



Excavation of petroleum-contaminated soil and tank removal sampling

Petroleum Remediation Program

This document describes the requirements for excavating petroleum-contaminated soil and for sampling during regulated petroleum tank removal when a release has occurred. General soil excavation requirements are provided as well as requirements for specific circumstances such as tank removal and installation. Sampling is required following tank removal to quantify residual contaminant levels and to determine whether further investigation is needed.

Release Reporting

Detection of any amount of contamination in soil or groundwater must be reported to the Minnesota Duty Officer, even if contaminant levels are lower than the action levels stated below.

Emergency Conditions

If there was a recent release, or there are vapor impacts, drinking water impacts, surface water impacts, free product, or a potentially unstable condition, immediately contact the Minnesota Duty Officer.

Additional Information

Additional guidance on release reporting, release response, and emergency conditions is found in [Reporting of Petroleum Releases](#), [Light Non-Aqueous Phase Liquid Management Strategy](#), [Recent Releases at Petroleum Tank Sites](#), and the [Petroleum Remediation Program General Policy](#).

I. General excavation requirements

A. Excavation prior to a limited site investigation

Contaminated soil may be excavated prior to completing a limited site investigation (LSI) in the situations listed below. Otherwise, contaminated soil should remain in place until an LSI has been completed.

Identifying receptors, defining the extent and magnitude of contamination, and evaluating risk during the LSI will determine if excavation is appropriate.

1. All contaminated soil meeting any of the field screening criteria listed in Table 1 can be excavated within a maximum of 200 cubic yards, providing that groundwater is not impacted or likely to become impacted. See subsection B below for more details. Prior Minnesota Pollution Control Agency (MPCA) approval is required to excavate more than 200 cubic yards of soil.

Table 1. Field screening criteria

Petroleum product	Soil headspace screening level (ppmv*)	Visual evidence	Petroleum sheen test
Gasoline, ethanol-blended fuel, and aviation gasoline	40 or above	Visual evidence of petroleum staining	Positive sheen test result
Diesel fuel, fuel oil, used or waste oils, jet fuel, kerosene	10 or above		

*ppmv (parts per million by volume)

2. Petroleum-saturated or grossly contaminated soil is accessible such as during tank removal or installation. Excavate up to 200 cubic yards of contaminated soil that is petroleum saturated or grossly contaminated. Use the petroleum sheen test to determine if soil is petroleum saturated. Use soil headspace screening with a photoionization detector (PID) to determine if soil is grossly contaminated. Soil with PID readings of 200 parts per million by volume (ppmv) or above is considered grossly contaminated. Soil headspace screening and petroleum sheen test procedures are described in [Soil Sample Collection and Analysis Procedures](#). In certain situations, the site-specific risk scenario may justify excavating more than 200 cubic yards. Please contact the MPCA for approval to exceed the 200-cubic yard limit.
3. A recent release has occurred. Quick removal of contamination can prevent the expansion of a contaminant plume. See [Recent Releases at Petroleum Tank Sites](#) for more information.
4. An obvious emergency condition exists where soil excavation is an appropriate interim corrective action. Refer to the [Petroleum Remediation Program General Policy](#) for more information on emergency conditions, and contact the MPCA for site-specific guidance.
5. Excavation is necessary to facilitate tank system installations (see Section II).

Excavation Limits

The total excavation volume allowed under subsections 1 and 2, applied separately or in combination, cannot exceed 200 cubic yards without prior MPCA approval. This limit is not applicable to subsections 3, 4, or 5, where site-specific circumstances dictate excavation volume.

