

## **SITE INVESTIGATION OUTLINE**



**ENERGY AND ENVIRONMENT CABINET  
DIVISION OF WASTE MANAGEMENT  
UNDERGROUND STORAGE TANK BRANCH  
200 FAIR OAKS LANE, SECOND FLOOR  
FRANKFORT, KENTUCKY 40601  
502-564-5981**

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# **SITE INVESTIGATION OUTLINE**

## **INTRODUCTION**

This outline identifies required site investigation activities for releases from underground storage tank (UST) systems, including protocols for sampling soil and/or groundwater to determine the horizontal and vertical extent of contamination in accordance with 401 KAR 42:060.

The UST Branch shall require a site investigation if contamination levels, outside the excavation zone, exceed the screening levels prescribed in the Classification Outline, incorporated by reference in 401 KAR 42:080, for regulated petroleum underground storage tank system(s). For definition of terms used within this outline, refer to 401 KAR 42:005.

The UST Branch shall direct all site investigation activities in writing. The UST Branch shall send written directives for site investigation activities until the full horizontal and vertical extent of contamination has been defined. Site investigation activities shall be reported on the Site Investigation Report Form, DEP8049 that shall be completed and signed by a Professional Engineer (P.E.) licensed with the Kentucky Board of Licensure for Professional Engineers and Land Surveyors, or a Professional Geologist (P.G.) registered with the Kentucky Board of Registration for Professional Geologists.

If free product is encountered outside of the excavation zone, with the exception of free product discovered in borings, monitoring or recovery wells or during over-excavation activities, or if vapors are detected in buildings or utility conduits, refer to the Release Response and Initial Abatement Requirements Outline. The UST Branch reserves the right to require additional information beyond that specified in this outline necessary to determine the full horizontal and vertical extent of contamination. The owner/operator shall be contacted, in writing, by the UST Branch if additional information is required.

If the cabinet determines, through an evaluation of submitted information and site-specific conditions, that the extent of vertical and horizontal contamination has been defined and that action is necessary in accordance with 401 KAR 42:060, the cabinet shall issue a written directive to initiate actions in accordance with the Corrective Action Outline.

## **1.0 SITE INVESTIGATION REPORTS**

Summaries of directed site investigation activities shall be submitted on the Site Investigation Report Form DEP8049. Sections 2 through 12 of this outline correspond to Sections 2 through 12 of the DEP8049 form. If Section 10 of the DEP8049 form will include a recommendation for source removal, information listed in Section 11 of this outline shall be provided in addition to data interpretation and conclusions. If information for any section of DEP8049 cannot be properly addressed on the form, attach additional documentation as appendices. Photographs as required in writing by the UST Branch or by regulation (e.g., photographs of site, monitoring well pads, potential receptors, etc.) shall be submitted in an appendix also.

## **2.0 SITE GEOLOGY AND HYDROGEOLOGY**

- 2.1 Provide a description of the local and regional geology, hydrogeology, and surface water hydrology based upon reasonably current scientific publications. Include a lithologic description of the underlying geology as described on the geologic quadrangle.

If the site is located in a carbonate bedrock setting, provide documentation indicating that a hydrogeologic survey was conducted, identifying all relevant features such as sinkholes, sinking streams, caves, and all springs in the locale surrounding the site (includes research of published information and field reconnaissance). Contact the Kentucky Division of Water at (502) 564-3410 to obtain any existing information on carbonate bedrock drainage near the site.

- 2.2 Provide a description of the site geology and hydrogeology based upon information obtained during soil boring and monitoring well drilling activities.

### **3.0 MAPS**

- 3.1 An Initial Site Survey shall be completed when directed in writing by the UST Branch. The Initial Site Survey shall establish a site map to be used for future site investigation activities. The Initial Site Survey map shall include the approximate property boundaries of the subject site and adjacent properties, and shall identify the name and contact information for each off-site property owner. The Initial Site Survey map shall also depict features in (a) and (b) below located within an approximate 30-meter (100 feet) radius of the UST system excavation zone. Maps shall be stamped and signed by a P.E. or a P.G. The Initial Site Survey map shall: be to scale, identify the reference point (i.e., a datum or USGS benchmark), include a North arrow, bar scale and legend, and accurately depict the following, as applicable:

- a) The excavation zone(s), sampling locations within the excavation zone, confirmatory sampling locations from over-excavation, buildings, roadways, approximate property lines, domestic-use wells, domestic-use cisterns, domestic-use springs, drinking water intake points, streams, ponds, lakes, piping, dispenser islands, soil borings, temporary monitoring wells, monitoring wells, canopies, railroad tracks, storm sewer catch basins, overhead utilities, buried utilities, septic systems, wetlands, paved areas, gravel areas, grassy areas, trees, bridges, drainage ditches, fences, inaccessible steep slopes, etc.;
- b) Any feature that would obstruct future sample collection shall be identified on a map and in writing (e.g., when a conventional drill rig is used for sample collection, identification of areas with limited space, overhead utilities, etc., is necessary); and
- c) The reference point used for surveying the top of casing elevations for existing monitoring wells shall be identified on the Initial Site Survey map and shall be maintained for future top of casing elevation measurements.

If permanent changes (e.g., construction, demolition, utility installations, etc.) are made at a site that would affect an ongoing site investigation, these changes shall be reported to the UST Branch. The Initial Site Survey map shall be amended, as directed in writing by the UST Branch, to reflect those changes.

Further field work (additional soil borings and/or monitoring wells) shall be surveyed when completed. For subsequent site investigation activities, the UST Branch may request an Additional Site Survey(s), if contamination in soil and/or groundwater extends beyond the area covered by the most recent site survey. Additional Site Surveys shall include features listed in this section, and extend approximately 30-meters (100 feet) beyond the perimeter of the most recent site survey area in the direction of confirmed contamination, as directed in writing by the UST Branch. Additional Site Surveys shall be depicted with the Initial Site Survey on a single map.

