APPENDIX B

RECAP

SITE INVESTIGATION REQUIREMENTS

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B1.0 INTRODUCTION, SCOPE, GOALS, AND TERMINOLOGY

B1.1 Introduction

The Louisiana Department of Environmental Quality (LDEQ) has developed this Appendix in order to provide a uniform process for the characterization and investigation of an Area of Concern (AOC) or Area of Investigation (AOI) for the Risk Evaluation/Corrective Action Program (RECAP).

B1.2 Scope

The information provided in this Appendix is applicable to all site investigations conducted under RECAP. Due to the varying complexity of AOC and AOI, strict adherence to this document may not always be possible. This information is provided for the purposes of promoting standardization and consistency in investigation procedures and reporting format for site investigations in order to expedite the investigation and/or remediation processes.

This Appendix sets forth performance-based standards for conducting site investigations under the RECAP. If a site investigation is conducted in accordance with the requirements of this Appendix, the requirement to submit a site investigation workplan to the Department for approval prior to initiating site investigation activities may be waived for a MO-1 or MO-2 submittal. The requirement to submit a site investigation workplan for a MO-1 or MO-2 assessment shall be made on a site-by-site basis by the Department. This allowance does not relieve the Submitter from any statutory or regulatory requirements. A workplan shall be required for all MO-3 RECAP evaluations.

B1.3 Goals

The goals of the Department in developing this Appendix are two-fold: 1) to provide a methodology for characterizing and investigating an AOC or AOI utilizing consistent, scientifically-defensible methods, and 2) to determine the necessity for corrective action and gather information required to make a recommendation regarding any corrective action which may be required. To help meet these goals, the use of innovative technologies and methodologies may be approved by the Department on a case-by-case basis. Examples of innovative technologies and methodologies include the use of minimally intrusive investigation tools, rapid screening techniques, a multi-disciplinary team approach, and real-time data acquisition and analysis. These techniques offer the opportunity to make decisions in the field, resulting in a determination of the full vertical and horizontal extent of the contaminants in all environmental media in an efficient, cost-effective manner.

B2.0 REQUIREMENTS FOR SITE INVESTIGATIONS

The purpose and objectives of the site investigation are to: 1) determine if COC are present; 2) to define the full horizontal and vertical extent of COC in impacted media in the AOI; 3) to gather adequate data and other site-specific information required to identify the AOIC for soils and the CC for groundwater; 4) to identify the source of the release; ~~4~~5) to determine if receptors have been, or are likely to be adversely impacted; and ~~5~~6) to determine if an off-site impact has or is likely to occur.

B2.1 Discussion of Preliminary Evaluation Results

Preliminary evaluations are conducted for the purpose of determining if a release of COC to the environment has occurred, i.e., screening of the site under the SO (refer to Section 3.0 of the RECAP document). The SO shall be used to determine if further evaluation of the AOC is warranted. If the screening process indicates that further evaluation is warranted, the SO SS shall be used to identify the AOI and COC for the next level of assessment. Note: If COC are detected at an AOC, applicable LDEQ notification requirements shall be met.

Preliminary evaluation investigations are conducted for the purpose of determining if a release of COC to the environment has occurred, i.e., screening of the site under the SO (refer to Section 3.0 of the RECAP document). Typically, these investigations (e.g. Phase II property transfer investigations) are of limited scope and are not sufficient to obtain a NFA-ATT decision from the Department if constituents of concern are detected. Preliminary evaluations may be used as tools to determine if a release of constituents of concern has occurred provided that the areas most likely to have been impacted are sampled and that all laws, regulations and permit conditions are followed. **Any preliminary evaluations that are self-implemented are done at the risk of the Submitter.** LDEQ may require confirmation sampling for any self-implemented preliminary evaluation where no further action is requested.

~~B2.2 Development of a Conceptual Site Model~~

~~A preliminary Conceptual Site Model (CSM) shall be developed based on the existing site data and shall be used to assist in the development of a Site Investigation Workplan (refer to Section 2.7 and Figure 4 of the RECAP document). It is the Department's preference that data meeting the QA/QC requirements set forth in Section 2.4 of the RECAP document are used for the development of the CSM. However, analytical data that do not meet these requirements may be considered to be acceptable for use in the development of a preliminary CSM. The CSM shall identify the known, potential, or suspected constituent source(s); routes of constituent migration; exposure media, points and pathways; receptors; source media to be evaluated under RECAP; and shall be revised as new data are developed during the site investigation. The CSM shall be utilized to direct sampling efforts to ensure that all potential exposure areas and migration pathways are adequately characterized at each AOC or AOI.~~

B2.~~3~~2 Evaluation of Additional Data Needs

Based on an evaluation of existing site data~~ and the CSM~~, an evaluation of additional data requirements shall be performed. Factors to be considered include the necessity to fully characterize the environmental setting, identification of the vertical and horizontal extent of impact as well as the soil AOIC and groundwater CC, predicted fate and transport of COC, potential exposure points and pathways and the activity patterns of potential receptors. Additionally, for all analytical data gathered, the intended use of the data shall be considered to assure adequate Quality Assurance/Quality Control (QA/QC) procedures are conducted.

B2.~~4~~3 Development of a Site Investigation Workplan

Prior to conducting field activities associated with the site investigation for a RECAP evaluation, the Submitter may be required to prepare and submit a Site Investigation Workplan (hereinafter "Workplan") for LDEQ approval. The Submitter shall contact the LDEQ to establish the necessity of a Workplan. The requirement for a site investigation Workplan for a MO-1 or MO-2 evaluation shall be made by the Department based on site-specific conditions. A site investigation Workplan shall be submitted for Department approval for all MO-3 evaluations.

Louisiana Motor Fuels Underground Storage Tank Trust Fund Eligible Investigations

Prior submittal of a Workplan for LDEQ review and approval may not be required for site investigations of sites determined to be eligible to participate in the Louisiana Motor Fuels Underground Storage Tank Trust Fund provided the investigation is completed in accordance with this document. However, a statement declaring that the investigation will be conducted in accordance with the requirements of this Appendix and a cost estimate to complete the proposed site investigation shall be prepared and submitted to the LDEQ for approval **prior** to initiation of field activities. The cost estimate shall include all costs related to the completion of the investigation and shall address unit costs should it become necessary to expand the proposed scope of the investigation (horizontally or vertically). Additionally, in order to ensure maximum potential eligibility under the Trust Fund, all site activities shall be conducted in accordance with the latest version of the *Louisiana Motor Fuels Underground Storage Tank Trust Fund Cost Control Guidance Document* and overseen or performed by a Response Action Contractor. Failure to follow these guidelines could result in some or all costs being ruled ineligible for Trust Fund reimbursements.

The Workplan introduction shall include the reason for implementation of the preliminary evaluation (if completed). The type of facility currently present on the AOI and uses of adjacent properties shall be described. Details of the notification of release that was provided to LDEQ or any other regulatory agency shall be included. The site history shall include information

regarding any former facilities or site activities, especially any that used potential COC, and any historical information regarding possible releases by those former facilities. Dates of operation of former facilities and owners/responsible parties shall be listed chronologically if known. Any available information regarding environmental conditions associated with former operations shall be detailed. The type of facility currently present (such as a chemical plant, petroleum refinery, retail petroleum facility, etc.) shall be described, including all chemicals and raw materials stored or in use in the AOI. The appropriate NAISC code shall be listed (refer to ~~Section 2.9 and~~ Appendix E). Dates and quantities of COC released shall be stated if known. The release mechanism and actions taken to control the release shall be discussed. Maps depicting the AOI general location, the overall layout of the facility, any permitted waste management units, and sampling locations shall be included. Any sampling results shall be detailed with a written description of the sampling procedures, maps showing sampling locations, boring logs, well construction details and applicable LDNR well registration and/or P&A forms (if installed), analytical results in tabular format with lab data sheets, and chain-of-custody documentation.

The results of the preliminary evaluation (if completed) shall be summarized. All constituents detected at the AOC shall be listed. The COC should be identified in accordance with Section 2.2.5~~2.6~~ of the RECAP document. Current or potential threats to sensitive receptors shall be included. Any interim measures that have been taken to date, including soil removal, free phase removal, groundwater recovery, capping, etc., shall be specified with recommendations for any additional emergency or interim corrective action warranted at the AOC or AOI.

