into a clean, stainless-steel bowl for compositing.
5. Repeat steps 1 through 4 at each subsample location. There will be a total of 30 subsample locations.
6. Mix the soil subsamples to obtain a homogenized sample.
7. Using a permanent marker, label your lab-provided glass sample containers with:
    a. A unique identifier for the sampling location,
    b. Your name, and
    c. The date and time the sample is being collected.
8. Fill up the glass sample containers with the mixed soil and seal them securely. Discard any extra soil back onto the mine waste pile.
9. Place the samples in an iced cooler and fill out a laboratory-provided chain-of-custody form to accompany the samples to the laboratory with the required information.

Site characterization procedure

1. Remove any large or nonrepresentative debris from the sample location before analysis. This includes rocks, pebbles, leaves, vegetation, and roots.

2. Use a clean (see Decontamination section below) stainless-steel trowel or shovel to dig an eight- to twelve-inch hole making an exposed vertical soil face to sample from.

3. Using a clean trowel or spoon, scrape soil from the side of the hole at the depth interval you are sampling and put the soil in the clean, stainless-steel mixing bowl. Avoid or discard pebbles, rocks, roots, or other debris. Collect soil evenly from the desired sampling depth of the hole. It is important to mix the soil well in the stainless-steel bowl.

4. Using a permanent marker, label your lab-provided glass sample containers with:

    a. A unique identifier for the sampling location,

    b. Your name, and

    c. The date and time the sample is being collected.

5. Fill up the glass sample containers with the mixed soil and seal them securely. Discard any extra soil back onto the hole. Do not composite (mix) samples from different locations.

6. Place the samples in an iced cooler and fill out a laboratory-provided chain-of-custody form to accompany the samples to the laboratory with the required information.

7. Between each sample, scrub and wash the sampling tool and mixing bowl clean using the decontamination procedures listed below.

8. For deeper samples, to identify the maximum extent of contamination, continue digging at the same location to reach the desired sample depth. Depending on the depth, you might need to excavate using mechanical equipment such as a backhoe or a drill rig. Collect deeper samples using the techniques described above by collecting the sample either from a drill rig core sampler or by scraping the sidewall of the excavation at the desired depth using the bucket of the excavation equipment. Do not enter deeper excavations.

X-ray fluorescence detector analysis

Ecology encourages the use of XRF technology for analyzing properties for metals contaminants. XRF analysis provides real-time data and makes sampling and analysis highly efficient. With real-time data, changes to your sampling plan can be made in the field based on analytical results. This can avoid multiple return sampling events that might be required when relying on delayed laboratory results. There are many brands and models of XRF. Ecology will accept data from any XRF that has detection limits below the cleanup levels presented in Table 2. Prior to taking the instrument into the field, calibrate the instrument according to the manufacturer's instructions. Include calibration results with the final cleanup report submitted to Ecology (see the Reporting to Ecology section).

Figure 3: Conducting XRF analysis on composite sample.

The same tools and techniques described above in "Sample Collection Steps" should be used for XRF analysis, except that the sample material can be placed in an XRF sample cup (if available) or a small plastic bag. Analyze the sample through the plastic bag or sample cup according to the XRF user's manual. Conduct calibration and calibration checks of the XRF instrument as required by the equipment manufacturer.

Initial sampling conducted with XRF does not require laboratory analysis results for comparison. Site characterization and performance sampling conducted by XRF requires that at least 10% of samples are submitted for laboratory analysis.

Note: Proper training for the safe operation of the instrument and radiation training should be completed by the analyst prior to analysis. Ecology recommends that an experienced environmental consultant be hired to do soil sampling as well as reporting of sampling methods and results (see the Help Desk section). If you choose to do such sampling yourself, Ecology expects documentation to be thorough and complete, and sampling procedures followed strictly to prevent potential cross-contamination and ensure high-quality data.

Decontamination

The objective of the decontamination procedure is to minimize the potential for cross-contamination between sample locations. Sampling equipment should be decontaminated using the following procedures immediately before each sampling event.

1. Put on a clean pair of nitrile gloves.
2. Brush equipment with a nylon brush to remove large particulate matter.
3. Wash equipment with non-phosphate detergent and water solution.
4. Rinse with distilled water, ensuring that all soap from the previous step has been removed.
5. Air dry equipment.

Laboratory analysis

If you elect to use a laboratory for analysis, see the Help Desk section of this guidance to select a lab.

Samples must be immediately placed in a cooler packed with enough ice to maintain a temperature between 2 and 8 degrees Celsius until receipt at the laboratory facility.

Make sure the sample containers and forms remain dry by sealing them in plastic bags inside the cooler. Bring the samples to the lab or follow its instructions for shipping. Include a copy of the sample inventory sheet (Form 2) and the chain-of-custody form provided by the lab. Keep copies for yourself.

The lab report should include a list or separate pages of results for each sampling location. It should have results for quality-control samples done at the lab. This is standard practice for all metals analysis. You will also see the chain-of-custody form signed by the laboratory. Keep everything you receive from the lab.

If you anticipate pursuing an NFA determination from Ecology, you will have to submit laboratory data to Ecology's Electronic Information Management system (EIM). To facilitate this process, you should request that the laboratory provide your data in an electronic deliverable format that is compatible with EIM. Most laboratories can produce this format.

Soil: Understanding your characterization results

Use the sample results to plan your next steps. If indicator hazardous substance (arsenic, cadmium, lead, and zinc) concentrations are "elevated" for any mine waste on the property, it needs cleanup. Elevated means one or more of the following criteria are met:

- Average mine waste contamination indicator hazardous substance (arsenic, cadmium, lead, and zinc) concentrations are greater than cleanup levels provided in Table 2.
- Maximum (any one sample) indicator hazardous substance is two times greater than cleanup levels provided in Table 2.

Use Appendix B (Form 2: Characterization Sampling Results) to calculate the average and maximum indicator hazardous substance concentrations for each mine waste pile. Mark which piles exceed cleanup levels.

For assistance with interpreting your results and deciding on cleanup options, please contact Ecology.

Chapter 8: Compliance Sampling

Performance sampling is a type of compliance sampling that determines if excavation was successful. WAC 173-340-410[70] describes the requirements of compliance monitoring. Samples must meet cleanup levels for contaminated mine site indicator hazardous substances except where residual contamination is contained under a cap.