- 3.2 Provide a vicinity map for the site and surrounding properties. The vicinity map does not have to be surveyed (but should be roughly to scale). It shall depict adjacent properties within 100 meters (328 feet) of the site (businesses, residences, other UST sites and their corresponding Agency Interest numbers, domestic-use wells, domestic-use springs, and domestic-use cisterns, etc). The vicinity map shall be submitted with the Initial Site Investigation Report or as requested by the UST Branch.

If domestic-use wells, domestic-use springs, or domestic-use cisterns are located between 100 and 300-meters, an expanded vicinity map extending to 300 meters that depicts the location of these features may be directed in writing by the cabinet.

- 3.3 Provide the portion of the 7.5-minute USGS (United States Geological Survey) topographic map

depicting the location of the site. The portion of the topographic map submitted shall indicate the name of the map, latitude and longitude of the UST facility, and a map scale. The topographic map shall be submitted with each Site Investigation Report.

- 3.4 Provide the portion of the 7.5-minute USGS geologic quadrangle map depicting the location of the site. The portion of the geologic quadrangle map submitted shall indicate the name of the map, latitude and longitude of the UST facility, the map scale and the legend. The geologic quadrangle map shall be submitted with each Site Investigation Report.
- 3.5 A groundwater potentiometric surface map shall be submitted for each groundwater sampling and gauging event where three or more sampling points are gauged. The groundwater flow direction shall be shown on the map with an arrow. Equipotential lines shall be properly labeled. Equipotential lines shall agree with the data. The map shall be supported by the data and shall not include equipotential representations outside the area covered by the data. Data from different sampling events shall not be included on the same map or represented as being equivalent or simultaneous. The most recent site survey map shall be used as a base map for groundwater potentiometric surface maps. Groundwater potentiometric surface maps shall be submitted with each Site Investigation Report involving groundwater sampling or gauging.
- 3.6 Provide a contaminant extent map that depicts the horizontal extent of residual soil contamination, as applicable, for the site (and adjacent properties, if affected) for each phase of site investigation, including residual soil contamination, verified by previous sampling events, that has not been remediated or re-sampled to verify residual levels below the applicable screening levels.

Provide a contaminant extent map that depicts the horizontal extent of residual groundwater contamination, as applicable, for the site (and adjacent properties, if affected) for each phase of site investigation including residual groundwater contamination, verified by previous sampling events, that has not been remediated or re-sampled to verify residual levels below the applicable screening levels.

An individual map shall be developed, depicting a single extent delineation line for BTEX, PAH, and Lead respectively, as applicable. Up to three (3) maps for soil and three (3) maps for groundwater may be necessary depending upon the contaminants present and the media impacted.

Extent delineation lines shall be supported by the analytical data and shall not include areas that have not been assessed or supported by data from soil borings and/or monitoring wells. The most recent site survey map shall be used as a base map for the contaminant extent map(s). Contaminant extent maps shall be submitted with each Site Investigation Report.

#### **4.0 FIELD INVESTIGATIONS – SOIL**

For soil samples collected during any phase of site investigation activities, the UST Branch shall require, in writing, the collection of soil samples using a grid-based or other pre-determined approach to delineate the vertical and horizontal extent of soil contamination. Reporting of site investigation activities shall include a discussion of soil sample collection, handling, and preservation. The following steps shall be followed for soil sample collection and handling at sample locations designated by the UST Branch.

- 4.1 The UST Branch shall send a written request that identifies required soil sampling locations on a site map where soil borings shall be advanced.
- 4.2 Soil borings shall be advanced at the center of the designated grid block, unless otherwise specifically required by the UST Branch. Where buildings, structures, utility conduits, trees, or

other features obstruct the center of the block, the soil boring shall be advanced within the available space as near as possible to the center of the grid block.

If a soil boring cannot be advanced in the designated area as requested, the soil boring shall be advanced in an area based on the best professional judgment of the P.E. or P.G. Photographic documentation shall be included in the report submitted to support the need for alternate boring placement. A narrative description shall be included within the report submitted to explain the selection of the alternative location determined for the soil boring.

- 4.3 In order to advance borings to the requested depth, appropriate equipment, determined on a site-specific basis (e.g. drill rigs, direct-push technology, hand auger), shall be utilized to penetrate obstructive layers that do not represent bedrock. Alternate locations within a grid block should be attempted if subsurface obstructions are encountered that are inconsistent with established site-specific conditions. A description of these efforts shall be included in the narrative of the submitted report.

- 4.4 Specific soil sample intervals for each sample location shall be identified in a written directive from the UST Branch. Continuous soil collection and continuous soil screening is required at each soil boring location. A representative soil sample shall be collected from within every two (2) feet of a directed interval and field screened with a properly calibrated field screening instrument, [e.g. PID (photoionization detector) or FID (flame ionization detector)]. The portion of the directed interval with the highest field screening reading shall be submitted for laboratory analysis. If field screening does not indicate the presence of contamination within a directed interval, a soil sample from the middle portion of that interval shall be submitted for laboratory analysis. Proper calibration of the field screening instrument shall be documented in any site investigation report submitted to the UST Branch.

If soil borings cannot be advanced to the required depth due to bedrock, the total depth of the boring shall be divided into intervals equal to the number of samples required (excluding the termination sample collected in accordance with 4.5 of this section) in the written directive. Each interval shall be field screened and a soil sample shall be collected from the interval with the highest field screen reading and submitted for laboratory analysis. If field screening does not indicate the presence of contamination within a directed interval, a soil sample from the middle portion of that interval shall be submitted for laboratory analysis.