The site investigation Workplan submittal shall at a minimum, meet the submittal requirements listed below. Any variance from these requirements shall be approved by the Department prior to submission of the site investigation Workplan. Additional information may be required in the workplan depending on statutory, regulatory, or permit-specific issues.

(1) Topographic map with AOC or AOI labeled and name of quadrangle;*
(2) Vicinity map with adjoining properties, cross streets and land use;*
(3) Facility site map with all significant features including the latitude and longitude of the primary facility entrance and method used to collect location data;*
(4) A description of the site including setting, size, geology, hydrology, and hydrogeology;
(5) A description of current and, if known, future land use at and in the vicinity of the AOC or AOI;
(6) Detailed AOC or AOI map with all proposed sampling locations;*
(7) A description of groundwater use at and in the vicinity (one-mile radius) of the AOC or AOI, including a ~~DOTD~~LDNR water well survey obtained within the last 12 months;
(8) Identification of all known underground utilities (≤ 15 feet bgs) within or immediately adjacent to the AOC or AOI;
(9) Identification of the analytical methods and quantitation limits to be used and QA/QC data to be collected;
(10) Preliminary identification of the COC;

(11) A description of the activities to be conducted at the AOC or AOI;

~~A preliminary RECAP Conceptual Site Model;~~

(12) Project/Activity schedule(s) and milestone chart;

(13) A schedule of deliverables/submittals and their due dates;

~~An organizational chart illustrating the lines of responsibility of the personnel involved in the investigation;~~

~~Data management and tracking procedures (if applicable); and~~

~~Data evaluation methods and results with regard to data usability for the RECAP.~~

*Note: All maps shall have a bar scale, legend, North arrow, contour intervals (if contoured), date data was obtained, and map date. All maps, figures, diagrams, and cross sections submitted shall be legible, and unless otherwise approved by the Department, not larger than 11 inches by 17 inches and shall be folded to a standard report format (8.5 inches by 11 inches).

If a site investigation Workplan was prepared, a copy of the Workplan shall be available at the site throughout all field activities. All persons involved in field activities shall be familiar with the Workplan.

Unless otherwise approved, LDEQ shall be notified at least five (5) working days prior to the commencement of all field activities so that, if available, a representative of the Department may be present to witness the investigation activities.

The following documents shall be developed for all sites and submitted to the LDEQ upon request:

(1) ***A Technical Sampling and Analysis (TS&A) Plan***, which includes all sampling required to characterize the surface soil, subsurface soil, surface water, sediment, biota and groundwater as required by the RECAP ~~CSM~~ and a QA/QC Plan. The vertical and horizontal extent of impact shall be defined for each AOC or AOI. All sample points, preliminary COC, proposed analytical methods, and required quantitation limits shall be identified. A sufficient number of sample locations shall be selected to completely define the vertical and horizontal extent of all impacted media and to adequately characterize the AOI. The number and locations of samples shall be properly justified and determined based on EPA SW-846 Chapter 9, Data Quality Objectives for risk-based programs, best professional judgement, and/or LDEQ policy. Sample locations shall be based on site size, site geology and hydrogeology, site topography, migration pathways, points of exposure, and knowledge of sources or potential sources. If this information is unavailable or inconclusive, a grid system may be proposed, but shall be approved by LDEQ prior to implementation. Sample parameters may be based on site history and constituents expected to be present, if justified. Source areas as well as areas of constituent migration shall be sampled. The type and frequency of calibration procedures for field instruments, laboratory instruments (as applicable), internal quality control checks, and quality assurance performance audits and system audits shall be addressed. Preventative maintenance procedures, schedules, and corrective action procedures for field instruments and laboratory instruments (as applicable) shall be specified. The plan shall address sample custody procedures

during sample collection, in the laboratory (as applicable), and as part of the final evidence files. The laboratory contracted to analyze samples pursuant to this Workplan shall be accredited as required by the Louisiana Administrative Code (LAC) 33:I, Subpart 3.

(2) ***A Health and Safety (H&S) Plan,*** which shall delineate all necessary precautions for the safety and protection of both personnel involved in site activities and the surrounding community during the implementation of all site work under the approved Workplan. The H&S Plan shall provide a site background discussion and describe personnel responsibilities, protective equipment, health and safety procedures and protocols, decontamination procedures, personnel training, and type and extent of medical surveillance. The H&S Plan shall also identify problems or hazards that may be encountered and how they are to be addressed. Procedures for protecting third parties, such as visitors or the surrounding community, shall also be provided.

(3) ***A Quality Assurance/Quality Control (QA/QC) Plan,*** which shall address limitations and uncertainties associated with the data so that only appropriate and reliable data for use in quantitative risk assessment are carried through the RECAP process. Quality assurance objectives for data shall address the appropriate test methods, quantitation limits, required precision and accuracy, completeness, representativeness, comparability, and intended use of the collected data. The site investigation data shall meet the data requirements presented in RECAP, Sections 2.2~~4~~, and shall be evaluated as per RECAP, Section 2.2.3~~5~~.

~~**Louisiana Motor Fuels Underground Storage Tank Trust Fund Eligible Investigations**~~

~~Prior submittal of a Workplan for LDEQ review and approval may not be required for site investigations of sites determined to be eligible to participate in the Louisiana Motor Fuels Underground Storage Tank Trust Fund provided the investigation is completed in accordance with this document. However, a statement declaring that the investigation will be conducted in accordance with the requirements of this Appendix and a cost estimate to complete the proposed site investigation shall be prepared and submitted to the LDEQ for approval **prior** to initiation of field activities. The cost estimate shall include all costs related to the completion of the investigation and shall address unit costs should it become necessary to expand the proposed scope of the investigation (horizontally or vertically). Additionally, in order to ensure maximum potential eligibility under the Trust Fund, all site activities shall be conducted in accordance with the latest version of the *Louisiana Motor Fuels Underground Storage Tank Trust Fund Cost Control Guidance Document* and overseen or performed by a Response Action Contractor. Failure to follow these guidelines could result in some or all costs being ruled ineligible for Trust Fund reimbursements.~~

B2.~~5~~4 Site Investigation Requirements

The following requirements shall apply to all site investigation activities conducted under the RECAP except where otherwise stipulated, such as in a Cooperative Agreement. Deviations

from these requirements may be granted by the LDEQ based upon site-specific conditions. Any deviation from these requirements shall be approved by the Department prior to implementing investigation activities, fully documented in the Workplan, and outlined in the cover letter accompanying the plan. Unless otherwise authorized, all site investigation Workplans shall be approved prior to the initiation of site investigation activities.

(1) A review of LDEQ files and other records pertinent to the site, area or region is recommended prior to implementation of investigation activities.

(2) The Submitter shall be responsible for securing authorization from the appropriate property owners necessary to conduct the investigation, as well as ensuring that all underground utilities are properly located and marked prior to the commencement of the investigation.

(3) The Submitter shall be responsible for ensuring that all applicable licenses, permits, insurance, bonds, QA/QC Plan, TS&A Plan and H&S Plan, are properly in effect and maintained throughout the project life. A copy of the QA/QC Plan, TS&A Plan and H&S Plan shall be on site and available for review during the field activities. The Submitter shall ensure that any subcontractors or other parties involved with the project have complied with these requirements.

(4) Data shall be reviewed to identify reliable, accurate, and verifiable numbers that can be used to quantitate risks. The data shall be reviewed in accordance with the requirements presented in Section~~s~~ 2.2~~4~~ ~~and 2.5~~ of the RECAP document. Specifically, the data shall be evaluated to assess the effect of quality control issues on data usability. All data submitted shall be generated by an accredited laboratory in accordance with LAC 33:I, Subpart 3. The laboratory shall be accredited in those parameters for the applicable test categories.

(5) In general, the site investigation efforts shall include, but may not be limited to:

(a) Identification of the source of the release;

(b) Characterization of all media suspected of being impacted;

(c) Identification of the COC present and their respective concentrations;

(d) Identification of the horizontal and vertical extent of COC impact;

(e) Identification and characterization of migration pathways and receiving media;

(f) Characterization of current or potential off-site impacts;

(g) Collection of data necessary to adequately conduct a RECAP evaluation; and

(h) Collection of data for modeling input (if any is anticipated).

