Mississippi Department of Environmental Quality
Underground Storage Tank Branch

Manual of Standard Operating Procedures

for Assessment and Cleanup at Leaking
Underground Storage Tank Sites

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Introduction

The Mississippi Department of Environmental Quality / Underground Storage Tank (MDEQ/UST) Standard Operating Procedures (SOP) Manual was created to replace the requirement for Environmental Response Action Contractors' (ERAC's) to submit a Quality Assurance/Quality Control (QA/QC) Plan, and to provide a clear, concise focus for performing UST assessment and cleanup work at UST sites in Mississippi. The purpose of this document is to standardize the work performed by ERACs in order to provide consistency in the quality and credibility of the data.

If a deviation from any requirement in this document is needed, the ERAC shall contact the MDEQ UST Project Manager for pre-approval prior to initiation of the field work. The tank owner will be informed by letter of any deviation not approved by the MDEQ, and this letter will be placed in the ERAC's performance file. Deviations not approved by the MDEQ UST Project Manager may not be reimbursable from the Mississippi Groundwater Protection Trust Fund (MGPTF).

For the consequences listed throughout the SOP, if the ERAC can provide justification for why the consequence should not be required, then the MDEQ UST project manager will review the justification for consideration.

I. Preinvestigation Activities

A. Obtaining Site History

In order to properly determine the necessary field activities (such as proper placement of soil borings and/or monitoring wells and boring/monitoring well depth), the ERAC shall obtain an accurate history of the site. Prior to any drilling activities, the ERAC shall, at a minimum, interview the tank owner and station manager, review MDEQ files pertaining to the site, and discuss boring/monitoring well placement and depth with the MDEQ UST project manager. Adjacent property owners may also be interviewed to obtain a history of the site.

To review MDEQ files pertaining to the site, please contact MDEQ's Freedom of Information Act (F.O.I.A.) Officer to schedule an appointment. The F.O.I.A. Officer can be contacted at (601) 961-5171.

B. Utility Survey

The ERAC shall contact the following utilities/persons to identify/mark any underground utilities to help prevent any damage to these utilities during the investigation:

1. Mississippi 811 (811) or (800-227-6477),
2. Utilities that are not a member of the Mississippi 811,
3. City Water and Sewer Departments,
4. Any other persons necessary to ensure that all underground utilities are located, (i.e. natural gas companies, local cable companies, etc.), and
5. Tank owner/operator for site utility layout, and UST system layout.

C. Water Well Survey

The United States Geological Survey (601-933-2900), Mississippi Office of Land and Water Resources (601-961-5200), and the local city or county water association shall be contacted to obtain the location of wells within a one mile radius of the site. The information obtained shall be field verified for those wells identified within a ¼ mile radius of the site.

D. Survey of Immediate Vicinity

The ERAC shall determine all other potential hydrocarbon sources and environmental receptors within a 500 foot radius of the site. Also, the ERAC shall screen all accessible utility vaults, manholes, drains, or other openings for the presence of volatile organic vapors. Each of the potential sources shall be screened using a Flame Ionization Detector (FID), Photo-Ionization Detector (PID), or other vapor meter approved by the UST Branch. The PID or FID shall be calibrated according to manufacturer's instructions. All vapor readings shall be recorded. If elevated organic vapors are detected, the potential sources shall be screened to determine the lower explosive limit (LEL).

E. Notification

The ERAC shall contact by e-mail or telephone the MDEQ UST project manager at least 48 hours in advance of **any field activities**, so that the project manager may have an opportunity to visit and assist with any field-related questions.

F. Manual of Standard Operating Procedures (SOP) Field Requirement

Field Personnel shall have a copy of the MDEQ approved scope of work for the site and the SOP with them at all times when in the field conducting UST site work. Field Personnel shall also maintain Occupational Safety and Health Administration (OSHA) health and safety plans and be OSHA 29 CFR 1910.120 Hazardous Waste Operations and Emergency Response (HAZWOPER) certified.

II. Boring Installation and Soil Sampling

A staff professional (engineer or geologist that is not required to have a professional registration) must oversee the boring and monitoring well installations. The driller must be licensed in the state of Mississippi. The licensed driller must follow the current regulations of the MDEQ Office of Land and Water Resources (OLWR). These regulations require the licensed driller to submit copies of the driller's logs to the MDEQ OLWR.

The site should be left as clean as it was when the ERAC and driller arrived, which includes soil disposal, if necessary.

A. Equipment

Soil borings shall be installed during fieldwork to provide information on shallow stratigraphy and the delineation of petroleum hydrocarbon constituents. Soil borings should not be placed within 25 feet of each other without prior approval from the MDEQ UST project manager. Soil borings shall be advanced using a continuous-flight hollow-stem auger, hand augers, hydraulically driven probes, or sonic driven core barrels. Each of the soil borings shall be **pre-drilled** using hand-held equipment to help prevent damage to any underground utilities.

B. Soil Sampling General Procedures

If using a hollow-stem auger, each boring shall be sampled at five-foot intervals using a cleaned Shelby tube or split-spoon sampler beginning immediately after pre-drilling. If using hydraulically driven probes, each boring shall be sampled at four or five foot intervals using plastic tubes. If using sonic drilling technology, each boring shall be sampled at five foot intervals, even if the length of the soil column is ten feet. Sampling will be carried out to the required depth while using standard ASTM protocols to recover the samples. A portion of the soil from each sampling interval shall be placed in a jar or zipper lock bag for headspace analysis (See **Section II. E. – Procedure for Headspace Analysis**). The other portion of the remaining sample shall be collected as if it were being sent to the laboratory for analysis. Once the boring has been drilled to the desired depth, all samples have been collected, and headspace analysis has been completed, choose the soil sample from the appropriate interval for submittal to the laboratory. Selection of the proper sample to be sent for laboratory analysis shall be based upon the following criteria:

1. If all PID readings are less than or equal to 10 ppm or if the FID readings are less than or equal to 250 ppm, collect the soil sample at the termination depth or at the soil/water interface, whichever is encountered first.
2. If any of the PID readings are greater than 10 ppm or if any of the FID readings are greater than 250 ppm, collect the soil sample with the highest vapor reading.

The aforementioned procedure is provided in Table 1 below.

Table 1. Proper Soil Sample Selection

PID Reading	FID Reading	Sample to be Analyzed
≤ 10 ppm	≤ 250 ppm	Termination depth or soil/water interface whichever is encountered first
> 10 ppm	> 250 ppm	Sample with highest vapor reading

C. Soil Sampling Procedures for Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX) and Methyl Tertiary Butyl Ether (MTBE) Analysis

The following procedures are based on the specific method as outlined in Table 2 (Recommended Containers, Preservation, Holding Times, and Methods for Soil Analysis) following the soil sampling procedures. Different procedures are listed depending on site conditions or environmental preference. Based on present cleanup levels, most UST sites will fall under High Range Sites; however, if regulations change or a Risk-Based Corrective Action Program is instituted, sites could fall under Low Range Sites.

1. High Range Sites (Total BTEX greater than 200 ppb)

   a. Sample Collection Without Preservative

      i. Don a new pair of disposable gloves (latex, nitrile, etc.).
      ii. Pack soil tightly into at least one sample container so as to avoid air spaces.
      iii. Carefully wipe the exterior of the sample container with a clean disposable wipe or paper towel.
      iv. Affix a label to each sample container. Labels shall include, at a minimum, the date, time, person collecting the sample, boring identification number, depth of sample, and analysis required.
      v. Place sample container in properly labeled zipper lock bag, seal bag, and immediately place on ice.
      vi. Using headspace analysis (**Section II. E. – Procedure for Headspace Analysis)**, determine which sample shall be sent to the laboratory. Properly dispose of sample containers that will not be sent to the laboratory.

   b. Sample Collection With Preservative

      i. Don a new pair of disposable gloves (latex, nitrile, etc.).
      ii. Using an appropriate sample collection device, collect approximately 5 grams of sample as soon as possible after the surface of the soil has been exposed to the atmosphere.
      iii. Carefully wipe the exterior of the sample container with a clean disposable wipe or paper towel.
      iv. Add the 5 grams of soil to the pre-labeled sample container containing 10 mL of methanol. Labels shall include, at a minimum, the date, time, person collecting the sample, boring identification number, depth of sample, preservatives, and the analysis required.
      v. Quickly brush any soil off the threads and immediately seal the sample container with the septum and screw cap.
      vi. Collect one additional sample aliquot for determination of dry weight.
      vii. Place sample container in properly labeled zipper lock bag, seal bag, and immediately place on ice.
      viii. Using headspace analysis (**Section II. E. – Procedure for Headspace Analysis)**, determine which sample shall be sent to the laboratory. Properly dispose of sample containers that will not be sent to the laboratory.