- 4.5 A soil sample from the termination depth of the deepest interval or from the soil-bedrock interface shall be analyzed.
- 4.6 Soil samples from borings may be collected by split-spoons, direct-push soil samplers, or hand augers. Written approval from the UST Branch shall be necessary for other soil collection methodology.
- 4.7 Collection of soil samples and transfer of soil samples from the sampling device to the sample container should minimize disturbance and the amount of time that the sample is exposed to air. Soil sample collection, handling, and preservation shall be achieved in a manner that reduces the loss of VOC (volatile organic compound) contamination due to volatilization and biodegradation. Sample collection and handling shall prevent cross contamination between samples and between sample locations. Samples shall be placed into containers with zero headspace, stored on ice at 4°C or less (plus or minus 2°C), etc. Soil samples shall be analyzed for the appropriate constituents (see Section 7.0 for sample handling, analysis, etc.). Documentation of soil sample collection, handling, and preservation procedures shall be reported for all field work. For VOC analyses, analytical results for soil samples collected from auger cuttings or from auger flights shall not be accepted by the UST Branch.
- 4.8 A soil boring log shall be submitted for each soil boring. Field screening results, from a properly calibrated instrument, corresponding to each two (2) foot interval shall be recorded on each soil

boring log. Soil boring logs shall include a description of soil lithologies, lenses or thin layers encountered, the presence or absence of water and free product, and the depth of water and product if encountered.

NOTE: It is preferred that all soil and unconsolidated lithological logging be completed by utilizing the Unified Soil Classification System (USCS). The USCS is a soil classification system, used in engineering and geology professions, to give field guidance to consistently and objectively determine and describe the texture, grain size and other pertinent properties of a soil or unconsolidated sediment.

- 4.9 For any report detailing site investigation activities, all current and historical analytical data for soil shall be reported in a soil data table (in chronological order) that includes the sample identification number, depth sampled, date sampled, and the analytical results (indicating appropriate units). Soil results from site check and/or tank/piping closure activities shall be included in the comprehensive historical soil data table. The table shall include the appropriate screening levels in mg/kg for the constituents of concern. For grouped constituents under cPAH and nPAH, list the individual constituent having the highest concentration. See Figure 1 at the end of this outline for an example of an historical soil data table.
- 4.10 All borings shall be properly decommissioned immediately after obtaining a sample. Proper decommissioning is achieved by sealing the boring with cement/bentonite or bentonite from bottom to top in a manner that prevents communication of surface water and groundwater through the boring and to prevent communication between two or more water-bearing zones through the boring. (Note that if a soil boring is to be converted to a monitoring well, then the soil boring does not need to be properly decommissioned prior to monitoring well installation.)
- 4.11 Cross-sections of the site that correspond to soil borings, that adequately illustrate the lithology of the site, shall be submitted as directed in writing by the UST Branch. Cross sections shall be drawn to scale (vertical and horizontal) with a legend. All data points and cross section lines on the map shall be accurately labeled.
- 4.12 The owner/operator/contractor/consultant bears the responsibility of exploring, identifying, and addressing all potential safety hazards throughout the course of field work.
- 4.13 If free product is discovered in a boring during site investigation activities, include a summary of the type of free product, thicknesses, locations, etc., and recommendations for free product recovery in the Site Investigation Report.

## **5.0 FIELD INVESTIGATIONS – GROUNDWATER**

If collection of groundwater samples is required for any phase of site investigation, the UST Branch shall send a written request requiring the collection of groundwater samples. Groundwater investigation shall utilize a grid-based approach for selecting monitoring well locations. Each phase of site investigation shall include a discussion of groundwater sample collection and handling. The following steps shall be followed for groundwater sample collection, handling, and preservation at sample locations designated by the UST Branch.

- 5.1 The UST Branch shall send a written request that identifies groundwater sampling locations on a site map overlain by a grid with grid blocks designated where monitoring wells shall be constructed. If directed by the UST Branch, installation of temporary monitoring wells may be required. For more information about temporary monitoring wells, refer to Closure Outline, incorporated by reference in 401 KAR 42:070.

- 5.2 Groundwater monitoring locations shall be at the center of the designated grid block, unless otherwise specifically requested by the UST Branch. Where buildings, structures, utility conduits, trees, or other features obstruct the center of the block, the groundwater monitoring location shall be within the available space as near as possible to the center of the grid block.

If a monitoring well or a temporary monitoring well cannot be advanced in the designated area as requested, the monitoring well or a temporary monitoring well shall be installed in an area determined by the best professional judgment of the P.E. or P.G. Photographic documentation shall be included in the report submitted to support the need for alternate well placement. A narrative description shall be included within the report submitted to explain the selection of the alternative location determined for the monitoring well or temporary monitoring well.

- 5.3 In order to advance groundwater monitoring wells to the requested depth, appropriate equipment, determined on a site-specific basis, shall be utilized to penetrate obstructive layers that do not represent bedrock. Alternate locations within a grid block should be attempted if subsurface obstructions are encountered that are inconsistent with established site-specific conditions. A description of these efforts shall be included in the narrative of the submitted report.
- 5.4 If collection of soil samples during monitoring well installation is directed, see Section 4.0 for the soil sampling protocol.
- 5.5 The depth to water in each monitoring well shall be gauged every time groundwater samples are collected. Each time a monitoring well is sampled, the date gauged, depth to water (top of casing should be marked for consistent measurements), the groundwater elevation, volume of purge water, screened interval, and a sample description (e.g., turbidity, odor, sheen, etc.) shall be recorded, in conjunction with historical gauging information, in a table and reported, in writing, to the UST Branch. Include the monitoring well name and AKGWA number in the table. See Figure 2 at the end of this outline for an example of a historical gauging table. For each sampling event, a groundwater potentiometric surface map shall be submitted where three or more sampling points are gauged (see Section 3.5 of this outline for groundwater potentiometric surface map requirements). Each site investigation report shall discuss trends in groundwater flow direction and groundwater fluctuations with regard to potential movement and distribution of contamination (e.g., smear zones).
- 5.6 Monitoring wells and temporary monitoring wells shall be properly purged to obtain groundwater samples that are representative of the groundwater at the site. Collection and transfer of a groundwater sample from the sampling device to the sample container should minimize disturbance and the amount of time that the sample is exposed to air. Groundwater sample collection, handling, and preservation shall be achieved in a manner that reduces the loss of VOC contamination due to volatilization and biodegradation. Sample collection shall minimize sample agitation. Sample collection and handling shall prevent cross contamination between samples and between sample locations. Samples shall be placed into containers with zero headspace, with the appropriate preservative, stored on ice at 4°C or less (plus or minus 2°C), etc. Groundwater samples shall be analyzed for the appropriate constituents (see Section 7.0 for sample handling, analysis, etc.). Provide a summary of groundwater sample collection, handling, and preservation procedures.
- 5.7 For any report detailing site investigation activities, all analytical data for groundwater shall be reported in a historical groundwater data table that includes the sample identification number, date sampled, and the analytical results in mg/L. Include the monitoring well name and AKGWA number in the table. Groundwater analytical results from site check and/or tank/piping closure activities shall be included in the comprehensive historical groundwater data table. The table shall include the appropriate screening levels in mg/L for the constituents of concern. For grouped constituents under cPAH and nPAH, list the individual constituent having the highest concentration. See Figure 3 at the end of this outline for an example of an historical groundwater data table.