When to do performance sampling

Performance sampling is required if using Model Remedy 1, Excavation and Offsite Disposal, or Model Remedy 3, Consolidation and Capping. Performance sampling is performed after excavating material, at the base of the excavation, and before placing backfill.

Sampling area

Use Appendix B (Form 6: Performance Sampling) to record the sampling area, sample numbers, and locations. Table 5 describes the minimum number of performance sample locations per mine waste pile.

Table 5: Minimum number of performance sample locations per mine waste pile

Sampling area in acres	Number of samples
Less than or equal to 0.25	4
0.25 to 1	8
1 to 5	15
5 to 10	20
Greater than 10	20 + 2 per 5 acres

For each mine waste pile, lay out sample points in an evenly spaced grid. Grid points should cover as much area as possible. Adjust the grid or add locations to make it fit. All samples are discrete, which means the soils for one sample come from a single sampling location.

Sample depth

Take performance samples from the remaining soil surface after excavating contaminated soil. Do this for every sample location.

[70]https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-410

Sampling by X-ray fluorescence detector

Performance sampling can be conducted by XRF, however, at least 10% of samples must be submitted for laboratory analysis. XRF analysis should only be performed by someone trained in the safe operation and data extraction techniques of this equipment. As described earlier, XRF analysis can be conducted without disturbing the soil to be analyzed.

Sampling process

The performance sampling process should be completed using the same process as characterization sampling for both XRF and laboratory samples (see Chapter 6).

Understanding performance results

Evaluate the performance sample results to confirm that each excavated area meets MTCA cleanup levels. If contaminated mine site indicator hazardous substances concentrations do not meet the MTCA cleanup levels for any excavated area, you will have to take further action to clean up the soils, such as excavating at least six inches deeper and doing performance sampling again.

When am I done?

Cleanup is complete when all excavated areas meet cleanup levels for soil. Make sure you have a complete packet for Ecology, future property owners, and your records. This packet should include:

- Characterization sampling results, lab report, and chain-of-custody
- Form 1 and Form 2 (characterization sampling)
- Form 6 (performance sampling)
- Performance sampling lab report and chain-of-custody
- One completed form for each cleanup method used for all mine waste piles
- Maps documenting characterization and performance sample locations and cleanup work
- For capping or consolidation and capping, include a description of institutional controls used.

Next steps

Keep a copy of the forms you filled out to pass on to future property owners, so they know cleanup was done and how to maintain any non-permanent remedies.

Chapter 9: Stockpile Sampling

You will save time and money by segregating clean soil and contaminated soil. When possible, soil should be sampled prior to excavation. For soil leaving your property for disposal, it must be sampled prior to transport.

When to do stockpile sampling

Sample stockpiles before transporting offsite. It might be required for a Waste Disposal Authorization; however, they might be able to use results from characterization samples instead of re-sampling stockpiles. Ask the permitted landfill where you will dispose of the contaminated soil and whether they will accept characterization sampling results.

Stockpile sampling is different from characterization sampling. You will be taking your samples from a pile of soil you excavated and plan to dispose of or reuse onsite as clean. The samples are "composite," meaning you are taking several subsamples and mixing them together for analysis. Use Appendix B (Form 7: Stockpile Sampling) to track your sampling.

Planning for sampling

Use the same equipment as in Chapter 6.

- Stainless steel tools for digging sampling holes and removing soil.
- Stainless steel mixing bowl and spoon for compositing.
- Clean glass containers from the analytical lab.
- Permanent marking pen to record sample locations on the jar.
- Wash bucket, soap, scrub brush, and rinse water (distilled or deionized).
- Nitrile gloves.

Number of samples

Take composite samples from each stockpile. Table 6 shows how many samples you need to collect for a certain size stockpile. Each composite should contain six subsamples that you mix into a single sample.

Table 6: Number of composite samples per stockpile

Stockpile volume (cubic yards)	Number of composites
0–500	2
501–1000	4
1,001–5000	6
5,001–10,000	10
10,001–20,000	14
>20,000	14 + 1 per 5,000 cubic yards