2. Low Range Sites (Total BTEX less than or equal to 200 ppb)

   Note: Three aliquots are required from each sampling point (1 sample for analysis, 1 sample for backup, and 1 sample to determine dry weight).

   a. Sample Collection Without Preservative

      i. Don a new pair of disposable gloves (latex, nitrile, etc.).
      ii. Using an appropriate sample collection device, collect 5 grams of soil as soon as

possible after the surface of the soil has been exposed to the atmosphere.

iii. Carefully wipe the exterior of the sample container with a clean disposable wipe or paper towel.
iv. Affix a label to each sample container. Labels shall include, at a minimum, the date, time, person collecting the sample, boring identification number, depth of sample, and analysis required.
v. Place sample container in properly labeled zipper lock bag, seal bag, and immediately place on ice.
vi. Using headspace analysis (**Section II. E. – Procedure for Headspace Analysis)**, determine which sample shall be sent to the laboratory. Properly dispose of sample containers that will not be sent to the laboratory.

b. Sample Collection With Preservative

i. Don a new pair of disposable gloves (latex, nitrile, etc.).
ii. Using an appropriate sample collection device, collect 5 grams of soil as soon as possible after the surface of the soil has been exposed to the atmosphere.
iii. Add the 5 grams of soil to a sample container containing a sodium bisulfate preservative solution.
iv. Quickly brush any soil off the threads and immediately seal sample container with septum and cap.
v. Carefully wipe the exterior of the sample container with a clean disposable wipe or paper towel.
vi. Affix a label to each sample container. Labels shall include, at a minimum, the date, time, person collecting the sample, boring identification number, depth of sample, preservatives, and analysis required.
vii. Place sample container in properly labeled zipper lock bag, seal bag, and immediately place on ice.
viii. Using headspace analysis (**Section II. E. – Procedure for Headspace Analysis)**, determine which sample shall be sent to the laboratory. Properly dispose of sample containers that will not be sent to the laboratory.

Note: A new pair of disposable gloves shall be worn for each four or five foot sampling interval.

D. Soil Sampling Procedures for Polynuclear Aromatic Hydrocarbons (PAH) Analysis

For PAH analysis, collect at least one 8-ounce sample from each sampling point. (A 4-ounce sample may be collected if allowed by the laboratory analyzing the sample.) The sampling procedure is as follows:

1. If disposable latex gloves are worn, use a stainless steel spoon, spatula or another appropriate sampling device to place soil sample into the sample container.
2. Otherwise, don a new pair of disposable nitrile gloves and pack soil tightly into sample container.
3. Carefully wipe the exterior of the sample container with a disposable laboratory grade wipe.
4. Affix a label to each sample container. Labels shall include, at a minimum, the date, time, person collecting the sample, boring identification number, depth of sample, and analysis required.
5. Place sample container in properly-labeled zipper lock bag, seal bag, and immediately place on ice.
6. Using headspace analysis (**Section II. E. – Procedure for Headspace Analysis**), determine which sample shall be sent to the laboratory. Properly dispose of sample containers that will not be sent to laboratory.

Table 2. Recommended Containers, Preservation, Holding Times, and Methods for Soil Analysis

Section II.	Required Analysis	Sample Container	Aliquots Per Location	Preservation	Maximum Holding Times for Analysis	Method
C.1.a.	BTEX & MTBE (High Range)	4-ounce (120-mL) amber glass jar with Teflon® lid	1	Cool to ≤ 6°C	14 days	8021B 8260B (5035)
C.1.b.	BTEX & MTBE (High Range)	Appropriate 5-gram sampling device and 40-mL vial with Teflon® septum sealed screw cap	2	10 mL of methanol added to the sample vial Cool to ≤ 6°C	14 days	8021B 8260B (5035)
C.2.a.	BTEX & MTBE (Low Range)	Appropriate 5-gram sampling device (i.e., Encore® sampler)	3	Cool to ≤ 6°C	Samples extracted within 48 hours, and extracts analyzed within 14 days following extraction	8021B 8260B (5035)
C.2.b.	BTEX & MTBE (Low Range)	Appropriate 5-gram sampling device and 40-mL vial with Teflon® septum sealed screw cap	3	1 gram of sodium bisulfate added to 5 mL of water Cool to ≤ 6°C	14 days	8021B 8260B (5035)
D.	PAH	8-ounce amber wide mouth glass jar with Teflon® lid (May use a 4-ounce jar if allowed by the laboratory analyzing the sample)	1	Cool to ≤ 6°C	Samples extracted within 14 days, and extracts analyzed within 40 days following extraction	8100 8270C 8310

Consequences if Samples are not analyzed within recommended holding times:
If soil samples collected during a sampling event are not analyzed within the recommended holding time, then all samples specified in the approved scope of work for that sampling event must be resampled. All associated QA/QC samples must also be collected. The costs related to the resampling will not be reimbursable from the MGPTF.

E. Procedure for Headspace Analysis

1. A PID or FID (or other UST approved vapor meter) must be used for headspace analysis.
2. Calibrate the instrument **daily** before any headspace readings are performed.
3. Clean glass jars shall be half-filled with soil and immediately covered with two sheets of aluminum foil. The threaded piece of a two-piece type lid shall be applied tightly to seal the jar. In lieu of the jars, zipper lock bags may be used. The zipper lock bags shall be half-filled with soil and immediately sealed.
4. The jar or bag shall be shaken vigorously for approximately 15 seconds, allowed to set for a minimum of 15 minutes and shaken again for at least 15 additional seconds. If the ambient temperature is below 60^{o} Fahrenheit, headspace analysis shall be conducted in a heated environment (i.e. inside a building or vehicle).

5. The probe tip of the vapor meter shall be quickly inserted through the aluminum foil covering towards the center of the headspace within the jar. (If zipper lock bags are used instead of jars, the vapor meter tip shall be inserted through the top 1/3 of the bag. The zipper lock bag shall not be reopened for the insertion of the probe tip.)
6. The highest meter response shall be recorded as the volatile organic vapor concentration.
7. Whether using jars or zipper lock bags, care shall be taken to ensure that neither water droplets nor soil particulates enter the probe tip.
8. All headspace analyses shall be completed at an equivalent time period between 15 minutes to an hour.

F. Boring Termination

The following guidelines shall be followed to terminate a boring:

NOTE: If possible, vapor meter readings shall be recorded through the termination of the boring (this includes into the water table).

1. If groundwater is at depths less than or equal to 20 feet:

    - If the PID reading is less than or equal to 10 ppm (PID ≤ 10 ppm) or FID reading is less than or equal to 250 ppm (FID ≤ 250 ppm), terminate the boring 10 feet into the water table.

    - If the PID reading is greater than 10 ppm (PID > 10 ppm) or FID reading is greater than 250 ppm (FID > 250 ppm) once into the water table, then the boring may need to be drilled deeper than just 10 feet into the water table.

        Therefore, contact the MDEQ UST project manager (the project manager's supervisor or other project managers may be contacted if the site project manager is unavailable) to discuss. If unable to contact an MDEQ UST representative, then the ERAC should use their best professional judgment on termination of the boring.