B2.~~5~~4.1 Sample Locations

A sufficient number of sample locations shall be selected to completely define the vertical and horizontal extent of all impacted media and to adequately characterize the ~~AOC or~~ AOI. The number and locations of samples shall be properly justified and determined based on EPA SW-846 Chapter 9, Data Quality Objectives for risk-based programs, best professional judgement and/or LDEQ policy. Sample locations shall be based on site size, site geology and hydrogeology, site topography, migration pathways, points of exposure, and knowledge of sources or potential sources. If this information is unavailable or inconclusive, a grid system may be proposed, but shall be approved by LDEQ prior to implementation. If the data is determined to be unacceptable (i.e. sample preparation fails to meet specified analytical method requirements, holding times are exceeded, inappropriate quantitation limits are used, etc.), resampling may be required. The longitude and latitude coordinates shall be obtained for all sample locations unless otherwise directed by the Department. The coordinate data should have an accuracy equal to, or better than, 3 meters (3 m) 2DRMS and shall be reported in units of decimal degrees. This data will serve to improve the accuracy of site characterization, delineation of the AOI, and identification of sample locations when re-sampling is warranted. Note, coordinate data is also required for geotechnical samples but is not required for QA/QC samples.

B2.~~5~~4.2 Soil Investigations

All soil investigations shall be performed in accordance with this Appendix, as well as the guidelines established in the latest versions of the LDEQ and LDOTD *Construction of Geotechnical Boreholes and Groundwater Monitoring Systems Handbook* and ~~the LDOTD *Water Well Rules, Regulations, and Standards.*~~Louisiana Administrative Code (LAC) Title 56 Part I "Water Wells" (LAC 56 Part 1).

The equipment used to advance soil borings shall consist of hollow stem auger, solid stem auger, direct push technology or other methods approved by LDEQ. Hand augers may be allowed if samples collected are not intended for volatile organic analysis or if site conditions make other methods impractical. All drilling rig and sampling equipment shall be decontaminated prior to the start of drilling, between each boring, and before leaving the site by rinsing with a high-pressure washer or other appropriate cleaning method. All investigation derived waste (cuttings, purge water, etc.) shall be collected and properly disposed in accordance with applicable LDEQ rules and regulations. The disposition of the waste shall be discussed within the site investigation report and shall include copies of waste manifests or other pertinent documentation regarding the disposition of the waste.

Soil investigation techniques shall be performed in a manner to ensure that contamination is not introduced into the borehole and that contamination is not carried from one water-bearing stratum to another.

When sampling soil, undisturbed continuous samples are to be collected from each boring location to determine the vertical depth of impact. At a minimum, sampling shall continue until first water is encountered or until the vertical extent of the impact has been defined. Site-specific conditions or the environmental fate and transport characteristics may necessitate the collection of additional soil samples with depth. The horizontal extent of the AOI shall be defined to the constituent's limiting standard for the Option being implemented as discussed in Section 2.3.1.2~~6~~ of the RECAP document. Each soil sample shall be visually classified by a professional geoscientist~~logist~~ or professional engineer in accordance with ASTM Method D2488 and documented on a boring log using the Unified Soil Classification System.

Soil samples are to be collected at a maximum of 2-foot intervals using a thin-walled sampler (e.g., Shelby tubes), split-spoon samplers, direct push samplers or other sampling tools approved by LDEQ. Soil samples shall be extruded in the field immediately following retrieval of each sampler. A representative portion of each soil sample shall be carefully trimmed to remove the smear zone formed during sample acquisition and split into two portions. One portion shall immediately be placed in a clean sample container appropriate for the method, labeled, and cooled to < 6~~4~~ degrees Centigrade while the other portion shall be placed in a clean 16-ounce glass container, covered with clean aluminum foil, and sealed. The soil in the 16-ounce glass container shall be allowed to volatilize for approximately 15 minutes prior to conducting a headspace screening analysis by penetrating the foil with the probe from a flame ionization detector, a photoionizaton detector, other organic vapor analyzer, or other instrument approved by LDEQ. If the organic vapor analyzer is incapable of detecting the COC due to constituent characteristics (e.g. non-volatiles, metals), alternative field screening tests or other rationale for selection of samples previously approved by LDEQ shall be employed. All samples shall be submitted with completed chain-of-custody forms to an accredited laboratory in accordance with LAC 33:I, Subpart 3.

Upon prior approval by the Department, a second boring located immediately adjacent to the first boring may be advanced as an alternative to continuous soil sampling. The second boring may be advanced in order to obtain discrete soil samples at intervals identified by the continuous headspace screening analysis conducted on soil within the first boring.

If warranted by site conditions, each sample may be screened using a standard dust and methane filter. These two types of filters are used in conjunction to differentiate between actual organic vapors and naturally occurring methane gas produced by the decomposition of organic matter in soil. By subtracting the methane filtered reading from the standard filtered reading, a corrected reading of volatile organic content may be obtained.

Source areas, as well as areas of constituent migration, shall be sampled. All sample collection methods, containers, preservation and analyses shall be conducted in accordance with the latest approved edition of the EPA SW-846, *Test Methods for Evaluating Solid Waste* and other pertinent EPA publications and methods unless otherwise specified by LDEQ. Soil samples collected for volatile analyses shall be collected using EPA SW-846 Method 5035 (or an equivalent method for volatile hydrocarbon fractions). If the COC is suspected to be present in the following media, each shall be sampled:

(1) Surface soil (0 - 15 feet bgs)
(2) Subsurface soil (15 feet bgs - depth of impact)
(3) Groundwater
(4) Surface water
(5) Sediment
(6) Biota

NOTE: If the site is a participant in the VRP program, then the soil in the 0-2 feet interval shall also be evaluated.

For each soil zone (i.e., surface soil and subsurface soil) suspected of being impacted, the soil sample indicating the highest organic vapor measurement or the soil sample chosen based on alternative screening rationale shall be retained for laboratory analyses. It is not necessary to retain a soil sample for laboratory analysis for any particular zone where the samples within that respective zone do not exceed background, as established on an area of the site unaffected by the potential COC. However, at a minimum a soil sample from each boring shall be collected from the:

(1) Soil interval from soil surface to a depth of 2 ft bgs (for releases that occur at the ground surface)
(2) Soil interval with the highest organic vapor measurement (greater than background or highest indication of COC presence using previously approved alternative screening methods) (surface soil or subsurface soil)
(3) Soil-groundwater interface (for light non-aqueous phase liquids)
(4) Total depth of the boring

If water is not encountered and all samples register background on the field screening instrument or provide no indication of impact using previously approved screening methods, the interval most likely to be impacted shall be retained for laboratory analysis along with the soil sample from the total depth of the boring. The interval most likely to be impacted shall include soils in the 0-2~~3~~ ft bgs interval if that interval is expected to be impacted based on the release mechanism and site conditions.

Soil samples shall be collected at a maximum of 2-foot intervals and analyzed as discrete samples

and shall not be combined to produce composite samples unless approved by LDEQ.

Further evaluation shall be warranted if:

(1) Analytical results indicate that the vertical and horizontal extent of the impact has not been delineated;
(2) A constituent concentration above the limiting standard for the Option being implemented is expected to impact receptors or media that were not evaluated~~ in the conceptual site model~~; or
(3) It has not been demonstrated that COC concentrations decrease to acceptable levels with distance (horizontally and vertically) from the sampling location of interest.

Fraction of Organic Carbon. It is required under MO-2, Appendix G MO-2, and MO-3 that a soil sample be collected to determine the fractional organic carbon (f_{oc}) content of the soil. ~~The fractional organic carbon soil sample shall be collected from a non-impacted area that is representative of the impacted soil conditions at the AOI.~~ The measure of a soil's fractional organic carbon (f_{oc}) content is useful in determining the portion of organic matter available to adsorb organic constituents of concern (COC) to the soil and thereby reducing the potential for COC to leach to groundwater. Therefore, under Appendix G, MO-2, and MO-3, site-specific f_{oc} soil samples shall be collected using the following criteria:

1. The soil boring location used for f_{oc} evaluation shall be from a non-impacted location since high levels of organic contaminants may result in artificially high carbon content. The non-impacted soil samples collected for foc evaluation shall be verified by OVM readings < 100 ppmv or by analysis for the COC.

2. At least one boring shall be advanced in the non-impacted location with a minimum of three (3) soil samples collected from each boring. One soil sample shall be collected from the strata immediately above the impacted soil interval at the AOI, one soil sample shall be collected at the same strata as the impacted soil interval at the AOI, and one soil sample shall be collected from the strata immediately below the impacted soil interval at the AOI. Additional borings from non-impacted locations may be required for larger AOI. The number and location of soil samples is subject to Department approval. It is also recommended to collect soil samples from any lithology change to determine site-specific ranges of soil organic carbon content.

