Excavation of petroleum-contaminated soil and tank removal sampling

Petroleum Remediation Program

This document describes requirements for petroleum contaminated soil excavation performed at the time of tank system removal, installation, or upgrade. A tank system includes any element of the system, such as tanks, dispensers, and/or piping. Also defined are sampling requirements that must be conducted during any tank system removal (including both regulated and unregulated tank systems) when a petroleum release is evident.

Release reporting

Report any detection of petroleum contamination in soil or groundwater to the Minnesota duty officer, even if contaminant levels are lower than the action levels stated below.

Emergency conditions

Immediately contact the Minnesota duty officer if there is a recent release or there are vapor impacts, drinking water impacts, surface water impacts, non-aqueous phase liquid (NAPL), or an unstable environmental condition.

Additional information

Additional guidance related to release reporting, release response, and emergency conditions can be 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

Excavate petroleum-contaminated soil prior to completing a limited site investigation (LSI) in the situations listed below. Otherwise, contaminated soil should remain in place until an LSI is completed.

1. Excavate all contaminated soil meeting any of the field screening criteria listed in Table 1 up to a maximum of 200 cubic yards, providing that groundwater is not impacted or likely to become impacted. Contaminated soil excavation in this scenario is intended to eliminate the need for an LSI. See subsection B below for more details. Soil sample collection and analysis procedures describes soil headspace screening and petroleum sheen test procedures. In certain situations, a site-specific risk scenario may justify excavating more than 200 cubic yards. Contact the Minnesota Pollution Control Agency (MPCA) for approval to exceed the 200 cubic yard limit.

Table 1. Field screening criteria

Petroleum product	Soil headspace screening level (ppmv*)	Visual evidence	Petroleum-saturated	Grossly contaminated (ppmv*)
Gasoline, ethanol-blended fuel, and aviation gasoline	40 or above	Visual evidence of petroleum staining	Positive sheen test result	200 or above
Diesel fuel, fuel oil, used or waste oils, jet fuel, kerosene	10 or above			

*ppmv (parts per million by volume)

2. If accessible, excavate up to 200 cubic yards of petroleum-saturated or grossly contaminated soil during tank removal, system installation, or system upgrade. 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 sample collection and analysis procedures describes soil headspace screening and petroleum sheen test procedures. In certain situations, a site-specific risk scenario may justify excavating more than 200 cubic yards. Contact the MPCA for approval to exceed the 200 cubic yard limit.

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.

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.
5. Excavate petroleum-contaminated soil if it is necessary to facilitate tank system installations (see Section II).

B. Situations requiring a limited site investigation

An LSI is necessary if:

1. Excavation of 200 cubic yards or less of did not remove petroleum-contaminated soils as described in item 5 below.
2. Groundwater is present in the excavation basin and has been in contact with 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 known or suspected impacts exist, such as 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. Post-excavation soil borings encounter contaminated groundwater (see subsection C below).

C. Post-excavation soil borings

Sites with sandy or silty sand soil (Unified Soil Classification System/American Society for Testing Materials) and water tables within 25 feet of the ground surface require a soil boring(s) to determine whether an LSI is necessary. Advance a soil boring directly through each suspected source area, such as former tank locations, dispensers, and piping runs, in the following situations:

a. Soil contamination is between 1 and 100 mg/kg GRO/DRO at a suspected source area excavation; 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.

An LSI is necessary if the boring(s) encounters contaminated groundwater.

An LSI may not be necessary if the boring(s) encounters soil contamination that does not intersect the water table and the groundwater sample is not contaminated and is not likely to become 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 Table 1. All petroleum-saturated or grossly contaminated soil **must** be disposed of or treated as described in subsection G.2 or G.3 below.

E. Field screening during excavations

Field screening includes completing soil headspace screening with a PID and the petroleum sheen test as described in Soil sample collection and analysis procedures. Collect and field screen soil samples frequently enough to verify the need for soil removal, with at least one sample for each 10 cubic yards of soil removed.

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.

Label removed samples with the prefix "R", the sample ID, and the sample depth. Accurately show the sample locations on a scaled map. 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.

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 from the bottom and sidewalls of the excavation, along removed piping runs, and beneath removed dispensers to document the contamination remaining in place.

Label soil and groundwater samples collected for laboratory analysis according to the sample type, location, and depth.

Collect and analyze soil samples following the procedures and analytical requirements described in Soil sample collection and analysis procedures as follows:

Sidewall samples: Remove at least one foot of exposed soil prior to collection to ensure a representative sample for laboratory analysis. Collect sidewall samples at a rate of one sample per 25 linear feet of sidewall; collect a minimum of four sidewall samples, one from each side, to document the contaminant levels remaining in place. Collect samples at the depth interval with the highest contaminant level detection in the removed soil, the “R” samples, 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.

Bottom samples: Remove at least one foot of exposed soil prior to collection to ensure a representative sample for laboratory analysis. 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).

Collect and analyze groundwater samples following the procedures and analytical requirements described in Groundwater sample collection and analysis procedures:

Groundwater samples: When groundwater is present in an excavation basin, collect one sample per basin to assess groundwater contamination. A sample is not required if obvious evidence of contaminated groundwater exists such as visible or measurable petroleum product on the water, including petroleum sheen.

Following sampling, provide an excavation map showing soil and groundwater sample locations, site features, the two-dimensional extent of the final excavation footprint at the ground surface, and the final excavation depth contours using a contour interval of 1 to 2 feet.

G. Post-excavation petroleum-contaminated soil management

1. **On-site 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. 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. **Soil treatment or disposal**

   See Treatment and disposal of petroleum-contaminated soil for options and specific stockpile sampling requirements.