2. If groundwater is at depths greater than 20 feet:

    - If the PID ≤ 10 ppm or FID ≤ 250 ppm, terminate the boring at 20 feet.

    - If the PID > 10 ppm or FID > 250 ppm at 20 feet, continue until the readings are PID ≤ 10 ppm or FID ≤ 250 ppm or until groundwater is encountered, whichever comes first. If groundwater is encountered, terminate the boring ten feet into the water table. If PID > 10 ppm or FID > 250 ppm once into the water table, then the boring may need to be drilled deeper than just 10 feet into the water table.

        Therefore, contact the MDEQ UST project manager (the project manager's supervisor or other project managers may be contacted if the site project manager is unavailable) to discuss. If unable to contact an MDEQ UST representative, then the ERAC should use their best professional judgment on termination of the boring.

Note: If a boring is to be converted to a monitoring well, then the boring shall be drilled to a minimum of 18 feet below land surface (BLS).

If a boring is not converted to a monitoring well, then the boring shall be plugged. Borehole plugging will require grouting by the tremie method (95% Portland cement and 5% bentonite by weight) to begin at the bottom of the boring and proceed to land surface. The patch at the land surface shall be the same as the material surrounding the borehole (i.e. asphalt, concrete, etc.).

G. Boring Logs

Boring logs shall include at least the following information.

1. Facility name and facility identification number
2. Boring hole number and boring hole diameter
3. Time and date the boring began
4. Time and date the boring was completed
5. Staff Professional's (geologist's or engineer's) name
6. Driller's name
7. Classification scheme used such as the Unified Soil Classification System including soil color and moisture
8. Boring depth
9. Depth to water immediately after drilling
10. If the boring is left open for a period of time, please specify the rise or fall of the water table and the observed time interval
11. FID or PID readings at each 4 or 5 foot sampling interval
12. Amount of free product encountered and time it was encountered, if applicable
13. Drilling Technique (hollow stem, solid stem, direct push, sonic)
14. Ambient weather conditions, including temperature

III. Monitoring Well Installation

A. Introduction

A staff professional (engineer or geologist that is not required to have a professional registration) must oversee the boring and monitoring well installations. The driller must be licensed in the state of Mississippi. The licensed driller must follow the current regulations of the MDEQ OLWR. These regulations require the licensed driller to submit copies of the driller's logs to the MDEQ OLWR.

B. Monitoring Wells

The design and installation of monitoring wells shall be such that the monitoring well shall provide high quality samples, shall last the duration of the project, and shall not serve as a conduit for contamination to migrate between aquifers. Also, the groundwater must intersect the screened interval of the monitoring well. Methods and procedures for the design and installation of monitoring wells to be employed in investigating Mississippi leaking UST sites are contained in this section. After all monitoring wells have been installed, the top of the well casing elevation shall then be surveyed to the nearest 0.01 foot.

Consequences if groundwater does not intersect the screened interval of the monitoring well:
If the groundwater does not intersect the screened interval of the monitoring well, redrilling may be necessary. The cost for redrilling may not be reimbursable from the MGPTF.

1. Monitoring Well Installation Using Hollow Stem Auger (4-inch or 2-inch)

The hollow-stem auger consists of a hollow steel shaft with a continuous, spiraled steel flight, welded onto the exterior side of the stem, connected to an auger bit that when rotated, transports cuttings to the surface. This method is most often used in performing environmental assessments and is most suitable for soils that have a tendency to collapse when disturbed.

The depth and volume of the borehole shall be calculated and the appropriate materials procured prior to drilling activities (casing, screen, filter material, bentonite, etc.). The borehole shall be of sufficient diameter so that well construction can proceed without difficulty. The well shall consist of at least a PVC schedule 40 (ASTM) body with threaded, flush joints. The well screen shall consist of at least PVC schedule 40 with 0.01-inch (unless otherwise approved by the MDEQ UST project manager) factory-slotted screen openings. Each screen shall be continuously slotted and at least 15 feet in length. PVC plugs shall be threaded onto the bottom of each well screen to prevent intrusion of filter material. No isopropanol or lubricating compounds will be used to aid pipe connection. The driller shall place expandable rubber seal caps onto the well casing opening at the surface. The well caps shall be watertight and lockable. **The well caps shall be replaced periodically to ensure that they remain watertight.**

The monitoring well shall be installed inside of the hollow stem augers to avoid the caving potential of the soils. To assure adequate size, a minimum 2-inch annular space is required between the casing and the hollow stem auger wall. The 2-inch annular space around the casing will allow the filter pack, bentonite seal, and the annular grout to be placed at an acceptable thickness at the specified intervals. The filter material (clean medium- to coarse-grain sand) shall then be tremied and/or poured around the well screen extending to a minimum of 1 foot above the top of the screen.

Next, a seal shall be placed on top of the filter pack. The seal shall consist of a 30% solids, pure bentonite material. The bentonite material shall be tremied and/or poured to the proper intervals. In order to insure that the bentonite is placed at the proper interval, the bentonite material shall be tamped with an appropriate tamping tool, while the measuring is being conducted. The bentonite seal shall be placed above the filter pack at a minimum vertical thickness of 2 feet. Potable water (or higher quality water) shall be used to hydrate the bentonite. The bentonite shall be allowed to hydrate for the amount of time specified in the manufacturer's recommendations.

After the bentonite seal has hydrated for the specified time, the remainder of the annular space shall be grouted with a grout mixture of 95% Portland cement and 5% bentonite. The grout shall be allowed to set for a sufficient amount of time before the concrete pad is installed.

After the grouting is complete, the monitoring well head protection shall be installed. In most cases the site will utilize concrete or asphalt as a covering material. Before installation of monitoring well head protection, the ERAC shall review Figure 1 to assure proper excavation prior to the pouring of concrete which forms the vehicular traffic protector. If the location of the monitoring well is within a covered area (asphalt or concrete), the existing surface around the well shall be removed using mechanical sawing or pneumatic hammer equipment to a depth of existing cover and the width and length as specified in Figure 1. Loose materials on the exposed earthen surface shall be removed or compacted to assure a smooth surface upon which to pour the concrete mixture. If the monitoring well is to be located outside a covered area, the earthen material shall be removed using a shovel or pickaxe to a depth of 6 inches and a width and length as specified in Figure 1. The monitoring well shall then be cut to the proper height so that the security casing cover will extend 2 inches above the well casing considering the requirements as outlined in Figure 1 and the security casing set.

The concrete mixture to be used as the well casing protector shall consist of a ratio of 5 pounds of Portland cement and 80 pounds of commercial concrete or a premixed type of concrete product. Water shall be added to the mixture in an amount necessary for desired consistency before the concrete is poured. If the poured concrete is to be delivered from a concrete supplier by truck, 2500 psi concrete shall be specified. The concrete surface of the protector should then be troweled so that the surface of the concrete on any side of the security casing is flush with the monitor well security casing well cap and matching cover material. A flush-mounted protective cover shall be installed on the well casing protector to protect the monitoring wells against damage from site activities. The words "Monitoring Well" or similar designation shall be embossed on the protective cover. The concrete shall be mounded such that there is a one inch rise. Label the monitoring well by writing the monitoring well (MW) number in the concrete before it sets; embedding a metal disk

with the stamped well number into the concrete is also acceptable. Figure 1 is a schematic of how a monitoring wellhead shall be protected.