- 5.8 Monitoring well and temporary monitoring well construction, modification, and abandonment shall be performed in accordance with 401 KAR 6:350. Copies of documentation for construction, modification, and abandonment activities shall be submitted to the UST Branch. In addition to the requirements of 401 KAR 6:350, the following are required for monitoring wells and temporary monitoring wells installed at UST facilities:
- a) Monitoring well screens and filter packs shall be installed in a manner that enables collection of groundwater samples at appropriate depths (i.e., the screened interval shall be constructed so that it intersects the surface of the water table and accounts for seasonal fluctuations in the static water level).
  - b) Monitoring wells shall be properly maintained throughout site investigation and corrective action activities. If a monitoring well is in a state of disrepair (e.g., cracked concrete pad, damaged protective casing, etc.), the monitoring well shall be properly repaired or abandoned (if repair is not possible). Maintenance, modification, or repair to monitoring wells shall be performed and reported as required by 401 KAR 6:350. For owners/operators seeking reimbursement from the UST Branch for monitoring well maintenance, modification, or repair, documentation shall be provided, including photographs, and a written directive from the UST Branch shall be issued prior to incurring costs.
  - c) Owners/operators/contractors/consultants shall ensure that all monitoring wells are properly maintained, marked and accessible (e.g., monitoring wells shall not be paved over).
  - d) Monitoring wells shall be properly developed as described in 401 KAR 6:350 and prior to the collection of groundwater samples from monitoring wells. Groundwater samples shall not be collected from a monitoring well for at least 48 hours after the monitoring well was installed (to allow well materials to cure and the subsurface to equilibrate).
  - e) Schematic monitoring well and temporary monitoring well construction diagrams shall be submitted to the UST Branch. The schematic construction diagrams shall, at a minimum, accurately depict the depth of the screen interval, riser casing interval, filter pack, bentonite seal thickness, and grout seal thickness. A written description of the procedures followed to ensure the integrity of the monitoring wells (e.g., locking caps, watertight seals, concrete pads) shall be submitted.
  - f) The borehole diameter shall be a minimum of four (4) inches larger than the outside diameter of the well casing unless a pre-packed screen is installed.
- 5.9 Provide documentation indicating that the drilling activities, if conducted, were terminated when bedrock was encountered in carbonate bedrock areas with potential subsurface solution channel flow. Site investigation activities shall initially include monitoring wells being placed into unconsolidated material only. After the evaluation of the monitoring wells in the unconsolidated material and the hydrogeologic investigation has been completed, deeper bedrock monitoring wells may be required on a site-specific basis. (Note that site-specific conditions (e.g., shallow bedrock) may prohibit the installation of overburden monitoring wells at the initiation of site investigation activities.) When a written directive for bedrock monitoring wells is issued by the UST Branch, special installation techniques that prevent cross-contamination of aquifers may have to be performed.
- 5.10 When a contractor's/consultant's professional opinion is that assessment of groundwater in bedrock is necessary, a proposal from a P.E. or P.G. shall be submitted to the UST Branch in writing. Bedrock monitoring wells shall be installed only if requested by the UST Branch in writing.



- 5.11 When a contractor's/consultant's professional opinion is that installation of piezometers is necessary, a proposal from a P.E. or P.G. shall be submitted to the UST Branch. Piezometers shall be installed only if requested by the UST Branch in writing. Note that analytical results for a groundwater sample collected from a piezometer shall not be accepted by the UST Branch unless the piezometer was installed by a certified monitoring well driller.
- 5.12 Cross-sections of the site that correspond to monitoring wells shall be submitted as requested by the UST Branch. Cross-sections shall depict lithology and groundwater surface elevation. Cross-sections shall be drawn to scale (vertical and horizontal) with a legend. All data points and cross-section lines on the map shall be accurately labeled.
- 5.13 The owner/operator/contractor/consultant bears the responsibility of exploring, identifying, and addressing all potential safety hazards throughout the course of field work.
- 5.14 If free product is discovered in a monitoring well during site investigation activities, include a summary of the type of free product, thicknesses, locations, etc., and recommendations for free product recovery in the Site Investigation Report. For owners/operators seeking reimbursement from the UST Branch for free product recovery activities, a written directive shall be issued by the UST Branch prior to beginning free product recovery activities. The recommendations shall include a discussion of the following to facilitate the development of a written directive by the UST Branch:
- Frequency of removal events (or site visits);
  - Number and location of wells used as extraction points; and
  - Equipment and materials necessary.
- 5.15 Domestic-use wells, domestic-use springs and domestic-use cisterns identified within a 300-meter (984 feet) radius from the UST system shall be sampled and analyzed for the appropriate constituents and MTBE, listed in Table B, as directed in writing by the UST Branch as necessary.
- Note: When directed in writing by the UST Branch, a domestic-use well or domestic-use cistern may be decommissioned in order to be disregarded in the determination of site classification. Cistern decommissioning consists of rendering the cistern inoperable by removing all accessible pumps and filling with inert material (grout, sand, gravel, etc.).
- 5.16 If groundwater, within the Point of Compliance, is contaminated above the screening levels specified in Groundwater Table 1, the UST Branch shall, if necessary, direct in writing that a groundwater assessment at the Point of Compliance be performed.