3. Analyze the soil samples for organic carbon using Heat Loss on Ignition (ASTM D2974) method (unless otherwise approved by the department). The units are typically reported as percent organic matter. To convert to f_{oc}, divide percent organic matter by 174.0.

$$f_{oc} = \text{Organic Matter (\%)} / 174$$

The site-specific f_{oc} for the AOI is the mean of the foc values derived from the analytical methods. However, if the f_{oc} values derived from the analytical methods vary by more than an order of magnitude, the mean value may not be used to develop a site-specific f_{oc} but rather the lowest foc value shall be used as the site-specific f_{oc} for the AOI. If the site-specific f_{oc} value is less than the default f_{oc} value of 0.006, then the default value may be used as the site-specific f_{oc} for the AOI.

Leach Test. A leach test may be used to relate concentrations of constituents adsorbed to soil organic carbon to soil leachate concentrations in the impacted zone. The EPA Synthetic Precipitation Leaching Procedure (SPLP, EPA SW-846 Method 1312, U.S. EPA, 1994) is the required leach test for evaluation of the soil to groundwater pathway unless otherwise approved by the Department. The SPLP was developed to model an acid rain leaching environment and is generally appropriate for an impacted soil scenario (*Soil Screening Guidance*, EPA April 1996).

It is the objective of the SPLP sampling plan to collect soil samples across the Area of Investigation (AOI) at various locations that represents a range of COC concentrations from the lowest suspected concentrations to the highest suspected concentrations. The soil samples from the selected locations should be collected continuously as to provide a profile of SPLP concentrations encountered at each location as well as SPLP concentrations encountered across each lithology change. Therefore, the number of soil samples collected for SPLP analysis will vary according to the size of the AOI, the COC under investigation, change in lithology, etc. The number and location of soil samples is subject to Department approval. It is also recommended to collect soil samples from any lithology change to determine site-specific ranges of soil geotechnical parameters (e.g., soil bulk density, porosity, soil moisture content, and organic carbon content).

Once the sampling locations have been identified, a discrete soil sample of sufficient volume should be collected and divided into two sub-samples. One sub-sample is to be analyzed for SPLP using EPA SW-846 Method 1312 and the other sub-sample is to be analyzed for the COC using the appropriate analytical method (e.g., BTEX using EPA SW-846 Method 8260).

In general, TCLP data may be considered acceptable for the evaluation of the soil to groundwater pathway if the data are current and appropriately represent site conditions. However, if the TCLP data indicate that the soil to groundwater pathway is a concern, then the SPLP should be used to provide a more appropriate evaluation of the pathway. The leachable chlorides test and the leachable TPH test included in the *Laboratory Procedures for Analysis of Exploration and Production Waste*, Louisiana Department of Natural Resources Office of Conservation Injecting and Mining Division are not acceptable methods for evaluating the soil to groundwater pathway under the RECAP.

The site investigation data shall meet the data requirements presented in RECAP, Sections 2.2~~4~~ and shall be evaluated as per RECAP, Section 2.2.3~~5~~.

B2.~~5~~4.3 Soil Characteristics/Geotechnical Analysis

Unless otherwise specified by the LDEQ, soil characteristic/geotechnical samples shall be collected from ~~each impacted~~ the lithologic unit that is most representative of the impacted soil interval at the AOI to assist in the analysis of environmental fate and transport of the constituents of concern. If possible, soil samples shall be collected in accordance with ASTM Method D1587 using thin-walled samplers (e.g., Shelby tubes) or other undisturbed sampling tools approved by LDEQ. Soil characteristics/geotechnical analyse~~i~~s that shall be required include, but may not be limited to:

(1) Organic matter (ASTM D2974 or other upon LDEQ approval)
(2) Unified Soil Classification System (ASTM D2487)
(3) Atterberg Limits (LL, PL, PI) (ASTM D4318)
(4) Particle Size Analysis (ASTM D422) [1]
~~Hydraulic Conductivity[1] (Constant Head) (Granular soils) (ASTM D2434)~~
~~Hydraulic Conductivity[1] (Falling Head) (Fine grained soils) (ASTM D5084)~~

Additional parameters that may be necessary include:

(1) Soil pH (ASTM D4972)
(2) Dry density (Calculated)
(3) Moisture content (ASTM D2216)
(4) Specific Gravity (ASTM D854)
(5) Total Porosity (Calculated)
(6) Hydraulic Conductivity (Constant Head) (Granular soils) (ASTM D2434)
(7) Hydraulic Conductivity (Falling Head) (Fine grained soils) (ASTM D5084)

[1] If groundwater monitoring wells are to be installed, it is highly recommended that an additional soil sample be collected from the saturated zone to determine the proper well design (e.g., filter pack, screen slot size, etc.).

~~[1] Not required if conducting an aquifer test~~

B2.~~5~~4.4 Groundwater Sampling from Boreholes and Monitoring Wells

Groundwater samples collected from boreholes shall be collected using discrete samplers or through temporarily installed factory slotted casing or other sampler approved by the department. If suspended solids could adversely affect sample analytical results, provisions shall be taken to ensure sample quality. A minimum of three well volumes (or until dry) shall be purged from each temporary well prior to sampling or a micropurging technique approved by LDEQ for this site shall be used. The groundwater samples collected from each temporary well or boring shall be obtained from an appropriate depth consistent with the impacted zone. Precautions shall be taken to prevent the zone that is sampled from being impacted by other strata.

Groundwater samples that are collected from borings may appear to be turbid. The turbid samples may exhibit concentrations that are not representative of the groundwater zone that is sampled, particularly in the case of inorganic constituents where sample acidification may leach inorganic constituents from suspended solids. For this reason, the LDEQ recommends that turbid samples be analyzed for both dissolved and total metals if metals are considered as a COC. When sampling for total or dissolved metals, the appropriate analytical method criteria for sample collection and preservation shall be followed.

For monitoring wells, the depth to groundwater and total depth of the wells shall be measured prior to purging. All wells shall be sampled within twenty-four hours of purging. Measurement levels shall be determined relative to the most recent National Geodetic Vertical Datum (NGVD). A minimum of three well volumes (or until dry) shall be purged from each well prior to sampling or a micropurging technique approved by LDEQ shall be used. Replicate measurements shall be taken of the three primary field parameters (pH, specific conductivity, and temperature) at each well. When using a micropurging technique, dissolved oxygen measurements shall be collected. The purpose of obtaining replicate samples is to determine if the groundwater entering the well has stabilized from purging and that the sample to be collected for laboratory analysis is representative of the water in the zone being monitored. Groundwater samples collected from a monitoring well shall be analyzed for total constituent concentration.

If a non-aqueous phase liquid of **known composition** is encountered, the apparent product ~~layer~~ thickness shall be measured and reported within the investigation report. If a non-aqueous phase liquid of **unknown composition** is encountered, the apparent product~~layer~~ thickness shall be measured and then sampled and analyzed to assist in the identification of the release source.

For boreholes and monitoring wells that do not exhibit the presence of a non-aqueous phase liquid, water samples shall be collected and analyzed using a method appropriate to detect the suspected COC. Sampling protocol, including equipment decontamination procedures, shall be conducted in accordance with the TS&A Plan. Documentation shall be provided in the investigation report demonstrating that approved QA/QC procedures were employed for both sample collection and analytical procedures.

Groundwater samples collected for the analysis of **volatile organic** compounds shall not be collected with a pump that causes aeration of the sample and care shall be taken not to agitate the samples. Groundwater samples shall not be combined to produce composite samples. Additional guidance on sample collection can be found in USEPA's *RCRA Sampling Procedures Handbook* and USEPA's *RCRA Groundwater Monitoring Technical Enforcement Guidance Document*. Specific sampling parameters may be required by regulation, permit, or to meet the requirements for a RECAP evaluation.

Water samples shall be collected in a progression from borings or monitoring wells where COC are least likely to be present, or expected to be present at low concentrations, to areas where the

highest concentrations are expected to be present. The sampler shall use clean latex or nitrile gloves at each sample location and between each sampling interval. It is recommended that clean plastic sheeting shall be used at each sample location to ensure that sampling equipment and sample containers are not inadvertently contaminated. If dedicated equipment is not used, the equipment shall be thoroughly decontaminated between sample locations.