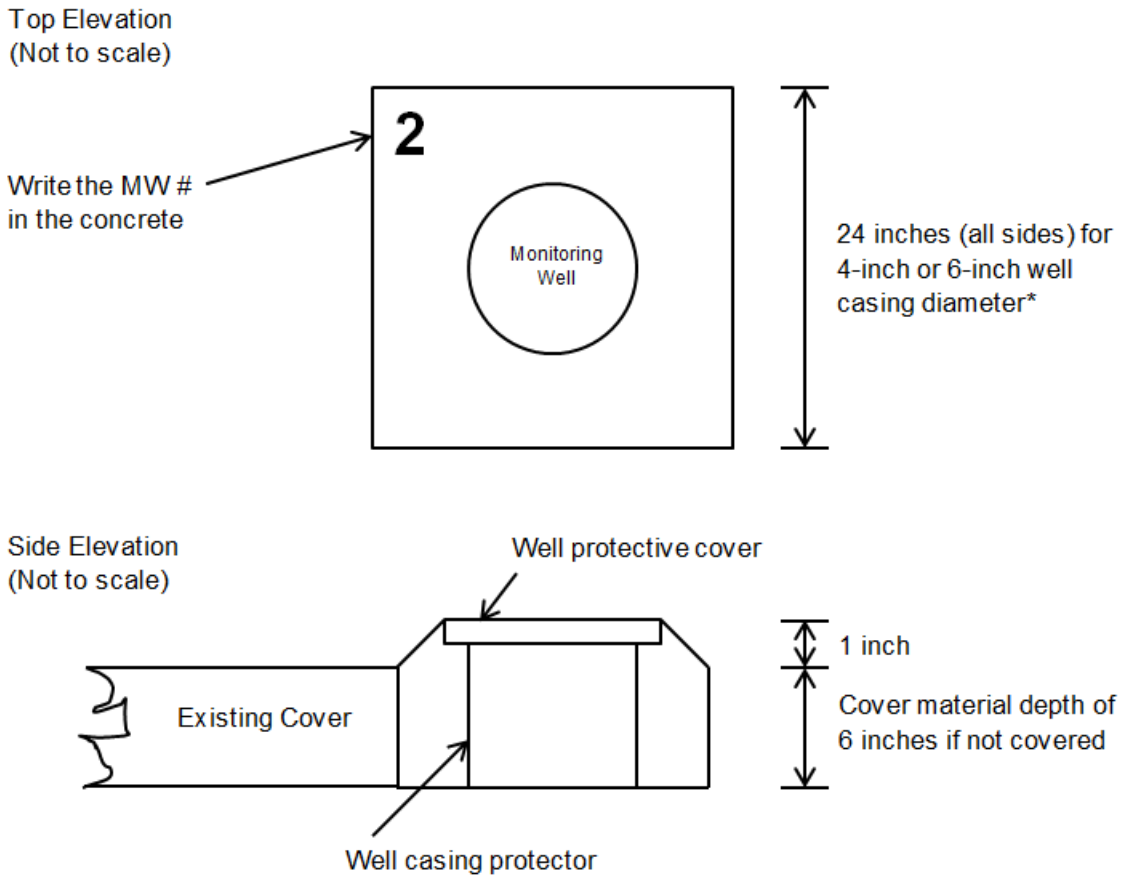

Figure 1. Monitoring Wellhead Protection

2. Monitoring Well Installation Using Direct Push Technology (up to 1-inch)

This procedure describes the installation of a permanent monitoring well using direct push technology. The well shall consist of at least a PVC schedule 40 (ASTM) body with threaded, flush joints. The well screen shall be at least PVC schedule 40 with 0.01-inch factory-slotted screen openings. Each screen shall be continuously slotted and at least 15 feet in length (a prepack well screen may also be used). PVC plugs shall be threaded onto the bottom of the well screen to prevent intrusion of filter material. No pesticide grade isopropanol or lubricating compounds shall be used in pipe connection. The driller shall place expandable rubber seal caps onto the well casing opening at the surface. **The well caps shall be replaced periodically to ensure that they remain watertight.**

Well installation begins by using a direct push percussion-probing machine to advance probe rods to a depth determined by **Section II. F. - Boring Termination**. Once the probes are set at depth, the well screen is lowered through the probe rods on the leading end of the PVC riser pipe. After the well screen and riser pipe are lowered to depth, the probe rods are retracted. As the rods are retracted above the screen, a clean medium to coarse-grain sand shall be installed by gravity

through the rod and PVC pipe annulus, forming a barrier around the screen. This sand barrier shall extend to a minimum of 1 foot above the top of the screen.

Next, a seal shall be placed on top of the filter pack. The seal shall consist of a 30% solids, pure bentonite material. The bentonite material shall be poured down the borehole above the filter pack while tamping and measuring the thickness with a metal rod. The bentonite shall have a minimum vertical thickness of 2 feet. Potable water (or higher quality water) shall be used to hydrate the bentonite. The bentonite shall be allowed to hydrate for the amount of time specified in the manufacturer's recommendations.

After the bentonite seal has hydrated for the specified time, the remainder of the annular space shall be grouted with a grout mixture of 95% Portland cement and 5% bentonite to approximately land surface. The grout shall be allowed to set for a sufficient amount of time before the concrete pad is installed.

After the grouting is complete, the monitoring well head protection shall be installed. The ERAC shall review Figure 1 to assure proper excavation prior to the pouring of concrete, which forms the vehicular traffic protector. If the location is within a covered area (asphalt or concrete), the existing surface around the well shall be removed using mechanical sawing or pneumatic hammer equipment to a depth of existing cover and the width and length as specified in Figure 1. Loose materials on the exposed earthen surface shall be removed or compacted to assure a smooth surface to pour the concrete mixture. If the monitoring well is to be located outside a paved area, the earthen material shall be removed using a shovel or pickaxe to a depth of 6 inches and a width and length as specified in Figure 1. The monitoring well shall then be cut to the proper height so that the security casing cover will extend 2 inches above the well casing considering the requirements as outlined in Figure 1.

The concrete mixture to be used as the well casing protector shall consist of a ratio of 5 pounds of Portland cement and 80 pounds of commercial concrete or a premixed type of concrete product. Water shall be added to the mixture in an amount necessary for desired consistency before the concrete is poured. If the poured concrete is to be delivered from a concrete supplier by truck, 2500 psi concrete shall be specified. The concrete surface of the protector should then be troweled so that the surface of the concrete on any side of the security casing is flush with the monitor well security casing well cap and matching cover material. A flush-mounted protective cover shall be installed on the well casing protector to protect the monitoring wells against damage from site activities. The words "Monitoring Well" or similar designation shall be embossed on the protective cap. The concrete shall be mounded such that there is a one inch rise. Label the monitoring well by writing the MW number in the concrete before it sets. Refer to Figure 1. However, **only a one foot by one foot pad is needed for the direct push wells.**

3. Monitoring Well Installation Using Sonic Drilling Technology (4-inch or 2-inch)

This procedure describes the installation of a permanent monitoring well using sonic drilling technology. Sonic drilling is a soil penetration technique that fluidizes porous materials. The sonic head contains mechanisms that allow the rotation and oscillation of the drill stem, which causes a high frequency force to be superimposed on the drill stem. The drill stem/drill bit physically vibrates up and down in addition to being pushed down and rotated. By using a sonic head, the drill casing and rods are brought to a certain vibration frequency. These waves are transmitted through the drill string to the end of the casing and reflected. This intense vibration causes a very thin layer of soil directly around the drill rods to fluidize. The soil in the influenced area behaves like a fluid, which dramatically reduces the friction between the drill rod and the surrounding soil, allowing very rapid penetration.

To explain further, during the coring process, the core barrel is advanced before the outer drill casing, without fluid or air. The outer drill casing is then advanced to the same depth by introduction of water, which aids in pushing the soil particles away from the drill bit and cooling the core barrel. With the outer casing left in place to hold the borehole open, the core barrel is

extracted, and the samples are vibrated out of the barrel into plastic sleeves. The outer casing also holds the borehole open while installing the monitoring well. The well casing, well screen, filter material, bentonite, and grout are inserted inside the outer casing. The guidelines for the filter material, bentonite, grout, and other monitoring well requirements not discussed within this section can be found in **Section III. B. 1. – Monitoring Well Installation Using Hollow Stem Auger**. After these materials are set, the outer casing is retrieved using sonic vibration.