## **6.0 DECONTAMINATION AND MATERIAL MANAGEMENT**

- 6.1 To prevent cross contamination, all down-hole equipment (drilling tools, soil and groundwater sampling tools, water level meters, etc.) shall be properly decontaminated prior to and between boreholes.
- 6.2 Provide a summary of the handling and storage of material generated during the field investigation (development/purge water, soil cuttings, etc.), and submit documentation regarding the proper management of the waste (e.g., chain-of-custody, waste manifest, receipts, etc.). If wastes are determined to be hazardous, contact the Hazardous Waste Branch, Division of Waste Management, at (502) 564-5981, for additional requirements pertaining to waste disposal, manifesting, registration, etc.
- 6.3 All submitted reports shall include a summary of the amount of containerized waste generated, stored on-site, and disposed, recycled, or treated at a permitted facility.

## **7.0 ANALYTICAL REQUIREMENTS AND RESULTS**

- 7.1 Provide documentation indicating that recognized methods, in accordance with US EPA SW-846, were followed for sample collection, sample preservation, sampling equipment, decontamination procedures, sample containers, sample size, and maximum sample holding times (see Table C). Samples shall be delivered to an appropriate materials testing laboratory for the analysis required (see Tables A, B and C). Laboratory data sheets shall be submitted with site investigation reports. A trip blank, as defined in 401 KAR 42:005, shall accompany all water samples collected for BTEX analysis and the trip blank analysis shall be included with the laboratory analysis within the Site Investigation Report as required by written directive from the UST Branch. Trip blanks are not required for water samples collected for PAH and lead analysis where BTEX analysis is not required. Additional quality assurance/quality control requirements shall be directed in writing by the cabinet as necessary.

All laboratory data sheets shall at a minimum indicate the:

- date of sample collection;
- date received by the laboratory;
- date analyzed;
- sample extraction date (if required);
- surrogate recovery percentages;
- US EPA SW-846 method number(s) used; and
- appropriate reporting limits.

- 7.2 Provide chain-of-custody (COC) documentation that identifies who has had possession of the sample, the time of possession, and where the sample has been from the time of collection until the laboratory accepts it. The COC shall indicate the method of preservation and the temperature at which the samples were received by the laboratory. COC procedures shall be followed to ensure the validity of all samples. If the COC is not maintained (e.g., if someone leaves a sample unattended), then the integrity of the sample is compromised and may be rejected by the UST Branch. The COC shall be maintained as indicated by US EPA SW-846 requirements and shall be attached to all analytical results submitted, and shall include the trip blank or other additional quality assurance/quality control samples as directed in writing by the cabinet.
- 7.3 Site investigation reports submitted to the UST Branch shall discuss the validity of any flagged data (surrogate recovery data out of range, samples received at high temperature, etc.).

## **8.0 OFF-SITE ACCESS REQUESTS**

- 8.1 If soil and/or groundwater contamination likely extends off-site, all potentially affected property owners shall be identified in the Site Investigation Report. Provide the off-site property owner's name, mailing address, and telephone number to the UST Branch, and identify all existing access agreements. Provide copies of all existing written access agreements. Requests for off-site access agreements shall be directed in writing by the UST Branch, as necessary.
- 8.2 In response to a written directive from the UST Branch for off-site access, an attempt shall be made to directly contact the off-site property owner. If an agreement is obtained, a copy of the signed access agreement shall be submitted in response to the written directive. If an off-site property owner denies property access, a written denial shall be submitted to the UST Branch. If a written denial or signed access agreement is not obtained, a certified letter requesting off-site access shall be sent to the off-site property owner with a 14-day response deadline. If there is no response to the certified letter, submit to the UST Branch a copy of the off-site access request letter with the signed certification of delivery card, and a detailed description of attempts to directly contact the property owner.

## **9.0 CONCLUSIONS AND RECOMMENDATIONS**

- 9.1 Provide a narrative description of the progress towards defining the horizontal and vertical extent of soil and groundwater contamination including site-specific conditions that affect the completion of that determination.
- 9.2 Discuss potential impacts to buried utility conduits.
- 9.3 Discuss abatement measures implemented at the UST facility for vapors, fumes, and free product, if applicable.
- 9.4 If the horizontal and vertical extent of contamination has not been defined, provide recommendations for future actions, including:
- A map depicting proposed sampling locations for future soil borings or monitoring wells.
  - A discussion of soil boring depths and monitoring well construction needed to further determine the horizontal and vertical extent of contamination.
  - If a monitoring well is in a state of disrepair (e.g., cracked concrete pad, damaged protective casing, etc.), provide photographs and descriptions of necessary monitoring well repairs.
  - Necessary off-site access agreements (see Section 8.0 of this outline).
  - Necessary additional site surveys (see Section 3.0 of this outline).
  - A discussion and interpretation of any available trends utilizing previous gauging and data analysis.
  - Source contamination removal by over-excavation (see Section 10.0 of this outline).
- 9.5 If the horizontal and vertical extent of contamination has been defined, provide a general recommendation regarding the initial corrective action strategy (see the Corrective Action Outline).