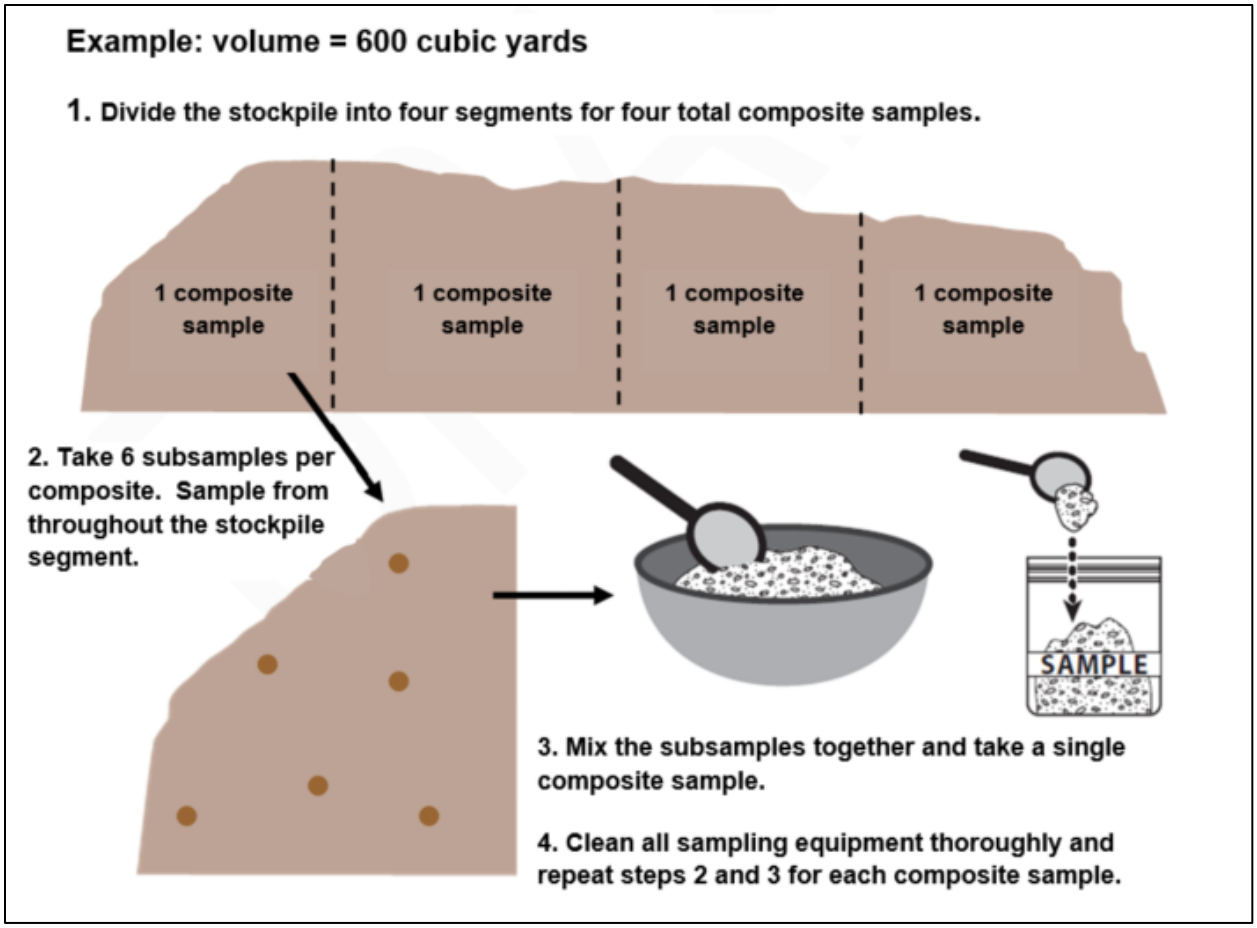

Figure 4: Stockpile sampling process

Sampling process

Before taking any samples, contact an Ecology-accredited lab. For more information, see the Help Desk section of this guidance. The lab might have special instructions about labeling and delivering the samples to their labs.

1. Check the number of composites needed and divide your stockpile into that many sections. Plan to take one composite per segment to have a good distribution throughout the stockpile.

2. Using a permanent marker, label the glass jar with:

    a. The stockpile identifier.

    b. Composite number (you will take multiple composites per stockpile).

    c. Your name.

    d. The date and time the sample is being collected.

3. For each composite sample, from each stockpile segment:

    a. Divide your six subsamples evenly among surface samples, mid-depth samples, and deep samples. Make sure to collect samples from several different parts of the pile. Make sure to collect about the same volume of material from each subsample location. Clean sample equipment in the wash bucket and change the dirty water between samples.

    b. Place all subsamples for a single composite into the stainless-steel bowl. It is important to mix the soil well. All subsamples should be the same size. Mix thoroughly with the stainless-steel spoon, fill up the sample jar with the mixture, and seal it securely. This is your composite sample for an individual segment.

    c. Repeat the sampling process for each segment.

    d. Between individual composite samples, scrub the bowl and spoon clean in the wash bucket, rinse, and pour the dirty water on the property where the sample was collected where it can soak into the ground. Do not pour dirty water down the storm drain.

    e. List all the composite soil samples in the sample inventory on Form 7.

    f. Place the samples in an iced cooler and fill out a laboratory-provided chain-of-custody form to accompany the samples to the laboratory with the required information.

Understanding your results

If any composite result is greater than cleanup levels for contaminated mine site indicator hazardous substances, that segment must be properly disposed of. If you want to reuse it on the property, you must cap it to meet model remedy requirements.

Disposal

If you plan to dispose of these soils, check with your local health department's solid waste division about their requirements. A waste disposal authorization form might be needed.

Reusing soils on site as "clean" soils

For any stockpiles that do not exceed MTCA cleanup levels, you may reuse the soil on the property.

Important: Transporting stockpiled soils offsite for use on another property, even if sampling shows they meet MTCA cleanup levels, is not a model remedy and not advised, as it might violate local anti-degradation policies.

Chapter 10: Imported Soils Sampling

Imported soils should meet MTCA cleanup levels for potential contaminants. This includes imported soils that are used on a site to backfill an excavation, create a soil cap, or for construction and landscaping projects.

What contaminants to test for in imported soils

The potential contaminants in your imported soil are dependent on the source. You might choose to purchase soil from a commercial supplier, or you might have your own source. If you purchase, ask your supplier:

- Does the soil contain metal concentrations above MTCA cleanup levels?
- Where does the soil come from?
- Is it blended with compost or additives? If so, where do they come from?
- Has it been tested for chemical contamination?
- Will the soil support sod, vegetation, etc.?

If the supplier cannot answer these questions, you should strongly consider another source.

If you have found your own source of soil, consider its location carefully. Steps to evaluate this source may include:

- Is this soil from a contaminated mine site? If so, you should test this soil for contaminated mine site indicator hazardous substances identified in this document.
- Does the source location fall within the historic orchard footprint found on the Dirt Alert map on Ecology's website? If so, you should test this soil for arsenic and lead at a minimum. There is a high probability that this soil contains elevated concentrations of arsenic and lead, and you should likely find another source. The map is available here: Dirt Alert Map.[71]
- Is this soil from a native, undisturbed location? If that is the case, the likelihood of contamination is low. You might still wish to collect one composite sample and analyze it for Priority Pollutant Metals. Native, undisturbed soil sources are the ideal choice.
- Is this soil from a quarry? Soil is often supplied from the fine material collected at a rock quarry. This material is not likely to contain contaminants but is also not likely to contain the nutrients required to support vegetation.
- Is this soil from a commercial or industrial location? Consider the activities conducted at the source location and analyze soil samples accordingly.

[71] https://apps.ecology.wa.gov/dirtalert/

- For example, if there were storage tanks or other types of chemical storage near your source, consider sampling for petroleum and other specific chemicals found at the site.

As with stockpile sampling, composite samples are allowed when evaluating import soils. Use Chapter 8 to determine the appropriate number of composite samples to collect from each stockpile of the imported soil source.

Chapter 11: Environmental Covenants and Institutional Controls

Institutional controls are required if contaminated soils remain on the property as part of the remedy. For this model remedy, institutional controls are required for capping in place and consolidation and capping model remedies. Institutional controls are also required for any portion of your property that is not being cleaned up to preserve natural areas.

Institutional controls limit or prohibit activities in areas with remaining contamination and they inform future property owners about contamination left on the property. They may also provide direction for regular maintenance and inspection of capped areas. The traditional form of institutional control is an environmental covenant, but they can include any instrument that effectively limits disturbing capped areas and notifies all future landowners of the conditions found on your property.

Types of institutional controls

For this model remedy, there are several types of institutional controls that are acceptable. The best option could be a combination of those listed below. Institutional controls include:

- **Physical measures,** such as fences.
- **Use restrictions,** such as limitations on the use of property or resources; or requirements that cleanup action occur if existing structures or pavement are disturbed or removed.
- **Educational programs**, such as signs, postings, public notices, health advisories, mailings, and similar measures that educate the public and/or employees about site contamination and ways to limit exposure.