4. Monitoring Well Schematic

The monitoring well schematic shall include at least the following information.

a. Facility name and facility ID number
b. Monitoring well number
c. Monitoring well construction
d. Slot size of screened interval
e. Elevations of screened interval (referenced to a known permanent or temporary benchmark)
f. Depth of monitoring well (+/- 0.01 foot)
g. Date well was installed
h. Well diameter
i. Surface elevation
j. Staff Professional's (geologist's or engineer's) name
k. Driller's name
l. Materials used for filter pack and annular sealant
m. Surface seal design/construction
n. Type of protective well cap
o. Type of end plug
p. Groundwater elevation in the monitoring well (+/- 0.01 foot)

5. Monitoring Well Development

Upon completion of the monitoring well installation, the well must be developed by bailing, pumping, surge block, etc. At least 3 well volumes must be pumped or the well should be pumped dry. The final water from the well should not be turbid. The ERAC's field staff professional shall make the decision as to when the well is properly developed.

IV. Groundwater Sampling

The "Monitoring Well Sampling Record" form (copy in the Appendix) shall be used for recording static groundwater data before sampling, well purging data, and well sampling data.

A. Free Product and Static Water Level Measurements

1. The monitoring wells shall be sampled 7 to 10 days after well development.
2. Before a monitoring well is sampled, it shall be checked for free product. Free product measurement shall be performed with an oil/water interface probe to the nearest 0.01 foot. (**Please note** that groundwater samples shall not be collected from monitoring wells containing more than 1/8 inch of free product.)
3. Then the static water level shall be measured to the nearest 0.01 foot using an electronic water level probe or oil/water interface probe.
4. All probes must be properly decontaminated between monitoring wells (see **Section V. Standard Field Cleaning Procedures**).

B. Purging

Wells shall be purged before collecting samples in order to clear the well of stagnant water, which is not representative of aquifer conditions. For permanently installed wells, the depth of water shall be determined before purging. Once the water level has been determined, the volume of water in the well shall be calculated. To determine the volume, the following method shall be used; measure the distance from the bottom of the well to the static water level, then measure the inside diameter of the well or casing. Obtain the volume of water in the well by the empirical formula:

$$V = 0.041 d^2 h \qquad \text{Equation (1)}$$

Where,
h = height of water in feet (total depth of well minus the depth to water)
d = diameter of well in inches
V = volume of water in gallons

For 1-inch well: V = 0.041h
For 2-inch well: V = 0.164h
For 4-inch well: V = 0.656h

If preferred, a quick reference nomograph or table may be used.

With respect to volume, an adequate purge is normally achieved when at least three times the volume of standing water in the well has been removed. The single well volume calculations and the minimum well volumes to be purged shall be recorded on the "Monitoring Well Sampling Record" form.

In some situations, a well may be evacuated to dryness. In these situations, this generally constitutes an adequate purge and the well can be sampled after the well has recovered to at least 75% of its original volume. The static water level shall be measured to the nearest 0.01 foot using an electronic water level probe or oil/water interface probe again to ensure that the well has recovered to at least 75%.

Consequences if sample is collected before well has recovered to ≥ 75% of its original volume:
Resampling may be required if the well is sampled before it reaches at least 75% recovery. All associated QA/QC samples must also be collected. If resampling is required, the costs related to the resampling will not be reimbursable from the MGPTF.

1. Purging Techniques (Wells with In-Place Plumbing)

If the pump runs continuously, and the sample can be collected prior to a storage/pressure tank, no purge other than opening a valve and allowing it to flush for a few minutes is necessary.

If the pump runs intermittently, it is necessary to determine the volume to be purged, including storage/pressure tanks that are located prior to the sampling location. The pump shall then run continuously until the required volume has been purged.

2. Purging Techniques (Wells Without Plumbing or In-Place Pumps)

When suction lift or centrifugal pumps are used, only the intake line is placed into the water column. To minimize contamination, the line placed into the water is either standard cleaned Teflon®, in the case of the suction lift pumps, or standard cleaned stainless steel pipe attached to a hose, when centrifugal pumps are used.

Note: For active recovery wells, there is no need to purge the wells. However, the recovery wells should be shut off for at least one hour before collecting the groundwater samples from these wells.

When disposable bailers or reusable Teflon® bailers are used, new nylon rope is attached to the top of the bailer and lowered into the top of the water column, allowed to fill, removed, and then the water is discarded into a container of known volume. This will allow for an accurate determination of the volume that has been purged.

C. Groundwater Sample Collection Procedures

Before collecting groundwater samples, don a new pair of disposable gloves (latex, nitrile, etc.) at each monitoring well / sampling point. For BTEX groundwater analysis, samples shall be collected in a 40-mL amber glass vial with a Teflon® septum lid. Three aliquots per location shall be taken; two aliquots per location are acceptable if allowed by the laboratory analyzing the sample. For PAH groundwater analysis, samples shall be collected in a 1-liter amber glass container with Teflon® lid. Only one aliquot is required per PAH sampling location. If sampling for both BTEX and PAHs, fill BTEX sample containers before filling PAH sample container. (Refer to Table 3 below for preservative and holding times.) Each sample container shall be labeled. Labels shall include, at a minimum, the date, time, person collecting the sample, monitoring well identification number, preservatives, and analysis required.

1. Collecting Groundwater Samples (Wells Without In-Place Plumbing)

If sampling wells without plumbing, samples shall be collected using one of the following two methods.

a. Disposable bailer or reusable bailer

The following procedure shall be followed when sampling with a bailer:

i. Use a new disposable bailer or clean reusable bailer and new nylon rope for each sampling point. (The disposable bailer used to purge a well may also be used to collect the groundwater sample from that same well.)
ii. Slowly lower the bailer into the water. Do not allow the bailer to free-fall.
iii. Once the bailer is filled, remove the bailer from the well.
iv. Transfer the sample from the bailer to the sample container(s).
v. Each sample shall be carefully poured down the inside wall of the sample container to minimize turbulence. As a rule of thumb, it is best to gently pour the last few drops into the sample container so that surface tension holds the water in a “convex meniscus”. Next, carefully pour a few drops into the cap. The cap is then placed on the sample container and some overflow is lost, however, air space in the bottle shall be eliminated. For PAH, fill sample container until the sample container has a sufficient volume for laboratory analysis.
vi. Verify no headspace by inverting the sample container and tapping it gently to check for trapped air bubbles. If trapped air is present, top off the sample or discard the sample container and collect a new sample in a new sample container.
vii. Place the three aliquots for BTEX or place the one aliquot for PAH into a single Zipper lock bag and immediately store on ice for shipment to the laboratory. Place enough ice on samples so that ice remains on samples during the entire shipment process.

b. Peristaltic pump

The peristaltic pump can be used for sample collection because it allows for sample collection without the sample coming in contact with the pump tubing. This is accomplished by placing a Teflon® transfer cap assembly onto the neck of a standard cleaned 4-liter (1-gallon) glass container. Teflon® tubing (1/4-inch O.D.) connects the container to both the pump and the sample source. The pump creates a vacuum in the container, thereby drawing the sample into the container without it coming in contact with the pump tubing.
Samples for volatile organic compound (VOC) analysis should be collected using a bailer or by filling the Teflon® tube, by one of two methods, and allowing it to drain into the sample

container. The tubing can be momentarily attached to the pump to fill the tube with water. After the initial water is discharged through the pump head, the tubing should be quickly removed from the pump and a gloved thumb should be placed on the tubing to stop the water from draining out. The tubing is then removed from the well and the water allowed to drain into the sample containers. Sample containers shall be pre-labeled before any sample collection begins, refer to **Section VII. Chain-of-Custody Procedures**. Alternatively, the tubing can be lowered into the well to the desired depth and a gloved thumb placed over the end of the tubing. This method will capture the water contained in the tubing. The tubing should then be removed from the well and the water should be collected by draining the contents of the tubing into the sample containers. Under no circumstances should the sample for VOC analysis be collected from the content of any previously filled container. All equipment should be cleaned using the procedures described in **Section V. Standard Field Cleaning Procedures**. Follow items v, vi, and vii in the procedure listed above to complete the sample collection.