NOTE: Upon completion of site investigation activities to determine the extent of contamination, the UST Branch shall determine whether site-specific information is sufficient to enable the performance of a statistical analysis of analytical data for soil samples, as appropriate. This statistical analysis shall determine whether individual soil sample data can be deemed statistically insignificant through a determination of the 95% Upper Confidence Limit (UCL). The spatial distribution of sample collection points shall be considered to ensure that the full extent of soil contamination is evaluated, and additional soil sampling shall be directed to fill data gaps as needed. If the existing site-specific information is sufficient to determine that residual soil contamination statistically meets the criteria for no further action at UST facilities for which groundwater contamination above screening levels does not currently exist, a No Further Action (NFA) letter shall be issued by the UST Branch.

If an NFA letter is not issued for soil contamination through a statistical analysis, or if groundwater contamination currently exists above screening levels, the UST Branch shall determine whether a Conceptual Site Model or a Corrective Action Plan is necessary in accordance with the Corrective Action Outline.

## **10.0 CONTAMINATION REMOVAL BY OVER-EXCAVATION**

In the interest of minimizing environmental contamination and promoting more effective cleanup, owners/operators may propose over-excavation of contamination above screening levels. For owners/operators seeking reimbursement from the cabinet for over-excavation activities, a written directive shall be issued by the cabinet prior to beginning over-excavation activities.

If contamination removal by over-excavation is recommended in the Conclusions and Recommendations (see Section 9.4) of a submitted site investigation report, include the following information in Section 10 of

the Site Investigation Report Form, DEP 8049 in order to facilitate the development of a written directive by the UST Branch:

- dimensions of the area(s) to be over-excavated and an estimate of the amount of soil to be removed (in tons);
- over-excavation area(s) depicted on a map;
- thickness and type of ground cover (e.g., concrete, asphalt, grass, etc.), including photographs;
- number and locations of confirmatory soil samples (if necessary);
- discussion of the management of pit water (if the presence of water is anticipated); and
- discussion of how over-excavation may affect future corrective action activities (e.g., short circuiting of remediation systems that may be used in the future).

10.1 In response to a written directive from the UST Branch, over-excavation activities shall be conducted as follows, unless otherwise directed by the UST Branch:

- If water is encountered that must be removed to allow for over-excavation, that water shall be managed properly.

NOTE: Eligible reimbursement for the removal, transportation and disposal or treatment of water, at a permitted facility, during over-excavation shall be made in accordance with 401 KAR 42:250, limited to one pit volume, and water encountered during over-excavation shall be sampled and analyzed to verify that contamination exceeds applicable screening levels.

- Confirmatory soil samples, if required, shall be collected within four (4) hours of the termination of over-excavation activities within each segment of excavated area. Soil samples shall be properly collected, handled, preserved, and analyzed according to SW-846;
- Excavated material contaminated above screening levels generated during over-excavation shall be properly received by a permitted disposal or treatment facility. The permitted facility shall have been issued a permit by the Solid Waste Branch prior to over-excavation.

NOTE: A petroleum contaminated soil treatment facility permit is required for a treatment facility to receive excavated material for the purpose of treatment. For additional information concerning petroleum contaminated soil treatment facility permits or to obtain a list of permitted disposal or treatment facilities in Kentucky, contact the Solid Waste Branch, Division of Waste Management, 200 Fair Oaks Lane, Second Floor, Frankfort, Kentucky 40601, or call (502) 564-6716.

- Excavated material treated at a permitted treatment facility shall meet the requirements of the permit prior to reuse as backfill material.
- Excavated material generated during over-excavation for regulated UST systems containing substances other than petroleum products is subject to a hazardous waste determination.
- Open pit management and safety is the responsibility of the owner/operator.

10.2 Over-excavation reports submitted in response to a written directive shall, at minimum, include:

- a narrative describing over-excavation activities, photographs of field work, an indication of the presence or absence of water in the over-excavation, and the volume of water removed, if encountered, etc.;
- laboratory data sheets and chains-of-custody for confirmatory soil and water samples;
- historical data tables for soil shall meet the requirements of Section 4.9 of this outline;
- documentation indicating the amount of excavated material accepted by a permitted disposal or treatment facility. A summary of weigh tickets for soil disposal or treatment that identifies the total tonnage disposed or treated (individual weigh tickets are not required with the technical report, but are required with the submittal of the claim for reimbursement);

- a map showing the initial excavation zone, previous soil and groundwater sampling locations, and the over-excavation area superimposed with confirmatory soil sample locations labeled; and

Owners/operators seeking reimbursement from the UST Branch for over-excavation activities shall follow 401 KAR 42:250. For questions regarding reimbursement, contact the UST Branch's Claims and Payment Section at (502) 564-5981.

## **11.0 SITE INVESTIGATION REPORT CERTIFICATION**

The Site Investigation Report Form, DEP8049 shall be completed and signed by a P.E. or a P.G.

**Table A**  
**Analytical Requirements for Soil Samples**

Product stored in UST System	Required Analysis	Acceptable Method	Maximum Acceptable Reporting Limit
Gasoline, Kerosene, or Jet Fuel	BTEX	Method SW-846 8240, 8260, 8020, or 8021	B: <0.01 ppm T: <0.7 ppm E: <0.9 ppm X: <5 ppm
Diesel or regulated Heating Oil	PAH	Method SW-846 8100, 8270, or 8310	Ch: <15 ppm B(a)A: <0.15 ppm c PAH: <0.3 ppm n PAH: <3 ppm NAP: <1 ppm
Waste Oil	PAH	Method SW-846 8100, 8270, or 8310	Ch: <15 ppm B(a)A: <0.15 ppm c PAH: <0.3 ppm n PAH: <3 ppm NAP: <1 ppm
	Total Lead	SW-846 7420, 7421, or 6010	Total Lead: <400 ppm
New Oil	PAH	Method SW-846 8100, 8270, or 8310	Ch: <15 ppm B(a)A: <0.15 ppm c PAH: <0.3 ppm n PAH: <3 ppm NAP: <1 ppm
Other Petroleum or Non-Petroleum	Contact the UST Branch		