What to consider in your institutional controls

The following information should be considered when you select your institutional control:

- Location of remaining contamination, including maps.
- Nature of remaining contamination, including sample results.
- How and when lessees, users, and future property owners will be notified.
- Cap locations and dimensions.
- Cap depth and materials used.
- Inspection schedule and cap maintenance.

How to prepare an environmental covenant

If you decide an environmental covenant is the institutional control you want to use, it is considered a legal document that must be recorded with your county. It is discovered during any property transaction during title searches and therefore is very effective at communicating property conditions to future owners. They also prevent activities or land uses that could make the cleanup less effective, such as removing or digging through a cap.

Prepare the environmental covenant using Ecology's template. Download the template by visiting the Publication Summary web page for "Toxics Cleanup Program Procedure 440A: Establishing Environmental Covenants under the Model Toxics Control Act"[72] (Publication 15-09-054) and clicking Microsoft Word format in the View Now field.

[72] https://apps.ecology.wa.gov/publications/SummaryPages/1509054.html

Help Desk

Selecting an analytical lab

Ecology's Laboratory Accreditation[73] website lists state-accredited labs that analyze soil. Approved sampling and analysis methods can be found at Ecology's Sampling and Analysis Procedures[74] website. The lab must be accredited for a metals analysis method in the 'solid and chemical materials' matrix. You do not have to use a local lab, since many labs can work with you through the mail. Most labs should be able to provide results within three to four weeks. Costs vary.

When you talk to the lab, ask them the following questions:

- Can they screen the soil sample to 2 millimeters?
- Can they report the results on a dry-weight basis?
- Will they provide a quality review of the data and a summary of the quality control results?
- How long will it take to get results?
- How much will it cost?

Hiring and working with a consultant

Ecology has a guide for finding and hiring a consultant, "Hazardous Waste Cleanups: Selecting an Environmental Consulting Firm."[75]

You may want to start the search by asking other companies in your industry (if applicable), environmental professional organizations, and banks for recommendations. Follow up with your own research. Ask questions and get at least three different proposals and cost estimates.

Questions you might want to ask include:

- What is your firm's experience with soil sampling and related cleanup work? Request a list of completed projects and references.
- What work might be subcontracted? Request the names of their subcontractors and check their experience.
- What is your firm's experience with regulatory requirements?

[73] https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Laboratory-Accreditation
[74] https://ecology.wa.gov/regulations-permits/guidance-technical-assistance/contamination-clean-up-tools/sampling-and-analysis-procedures#Table
[75] https://apps.ecology.wa.gov/publications/SummaryPages/FTCP92116.html

- Which staff members will be assigned to my project? Ask for resumes, roles, and the project manager.
- Is your field staff trained in safety procedures required by the Washington Industrial Safety and Health Act (WISHA)?
- Does your firm and its subcontractors have environmental liability insurance?
- How will you plan to be cost-effective?

Ask each firm to prepare a proposal for the sampling work. The proposal should include a detailed approach and cost estimate by specific task. It may be difficult to provide specific estimates for future work because they will depend on the characterization sampling results.

Other situations

For all projects, check if federal, state, or local land-use permits are needed. For situations not covered by this guidance, please call 509-575-2490 for Ecology's Contaminated Mine Sites team.

Healthy actions to reduce exposure to contaminated soils

Anyone working or playing in potentially contaminated soils should follow a few simple actions:

- Wash hands after working or playing outside, and before eating.
- Take off shoes at the door or use a doormat.
- Damp dust, damp mop, and vacuum with a HEPA filter regularly.
- Wear gloves when working in soil.
- Wash home-grown fruits and vegetables well, peeling or scrubbing root vegetables.
- Keep pets clean.

For a full list of healthy actions, visit Healthy Actions - protect yourself from arsenic and lead in dirt.[76]

[76] https://ecology.wa.gov/Spills-Cleanup/Contamination-cleanup/Dirt-Alert-program/Healthy-actions

Literature Cited

CES. (2016). "Non-Time-Critical Removal Action Report, Monte Cristo Mining Area." (Project No. 2015230017). Cascade Earth Sciences. Albany, OR. Prepared for USDA Forest Service. Retrieved from: https://apps.ecology.wa.gov/cleanupsearch/site/4550

Ecology. (1994). "Minnie Mine Implement Cleanup Action Plan." (Enforcement Order No. DE 94TC-C433). Washington State Department of Ecology, Toxics Cleanup Program. Retrieved from: https://apps.ecology.wa.gov/cleanupsearch/site/4356

Ecology. (2012). "Asarco Tacoma Smelter Site, Final Interim Action Plan for Tacoma Smelter Plume." (Publication No 12-09-086). Washington State Department of Ecology, Toxics Cleanup Program. Retrieved from: https://apps.ecology.wa.gov/publications/SummaryPages/1209086.html

Ecology. (2013). "Model Toxics Control Act regulation and statute: MTCA Cleanup Regulation Chapter 173-340 WAC, Model Toxics Control Act Chapter 70.105D RCW, Uniform Environmental Covenants Act Chapter 64.70 RCW." (Publication No. 94-06). Olympia, WA: Washington State Department of Ecology, Toxics Cleanup Program. Retrieved from: https://apps.ecology.wa.gov/publications/summarypages/9406.html

Ecology. (2015). "Guidelines for property cleanups under the Voluntary Cleanup Program." (Publication No. 08-09-044). Olympia, WA: Washington State Department of Ecology, Toxics Cleanup Program. Retrieved from: https://apps.ecology.wa.gov/publications/summarypages/0809044.html

Ecology. (2016). "Procedure 440A: Establishing Environmental Covenants under the Model Toxics Control Act." (Publication No. 15-09-054). Olympia, WA: Washington State Department of Ecology, Toxics Cleanup Program. Retrieved from: https://apps.ecology.wa.gov/publications/SummaryPages/1509054.html

Ecology. (2021). "Model Remedies for Cleanup of Former Orchard Properties in Central and Eastern Washington" (Publication No. 21-09-006). Union Gap, WA: Washington State Department of Ecology, Toxics Cleanup Program. Retrieved from: https://apps.ecology.wa.gov/publications/SummaryPages/2109006.html