Immediately upon collection, the water sample shall be labeled and preserved using the appropriate handling and preservation protocol. At a minimum, sample labels shall include sample number, date, time, sample location, sampler's name, sample type, analysis to be performed, preservatives used and any other pertinent information that may be useful to ensure proper sample identification. Samples requiring refrigeration must be stored in ~~-~~an ice chest or suitable alternative capable of ~~-~~maintaining a temperature ~~no greater~~less ~~-~~than or equal to ~~4~~6 degrees Centigrade until samples are prepared for analysis by an accredited laboratory. The samples shall always be accompanied with completed chain-of-custody forms.

For routine sampling events, it is required that field QA/QC samples be collected and analyzed. Refer to Section 2.2.2~~4~~ of the RECAP document for further guidance on the QA/QC requirements for the RECAP.

All sample collection methods, containers, preservation and analyses shall be conducted in accordance with the latest approved edition of the EPA SW-846, *Test Methods for Evaluating Solid Waste* and other pertinent EPA publications and methods unless otherwise specified by LDEQ. If the acid preservative causes effervescence in a groundwater volatile organic sample, then the sample shall be collected without an acid preservative and kept refrigerated at 4 degrees Centigrade from the time of collection until analysis **within seven days**. Proposed laboratory methods shall be specified in the Workplan and shall be consistent with the suspected COC for the site. Sample quantitation limits shall be consistent with those listed in SW-846 unless samples collected are expected to contain high levels of contaminants, or SW-846 sample quantitation limits exceed Maximum Contaminant Levels for drinking water or any risk-based corrective action level that may be applicable. Should samples be analyzed using a quantitation limit higher than that listed in SW-846, the Maximum Contaminant Level for drinking water or any applicable risk-based corrective action level and results are reported as non-detect, additional sample collection and analysis may be required. All data submitted shall be generated by an accredited laboratory in accordance with LAC 33:~~-~~I, Subpart 3. The laboratory shall be accredited in those parameters for the applicable test categories.

B2.~~5~~4.5 Groundwater Monitoring Wells

Well installation and construction shall follow the guidelines established in the latest versions of ~~the LDEQ and LDOTD *Construction of Geotechnical Boreholes and Groundwater Monitoring Systems Handbook*~~ the *LDNR/LDEQ Manual of Environmental Boreholes and Monitoring*

Systems -and Louisiana Administrative Code (LAC) Title 56 Part I "Water Wells"~~the LDOTD *Water Well Rules, Regulations, and Standards*~~. Monitoring wells shall be located so that the contaminant plume, as well as upgradient and downgradient groundwater conditions can be adequately monitored. Wells shall also be installed in areas where immiscible (non-aqueous phase liquid) COC are encountered but shall not be advanced beyond the impacted zone in these areas or other areas suspected of NAPL impact.

Soil borings which will be converted to monitoring wells shall be advanced with hollow stem augers or other methods as approved by LDEQ. Drilling and well development/sampling techniques shall be performed in such fashion to ensure that contamination is not introduced into the borehole/monitoring well and that contamination is not carried from one water bearing stratum to another. Any boring capable of providing a conduit to a deeper zone shall be properly cased to prevent vertical migration of COC. Specific procedures for borehole advancement, monitoring well installation, monitoring well development, and borehole plugging shall be included within the investigation report. Boring logs and monitor well construction diagrams shall be completed and also included within the investigation report.

Well construction material shall be compatible with contaminants and contaminant levels expected to be present. Wells shall not be constructed of dissimilar metals due to the possibility of accelerated corrosion. Well screens shall not exceed ten feet in length unless otherwise approved by the LDEQ. Site-specific conditions may necessitate deviation from proposed depths and screened intervals. For investigation of unconfined aquifers, ~~W~~wells shall be screened across the seasonal phreatic zone if light non-aqueous phase liquids are expected to be present, or at the base of the permeable zone if dense non-aqueous phase liquids are expected to be present. Collection of a soil sample from the saturated zone for particle size analysis is highly recommended from all permeable zones in which the wells are screened to assist in determining the proper filter pack and screen slot size. Well development shall be continued until turbidity, pH, specific conductance and temperature have stabilized.

B2.~~5~~4.6 Aquifer Hydraulic Characteristics/Properties

Unless previously completed, an evaluation of the hydrologic characteristics of the first or subsequent saturated zone shall be performed unless:

(1) Evidence exists that the impact has not migrated to groundwater (e.g., the spatial distribution of COC within the unsaturated soil zone); and
(2) It is assumed that the first saturated zone meets the definition of Groundwater Classification 1 for the identification and application of the soil concentration protective of the groundwater RECAP standard.

In order to determine the site-specific hydraulic properties of an aquifer, an aquifer test shall be conducted ~~and unless otherwise specified or approved by the Department, a slug test shall be conducted~~ on an adequate number of monitoring wells that do not contain non-aqueous phase

liquids. ~~For wells that are partially penetrating, the withdrawal slug test is recommended to overcome the affects of the filter pack. For fully penetrating wells where the well screen remains completely saturated, either the injection or withdrawal slug test is appropriate. In some cases, a pumping test may be required by the LDEQ to more adequately define the groundwater regime at the site.~~ For guidance on conducting aquifer tests, refer to RECAP Appendix F.

In order to evaluate an AOC or an AOI under RECAP, groundwater shall be classified into Groundwater Classifications 1, 2, or 3 as determined by current or potential use, maximum sustainable well yield, and total dissolved solids concentration (refer to Section 2.3.2.1~~10~~ of the RECAP document). The information required to classify the groundwater zone(s) of concern at the AOI shall be collected during the site investigation. The current use of an aquifer shall be determined by identifying all existing water wells and usage within one-mile radius of the AOI property boundaries (at a minimum, a L~~DOTD~~DNR water well survey obtained within the past 12 months and a 500-foot radius walking receptor survey shall be performed). Maximum sustainable well yield shall be determined by well yield estimation methods or by direct measurements as outlined in RECAP, Appendix F. EPA Method ~~160.1~~ 2540 shall be used to determine the background total dissolved solids concentration of groundwater collected from the aquifer of concern.

In order to take advantage of the groundwater information gathered from hundreds of sites across the State and to aid in expediting the remediation process, groundwater may be classified at a site using information from sites within one mile of the AOI (unless otherwise approved by the Department) provided that it can be demonstrated that the geological and hydrogeological conditions are similar between the sites. Boring logs, well completion diagrams, hydrological and hydrogeological data, including aquifer test data and potentiometric surface maps, should be reviewed to make the demonstration. Consideration should also be given to the existence of nearby pumping centers, perched water zones, nearby water bodies, faults, etc. Approval of a site groundwater classification using data from other area sites will be at the discretion of the Department and prior approval is REQUIRED.

B2.~~5~~4.7 Plugging and Abandonment of Monitoring Wells/Boreholes

All plugging and abandonment activities of monitoring wells or boreholes shall be conducted in accordance with the latest version of the LDEQ and LDOTD *Construction of Geotechnical Boreholes and Groundwater Monitoring Systems Handbook* and the Louisiana Administrative Code (LAC) Title 56 Part I "Water Wells".~~LDOTD *Water Well Rules, Regulations, and Standards.*~~

B2.~~5~~4.8 Sediment Sampling

It is advisable that LDEQ approval be obtained prior to conducting any sediment sampling activities. Prior to commencing field operations, thought shall be given to the Data Quality Objectives of the project. Pertinent considerations include the type(s) of sediment samples that will be required and how they will be analyzed. The primary goal of sediment sampling is to collect a sample that accurately represents the sediment condition *in situ.* Specific collection and preservation requirements shall depend on site-specific conditions. For example, benthic community analyses require different sediment collection and preservation methods than those for chemical analyses. The technique chosen will depend on several considerations, including the numbers and types of analyses required, the type(s) of sediment being collected, and the depth to which sediment is to be sampled.

B2.~~5~~4.9 Surface Water Sampling

It is advisable that LDEQ approval be obtained prior to conducting surface water sampling activities. Surface water is generally characterized by one of four types of environments:

(1) Rivers, streams, bayous, and creeks;
(2) Lakes and ponds;
(3) Impoundments and lagoons; and
(4) Estuaries.