BTEX: Benzene, Toluene, Ethylbenzene, and Xylene (total)  
 PAH: Polynuclear Aromatic Hydrocarbons  
 Ch: Screening level individually for Chrysene  
 B(a)A: Screening level individually for Benzo(a)anthracene  
 c PAH: Maximum Acceptable Reporting Limit Individually for Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, and Indeno(1,2,3-cd)pyrene  
 n PAH: Maximum Acceptable Reporting Limit Individually for Acenaphthene, Acenaphthylene, Anthracene, Benzo(ghi)perylene, Fluoranthene, Fluorene, Phenanthrene and Pyrene  
 NAP: Naphthalene  
 ppm: parts per million (mg/kg)

**Table B**

**Analytical Requirements for Pit Water and Groundwater Samples**

Product stored in UST System	Required Analysis	Acceptable Method	Maximum Acceptable Reporting Limit
Gasoline, Kerosene, or Jet Fuel	BTEX**	Method SW-846 8240, 8260, 8020, or 8021	B: <0.005 ppm T: <0.94 ppm E: <0.47 ppm X: <5.89 ppm
Diesel or regulated Heating Oil	c PAH n PAH NAP	Method SW-846 8100, 8270, or 8310	c PAH: <0.005 ppm n PAH: <3 ppm NAP: <0.3 ppm
Waste Oil	c PAH n PAH NAP  Dissolved Lead *	Method SW-846 8100, 8270, 8310  SW-846 7420, 7421, or 6010	c PAH: <0.005 ppm n PAH: <3 ppm NAP: <0.3 ppm  Dissolved Lead <0.015 ppm
New Oil	c PAH n PAH NAP	Method SW-846 8100, 8270, 8310	c PAH: <0.005 ppm n PAH: <3 ppm NAP: <0.3 ppm
MTBE sampling as required by the cabinet for domestic use water sources only	MTBE	Method SW-846 8240, 8260, 8020, or 8021	MTBE: <0.05 ppm
Other Petroleum or Non-Petroleum	Contact the UST Branch		

BTEX: Benzene, Toluene, Ethylbenzene, and Xylene (total)  
 PAH: Polynuclear Aromatic Hydrocarbons  
 c PAH: Maximum Acceptable Reporting Limit Individually for Benzo(a)pyrene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Chrysene, Dibenzo(a,h)anthracene, and Indeno(1,2,3-cd)pyrene  
 n PAH: Maximum Acceptable Reporting Limit Individually for Acenaphthene, Acenaphthylene, Anthracene, Benzo(ghi)perylene, Fluoranthene, Fluorene, Phenanthrene, and Pyrene  
 NAP: Naphthalene  
 ppm: parts per million (mg/L)  
 \* Samples shall be filtered prior to acid preservation. See Table C.  
 \*\* Shall include a trip blank analysis

**Table C**

**Appropriate Containers, Sample Sizes,  
Preservation Techniques and Maximum Holding Times\***

Parameter	Container Type	Sample Size	Preservation Method	Holding Times (Maximum)
Volatile Organics for Soil (BTEX)	Wide-mouth glass w/ Teflon lined cap	120 ml or 4 oz.	Cool to 4°C	14 days
Volatile Organics for Water (BTEX; MTBE)	Two (2) clear glass w/ Teflon-lined cap (VOA)	40 ml or 1 oz.	Add four drops of HCl to each, Cool to 4°C	14 days
Polynuclear Aromatic Hydrocarbons for Soil (PAH)	Wide-mouth glass w/ Teflon-lined cap	250 ml or 8 oz.	Cool to 4°C	14 days until lab extraction; 40 days after lab extraction
Polynuclear Aromatic Hydrocarbons for Water (PAH)	Amber glass w/Teflon-lined cap	1 liter	Cool to 4°C	7 days until lab extraction; 40 days after lab extraction
Total Lead for Soil	Wide-mouth glass w/ Teflon-lined cap	500 ml or 16 oz.	N/A	180 days
Dissolved Lead for Water (shall be filtered prior to acid preservation)	Plastic or glass	500 ml or 16 oz.	Cool to 4°C Add HNO <sub>3</sub> after filtering until pH is less than 2	180 days
Volatile Organics for Sludge (TCLP)	Wide-mouth glass w/ Teflon-lined cap	120 ml or 4 oz.	Cool to 4°C	14 days until lab extraction 14 days after lab extraction
Acid/Base/Neutral for Sludge (TCLP)	Wide-mouth glass w/ Teflon-lined cap	120 ml or 4 oz.	Cool to 4°C	14 days (hold) 7 days until lab extraction; 40 days after lab extraction
Metals for Sludge (TCLP)	Wide-mouth glass w/ Teflon-lined cap	500 ml or 16 oz.	Cool to 4°C	180 days until lab extraction 180 days after lab extraction
Mercury for Sludge (TCLP)	Wide-mouth glass w/ Teflon-lined cap	500 ml or 16 oz.	Cool to 4°C	28 days until lab extraction 28 days after lab extraction

- FOR FURTHER INFORMATION REFER TO US EPA SW-846 PUBLICATION.