Ecology. (1994). "Natural Background Soil Metals Concentrations in Washington State" (Publication No. 94-115). Olympia, WA: Washington State Department of Ecology, Toxics Cleanup Program. Retrieved from: https://apps.ecology.wa.gov/publications/documents/94115.pdf

GeoEngineers. (2017). "Feasibility Study, Van Stone Mine. Onion Creek, Washington" (Project No. 0504-100-00). GeoEngineers, Inc. Spokane, WA. Prepared for Washington State Department of Ecology. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/site/461

Hart Crowser. (2013). "Feasibility Study Saddle Rock Park. Wenatchee, Washington" (Project No. 17917-00). Hart Crowser, Inc. Seattle, WA. Prepared for the City of Wenatchee. Retrieved from: https://apps.ecology.wa.gov/cleanupsearch/site/11610

USEPA. (2000). Abandoned Mine Site Characterization and Cleanup Handbook. United States Environmental Protection Agency. Region 10. Retrieved from:

https://www.epa.gov/sites/default/files/2015-09/documents/2000_08_pdfs_amscch.pdf

USEPA. (2021). Integrated Risk Information System. "Chemical Assessment Summary: Arsenic." United States Environmental Protection Agency. National Center for Environmental Assessment. Retrieved from: https://cfpub.epa.gov/ncea/iris/iris_documents/documents/subst/0278_summary.pdf

URS. (2009). "Removal Action Final Report Beth Lake Prospect, Okanogan and Wenatchee National Forests." URS. Portland, OR. Prepared for USDA Forest Service. Retrieved from: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5340447.pdf

USGS. (2000). "Sampling Strategy for the Rapid Screening of Mine-Waste Dumps on Abandoned Mne Lands" (Open-File Report 00-016). Denver, CO: United States Geological Survey. Retrieved from: https://pubs.er.usgs.gov/publication/ofr0016

Appendix A: Model Remedies

MTCA regulations (WAC 173-340-390)[77] specify that Ecology must identify the circumstances under which the application of a model remedy meets the requirements for the selection of cleanup actions established under WAC 173-340-360.[78] If a site meets the requirements for using a model remedy, it is not necessary to conduct a feasibility study under WAC 173-340-351.[79]

A model remedy may be selected as a cleanup action, or a component of a cleanup action if the site meets the conditions for using the model remedy identified in this document. To make this demonstration, sufficient information must be collected and documented during the remedial investigation.

Soil cleanup levels

Ecology has developed soil cleanup levels for contaminated mine sites intended to address the soil direct-contact exposure pathway.

The process for establishing soil cleanup levels involves the following:

- Confirm lack of impacts to sediment, surface water, and groundwater;
- Develop cleanup levels for individual contaminants; and
- Determine which contaminants contribute the majority of the overall risk (indicator hazardous substances).

Note: Method A cleanup levels may be used to establish cleanup levels at sites that have few hazardous substances and are undergoing a routine cleanup action. Method B is the standard method for establishing cleanup levels and can be used at any site.

Contaminants of concern for mine sites

For the model remedies presented in this document, cleanup level development centers on metal contaminants in soil. Based on previous investigation work with contaminated mines in Washington, arsenic, cadmium, lead, and zinc are identified as indicator hazardous substances.

Soil cleanup levels based on protection of human health and upland ecological risk

When determining soil cleanup levels based on protection of human health and upland ecological risk, Ecology evaluated the following pathways:

[77] https://apps.leg.wa.gov/wac/default.aspx?cite=173-340-390
[78] https://apps.leg.wa.gov/WAC/default.aspx?cite=173-340-360
[79] https://apps.leg.wa.gov/WAC/default.aspx?cite=173-340-351

- Human health:
    - Direct-contact non-cancer
    - Direct-contact cancer
- Terrestrial Ecological Evaluation
    - Protection of plants
    - Protection of soil biota
    - Protection of wildlife
        - Mammalian predator
        - Mammalian herbivore
        - Avian predator

The following provides the cleanup levels developed for this model remedy. Cleanup levels were developed for typical metal contaminants found in mine wastes and meet the requirements of MTCA for both human health direct contact and ecological receptors based on site-specific terrestrial ecological evaluation procedure values found in Table 749-3 of WAC 173-340-900.[80] Leaching to groundwater or exposure to surface water and sediment are not considered in this evaluation.

Antimony:

- Human health = 32 milligrams per kilogram (mg/kg) – Based on soil Method B (direct-contact non-cancer)
- Upland ecological risk = 5 mg/kg – Based on site-specific terrestrial ecological evaluation procedures (protection of plants)
- Final value = 5 mg/kg

Arsenic:

- Human health = 20 mg/kg – Based on soil Method A (contaminated mine sites approved under the model remedies qualify for Method A because they are considered routine with few hazardous substances)
- Upland ecological risk = 7 mg/kg – Based on site-specific terrestrial ecological evaluation procedures (protection of wildlife). **Note:** Upland ecological risk is based on arsenite (As III)
- Final value = 20 mg/kg (based on MTCA Method A cleanup level,)

[80] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-900

Beryllium:

- Human health = 160 mg/kg – Based on soil Method B (direct-contact non-cancer)
- Upland ecological risk = 10 mg/kg – Based on site-specific terrestrial ecological evaluation procedures (protection of plants)
- Final value = 10 mg/kg

Cadmium:

- Human health = 80 mg/kg – Based on soil Method B (direct-contact non-cancer)
- Upland ecological risk = 4 mg/kg – Based on site-specific terrestrial ecological evaluation procedures (protection of plants)
- Final value = 4 mg/kg

Chromium:

- Human health = 1.20E+05 mg/kg – Based on soil Method B (direct-contact cancer).
- Upland ecological risk = 42 mg/kg (based on adjustment to natural background)
- Final value = 42 mg/kg

Copper:

- Human health = 3,200 mg/kg – Based on soil Method B (direct-contact non-cancer)
- Upland ecological risk = 50 mg/kg – Based on site specific evaluation (protection of soil biota)
- Final value = 50 mg/kg

Lead:

- Human health = 250 mg/kg – Based on preventing unacceptable blood screening levels
- Upland ecological risk = 250 mg/kg – Based on Tacoma Smelter Plume Protection (Ecology 2012)[81]
- Final value = 250 mg/kg

Mercury:

- Human health = 24 mg/kg – Based on mercuric chloride soil Method B (direct-contact non-cancer)
- Upland ecological risk = 5.5 mg/kg – Based on site-specific evaluation (protection of wildlife). **Note:** Although little information is available on the toxicity of mercury to plants or soil biota, the available data suggest that the soil concentration on wildlife protection should also be adequately protective of plants and soil biota.[82]
- Final value = 5.5 mg/kg

[81] Ecology, 2012. Asarco Tacoma Smelter Site. Final Interim Action Plan for the Tacoma Smelter Plume.
[82] Ecology, 2000. Attachment V. WAC 173-340 Table 749-2. Chemical-specific Technical Support Documents.