B. Situations requiring a limited site investigation

An LSI is necessary if any of the following situations exist:

1. Contamination cannot be addressed by excavation of 200 cubic yards or less of soil.
2. Groundwater is present in the excavation and has been in contact with either petroleum product or petroleum-contaminated soil, or groundwater contamination is suspected.
3. Contamination intercepts a seasonally high water table (indicated by mottling on the excavation sidewalls) or bedrock.
4. Other impacts are known or suspected (e.g., discharge of contaminated water to surface waters or sewers, vapor impacts to buildings or utilities, etc.).
5. Residual soil contamination meets any of the field screening criteria in Table 1 or has a soil analytical result greater than 100 mg/kg gasoline range organics (GRO) or diesel range organics (DRO).
6. Contaminated groundwater is encountered in post-excavation soil borings (see subsection C below).

C. Post-excavation soil borings

A soil boring(s) is necessary at sites with sandy or silty sand soil (Unified Soil Classification System/American Society for Testing Materials) and where the water table is within 25 feet of the ground surface. The purpose of this boring(s) is to determine whether or not an LSI is necessary. Advance a soil boring directly through each suspected source area (e.g., former tank locations, dispensers, and piping runs) in the following situations:

- a. Soil contamination from a suspected source area excavation is between 1 and 100 mg/kg GRO/DRO; or
- b. Visual or other evidence of contamination remains in a suspected source area.

Collect and analyze soil samples following the procedures and analytical requirements described in [Soil Sample Collection and Analysis Procedures](#). Collect and analyze groundwater samples following the procedures and analytical requirements described in [Groundwater Sample Collection and Analysis Procedures](#).

If the boring(s) encounters contaminated groundwater, an LSI is necessary.

If the boring(s) encounters historical contamination that does not intersect the water table and the groundwater sample is not contaminated, an LSI may not be necessary depending on the likelihood of groundwater becoming contaminated.

D. Returning contaminated soil to the excavation basin

When an LSI is necessary, return contaminated soil to the excavation basin **except** petroleum-saturated or grossly contaminated soil as described in subsection A.2 above.

E. Field screening during excavations

All soil samples collected for field screening must be labeled so as to designate the sample type, sample location, and sample depth (see below). All excavation soil sample locations must be shown on a map of the excavation.

Field screening includes completing soil headspace screening with a PID and the petroleum sheen test as described in [Soil Sample Collection and Analysis Procedures](#). As excavation proceeds, collect and field screen soil samples frequently, enough to verify the need for soil removal (at least one sample for each 10 cubic yards of soil removed). Label removed samples with the prefix "R", the sample ID, and the sample depth. Accurately show the sample locations on a scaled map. The field technician should carefully document successive PID readings vertically below the source of release, indicating the location and depth of each sample on a map of the excavation. *Example:* R-1(2'), R-1(4'), R-1(6'), R-2(4'), etc. Note: R-1 samples are from the same location but successively deeper.

Following excavation, screen soil samples from the bottom and sidewalls of the excavation, along removed piping runs, and beneath removed dispensers. Collect and label field screening sidewall and bottom samples as discussed in subsection F below.

F. Sampling requirements following soil removal

After the excavation is complete but before returning any soil to the excavation basin, collect soil samples for laboratory analysis to document the contamination remaining in place. Also, in order to document the contamination removed, stockpile soil samples must be collected (see subsection G.2 below). Label soil samples collected for laboratory analysis according to the sample type, location, and depth (see below). All soil sample locations must be shown on a map of the excavation. The map must show site features and the two-dimensional extent of the final excavation footprint at the ground surface, along with final excavation depth contours using a contour interval of 1 to 2 feet. Collect and analyze soil samples following the procedures and analytical requirements described in [Soil Sample Collection and Analysis Procedures](#) according to the following schedule:

1. **Sidewall samples.** Remove at least one foot of exposed soil prior to collection to ensure collecting a representative sample. Collect sidewall samples at a rate of one sample per 25 linear feet of sidewall; however, a minimum of four sidewall samples (i.e., one from each side) must be collected to document

the contaminant levels remaining in place. Collect samples at the depth interval where the highest contaminant level was detected in the removed soil (i.e., "R" samples), typically near the bottom of the excavation basin. Label sidewall samples with the prefix "S", the sample ID, and the sample depth. Accurately show the sample locations on a scaled map. *Example:* S-1(6'), S-2(8'), S-3(5'), etc.