Sediments are often sampled in conjunction with surface water, and are considered an integral part of the surface water environment since each type of surface water is in contact with sediments. Because surface waters can exhibit a wide range of general characteristics, such as size or flow, the collection technique shall be adapted to site-specific conditions.

Surface water sampling locations will vary with the size of the water body, flow regime, and the amount of mixing (turbulence). Best professional judgment shall be utilized to evaluate whether changes in sampling locations are reasonable and consistent with the objectives of the sampling and analysis activities.

B2.~~5~~4.10 Biota Sampling

It is advisable that LDEQ approval be obtained prior to conducting biota sampling activities. Biota sampling shall be conducted when exposure pathways involving biota are determined to be complete, or potentially complete, for the AOI or areas adjacent to the AOI. The sampling and analysis of biota shall be conducted in accordance with current EPA risk assessment guidelines. The sampling of fish and shellfish shall be conducted in accordance with the guidelines presented in *Protocol for Issuing Public Health Advisories for Chemical Contaminants in*

Recreationally Caught Fish and Shellfish prepared by Louisiana Department of Health in collaboration with Louisiana Department of Environmental Quality, Louisiana Department of Agriculture and Forestry and Louisiana Department of Wildlife and Fisheries, February 2012.

B2.~~5~~4.11 Groundwater Monitoring

In general, unless otherwise approved by the Department, beginning the first quarter after the investigation is completed, quarterly monitoring of all groundwater monitoring wells (if installed) shall be implemented at sites where COC have been detected until this requirement is modified or terminated by the Department. Where NAPL is present, wells containing NAPL should be gauged but not sampled unless specifically directed to do so by the Department in order to identify a source of release or constituent of concern.

Quarterly gauging and sampling results shall be reported to the Department in triplicate on a semi-annual basis, due within thirty days after the end of each semi-annual period unless otherwise specified or approved by the Department. Quarterly periods include January 1 through March 31, April 1 through June 30, July 1 through September 30, and October 1 through December 31. Department Team Leaders must be notified five days in advance of monitoring events and the events must be separated by a sixty-day intervening period unless otherwise approved by the LDEQ.

For underground storage tank sites with treatment units or utilizing passive remediation that are eligible for Louisiana Motor Fuels Underground Storage Tank Trust Fund reimbursement, the sampling frequency shall be modified to annually in any well that has exhibited COC concentrations below the Departmentally approved remediation standard for four consecutive quarters unless otherwise directed by the Department.

Results of quarterly monitoring must be reported **semi-annually** using the format specified in Section B4.0 unless another reporting frequency or format is stipulated by regulation or approved by the LDEQ. The required format includes a title page, a summary of the monitoring events, any recommendations for future monitoring, a summary of remediation system operations (as applicable), figures, tables, signed certification that appropriate sampling protocols were followed, full laboratory reports with completed chain-of-custody, laboratory QA/QC reports, and field data sheets for all sampling events during the reporting period, and documentation of the disposition of purge water.

The monitoring summary shall describe the activities associated with each of the monitoring events during the semi-annual period. Recommendations should be provided regarding current and future monitoring. If a remediation system is present, the report must include: a summary of remediation system operations; run-time percentages; reasons for non-operational days; identification of wells in use for treatment and/or recovery; gallons of NAPL/water recovered; system monitoring results, including but not limited to operation and maintenance logs,

discharge monitoring report summaries and excursions, and air monitoring results (if applicable); a pre-remediation contaminant distribution map; an evaluation of system efficiency, including a comparison of the projected and actual rate of contaminant reduction; a discussion of the progress made toward meeting the remediation standard, including the percent reduction of each COC in relation to its remediation standard; and any recommendations for system modification to improve efficiency.

For sites with remediation systems that are recovering impacted groundwater or vapor, the LDEQ may require periodic sampling of the groundwater and/or vapor influent for analysis and quantification of contaminant mass removed. If so directed, mass removal rates shall be included in the semi-annual reports in the discussion of system efficiency.

Required figures include a scaled site plan (use of 11" X 17" maps are encouraged), a potentiometric map for each zone monitored in the gauging event using the scaled site plan, and isoconcentration map for each COC which exceeds remediation standards for each zone monitored in the sampling event. Required tables include Forms -3~~2~~, 4, and 5~~, and 6~~ present in RECAP Appendix C, as well as a Historical Groundwater Monitoring Summary Form~~ (see Section 4.2)~~. The historical table shall include at least the eight previous monitoring events. If NAPL is detected, the NAPL thickness should be reported in the comments section of F~~f~~orms 4, 5~~6~~, and in the appropriate column on the Historical Groundwater Monitoring Summary Form. Groundwater elevation should be adjusted where NAPL is encountered and the adjusted elevation used on potentiometric maps.

Signed and dated certification must be provided in each report stating that all applicable QA/QC procedures were followed for each monitoring event and that all laboratory analyses have been performed by laboratories accredited by the State of Louisiana in accordance with LAC 33:I, Subpart 3. Full laboratory reports and QA/QC certification must be included for each COC for each sampling event. Copies of all completed chain-of-custody documents and field data sheets must be provided for each monitoring event during the reporting period, as well as documentation of the disposition of purge water.

~~*B2.5.12 Air Sampling*~~

~~Air sampling should be considered for the evaluation of the vapor intrusion pathway when all other methods (application of the Soil$_{es}$ and/or GW$_{es}$ RS, soil gas assessment, etc.) have been implemented or determined to not be feasible based on site-specific conditions. Prior to performing air sampling to demonstrate under RECAP that the air pathway is not being impacted, a workplan should be submitted to the Department.~~

~~The principal objective of air sampling is to obtain an upper-bound representation of baseline conditions that provide a conservative indication of exposure and health risk. To obtain such a worst-case estimate, baseline samples must be collected under conditions expected to give rise to~~

~~maximum air concentrations. Such conditions may include periods of high groundwater levels or, for enclosed structures, soil vapor intrusion in winter when use of a heating system creates a chimney effect, drawing vapors into the structure.~~

~~Many variables can influence air sampling results. For ambient air sampling, this could include meteorological and hydrogeological conditions. For indoor air sampling, this could include the air exchange rate for the home, operation of a building HVAC system, hydrologic and meteorological conditions, and household activities including chemical use. These variables combine to create site-specific and temporal exposure conditions that must be considered in evaluating constituents of concern.~~

~~Instantaneous indoor air sample collection protocol:~~

~~(a) Place samplers at breathing zone height to collect a representative sample of COC concentration in indoor air.~~

- ~~Perform sampling in a room that is used regularly, such as a living room, den, or playroom.~~
- ~~Avoid bedrooms, kitchens, and laundry rooms where use of personal products and other chemical products may interfere with sampling.~~
- ~~Perform "living area" sampling at lowest level of the house suitable for occupancy.~~
- ~~Close windows and outside doors and keep them closed as much as possible during sampling except for normal entry and exiting.~~
- ~~Place samplers approximately 1 meter above the floor away from drafts (e.g., vents, open doors and windows, air conditioners, fans), high heat (heaters and heat vents), high humidity, exterior walls, and other obstructions to air flow.~~
- ~~Samplers should be placed on wooden stands or a piece of furniture in the central part of the room.~~
- ~~All sampling equipment should be placed away from family traffic patterns and out of reach of pets and children.~~
- ~~Do not operate fans or other ventilation equipment.~~
- ~~Only operate air conditioning units that recirculate interior air.~~
- ~~Samplers should not be placed close to attached garages, ash trays, or other possible sources that may bias sampling results.~~

- ~~Using the attached questionnaire, document household conditions and activities during the sampling period including characteristics, resident activities, and potential ambient sources that may influence indoor air sampling results.~~

- ~~Provide a diagram of sampling locations.~~

~~Quality Assurance/Quality Control protocol:~~

~~(a) Refer to RECAP Section 2.4.~~
~~(b) Follow the EPA Method.~~
~~(c) Field blanks and duplicate samples shall be collected for a minimum of 5% of the samples collected.~~
~~(d) Air samples collected using sample bags shall not be shipped by air unless the cargo cabin is pressurized.~~
~~(e) The general weather conditions during sampling shall be recorded including ambient temperature.~~

~~Sampling Methods:~~

~~Prior to implementation of an air sampling event, a background air sample shall be collected for the subject site as near the time of the air sample collection as possible. The background sample shall be collected upwind of the AOI or structure under evaluation and shall be in an area unaffected by the source COC. It is recommended that an additional background sample be collected downwind of the AOI or structure, which can provide additional information to aid in evaluating the air exposure concern. For an enclosed structure, it may also be necessary to obtain a background air sample from a structure with a similar use and occupancy that has no potential to be affected by the source COC.~~