Nickel:

- Human health = 1,600 mg/kg – Based on soil Method B (direct-contact non-cancer)
- Upland ecological risk = 30 mg/kg – Based on site-specific evaluation (protection of plants)
- Final value = 38 mg/kg (based on an upward adjustment to natural background)

Selenium:

- Human health = 400 mg/kg – Based on soil Method B (direct-contact non-cancer)
- Upland ecological risk = 0.3 mg/kg – Based on site-specific evaluation (protection of wildlife)
- Final value = 0.78 mg/kg (based on an upward adjustment to natural background)

Silver:

- Human health = 400 mg/kg – Based on soil Method B (direct-contact non-cancer)
- Upland ecological risk = 2 mg/kg – Based on site-specific evaluation (protection of plants)
- Final value = 2 mg/kg

Thallium:

- Human health = 0.8 mg/kg – Based on soil Method B (direct-contact non-cancer)
- Upland ecological risk = 1 mg/kg – Based on site-specific evaluation (protection of plants)
- Final value = 0.8 mg/kg

Zinc:

- Human health = 24,000 mg/kg – Based on soil Method B (direct-contact non-cancer)
- Upland ecological risk = 86 mg/kg – Based on site-specific evaluation (protection of plants)
- Final value = 86 mg/kg

MTCA defines the factors used to determine whether a substance should be retained as an indicator hazardous substance for a site. When defining a cleanup level at a site contaminated with several hazardous substances, Ecology may eliminate those contaminants contributing a small percentage of the overall threat to human health and the environment from further consideration. WAC 173-340-703[83] provides the following factors to consider when eliminating individual hazardous substances from further consideration:

[83] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-703

- The toxicological characteristics of the substance that govern its ability to adversely affect human health or the environment relative to the concentration of the substance.
- The chemical and physical characteristics of the substance which govern its tendency to persist in the environment.
- The chemical and physical characteristics of the substance which govern its tendency to move into and through the environment.
- The natural background concentration of the substance.
- The thoroughness of testing for the substance.
- The frequency of detection.
- The degradation of by-products of the substance.

Appendix B: Forms

Form 1: Characterization Sampling

Reminder: Keep a copy of the completed forms to pass on to future property owners.

Part 1: Determine mine waste areas

1. Total property size: _____ acres

2. Check all that apply and identify mine waste in any of these cases:

   - ☐ Mine waste pile volumes are less than 2,001 cubic yards.
   - ☐ Mine structures such as former mill buildings are on your property.
   - ☐ Mine features such as adits or shafts are on your property.
   - ☐ Property has geographic features, such as steep slopes or other unusable areas.
   - ☐ More than one type of land use is planned for the development of the property.
   - ☐ Parts of the property will be play areas, gardens, or other high-use areas.

3. On the next page in Table 8, list the mine waste piles on your property and their size. Use Table 9 or Table 10 to determine the number of samples needed for each pile.

Part 2: Soil sample depth

4. Complete Table 1 on the next page with the sample depths.

   - **At every location:** Take samples from the top 0–6 inches of soil after clearing away grass, leaves, gravel, or debris on the surface.
   - **At every other location (50% of the samples):** Take one soil sample from depths immediately below the bottom of the waste-rock pile based on visual observations.

Part 3: Overlay a sampling grid for each mine waste pile

5. Attach a diagram showing property dimensions and mine waste locations.

6. Attach a separate diagram for each mine waste pile, including dimensions, existing structures, and which features will remain after development.

Table 7: Characterization sampling plan

Mine waste area description (past use, planned use)	Cubic yards (cy)	# of samples	Sample depth

Table 8: Minimum number of soil sample locations per mine waste pile

Cubic yards of mine waste	Number of samples for chemical analysis	Number of sample locations with depth profile samples
0–100	4	2
101–500	6	3
501–1,000	8	4
1,001–2,000	10	5

Form 2: Characterization Sampling Results

Reminder: Keep a copy of the completed forms to pass on to future property owners.

Completing the sample inventory

1. List the samples by mine waste pile in the inventory on the back of this page. Enter the depth of each sample. When sampling multiple depths at a single location, mark each depth as a separate sample number.

2. Record the date and time.

3. Complete the rest of the columns when you get the sampling results.

Determining if indicator hazardous substance concentrations are elevated

4. Calculate average contaminant (arsenic, cadmium, lead, and zinc) levels **for each sampling depth** and **each mine waste pile** and enter them on the inventory sheet. For each mine waste pile, circle the average concentrations that are greater than or equal to the following values:

Contaminant	**Cleanup Level in milligram per kilogram (mg/kg)**
Arsenic	20
Cadmium	4
Lead	250
Zinc	86

* Milligrams per kilogram is equivalent to parts per million (ppm).

5. Attach a copy of your lab results and chain-of-custody.

6. For mine waste piles with a circled value (maximum or average), note in the Comments column that cleanup is needed for that entire pile. See Chapter 2 to review options for cleaning up those piles.

   If no mine waste piles have elevated contaminant concentrations, no cleanup is necessary. Because no cleanup is being done, you do not need to take any compliance samples. The characterization samples demonstrate your soils meet state standards. Treat these results as compliance sampling results and read Chapter 7 for next steps.

Soil Characterization Sampling Inventory Sheet

Property address: **Phone:** **Sampled by:**					**Testing parameters (ppm)**			
WP no.	Sample no.	Sample depth	Date	Time	Arsenic	Cadmium	Lead	Zinc

Notes: WP = waste pile

Form 3: Excavation and Offsite Disposal

Reminder: Keep a copy of the completed forms to pass on to future property owners.