- 2. Bottom samples.** Remove at least one foot of exposed soil prior to collection to ensure collecting a representative sample. Collect bottom samples from the bottom of the excavation basin at a rate of one bottom sample per 100 square feet of bottom area and beneath removed dispensers. Label bottom samples with the prefix "B", the sample ID, and the sample depth. Accurately show the sample locations on a scaled map. *Example:* B-1(7'), B-2(14'), B-3(10'), etc.

Note: Laboratory analysis to document remaining contamination is not generally required after removing contaminated surface soil as a corrective action (see Section IV).

- 3. Groundwater samples.** When groundwater is encountered in an excavation basin, collect one sample per basin to assess groundwater contamination. If obvious evidence of contaminated groundwater exists such as visible or measureable petroleum product on the water, including petroleum sheen, a sample is not required. Collect and analyze groundwater samples following the procedures and analytical requirements described in [Groundwater Sample Collection and Analysis Procedures](#).

G. Management of petroleum-contaminated soil after excavation

1. Storage

Stockpile contaminated soil on an impervious surface or on minimum 40-mil plastic. Cover the stockpile at the end of each day with minimum 6-mil reinforced plastic or 10-mil unreinforced plastic. Securely anchor the stockpile cover with clean soil or other suitable material. Remember to obtain local government and MPCA approval prior to moving contaminated soil for off-site storage. Storage at land treatment sites must be in accordance with [Minn. R. 7037.0810](#). Improper storage of contaminated soil may cause an additional release to the environment and result in a reduction in Petrofund reimbursement.

2. Stockpile sampling

Collect and analyze soil samples from representative portions of the stockpile following the procedures and analytical requirements described in [Soil Sample Collection and Analysis Procedures](#). Label stockpile samples with the prefix "SP" and the sample ID. *Example:* SP-1, SP-2, etc.

Note: If less than 10 cubic yards of contaminated soil is removed for treatment, soil samples will not normally be necessary if the soil will be land treated, unless the soil is a potential hazardous waste as described in [Soil Sample Collection and Analysis Procedures](#).

3. Soil treatment and disposal

Petroleum-contaminated soil may be land treated, composted, thermally treated, or disposed of at a sanitary landfill. There are specific documents detailing the requirements for [land treatment](#) and [composting](#). Contact the MPCA if you wish to thermally treat contaminated soil. Soil disposal at a landfill is regulated by the MPCA's [Solid Waste Program](#). Contact the landfill to obtain soil disposal requirements.

See [Thin Spreading Small Quantities of Petroleum-Contaminated Soil](#) as a treatment option for soil volumes less than 10 cubic yards.

H. Excavation report

Complete a [General Excavation Report](#) in all cases where petroleum contamination is encountered during an excavation completed prior to an LSI, even if no soil is removed for off-site treatment. If an LSI is not being completed, promptly submit the *General Excavation Report* for MPCA review. If an LSI is being completed, include the *General Excavation Report* as an appendix in the [Investigation Report](#). The reporting deadline is

10 months from the date the MPCA issues a *Petroleum Storage Tank Release Investigation and Corrective Action* letter. The MPCA will establish a shorter deadline for high-priority sites.

I. Endangering structures

Do not allow excavations to endanger structures, including buildings, roads, utility lines, etc. Excavations must comply with Occupational Safety and Health Administration (OSHA) standards.

II. Excavation during tank system removals or installations

A. Planning ahead

It is in your best interest to obtain at least two bids on the work before you hire a contractor. By doing this, you will have met the Petrofund bidding requirement should contaminated soil be encountered. Bid forms are available from the [Department of Commerce](#), or call 651-539-1515 (800-638-0418).

Note: Regulated underground storage tanks (USTs) must be removed by an MPCA-certified contractor.

Prior to any tank work, plan ahead for storage and treatment of contaminated soil (see Section I.G). Remember to obtain local government and MPCA approval prior to moving contaminated soil for off-site storage.