H. Excavation report

Complete a General excavation report worksheet when petroleum contamination is encountered during a tank system excavation prior to an LSI, even if no soil is removed for off-site treatment or disposal. If an LSI will not be completed, submit the General excavation report worksheet for MPCA review. If an LSI will be completed, include the General excavation report worksheet as an appendix in the Investigation report. The reporting deadline is 10 months from the date the MPCA issues a Petroleum Storage Tank Release letter. The MPCA establishes shorter deadlines for high-priority sites.

I. Endangering structures

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

II. Excavation during tank system replacement or removal

A. Planning ahead

It is recommended to gather at least two competitive bids prior to hiring a contractor in order to satisfy the Petrofund competitive bidding requirement in case petroleum contamination is encountered during excavation.

Bid forms are available from the Minnesota Department of Commerce Petrofund program, or by calling 651-539-1515 or 800-638-0418.

Note: Removals and installations of regulated tanks must be performed by MPCA-certified tank contractors.

Prior to beginning any tank work, plan for petroleum-contaminated soil storage and treatment or disposal (see Section I.G). 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. Replacement or removal of underground storage tanks

Report any detection of petroleum contamination in soil or groundwater to the Minnesota duty officer, even if contaminant levels are lower than the action levels stated in Table 1.

Conform to section I.A above, by removing and separating contaminated soil meeting any of the field screening criteria in Table 1, up to 200 cubic yards. Petroleum-saturated or grossly contaminated soil must be excavated if accessible. Contact the MPCA for approval to exceed the 200 cubic yard limit. For tank replacement(s), see Table 2 on the following page for allowable soil excavation based on tank volume.

Screen soil from around removed tanks, piping, and dispensers. Collect sidewall and bottom samples from the tank basin, piping, and dispenser areas if the excavation removed all contaminated soil meeting the criteria in Table 1 and groundwater is not likely to be impacted. Analyze soil samples following the procedures and analytical requirements described in Soil sample collection and analysis procedures.

An LSI is necessary 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. 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 Table 1.

Refer to Appendix A for a flowchart detailing petroleum-contaminated soil management during UST removals or installations. If the site is a closed petroleum release site, refer to Assessment of petroleum contamination at closed leak sites.

Table 2. Allowable contaminated soil removal during UST replacement

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 cubic yard for every linear foot of contaminated trench.

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

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

Remove up to 370 cubic yards of contaminated soil.

Example 2: Two 10,000-gallon tanks are being installed in the old tank basin, where one 4,000-gallon tank and one 6,000-gallon tank were 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

Remove up to 500 cubic yards of contaminated soil.

C. Replacement or removal of aboveground storage tanks

Excavation requirements at aboveground storage tank (AST) sites are similar to those for UST sites. Contaminated surface soil at AST sites often occurs at loading and transfer areas, valve locations, piping runs, and from tank releases. Contaminated surface soil poses a risk to surface water, groundwater, and human health via direct contact, and requires corrective action.

Contaminated surface soil

Excavating contaminated surface soil when upgrading or installing AST systems is not equivalent to 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 replacement or removal (Section I.A.1), field screening and soil sampling are required as described in Section I.

Conform to Section I.A above, by removing and separating contaminated soil meeting any of the field screening criteria in Table 1, up to 200 cubic yards. Petroleum-saturated or grossly contaminated soil must be excavated if accessible. Contact the MPCA for approval to exceed the 200 cubic yard limit.

If excavation encounters contaminated surface soil (meeting field-screening criteria in Table 1) during an AST upgrade or new system installation, remove up to two feet of contaminated soil below piping, dispenser areas, loading and transfer areas, and the footprint of the new AST containment berm up to 200 cubic yards.

If the contaminated soil 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 MPCA approval before excavating beyond the stated limits or exceeding the 200 cubic yard limit.

If contaminated surface soil exists in areas of the site other than those listed above, removal or other corrective actions may be necessary but should wait until an LSI is conducted. Conduct soil removal prior to an LSI 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 and I.A.2.

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

The following requirements apply when there is evidence of a release from a tank system, regardless of tank regulation status, e.g., federal, state, or unregulated. 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 above in Section I.F, which include excavation sidewall and bottom sampling.

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
Piping	One sample below each suspected point of release, or every 20 feet if the release point is unknown

Collect 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	Two 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 (example below*)	Two feet below the tank, evenly spaced
Horizontal tank up to 10,000 gallons	One sample	Two feet below the center of tank
Horizontal tank greater than 10,000 gallons	Two samples	Two 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 transfer area	Two feet below the loading rack
Piping[1]	One sample below each suspected point of release, or every 20 feet if the release point is unknown	Two feet below the sampling location
Visible contamination	One sample from each distinct stained area	Submit sample from the most heavily stained soil
Collect 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. Meet all analytical requirements, 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, such as drinking water or surface water impact, vapor intrusion, or direct human contact. Corrective action design and implementation describes the design, implementation, and reporting of soil excavation as a corrective action. If excavating soil as a corrective action after an LSI, report the results in a Corrective action excavation report.

Two scenarios for excavation as corrective action following an LSI include: excavation of an 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 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, expedite subsequent site closure. Consider source removal by excavation as an option when remediation is necessary.

Field screen overburden soil to assure that no portion of it is contaminated with LNAPL. 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. Use soil headspace screening to pre-screen soil, but positive detections are not sufficient evidence of LNAPL impacts. If soil headspace is used to pre-screen soil, confirm LNAPL impacts using other, more direct methods. The MPCA considers other screening methods, such as ultraviolet black box or 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 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

Excavate contaminated surface soil 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 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. Tank replacement or removal flowchart.