1. **List mine waste piles being excavated:** **Depth**

_____ _____
_____ _____
_____ _____

2. **Prevent soils from escaping the site and plan for worker safety:**
   - ☐ Make a water source available for dust control
   - ☐ Install erosion-control devices
   - ☐ Cover trucks carrying contaminated soil
   - ☐ Set up rinsing area for truck wheels and quarry spall at the entrance
   - ☐ Follow Department of Labor & Industries worker safety regulations

3. **Record soil disposal information:**

Name of landfill facility: _____
Contact name and phone: _____

- ☐ Attached a copy of the Waste Disposal Authorization form

4. **Record the clean fill soil source:**
   - ☐ Off-site soils —Supplier: _____

     Supplier phone: _____
   - ☐ On-site soils

5. **Conduct stockpile sampling or imported soil sampling:**
   - ☐ Completed stockpile sampling for onsite soils and filled out Form 7.
   - ☐ Completed imported soil sampling and filled out Form 8, or soils were certified to be clean by the supplier.

6. **Conduct performance sampling:**
   - ☐ Filled out Form 6.
   - ☐ Attached a map showing areas excavated and the depth of excavation and performance sampling locations.

Form 4: Capping in Place

Reminder: Keep a copy of the completed forms to pass on to future property owners.

1. List the mine waste piles and cap information for each one.

Mine waste pile	Type of cap	Cap depth	Geotextile used?

2. Prevent soils from escaping the site and plan for worker safety:

- ☐ Follow dust- and erosion-control practices
- ☐ Follow Department of Labor & Industries worker safety regulations

3. Record the soil source:

- ☐ Off-site soils —Supplier: _____

  Supplier phone: _____
- ☐ On-site soils

4. File the environmental covenant:

- ☐ Filed a deed notice with: _____ County

Recording number: _____

5. Compile the following attachments:

- ☐ Map showing areas with results above cleanup levels capped and any additional details about the cap a future property owner would need to know
- ☐ Maintenance and monitoring plan
- ☐ A copy of the environmental covenant

Form 5: Consolidation and Capping

Reminder: Keep a copy of the completed forms to pass on to future property owners.

1. List the mine waste piles and excavation and consolidation information for each one.

Mine waste pile	Excavation depth

2. Conduct performance sampling after excavation.

- ☐ Filled out Form 6

3. Prevent soils from escaping the site and plan for worker safety:

- ☐ Follow dust- and erosion-control practices
- ☐ Follow Department of Labor & Industries worker safety regulations

4. Record cap information:

Cap type: _____ Cap depth: _____

- ☐ Used a geotextile barrier
- ☐ Attached a map showing both excavated and consolidated capped areas and included details about the cap a future property owner would need to know

5. Record the soil source:

- ☐ Off-site soils —Supplier: _____

  Supplier phone: _____
- ☐ On-site soils

6. File the environmental covenant:

- ☐ Filed a deed notice with: _____ County

  Recording number: _____

7. Compile the following attachments:

- ☐ Map showing areas with results above cleanup levels capped and any additional details about the cap a future property owner would need to know
- ☐ Maintenance and monitoring plan
- ☐ A copy of the environmental covenant

Form 6: Performance sampling

Reminder: Keep a copy of the completed forms to pass on to future property owners.

1. **Record the total volume for excavated areas:**

- Mine Waste Pile: _____Excavated: _____cubic yards
- Mine Waste Pile: _____Excavated: _____cubic yards
- Mine Waste Pile: _____Excavated: _____cubic yards
- Mine Waste Pile: _____Excavated: _____cubic yards

2. **Calculate the number of samples needed using Table 12.**

Table 9: Minimum number of performance sample locations per mine waste pile

Sampling area in acres*	Number of samples
Less than or equal to 0.25	4
0.25 to 1	8
1 to 5	15
5 to 10	20
Greater than 10	20 + 2 per 5 acres

* 1 acre = 43,560 square feet

3. **Attach a property diagram with performance sampling grid overlaid (see Chapter 7), showing which areas were cleaned up and the locations of paved or built areas.**

4. **Complete the sample inventory.**

   a) List the samples by mine waste pile on the Performance Sampling Inventory sheet. Enter the depth of each sample. When sampling multiple depths at a single location, mark each depth as a separate sample number.

   b) Fill in the date and time.

   c) Complete the rest of the columns when you get the sampling results.

5. **Determine if indicator hazardous substances (arsenic, cadmium, lead, and zinc) concentrations are elevated.**

   a) Calculate average concentrations for the area sampled and enter them on the inventory sheet. For each mine waste pile where average concentrations exceed Table 13, circle the average.

Table 10: State cleanup levels for inactive and abandoned mine lands indicator hazardous substances

Contaminant	Cleanup Level in milligram per kilogram (mg/kg)
Arsenic	20
Cadmium	4
Lead	250
Zinc	86

b) Circle every value where concentrations are two times greater than cleanup value in Table 12.

c) Attach a copy of the lab results and chain of custody.

d) For each sampled area with a circled value (maximum or average), note in the Comments column that more cleanup is needed for that area. Return to Chapter 3 to review options for cleaning up those mine waste piles. If mine waste piles do not have elevated arsenic or lead, read Chapter 7 for the next steps.

Performance Sampling Inventory

Property address: **Phone:** **Sampled by:**					**Testing parameters (ppm)**			
WP no.	Sample no.	Sample depth	Date	Time	Arsenic	Cadmium	Lead	Zinc

Notes: WP = Waste Pile

Form 7: Stockpile sampling

Reminder: Keep a copy of the completed forms to pass on to future property owners.

Each composite should contain six subsamples mixed together. In Table 13, fill in the number of composite samples needed for each stockpile, based on its size (Table 14).

Table 11: Planning for stockpile sampling

Stockpile identifier	Stockpile volume	# of subsamples	# of composites
		6	
		6	
		6	
		6	

Table 12: Number of composite samples per stockpile

Stockpile volume (cubic yards)	Number of composites
0 - 500	2
501–999	4
1,001–5,000	6
5,001–10,000	10
10,001–20,000	14
> 20,000	14 +1 per 5,000 cubic yards

1. **Complete the sample inventory.**
   a) List the composite samples by stockpile in the inventory on the next page.
   b) Fill in the date and time.
   c) Note any unusual observations in the Comments column.
   d) Complete the rest of the columns when you get the sampling results.

2. **Determine if indicator hazardous substances are elevated.**
   a) Mark each composite sample that exceeds cleanup levels for indicator hazardous substances. These segments cannot be reused on the property. See Chapter 8 for next steps.
   b) Attach a copy of the lab results and chain of custody.