2. Collecting Groundwater Samples (Wells with In-Place Plumbing)

When sampling a well with in-place plumbing, samples shall be collected from a valve or cold water tap as near to the well as possible. Samples shall be collected directly into the appropriate sample containers. Follow items v, vi, and vii in the procedure listed above to complete the sample collection.

Table 3. Recommended Containers, Preservation, Holding Times, and Methods for Groundwater Analysis

Required Analysis	Containers	Aliquots Per Location	Preservation	Maximum Holding Times for Analysis	Method
BTEX/ MTBE	40-mL amber glass vial with Teflon® septum sealed screw cap	3	Cool to ≤ 6°C and adjust pH to < 2 with HCl[a]	14 days	8021B 8260B
PAH	1-liter amber glass container with Teflon® lid	1	Cool to ≤ 6°C	Samples extracted within 7 days, and extracts analyzed within 40 days following extraction	8100 8270C 8310
PAH	40-mL amber glass vial with Teflon® septum sealed screw cap	3	Cool to ≤ 6°C	Samples extracted within 7 days, and extracts analyzed within 40 days following extraction	8270D (SIM)
EDB[b]	40-mL amber glass vial with Teflon® septum sealed screw cap	3	Cool to ≤ 6°C and adjust pH to < 2 with HCl[a]	14 days	8011 8021B 8260B
1,2-DCA[c]	40-mL amber glass vial with Teflon® septum sealed screw cap	3	Cool to ≤ 6°C and adjust pH to < 2 with HCl[a]	14 days	8021B 8260B

a. Hydrochloric Acid (HCl)
b. Ethylene Dibromide (EDB)
c. 1,2-Dichloroethane (1,2-DCA)

EDB and 1,2-DCA are only to be analyzed when specifically requested by the MDEQ.

Note: Two aliquots per location instead of three are acceptable if allowed by the laboratory analyzing the sample.

Consequences if Samples are not analyzed within recommended holding times:
If groundwater samples collected during a sampling event are not analyzed within the recommended holding time, then all samples specified in the approved scope of work for that sampling event must be resampled. All associated QA/QC samples must also be collected. . The costs related to the resampling will not be reimbursable from the MGPTF.

V. Standard Field Cleaning Procedures

A. Introduction

The following procedures are intended to remove contaminants of concern from sampling, drilling, and other field equipment so that they do not impact the integrity of the field investigation. Cleaning procedures in this section are intended for use by personnel for drilling, sampling, and other equipment in the field.

B. Cleaning Solutions

1. Tap water – Water from any municipal water treatment system. Use of an untreated potable water supply is not an acceptable substitute for tap water.
2. Distilled water – Water that has been purified by vaporization to eliminate contaminants and then condensed.
3. Phosphate-free laboratory detergent – Liquinox, etc.
4. Isopropanol – isopropyl alcohol

C. Handling and Containment of Cleaning Solutions

Improperly handled cleaning solutions may easily become contaminated. Storage and application containers shall be constructed of the proper materials to ensure their integrity. The following are acceptable materials used for containing the specified cleaning solutions:

1. Tap water may be kept in clean tanks, hand pressure sprayers, squeeze bottles, or applied directly from a hose.
2. Distilled water shall be stored in clean glass, stainless steel, or plastic containers that should be closed prior to use. It shall be applied from plastic squeeze/spray bottles.
3. Phosphate-free laboratory detergent shall be kept in clean plastic, metal, or glass containers until used. It shall be poured directly from the container during use.
4. Isopropanol shall be stored in the unopened original containers until used. It shall be applied using a squeeze/spray bottle.

D. Handling of Cleaned Equipment

To prevent recontamination after field cleaning, equipment shall be handled by personnel wearing clean gloves. If the equipment is not to be immediately reused, it shall be covered with plastic sheeting or wrapped in aluminum foil to prevent recontamination. The area where the equipment is stored shall be free of contaminants.

E. Field Equipment Cleaning Procedures

1. Sampling Equipment

   The following procedures shall be used, at a minimum, for all sampling equipment used to collect routine samples (e.g., Shelby tubes, split-spoons, stainless steel spoon or spatula, bailers, etc.):

a. Clean with tap water and phosphate-free laboratory detergent using a brush if necessary to remove particulate matter and surface films. Equipment may be cleaned by using a phosphate-free laboratory detergent and high-pressure water rinse (high-pressure wash) as an alternative to brushing.
b. Rinse thoroughly with tap water.
c. Rinse thoroughly with isopropanol. Do not rinse PVC or plastic items with isopropanol.
d. Rinse thoroughly with distilled water.

2. Field Measurement Devices

The following procedures shall be used, at a minimum, for field measurement devices used to collect field data (e.g., water level indicators, oil/water interface probes, etc.):

a. Wash with phosphate-free laboratory detergent and tap water.
b. Rinse with tap water.
c. Rinse with isopropanol.
d. Rinse with distilled water.

3. Peristaltic Pump

Peristaltic pumps shall be cleaned prior to use and between each monitoring well. The following procedure is required:

a. Pump a sufficient amount of soapy water through the hose to flush out any residual purge.
b. Using a brush, scrub the exterior of the contaminated hose and pump with soapy water. Rinse the hose with distilled water and recoil onto spool.
c. Pump a sufficient amount of tap water through the hose to flush out all of the soapy water (approximately one gallon).
d. Pump a sufficient amount of distilled water through the hose to flush out the tap water, then purge with the pump in the reverse mode.
e. Rinse the outside of the pump housing and hose with distilled water (approximately ¼ gallon).
f. Place pump and reel in clean plastic bag.

4. Peristaltic pump with ball check valve

If the pump has a ball check valve, use the following procedure:

a. Completely dismantle ball check valve. Check for wear and/or corrosion and replace as needed.
b. Using a brush, scrub all components with soapy, tap water.
c. Rinse with distilled water.
d. Reassemble and reattach the ball check valve to the pump head.

F. Downhole Drilling Equipment

The following procedures shall be used for drilling equipment involving the collection of soil samples and for the construction of monitoring wells to be used for the collection of groundwater samples.

1. Preliminary Cleaning and Inspection

Prior to mobilization to the site, any part of the drill rig and/or equipment that comes in contact with the borehole will be thoroughly cleaned to remove all oil, grease, mud, tar, etc. The cleaning process will consist of scrubbing the equipment with a detergent and tap water then using a high-pressure water rinse. The drill rig shall be cleaned of any contaminants that may

have been transported from another site. The following shall be performed prior to arrival on site:

a. All downhole augering, drilling, and sampling equipment shall be sandblasted before use if painted and if there is a buildup of rust, hard or caked matter, etc., that cannot be removed by high-pressure wash, or wire brushing.
b. The drill rig and other equipment associated with the drilling and sampling activities shall be inspected to insure that all surficial oils, greases, hydraulic fluids, etc. have been removed and that all seals and gaskets are intact with no fluid leaks.
c. PVC or plastic materials such as tremie tubes shall be inspected. Items that cannot be cleaned are not acceptable and shall be discarded.

2. Field Cleaning Procedures for Drilling Equipment

The following is standard procedure for field cleaning augers, drill stems, rods, tools, and associated equipment. The following procedures shall be followed between each boring and/or monitoring well installation. Special attention should be given to the threaded section of the casing. Petroleum based lubricants shall not be used to prevent binding.