~~Concurrent with the air sampling event, the ambient air within the AOI and all rooms of an enclosed structure and any enclosed spaces (closets, cabinets) shall be screened with an OVA, TVA, and/or other appropriate volatile organic monitoring device in accordance with the manufacturer's specifications. In the case that the monitoring instrument detects a concentration level of greater than 2 ppm above background within a defined area of the AOI or enclosed structure, then the Summa canister air sample shall be collected in the center of the enclosed structure.~~

~~If the analyzer does not detect a concentration greater than 2 ppm above background within the building, then the Summa canister air sample will be collected in the center of the enclosed structure.~~

~~The analyst will maintain a logbook of all recordings. The analyst shall complete a Canister Sampling Field Data Sheet for each sample. The data sheet shall serve as the chain of custody~~

~~document. In addition to writing the time and location of each canister sample on the data sheet, the analyst shall indicate the sample location on a schematic drawing. The analyst shall take a photo of each sample location. Photos will be part of the documentation package. If a canister sample is collected due to an elevated analyzer reading, that reading will be included on the Canister Sampling Field Data Sheet along with any other pertinent observations (note the presence of items such as ash trays, household cleaning supplies, and insecticides). Traffic conditions at the sampling locations should be noted on the data sheet for ambient air samples.~~

~~During a sampling event of an enclosed structure, doors and windows should be kept closed as much as possible, except to allow authorized personnel access to perform duties necessary to collect the air samples.~~

~~Analytical Methods:~~

~~Samples shall be analyzed using EPA Reference Method TO-15 or TO-17 using a gas chromatograph with flame ionization detection and a gas chromatograph with mass selective detector. All method performance criteria will be met. Laboratory analysts will follow procedures in the LSD SOP *HP GC/MS Determination of Ozone Precursor Compounds and Target Compounds Based on EPA Method TO-15 Collected in Summa Canisters*. Any other analytical procedure shall be justified in the work plan and shall receive approval from the Department prior to sampling.~~

~~References:~~

~~*EPA Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils*, November 2002.~~

~~*EPA User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings*, June 2003.~~

B3.0 SITE INVESTIGATION SUBMITTAL REQUIREMENTS

Unless otherwise approved, at a minimum, the site investigation report shall:

(1) Document the person(s) involved with the project;

(2) Incorporate certification, signed by the project manager, verifying compliance with the Remediation Investigation Workplan, QA/QC Plan, TS&A Plan and H&S Plan;

(3) Include a description of any unusual events that occurred or conditions encountered during the investigation;

(4) Describe the method(s) of investigation with the rationale for the method(s) and an explanation detailing how the investigation met the assessment goal;

(5) Clearly state conclusions regarding all sources (on-site and off-site) for any impacted media encountered within the study area;

(6) Identify all landowners, lessees, and servitude holders where COC are confirmed or projected to be present above RECAP SS;

(7) Include groundwater gauging results (if collected) graphically in the form of a potentiometric surface map;

(8) Tabulate and graphically present in isopleth format the soil concentrations of COC encountered;

(9) Provide a separate isopleth map for each impacted soil zone (surface soil and subsurface soil - contours shall be extrapolated to show the estimated concentration between soil borings, but shall not be projected beyond boring locations for which data are available);

(10) Tabulate and graphically present in isopleth format the groundwater concentrations of COC encountered (contours shall be extrapolated to show the estimated extent of the impacted groundwater between monitoring points, but shall not be projected beyond locations for which data are available);

(11) Tabulate and graphically present in isopleth format the apparent measured thickness of any immiscible layers (non-aqueous phase liquids) obtained from boreholes or monitoring wells (if detected);

(12) Include the calculations, results, and conclusions of the estimated flow velocity, quality, and classification of the groundwater (if determined);

(13) Include the calculations, results and conclusions of all aquifer tests (if provided);

(14) Discuss the disposition of the cuttings, water, and wastes generated during the investigation;

(15) Include a geologic fence diagram or cross section of the study area;

(16) Determine the location of all underground utility lines, list their material of construction (if known), and present their location(s) graphically on a site map;

(17) Include the results of a water well survey (both in the text and graphically) provided within a one-mile radius of the AOI property boundaries (at a minimum, an L~~DOTD~~DNR water well survey obtained within the past 12 months and a 500-foot radius walking receptor survey shall be performed);

(18) Propose interim remedial action if non-aqueous phase liquids or imminent threats to sensitive receptors are discovered during the course of the investigation (any unknown non-aqueous phase liquid detected shall be characterized);

(19) Submit RECAP Form 1 Submittal Summary Form (Appendix C)~~ completed through question 35~~;

(20) Complete and include a RECAP evaluation (risk analysis of the investigation results in accordance with RECAP shall be provided unless COC concentrations do not exceed RECAP screening standards or this requirement is waived by LDEQ; **for Louisiana Motor Fuels UST Trust Fund sites, details of the RECAP evaluation, including the management option to be applied and input parameters with justification, shall be provided to LDEQ for approval prior to the initiation of the evaluation**); and

(21) Provide recommendations regarding the need for corrective action based upon the results of the RECAP evaluation.

Requirements for Site Investigation Reports are addressed in more detail in Section B3.1.

Note: All maps shall have a bar scale, legend, north arrow, contour intervals (if contoured), date data was obtained, and map date. All maps, figures, diagrams and cross sections submitted shall be legible and unless otherwise approved by the Department, not larger than 11 inches by 17 inches and shall be folded to a standard report format (8.5 inches by 11 inches).

All site investigation information shall be reported in the following format:

B3.1 Title Page

SITE INVESTIGATION REPORT
NAME OF INVESTIGATION LOCATION
STREET ADDRESS
CITY AND STATE
PARISH
LDEQ AI# (if assigned)
FID # (UST SITES)
INCIDENT # (UST SITES)
COMPLIANCE ORDER # (if applicable)

SUBMITTER
CONTACT PERSON
MAILING ADDRESS
AREA CODE AND PHONE #

CONSULTANT
CONTACT PERSON
MAILING ADDRESS
AREA CODE AND PHONE #

SIGNATURE OF PREPARER
TYPED NAME OF PREPARER AND TITLE
DATE OF REPORT

B3.2 Executive Summary

(Brief, concise bullets; double space between items)

(1) AOI history
(2) Reason for investigation

(3) Site characteristics
(4) Site status (active/inactive)
(5) Release source(s)
(6) Soil type
(7) Highest concentrations in all impacted media
(8) Free product conditions
(9) Potential and/or affected receptors
(10) Problem evaluation

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B3.4 Site History

(1) Previous land use
(2) Current use
(3) For storage vessels (underground or aboveground) or pipelines:
  (a) Age and history of storage vessel or pipeline (list any prior releases)
  (b) Number of storage vessels and material of construction
  (c) Substance stored or transported
  (d) System type (pressure, suction, or gravity, if applicable)

(e) Current status
(f) Adjacent site uses
(g) Any other pertinent information
(4) Future land use (if known)
(5) Zoning of site
(6) Description of release
(a) Substance(s) released
(b) Quantity released (if known)
(c) How and when the released occurred
(d) Location of the release on the site
(e) Migration routes of release
(f) Any other pertinent information
(7) Results of the Preliminary Evaluation (if performed)

B3.5 Emergency/Interim Corrective Action

(1) Free product monitoring and recovery
(2) Vapor abatement
(3) Soil excavation and disposal
(4) Disposal of water and free product
(5) Other emergency measures (evacuation, drinking water supply replacement, etc.)

B3.6 Investigation Description

(1) Sample collection and screening rationale
(2) Boring and monitoring well placement or other exploratory method rationale
(3) Geology/hydrology discussion
(a) Regional groundwater characteristics
(b) AOI soil and groundwater characteristics
(c) Aquifer testing
(d) Groundwater classification (GW-1, GW-2, or GW-3)
(e) Any other pertinent information
(4) Constituent(s) of concern distribution
(a) All phases
(b) All media
(5) Off site impact
(6) Off site sources
(7) Unusual conditions or findings

B3.7 Sensitive Receptors

(1) Contaminant migration pathways
(a) Man-made (conduits, utilities, sewers, etc.)