**Figure 1 - Historical Soil Analytical Data Table Example**

Sample ID	Sample Interval (ft)	Date Sampled	On-site or Off-site	B (mg/kg)	T (mg/kg)	E (mg/kg)	X (mg/kg)	Resample Status/Comments
N. Wall	--	4/9/2003	On-site	<0.01	0.17	<0.01	<0.01	Below screening levels; CAR sample
S. Wall	--	4/9/2003	On-site	0.23	0.02	0.04	0.11	Below screening levels; CAR sample
E. Wall	--	4/9/2003	On-site	<b>3.2</b>	1.9	4.7	9.2	Resampled; below screening levels 6/29/2006
W. Wall	--	4/9/2003	On-site	1.4	0.23	0.94	1.3	Below screening levels; CAR sample
Bottom	--	4/9/2003	On-site	0.97	0.55	0.72	1.1	Below screening levels; CAR sample
PT/PI	--	4/9/2003	--	<i>no sample - pump island above tank pit</i>				
SB1	8-10	7/6/2003	On-site	<b>3.1</b>	0.37	0.44	0.95	Resampled; below screening levels 6/9/2006
SB2	8-10	7/6/2003	On-site	<0.01	<0.01	<0.01	<0.01	SI sample; below screening levels
SB3	6-8	7/6/2003	Off-site	<0.01	<0.01	<0.01	<0.01	SI sample; below screening levels
EW-R	--	1/22/2006	On-site	0.93	0.56	3.2	3.1	Resample of E. Wall soil; invalid sample - improper preservation
SB1-R	8-10	1/22/2006	On-site	0.42	0.22	0.21	0.53	Resample of SB1; invalid sample - improper preservation
EW-RR	--	6/29/2006	On-site	0.59	0.61	2.9	3	Resample of E. Wall soil; below screening levels
SB1-RR	8-10	6/29/2006	On-site	0.38	0.49	0.18	0.48	Resample of SB1; below screening levels
<i>Class A Screening Levels - Adjusted (mg/kg):</i>			<i>On-site</i>	<i>2</i>	<i>35</i>	<i>30</i>	<i>210</i>	
<i>Class B Soil Matrix Table I Screening Levels (mg/kg):</i>			<i>Off-site</i>	<i>0.1</i>	<i>35</i>	<i>30</i>	<i>210</i>	

**Figure 2 - Historical Groundwater Gauging Data Table Example**

Well Name (AKGWA number)	Date Measured	(A)* Top of Casing Elevation (ft)	(B) Depth to Hydrocarbon (ft)	(C) Depth to Water (ft)	Depth of Bore (ft)	Depth of Screened Interval (ft)	(A)-(B) Hydrocarbon Surface Elevation (ft)	(A)-(C) Water Surface Elevation (ft)	(C)-(B) Hydrocarbon Thickness (ft)	(See Note) Potentiometric Surface Elevation (ft)
MW1 (8004-1372)	1/30/2001	98.45	5.64	5.93	15.00	5-15	92.81	92.52	0.29	92.73
	9/12/2001		5.91	5.95			92.54	92.50	0.04	92.53
	11/13/2002		N/A	6.01			N/A	92.44	N/A	92.44
	3/15/2004		N/A	5.84			N/A	92.61	N/A	92.61
	6/16/2005		N/A	6.39			N/A	92.06	N/A	92.06
MW2 (8004-1373)	1/30/2001	97.55	N/A	7.67	15.00	5-15	N/A	89.88	N/A	89.88
	9/12/2001		N/A	7.89			N/A	89.66	N/A	89.66
	11/13/2002		N/A	8.01			N/A	89.54	N/A	89.54
	3/15/2004		N/A	7.55			N/A	90.00	N/A	90.00
	6/16/2005		N/A	6.79			N/A	90.76	N/A	90.76
MW3 (8004-1374)	1/30/2001	97.96	N/A	7.88	17.00	5-17	N/A	90.08	N/A	90.08
	9/12/2001		N/A	7.54			N/A	90.42	N/A	90.42
	11/13/2002		N/A	7.97			N/A	89.99	N/A	89.99
	3/15/2004		N/A	7.25			N/A	90.71	N/A	90.71
	6/16/2005		N/A	6.89			N/A	91.07	N/A	91.07

\* Identify the reference point utilized to determine top of casing elevations: \_\_\_\_\_  
 Water/hydrocarbon level measurements are recorded to 0.01 ft accuracy.  
 Specific gravity of hydrocarbons (S.G.) - 0.73  
 Note: Potentiometric Surface Elevation = (A)-(C)+S.G.[(C)-(B)]  
 N/A - Not Applicable

**Figure 3 - Historical Groundwater Analytical Data Table Example**

<b>Sample ID</b>	<b>Date Sampled</b>	<b>On-site or Off-site</b>	<b>B (mg/L)</b>	<b>T (mg/L)</b>	<b>E (mg/L)</b>	<b>X (mg/L)</b>	<b>cPAH (mg/L)</b>	<b>nPAH (mg/L)</b>	<b>NAP (mg/L)</b>	<b>Lead (mg/L)</b>
Pit Water	11/9/2003	On-site	<b>3.6</b>	0.99	0.77	2.1	<0.005	<0.005	<0.005	<0.005
MW1 (8004-1372)	4/12/2005	On-site	<b>1.7</b>	0.33	0.84	0.011	<0.005	0.25	0.003	<0.005
	8/15/2005		<b>1.57</b>	0.45	0.04	<0.005	<0.005	<0.005	0.004	<0.005
	12/5/2005		<b>1.03</b>	0.14	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	3/21/2006		<b>0.88</b>	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	6/29/2006		<b>0.56</b>	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	9/30/2006		<b>0.66</b>	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	1/8/2007		0.39	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
MW2 (8004-1373)	4/12/2005	On-site	0.004	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	8/15/2005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	12/5/2005		0.008	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	3/21/2006		0.009	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	6/29/2006		0.003	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	9/30/2006		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	1/8/2007		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
MW3 (8004-1374)	4/12/2005	On-site	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	8/15/2005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	12/5/2005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	3/21/2006		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	6/29/2006		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	9/30/2006		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	1/8/2007		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
MW4 (8004-1375)	1/8/2007	Off-site	0.004	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
MW5 (8004-1376)	1/8/2007	Off-site	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
<i>Groundwater Table 3 Screening Levels (mg/L):</i>		<i>On-site</i>	<i>0.31</i>	<i>101</i>	<i>148</i>	<i>719</i>	<i>0.005</i>	<i>3.0</i>	<i>0.3</i>	<i>0.015</i>
<i>Groundwater Table 1 Screening Levels (mg/L):</i>		<i>Off-site</i>	<i>0.007</i>	<i>0.94</i>	<i>0.47</i>	<i>5.89</i>	<i>0.005</i>	<i>3.0</i>	<i>0.3</i>	<i>0.015</i>