Note: This procedure does not apply to well casings, well screens, or split-spoon samplers used to obtain samples, which shall be cleaned as outlined in **Section V. E. - Field Equipment Cleaning Procedures** above.

a. Clean with tap water and phosphate-free laboratory detergent, using a brush if necessary, to remove particulate matter and surface films. A high-pressure wash may be necessary to remove matter that is difficult to remove with the brush. Hollow stem augers, drill rods, etc., that are hollow shall be cleaned on the inside with vigorous brushing.
b. Rinse thoroughly with tap water.

Note: Be sure to elevate the equipment to ensure that it does not come into contact with the contaminated water.

VI. Field Quality Control Checks

A. Trip Blanks

A trip blank shall be transported in each cooler from the laboratory to the sampling site, and then shall be returned to the laboratory for analysis to determine the Quality Assurance/Quality Control (QA/QC) of the sample handling procedures. A trip blank is required to accompany all soil and water samples.

One trip blank **per cooler** of samples taken to the laboratory is required. The laboratory shall provide the trip blank, which shall consist of two sealed 40-mL vials of distilled water.

If samples for BTEX and PAH are transported, then the trip blanks shall be analyzed for BTEX; however, if samples for only PAH are transported, then the trip blanks shall be analyzed for PAH.

Table 4. Analysis of Trip Blanks

Samples Transported	Analyze the Trip Blanks *for*
BTEX	BTEX
BTEX and PAH	BTEX
PAH	PAH

Consequences if Trip Blank analyte is greater than "none detected":
If the trip blank analytical result is an order of magnitude (10x) greater than the lowest field sample analyte, then the laboratory performing the sample analysis shall rerun the sample. If the trip blank analytical result is still an order of magnitude greater than the lowest field sample analyte, then all samples specified in the approved scope of work for that sampling event must be resampled, because the data may not be legally defensible. All associated QA/QC samples must also be collected. The costs related to rerunning the sample and to the resampling will not be reimbursable from the MGPTF.

Consequences if Trip Blank was not collected:
If a trip blank was not collected during a sampling event, then all samples specified in the approved scope of work for that sampling event must be resampled, because the data may not be legally defensible. All associated QA/QC samples must also be collected. The costs related to the resampling will not be reimbursable from the MGPTF.

B. Equipment/Rinse Blanks

Distilled water shall be passed through an item of field sampling equipment and returned to the laboratory for analysis, to determine the effectiveness of equipment decontamination procedures. One equipment/rinse blank per sampling event shall be required. The hierarchy for collecting equipment/rinse blanks is as follows.

If groundwater samples are taken, the following shall occur:

1. If reusable bailers are used, then an equipment/rinse blank shall be collected from the bailer.
2. If a pump is used, then an equipment/rinse blank shall be collected from the inside of the tubing used to collect the sample.
3. If disposable bailers are used, then during the soil sampling activities, an equipment/rinse blank shall be collected from the split-spoon, Shelby tube, or the bottom cap depending on what type of drilling technique is used (see below). If no soil sampling activities are associated with the groundwater sampling, then no equipment/rinse blank is required.

If groundwater samples are not taken, the following shall occur:

1. If a hollow stem auger is used, then an equipment/rinse blank shall be collected from the split-spoon or Shelby tube.
2. If direct push technology is used, then an equipment/rinse blank shall be collected from the bottom cap or "shoe".
3. If sonic drilling technology is used, then an equipment/rinse blank shall be collected from the core barrel.

Table 5. Analysis of Equipment/Rinse Blanks

Samples Collected *for*	Analyze the Equipment/Rinse Blanks *for*
BTEX	BTEX
BTEX and PAH	BTEX
PAH	PAH

If sampling for BTEX and PAH or for BTEX only, equipment/rinse blanks shall be analyzed for BTEX only. If sampling for PAH only, equipment/rinse blanks shall be analyzed for PAH only.

Consequences if Equipment Blank analyte is greater than "none detected":
If the equipment blank analytical result is an order of magnitude (10x) greater than the lowest field sample analyte, then the laboratory performing the sample analysis shall rerun the sample. If the equipment blank analytical result is still an order of magnitude greater than the lowest field sample analyte, then all samples specified in the approved scope of work for that sampling event must be resampled, because the data may not be legally defensible. All associated QA/QC samples must also be collected. The costs related to rerunning the sample and to the resampling will not be reimbursable from the MGPTF.

Consequences if Equipment Blank was not collected (when required by the SOP):
If an equipment blank was not collected during a sampling event, then all samples specified in the approved scope of work for that sampling event must be resampled, because the data may not be legally defensible. All associated QA/QC samples must also be collected. The costs related to the resampling will not be reimbursable from the MGPTF.

C. Duplicate Samples

Duplicate samples provide a check on the sampling techniques as well as laboratory equipment. Duplicate samples shall be collected simultaneously from the same source under identical conditions into separate containers. Also, the duplicate sample shall be collected from a well that is known or suspected to be contaminated. Duplicate samples shall only be collected on groundwater samples at the frequency of one per sampling event. Duplicate samples shall be analyzed for the same constituents as the sample it duplicates. (If a well is being sampled for BTEX and PAH, then a duplicate sample should be collected for BTEX and PAH.) The validity of a duplicate sample shall be judged by the Relative Percent Difference (RPD) method of the contamination level of the samples as expressed in the following equation:

$$\text{RPD } (\%) = \left[\frac{2(X_1 - X_2)}{X_1 + X_2}\right] \times 100 \qquad \text{Equation (2)}$$

Where,
X_1 = contamination level of the original sample
X_2 = contamination level of the duplicate sample

When there is a duplicate sample for BTEX, the RPD should be for Total BTEX. If there is a duplicate sample for PAH, the RPD should be for the total PAH and not for each individual constituent.

The RPD for duplicate samples must be ≤ 25% to be considered valid.

Note: Duplicate samples shall not be labeled as duplicates on the Chain-of-Custody Record, but shall be labeled in the same manner as other water samples. However, the duplicate shall be identified in the report.

Consequences if the Duplicate Sample does not meet RPD value of 25% or less:
If the RPD exceeds 25% during a sampling event, then the laboratory performing the sample analysis shall rerun the sample and the associated duplicate. If the subsequent results still reveal a RPD greater than 25%, then all samples specified in the approved scope of work for that sampling event must be resampled and analyzed, because the data may not be legally defensible. All associated QA/QC samples must also be collected. The costs related to rerunning the sample and to the resampling will not be reimbursable from the MGPTF.

Consequences if the Duplicate Sample was not collected:
If a duplicate sample was not collected during a sampling event, then all samples specified in the approved scope of work for that sampling event must be resampled, because the data may not be legally defensible. All associated QA/QC samples must also be collected. The costs related to the resampling will not be reimbursable from the MGPTF.

All reports that include groundwater sampling activities must list the RPD calculations for the duplicate sample and discuss the results.

VII. Chain-of-Custody Procedures

A. Introduction

Chain-of-Custody procedures are comprised of the following elements: 1) maintaining sample custody and 2) documentation of samples for evidence. To document chain-of-custody, an accurate record shall be maintained to trace the possession of each sample from the moment of collection to its submittal to the laboratory. For the purposes of this section, sample custodian means the person in possession of the sample excluding common mail carriers.

A sample is in custody if:
1. It is in the actual possession of the sample custodian;
2. It is in the view of the sample custodian, after being in their physical possession; and/or
3. It was in the physical possession of the sample custodian, and then they secured it to prevent tampering.

B. Documentation of Chain-of-Custody

1. Chain-of-Custody Record

The Chain-of-Custody Record is used to record the custody of all samples collected and maintained by the sample custodian. A Chain-of-Custody Record shall accompany all sample sets. This Chain-of-Custody Record documents transfer of custody of samples from the sample custodian to another person, to the laboratory, or to other organizational elements. The person collecting the samples shall be identified as the first person on the Chain-of-Custody. To simplify the Chain-of-Custody Record, as few people as possible shall have custody of the samples during the investigation.