Arrange for an environmental consultant with appropriate equipment to field screen soil and collect soil samples for laboratory analysis during and after excavation as described in Sections I and III.

B. Installation or removal of underground storage tanks

Refer to Appendix A for a flowchart on managing petroleum-contaminated soil during UST removals or installations.

1. Excavation when new UST systems are being installed and:

a. The site is a closed petroleum release site. If the site is a closed release site, refer to [Assessment of Petroleum Contamination at Closed Sites](#).

b. The site is an open petroleum release site or contamination is discovered during installation.

Remove and separate contaminated soil meeting any of the field screening criteria in Table 1, up to the volume allowed by Table 2. Screen soil from around any removed tanks, piping, or dispensers. If excavation removed all contaminated soil meeting the criteria in Table 1 and groundwater is not likely to be impacted, collect sidewall and bottom samples from the tank basin, piping, and dispenser areas. Analyze soil samples following the procedures and analytical requirements described in [Soil Sample Collection and Analysis Procedures](#).

If groundwater is likely to be impacted or test pits indicate the volume of contaminated soil remaining after removing the allowable volume based on Table 2 exceeds 200 cubic yards, an LSI is necessary. Do not remove additional soil beyond the volume allowed for the tank installation at this phase of work, unless it is petroleum saturated or grossly contaminated as described in Section I.A.2.

Table 2. Allowable contaminated soil removal during new UST installation

Table 2A		Table 2B	
New tank size (gallons)	For each tank to be installed add: (cubic yards)	Old tank size (gallons)	For each tank to be removed subtract: (cubic yards)
550	30	550	3
1,000	40	1,000	5
2,000	70	2,000	10
3,000	90	3,000	15
4,000	110	4,000	20
5,000	130	5,000	25
6,000	140	6,000	30
8,000	170	8,000	40
10,000	210	10,000	50
12,000	240	12,000	60
15,000	260	15,000	75
20,000	320	20,000	100
25,000	400	25,000	125

Note: For new pipe trenching allow one-third (0.33) cubic yard for every one (1) linear foot of contaminated trench.

Example 1: Two 10,000-gallon tanks are to be installed in the old tank basin, where one 4,000-gallon tank and one 6,000-gallon tank will be removed.

$$(210 + 210) - (20 + 30) = 370$$

Up to 370 cubic yards of contaminated soil may be removed.

Example 2: Two 10,000-gallon tanks are to be installed in the old tank basin, where one 4,000-gallon tank and one 6,000-gallon tank will be removed. Test pits indicate the removal of an additional 130 cubic yards of petroleum-contaminated soil would remove all the soil contamination meeting the field screening criteria in Table 1 and groundwater impacts are not likely.

$$(210 + 210) - (20 + 30) + 130 = 500$$

Up to 500 cubic yards of contaminated soil may be removed.

2. Excavation when USTs are removed but new tank installation will not occur

If the site is a closed petroleum release site, refer to [Assessment of Petroleum Contamination at Closed Sites](#). If the site is an open release site or a newly discovered release, refer to Section I of this document.

C. Excavation when upgrading, installing, or removing aboveground storage tanks

Excavation requirements at AST sites are similar to those for UST sites. The main difference is that contaminated surface soil at AST sites often occurs at loading and transfer areas, valve locations, piping runs, and from tank releases. Contaminated surface soil can pose a risk to surface water, groundwater, and direct human contact and requires corrective action. Except for the site-specific situations listed in Section I.A and subsection 1 below, contaminated soil should remain in place until an LSI has been completed.

For additional guidance, refer to [Frequently Asked Questions \(FAQs\) about Investigation and Remediation of Above-Ground Storage Tank Facilities](#).