Stockpile Sampling Inventory

Property address: **Phone:** **Sampled by:**				**Testing parameters (ppm)**			
Stockpile no.	Sample depth	Date	Time	Arsenic	Cadmium	Lead	Zinc

Sampling and Cleanup Checklist

Characterization sampling

Form 1: Characterization Sampling

- ☐ Appropriate number of samples per mine waste pile (0–6 inch depth)
- ☐ 50% of samples collected from the bottom of the mine waste pile, if applicable

Form 2: Characterization Sampling Results

- ☐ Maximum indicator hazardous substance concentrations are less than 2 times cleanup values and average concentrations are less than cleanup values (stop here)
- ☐ Maximum indicator hazardous substance concentrations are greater than or equal to 2 times cleanup values or average concentrations are greater than cleanup values (continue below)

Cleanup and performance sampling

Performance sample depth should be at least 6 inches.

To be protective, cap depth should meet the guidelines in Chapter 4 or Chapter 5. Ensure future owners know to maintain the remedy by providing them with the sample results and cleanup information.

1. Excavation and removal
   - ☐ **Form 3** with cleanup map
   - ☐ **Form 6** with sampling grid map
   - ☐ **Form 7** stockpile sampling (if applicable)
2. Capping in place
   - ☐ **Form 4**
   - ☐ Environmental covenant*
3. Consolidation and capping
   - ☐ **Form 5**
   - ☐ Environmental covenant*

**The environmental covenant should describe the remaining contamination and how to inspect and maintain the remedy.*

Appendix C: Worksheets

Worksheet 1: Planning for excavation and offsite disposal

1. Calculate soil removal depth by mine waste pile

Remove enough soil to reach soils meeting state cleanup levels below the contaminated surface soils (Figure 6).

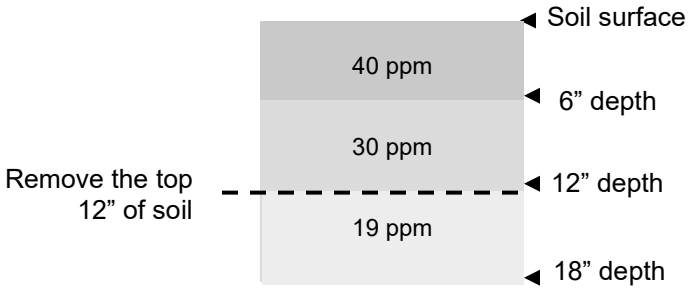

Figure 6. Example soil profile for arsenic

2. Calculate the volume of soil to be removed in cubic yards (yds^3) by the mine waste pile.

DU1 area _____ sq ft **x** removal depth _____ ft**/**27 **=** _____ yds^3

DU2 area _____ sq ft **x** removal depth _____ ft**/**27 **=** _____ yds^3

DU3 area _____ sq ft **x** removal depth _____ ft**/**27 **=** _____ yds^3

DU4 area _____ sq ft **x** removal depth _____ ft**/**27 **=** _____ yds^3

3. Calculate soil transport cost by volume.

_____ yds^3 (from step 1) x 1.5 tons/yds^3 x $_____ /ton = $_____

4. Select a municipal or private permitted landfill and call for waste disposal authorization fee information.

Landfill name: _____

Phone: (____) _____ Fee: $_____

5. Ask the permitted landfill or your local health department what type of sampling is required for soil disposal. It may require stockpile sampling (Chapter 7) or toxicity characteristic leaching procedure (TCLP) testing. This test determines if soil is safe for landfill disposal. Ask your lab if they can do TCLP, which typically costs $75–100.

Sampling or TCLP: $ _____

6. **Calculate the soil disposal cost by volume.**

_____tons of soil x $_____ /ton= $_____

7. **Calculate the fill cost by volume:** Use the excavated soil volume from step 1 as your backfill volume. To ensure you are not re-contaminating the property, check the soil quality with your supplier. Ask if they have any data on metals in their soils. If not, ask if they can sample for you (see Chapter 9).

_____ yds^3 fill x $_____ /cubic yd = $_____

8. **Other costs:** Estimate the labor and equipment costs of soil removal and backfilling. Also, think about the cost of performance sampling (Chapter 6) and possible imported soil sampling (Chapter 8).

$_____

9. **Total the costs:**

3	Soil transport	$ _____
6	Soil disposal	+ $ _____
7	Backfill	+ $ _____
8	Other costs	+ $ _____
		= $ _____

Worksheet 2: Planning for capping in place

Hard cap—There should be no extra cost to your project if the building or pavement area was part of the original plan.

Soil cap—There should be little additional cost for areas where landscaping was part of the original plan.

1. Calculate soil cap cost.

a. Calculate the volume of soil by pile:

Mine Waste area _____ft^2 x _____ft depth of cap / 27 = _____ yd^3

b. Request a cost estimate for the new soil and delivery.

$ _____/yd^3 x _____yd^3 = $_____

c. Calculate the cost of the geotextile:

Mine Waste area _____ ft^2 / 9 x $ _____/yd^2 material = $ _____

d. Labor cost of installing the cap = $_____

2. Estimate monitoring and maintenance costs.

Inspect caps at least once every year. Factor in the cost of regular inspections and repairs. Maintenance may include replenishing soil or landscaping materials.

3. Total estimated costs:

1b	Soil cap	$ _____
1c	Geotextile	+ $ _____
1d	Labor	+ $ _____
2	Monitoring and maintenance	+ $ _____
	Total	= $ _____

Worksheet 3: Planning for consolidation and capping

1. **Calculate consolidation costs**—Labor and equipment costs may vary depending on the volume of contaminated soil and how far it is being moved.

Hard cap—There should be no additional cost to your project if the building or pavement area was part of the original plan.

2. **Calculate the soil cap cost**—There should be little extra cost for areas where landscaping was part of the original development plan.

   a. Calculate the volume of soil:

Consolidated area _____ft^2 x ____ft depth of soil cap / 27 = _____ yd^3

   b. Request a cost estimate for the soil:

$ _____/yd^3 x _____yd^3 = $_____

   c. Calculate the cost of the geotextile:

DU area _____ ft^2 / 9 x $ _____/yd^2 material = $ _____

   d. Labor cost of installing the cap = $_____

3. Estimate the monitoring and maintenance costs.

Inspect caps at least once every year. Factor in the cost of regular inspections and repairs. Maintenance may include replenishing soil or landscaping materials.

4. Total estimated costs:

1	Consolidation	$ _____
2b	Soil cap	+ $ _____
2c	Geotextile	+ $ _____
2d	Labor	+ $ _____
3	Monitoring and maintenance	+ $ _____
	Total	= $ _____