The following information shall be supplied to complete the field Chain-of-Custody Record:

a. The facility ID number.
b. The facility or site name.
c. All samplers shall sign in the designated signature block.
d. The sampling station number, date and time of sample collection, grab or composite (composite samples shall not be used unless previously approved by the MDEQ UST project manager) sample designation, and a brief description of the type of sample and/or the sampling location shall be included on each line. One sample shall be entered on each line.
e. The total number of sample containers shall be listed in the “Total Containers” column for each sample.
f. Required analysis shall be circled or entered in the appropriate location as indicated on the Chain-of-Custody Record.
g. The sample custodian and subsequent transferee(s) shall document the transfer of the samples listed on the Chain-of-Custody Record. Both the person relinquishing the samples and the person receiving them shall sign the form. Also, include the company that the person signing the form represents. The date and time that this occurred shall be documented in the proper space on the Chain-of-Custody Record.
h. Temperature of the samples when received by the laboratory.

2. Transfer of Custody with Shipment

   a. Samples shall be properly packaged for shipment in accordance with the procedures outlined in the following section, Shipment of Environmental Laboratory Samples.
   b. When shipping samples via common carrier or mail, the "Relinquished By" box should be filled in with the associated time; the "Received By" box should indicate the shipment method (e.g., USPS, FedEx, UPS, etc.). The project leader shall retain one copy of the Chain-of-Custody Record. The laboratory sample custodian is responsible for receiving custody of the sample and shall fill in the "Received By" section of the Chain-of-Custody Record. The original Chain-of-Custody Record shall be transmitted to the project leader after the laboratory accepts the samples.
   c. If sent by mail, package shall be registered with a return receipt requested. If sent by common carrier, a Government Bill of Lading shall be used. Receipts from the post office and copies of Government Bill of Lading shall be retained as part of the documentation of the chain-of-custody.
   d. Usually, the last person receiving the samples shall be the laboratory sample custodian or their designee(s).

C. Shipment of Environmental Laboratory Samples

Environmental samples shall be packed prior to shipment using the following procedures:

1. Be sure the lids on all bottles are tight (will not leak).
2. Place bottles in separate and appropriately sized polyethylene bags and seal the bags with tape. (The three 40-mL groundwater bottles from the same sampling location can be placed into the same polyethylene bag).
3. Select a sturdy cooler. Secure and tape the drain plug.
4. Put "blue ice" or bagged ice on top of and/or between the samples. A sufficient amount of ice shall be placed in the cooler to ensure that ice remains in the cooler through the entire shipment process.
5. Place the Chain-of-Custody Record into a plastic bag and tape the bag to the inner side of the cooler lid.
6. Close the cooler and securely tape the top of the cooler shut. Chain-of-Custody seals shall be affixed to the top and sides of the cooler so that the cooler cannot be opened without breaking the seal.

Consequences if the samples are greater than 6^{o}C when received by the laboratory:
If the temperature of the samples is greater than 6^{o}C when received by the laboratory, then all samples specified in the approved scope of work for that sampling event must be resampled and analyzed, because the data may not be legally defensible. All associated QA/QC samples must also be collected. The costs related to the resampling will not be reimbursable from the MGPTF. If the samples are delivered to the laboratory on the same day that they are collected, then this consequence may not apply.

Consequences if the Chain-of-Custody Record or process is incomplete:
If the Chain-of-Custody Record or the process is not completed as described above, then all samples (including QA/QC samples) for that event must be resampled and analyzed. The costs related to the resampling will not be reimbursable from the MGPTF.

VIII. Plugging Monitoring Wells

Monitoring wells/recovery wells must be plugged according to the OLWR Regulations. In order to receive copies of these regulations, please contact the OLWR, P.O. Box 2309, Jackson, Mississippi, 39225-2309. The UST Branch requires the following revisions to the OLWR procedures:

1. All wells to be plugged must be checked for free product prior to the plugging activities. If a well contains free product, contact the UST Branch immediately. Do not proceed with the plugging activities unless the UST Branch directs otherwise.
2. Recovery well vaults shall also be plugged at the time of the well plugging. The vaults shall be plugged with a concrete mixture and the plugged vaults shall be flush to the ground.
3. The area around the well should be as clean after plugging as when the contractor arrived.
4. Upon completion of plugging procedures, the owner is required to report, on forms required by OLWR, the procedures used for well plugging and the number and location of the wells plugged. The owner is also required to submit the MDEQ UST Branch Plugging Report for Monitoring Wells to the UST Branch.

IX. Miscellaneous

A. Content of Proposals and Reports

The MDEQ/UST Branch provides formats for preparing proposals and reports. Below are some additional items required:

1. All proposals and reports must include a site map.
2. In proposals and reports submitted to the MDEQ/UST Branch, all maps/figures shall be **to scale**, and include north arrow, tank owner name, facility ID#, facility address, and the date.
3. On one of the maps/figures, place the reference point used for surveying the wells and the assumed elevation.
4. When recording groundwater elevations in the tables and figures of the report, correct the groundwater elevations when free product is present in wells.
5. Proposals and reports must be signed and stamped by a Professional Engineer or Professional Geologist who is licensed in the State of Mississippi.
6. Field logs shall be included for all reports.
7. Documentation such as receipts and copies of Government Bill of Lading shall be included in all reports containing initial sample results when the samples were sent by mail to the laboratory.
8. Monitoring Well Sampling forms or equivalent shall be included in all reports, where applicable.
9. Whenever offsite access is required, a copy of the completed offsite access approval form shall be included in the associated report.
10. When required, accurate arrival/departure times must be supplied on any MDEQ equivalent form. Arrival/departure time should only reflect actual time spent on the site; no travel time should be included.

B. Submittal of Proposals and Reports

Proposals and reports submitted to the MDEQ/UST Branch must meet the following requirements:

1. All proposals and reports shall be bound. If the proposal/report is less than 50 pages, then it may be stapled. Binder clips and three ring binders are not acceptable due to limited file space.
2. Proposals and reports shall be printed on both sides of the paper used for submittal.
3. Faxed or electronic proposals are acceptable for meeting the due date as long as they are signed by the tank owner and ERAC and stamped by the ERAC. However, a hard copy should still be submitted.
4. Faxed or electronic reports are acceptable for meeting the due date as long as they are signed and stamped by the ERAC. However, a hard copy should still be submitted.

Appendix

MONITORING WELL SAMPLING RECORD

Facility	Name:	Address:	ID#:
Sampling	Company/Firm:	Personnel:	Date:

Monitoring Well Identification #					
Well Diameter (d) (inches)					
1. STATIC GROUNDWATER DATA BEFORE SAMPLING					
A. Depth to Well Bottom measured during this event (feet)					
B. Depth to Free Product (feet)					
C. Depth to Groundwater (feet)					
D. Relative Top of Casing Elevation (feet)					
E. Groundwater Elevation (feet)					
F. Free Product Thickness [1B-1C] (feet)					
G. Volume of Groundwater in Well [$0.041d^2$(1A-1C)] (gallons)					
2. WELL PURGING DATA					
A. Purging Technique					
B. Minimum Well Volumes to be Purged [3x1G] (gallons)					
C. Time Purging Began					
D. Time Purging Completed					
E. Actual Gallons Purged (Indicate if Purged Dry)					
F. Depth to Groundwater After Purging Completed (feet)					
3. WELL SAMPLING DATA (All information in this section should be measured and recorded after at least 75% of the original volume has recovered.)					
A. Calculated Depth to Groundwater at 75% Recovery (feet)					
B. Depth to Groundwater Before Collection of Samples (feet)					
C. Time the Depth Was Measured in 3B					
D. Volume of Groundwater in Well at Time of Sampling (gallons)					
E. Total Time for Recovery [3C-2D] (minutes)					
F. Estimated Rate of Recharge [3D/3E] (gallons/minutes)					

Produced by the Mississippi Department of Environmental Quality, Underground Storage Tank Branch, P.O. Box 2261, Jackson, MS 39225-2261 / (601) 961-5171 11/17/2015