1. Excavation when upgrading or installing AST systems

If contaminated surface soil (meeting field-screening criteria in Table 1) is encountered during an AST upgrade or new system installation, you may remove up to two (2) feet of contaminated soil in the following areas:

- a. below the footprint of the new AST containment berm
- b. below piping, dispenser areas, and loading and transfer areas

If the contaminated soil encountered appears to pose a human or environmental risk and the upgrade or installation will make the soil inaccessible, additional removal beyond the limits stated above may be appropriate prior to an LSI. Obtain prior MPCA approval before excavating beyond the stated limits.

If contaminated surface soil exists in areas of the site other than those listed above, removal or other corrective actions will probably be necessary but should wait until an LSI has been conducted. Soil removal prior to an LSI may be conducted if excavating up to 200 cubic yards completely addresses the release and eliminates the need for an investigation at the site, as described in Section I.A.1.

Contaminated Surface Soil

Excavating contaminated surface soil when upgrading or installing AST systems should not be confused with excavating contaminated surface soil when completed as a corrective action (Section IV). Excavation during an upgrade or installation occurs before an LSI, with removal criteria based solely on field evidence (Table 1). When addressing a release by excavation alone during an AST upgrade or install (Section I.A.1), field screening and soil sampling are required as described in Section I.

Contaminated soil must be managed in accordance with Section I.G.

2. Excavation at the time of AST decommissioning

Refer to Section I to determine if excavation alone will adequately address the release or if an LSI will be required.

III. Soil sampling requirements during tank or tank system component removal

The following requirements apply when there is evidence of a release from a regulated tank system. For sampling requirements when there is no evidence of a release, refer to [Site Assessment for Underground Storage Tanks With No Apparent Contamination](#) and [Out-of-Service Above-Ground Storage Tank Systems](#). The requirements below are in addition to the sampling requirements described in Section I.F, which include excavation sidewall and bottom sampling.

Unregulated Tanks

The MPCA strongly encourages owners of unregulated petroleum tanks to follow the sampling requirements described in this section when there is evidence of a release at the time of removal. Soil sample results may be used to justify not requiring a costlier site investigation when a release has occurred. Petroleum release reporting requirements apply to all tanks regardless of their regulation status.

A. Sample collection requirements

Collect soil samples for soil analysis according to the requirements in Tables 3 and 4. Collect samples following the methods and procedures described in [Soil Sample Collection and Analysis Procedures](#). Note: AST sampling is required in any circumstance when a release has occurred or visible contamination is present, including tank facility upgrades and tank decommissioning.

Table 3. Underground storage tank sampling requirements

Sample location	Sampling specifics
Tanks	
One tank, any size, in an individual tank basin	two samples; one sample directly below each end of the tank
More than one tank, less than 10,000 gallons, in a single tank basin	one sample directly below the center of each tank
More than one tank, 10,000 gallons or larger, in a single tank basin	two samples; one sample directly below each end of each tank
Tank system components	
Dispensers	one sample below each removed dispenser
Leaking pipes	one sample below each suspected point of release, or every 20 feet if the release point is unknown

Collect any additional samples needed to adequately characterize the excavation(s) as described in Section I.E.

Table 4. Aboveground storage tank sampling requirements

Sample location	Number of samples	Sampling specifics
Tanks (type and size)		
Vertical tank up to 15-foot diameter	one sample	2 feet below the center of the tank
Vertical tank greater than 15-foot diameter	divide tank bottom surface area in square feet by 113 square feet and round to the nearest whole number (see example below*)	2 feet below the tank, evenly spaced
Horizontal tank up to 10,000 gallons	one sample	2 feet below the center of tank
Horizontal tank greater than 10,000 gallons	two samples	2 feet below each end of the tank

***Example:** 27-foot diameter tank: $573/113 = 5.07$. Round to the nearest whole number, 5. Five soil samples are required.

Tank system components		
Transfer area(s)	one sample in each area if there is more than one transfer area	2 feet below the loading rack
Leaking pipes ¹	one sample below each suspected point of release, or every 20 feet if the release point is unknown	2 feet below the sampling location
Visible contamination	one sample from each distinct stained area	submit sample from the most heavily stained soil

Collect any additional samples needed to adequately characterize the release(s).