(b) Natural (air, soil, surface/groundwater, etc.)
(2) Biological receptors
(3) Natural receptors (surface water, groundwater, etc.)
(4) Man-made receptors (water wells, buildings, utilities, etc.)

B3.8 Recap Evaluation Results

B3.9 Summary o~~O~~f Findings

(1) Release source(s)
(2) Soil type
(3) High concentrations (all phases and media)
(4) Free-product conditions (if applicable)
(5) Potential and/or affected receptors
(6) Off-site impact
(7) Off-site sources
(8) Groundwater conditions (if applicable)
  (a) Direction and velocity of flow
  (b) Quality and yield
  (c) Groundwater classification (GW-1, GW-2, or GW-3)
  (d) Potential for COC migration via groundwater

B3.10 Recommendations

(1) Recommendations for interim corrective action
(2) Recommendation for corrective action based on RECAP findings

B3.11 Appendices

B3.11.1 *Appendix A - Figures* (11” x 17” fold out acceptable and encouraged)

(1) Regional topographic map
(2) Regional site map (including adjacent properties)
(3) Sensitive receptor map (1-mile radius and 500-foot walking receptor survey)
(4) Scaled site plan
  (a) Release source(s)
  (b) Sampling locations
  (c) Utilities
  (d) Structures
(5) Potentiometric map
(6) Free product thickness map (if applicable)
(7) Isoconcentration maps
  (a) Soil (for each impacted interval – surface soil and subsurface soil)

(b) Groundwater
(c) Other media (if applicable)

(8) Fence diagram(s) and/or cross section(s)

B3.11.2 Appendix B – Tables

(1) Well data
(a) Monitoring well number
(b) L~~DOTD~~DNR identification number
(c) Well type
(d) Casing material
(e) Casing diameter (inches)
(f) Development method
(g) Top of casing elevation (NGVD)
(h) Ground water elevation at installation
(i) Well depth
(j) Ground surface elevation
(k) Elevation at top of screen
(l) Elevation at bottom of screen
(m) Sump length
(n) Latitude and longitude
(o) Latitude/longitude method
(p) Date completed

(2) Sampling data
(a) Monitoring well identification number
(b) Date sampled
(c) Gallons purged
(d) Purge method
(e) Sampling frequency
(f) Water elevation
(g) Total depth
(h) Free product elevation
(i) Comments

(3) Groundwater analytical summary (see RECAP Appendix C)

(4) Soil analytical summary (see RECAP Appendix C)
Include field data (specify instrument used) and laboratory

(5) Free product recovery data (if applicable)
(a) Product thickness over time
(b) Recovery results per event
(c) Total product recovered

B3.11.3 Appendix C - Boring logs and monitoring well construction diagrams

See LDEQ~~OTD~~ and LD~~EQ~~OTD *Construction of Geotechnical Boreholes and Groundwater Monitoring Systems Handbook* for requirements.

B3.11.4 Appendix D - Aquifer test data with calculations and Geotechnical data

B3.11.5 Appendix E – RECAP calculations

B3.11.6 Appendix F - Signed certifications of compliance with QA/QC, TS&A and H&S plans

B3.11.7 Appendix G - Lab data sheets and signed chain-of-custody forms

B3.11.8 Appendix H - Reconciled 90-day inventory records (for UST sites)

B3.11.9 Appendix I - Release detection records for one year (for UST sites)

B3.11.10 Appendix J - Tank tightness records (for UST sites)

B3.11.11 Appendix K - Registration forms

(1) Monitoring wells (L~~DOTD~~DNR – if applicable)
(2) USTs (if applicable)

B3.11.12 Appendix L – References

B4.0 GROUNDWATER MONITORING SUBMITTAL REQUIREMENTS

Unless otherwise approved, at a minimum, site groundwater monitoring reports shall include the following items:

(1) Title Page ~~(see example)~~

(Example Groundwater Monitoring Report Title Page)

Groundwater Monitoring Report
Monitoring Period (Ex. Jan.-June, 2002)
Name of Agency Interest/Area of Investigation
Street Address
City, State
Parish
Agency Interest Number

Responsible Party
Contact Person
Mailing Address
Area Code and Telephone Number

Consulting Firm
Contact Person
Mailing Address
Area Code and Telephone Number

_____
Signature of Preparer
Typed Name and Title of Preparer

Date of Report

(2) Summary of each monitoring event, including any unusual conditions encountered

(3) Recommendations for future monitoring events

(4) Summary of remediation system operations (as applicable), including but not limited to: a summary of remediation systems operations during the reporting period; run time percentage; reasons for non-operational days; identification of wells in use for treatment and/or recovery;

gallons of NAPL/groundwater recovered; system monitoring results, including operation and monitoring logs, discharge monitoring excursions, and air monitoring results; a pre-remediation contaminant distribution map; and evaluation of system efficiency, including a comparison of the projected and actual rate of contaminant reduction, a discussion of the progress made toward meeting the remediation standards, including the percent reduction of each COC in relation to its remediation standard; and any recommendations for modifications to improve efficiency.

(5) Figures (11" x 17" preferred)
   (a) Scaled site plan
   (b) Potentiometric map for each zone monitoring during each monitoring event
   (c) A pre-remediation contaminant distribution map
   (d) Isoconcentration maps for each COC detected at concentrations exceeding its remediation standard for each monitoring event

(6) Tables
   (a) RECAP Form ~~5~~4 (Groundwater Monitoring Well Characteristics~~ Report Form~~)
   ~~(b) RECAP Form 4 (Sampling Information Summary Report Form)~~
   (b) RECAP Form 3 (Groundwater Analytical Data Summary)
   (c) RECAP Form ~~6~~5 (Groundwater Monitoring Well Sampling Event Summary~~ Form~~)
   ~~(d) RECAP Form 3 (Analytical Data Summary Report Form)~~
   ~~(e) Historical Groundwater Monitoring Summary Form (see example)~~

(7) Signed and dated certification by the Project Manager that the monitoring events were completed in accordance with appropriate QA/QC
(8) Laboratory analytical and QA/QC reports for each sampling event
(9) Completed chain-of-custody forms for sampling event
(10) Field data sheets for each sampling event
(11) Documentation of the disposition of purge water, including manifests (if applicable)
(12) Any additional information deemed appropriate

~~B4.1 Title Page~~

~~(Example Groundwater Monitoring Report Title Page)~~

~~Groundwater Monitoring Report~~
~~Monitoring Period (Ex. Jan. June, 2002)~~
~~Name of Agency Interest/Area of Investigation~~
~~Street Address~~
~~City, State~~
~~Parish~~

~~Agency Interest Number~~

~~Responsible Party~~
~~Contact Person~~
~~Mailing Address~~
~~Area Code and Telephone Number~~

~~Consulting Firm~~
~~Contact Person~~
~~Mailing Address~~
~~Area Code and Telephone Number~~

~~Signature of Preparer~~
~~Typed Name and Title of Preparer~~

~~Date of Report~~

~~B4.2 Example Historical Groundwater Monitoring Summary Form~~

~~Monitoring Well Number ___~~								~~Monitoring Well Number ___~~				
~~Date Sampled~~	~~Depth to Groundwater (~~	~~NAPL Thickness (~~	~~Parameter (units)~~	~~Parameter (units)~~	~~Parameter (units)~~	~~Parameter (units)~~	~~Parameter (units)~~	~~Date Sampled~~	~~Depth to Groundwater (BGL)~~	~~NAPL Thickness (~~	~~Parameter (units)~~	~~Par (un~~

~~Monitoring Well Number ___~~								~~Monitoring Well Number ___~~				
~~Date Sampled~~	~~Depth to Groundwater (~~	~~NAPL Thickness (~~	~~Parameter (units)~~	~~Parameter (units)~~	~~Parameter (units)~~	~~Parameter (units)~~	~~Parameter (units)~~	~~Date Sampled~~	~~Depth to Groundwater (~~	~~NAPL Thickness (~~	~~Parameter (units)~~	~~Par (un~~

~~**Monitoring Well Number:** The identification commonly used to identify this well in correspondence to the LDEQ.~~
~~**Date Sampled:** The year, month and day the well was sampled. **Example: 010525**~~
~~**BGL:** Below ground level~~
~~**Parameter (units):** Parameter name and the units that the sample results and sample quantitation limit are reported in.~~
~~Examples: Benzene (ug/L), TPH as Gasoline (mg/L)~~