¹ Field screen soil two feet below the following areas: pipefittings, joints, and any other area where there is evidence of a suspected release from the piping.

B. Analytical requirements

Analyze soil samples following the procedures and analytical requirements described in [Soil Sample Collection and Analysis Procedures](#). All analytical requirements must be met, including volatile organic compounds (VOCs), as well as metals and polychlorinated biphenyls (PCBs) when applicable to the product type.

IV. Excavation as corrective action after a limited site investigation

Soil excavation can be an appropriate corrective action to address actual or potential impacts where risks are high (e.g., drinking water or surface water impact, vapor intrusion, or direct human contact). Design, implementation, and reporting of soil excavation as a corrective action are described in [Corrective Action Design and Implementation](#). When soil is excavated as a corrective action after a limited site investigation, the results are reported in a [Corrective Action Excavation Report](#).

Two scenarios for excavation as corrective action following a limited site investigation include: excavation of a light non-aqueous phase liquid (LNAPL) body and excavation of contaminated surface soil. The general excavation requirements for field screening, soil sampling, and management of petroleum-contaminated soil described in Section I are typically applied to these two scenarios with exceptions noted below.

A. Excavation of an LNAPL body

Excavation of an LNAPL body can be a cost-effective method for reducing or eliminating long-term risks if the LNAPL body is accessible given depth, soil types, groundwater occurrence, and the absence of obstructions such as buildings or utilities. Excavation of the LNAPL body can result in nearly complete removal of the contaminant source mass and, depending on the site-specific risk scenario, subsequent site closure. Source removal by excavation should be considered as an option when remediation is necessary.

Field screen overburden soil as it is removed to assure that no portion of it is contaminated with LNAPL. In addition, screen soil near the lateral and vertical extents of the LNAPL body to confirm the final excavation extent. Screening can be accomplished using direct evidence of LNAPL, including visual observation for staining and sheen and/or use of the petroleum sheen test. Soil headspace screening may be used to pre-screen soil, but positive detections should not be considered sufficient evidence of LNAPL impacts. If soil headspace is used to pre-screen soil, LNAPL impacts should be confirmed using the other, more direct methods. The MPCA will consider the use of other screening methods (e.g., ultraviolet black box, mobile laboratory) on a case-by-case basis. Contact the MPCA for approval to excavate beyond the approved extent or to exceed the approved volume.

Remove and segregate all LNAPL-impacted soil for treatment or disposal. Collect final excavation sidewall and bottom samples for laboratory analysis as described in Section I unless the excavation is being completed solely to address LNAPL migration risk. Re-use clean overburden soil to backfill the interval from which it was originally removed and import clean fill to backfill the interval from which the targeted LNAPL-impacted soil was removed. If the LNAPL body is present in fine-grained soil, imported fill should consist of fine-grained soil.

See [Corrective Action Design and Implementation](#) for additional considerations regarding LNAPL body excavation design and implementation.

B. Excavation of contaminated surface soil

Contaminated surface soil is excavated following an approved corrective action design based on petroleum sheen test and soil analytical results. Field screening during surface soil excavation is generally limited to the petroleum sheen test. Screen soil at the edges of the approved excavation extent using the sheen test to determine if additional excavation is necessary. Contact the MPCA for approval to excavate beyond the approved extent or to exceed the approved volume.

Post-excavation soil sampling is not required to document contamination remaining in place after a surface soil excavation. Sampling of the removed soil, however, may be required prior to soil treatment or disposal approval. Backfill excavated areas with clean fill to restore the site to its original surface grade.

See [Risk Evaluation and Site Management Decision at Petroleum Release Sites](#) for additional information regarding the contaminated surface soil pathway. Refer to [Soil and Groundwater Assessments Performed During Site Investigations](#) for information on completing a surface soil assessment.

Appendix A. UST removal/installation flowchart

