FINAL

SAMPLING AND ANALYSIS PLAN
VOLUME I
FIELD SAMPLING PLAN

FOR THE
US OIL RECOVERY SUPERFUND SITE
AREA OF INVESTIGATION 1
400 N. RICHEY STREET
PASADENA, TEXAS

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LIST OF ACRONYMS

AOC	Administrative Order on Consent
AOI	Area of Investigation
AST	Aboveground storage tank
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COC	Chain-of-custody
COPCs	Constituent of Potential Concern
CPT	Cone Penetrometer Testing
DA	Drainage Area Investigation Unit
DI	De-ionized
DO	Dissolved Oxygen
DOT	Department of Transportation
DQO	Data Quality Objectives
DPT	Direct Push Technology
EB	Equipment Blanks
FD	Field Duplicates
foc	fraction organic carbon
FS	Feasibility Study
FSP	Field Sampling Plan
ft	feet
GPR	Ground-penetrating Radar
GPS	Global Positioning System
GW	Groundwater
HASP	Health and Safety Plan
HRS	Hazard Ranking System
HRSC	High-resolution Site Characterization
HSC	Houston Ship Channel
IA	Source Area/Industrial Activities Investigation Unit
ID	Identification
IDW	Investigation-Derived Waste
mL	milliliter
MQL	Method Quantitation Limit
MS/MSD	Matrix Spike/Matrix Spike Duplicate
msl	mean sea level
µm	micron
MW	Monitoring Well
NAPL	Non-Aqueous Phase Liquid
NPL	National Priority List
NTU	Nephelometric Turbidity Unit
OP	Off-property Investigation Unit
ORP	Oxidation-reduction Potential
OVM	Organic Vapor Meter
PBW	Pastor, Behling & Wheeler, LLC

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PCB	Polychlorinated Biphenyls
PCL	Protective Concentration Level
PCSM	Preliminary Conceptual Site Model
PID	Photoionization Detector
PRG	Preliminary Remediation Goal
PRP	Potentially Responsible Party
PSA	Potential Source Area
PSV	Preliminary Screening Value
PVC	Polyvinyl Chloride
PW	Ponded Water Investigation Unit
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RI	Remedial Investigation
ROST	Rapid Optical Screening Tool
SAP	Sampling and Analysis Plan
SB	Soil
SD	Sediment
SOP	Standard Operating Procedure
SOW	Statement of Work
SW	Surface Water
TB	Trip Blanks
SVOCs	Semi-volatile Organic Compounds
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TRRP	Texas Risk Reduction Program
TSS	Total Suspended Solids
TW	Temporary Well
USOR	US Oil Recovery
EPA	United States Environmental Protection Agency
VB	Vince Bayou/Little Vince Bayou Investigation Unit
VOCs	Volatile Organic Compounds
WP	Work Plan
WRN	Work Plan Refinement Notice
WT	Waste

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1.0 INTRODUCTION

The US Oil Recovery (USOR) Superfund Site (the Site) is comprised of three separate parcels of land located on North Richey Street in Pasadena, Harris County, Texas, in an industrial area situated north of Highway 225 (Figures 1 and 2). The Site consists of:

- Area of Investigation 1 (AOI-1, also referred to as the USOR Property), located at 400 North Richey Street (Figure 2); and
- Area of Investigation 2 (AOI-2, also referred to as the City of Pasadena/MCC Property), located at 200 North Richey Street (Figure 2) (two separate properties).

When the Site was last operational, it was known as US Oil Recovery LP and operated as a used oil processing and waste treatment facility (USOR LP and related entities herein referred to as "USOR LP"). The Site was proposed to the National Priorities List (NPL) on September 16, 2011, and was placed on the National Priorities List on September 18, 2012. An Administrative Settlement Agreement and Administrative Order on Consent (Removal Action AOC) for a Removal Action for the Site (both AOI-1 and AOI-2) was executed by certain Potentially Responsible Parties (PRP Group, or Respondents) and the U.S. Environmental Protection Agency (EPA) on August 25, 2011. An AOC for the AOI-1 Remedial Investigation/Feasibility Study (RI/FS) was executed by the Respondents and the EPA effective on May 14, 2015. Note that the term RI/FS as used in this document references plans and anticipated work only at AOI-1.

This Field Sampling Plan (FSP), Volume 1 of the Sampling and Analysis Plan (SAP), was prepared on behalf of the Respondents in accordance with Paragraph 27a of the Statement of Work (SOW) for the RI/FS for AOI-1, which is an Attachment to the RI/FS AOC. This FSP is based largely on the Technical Scope of Work developed for AOI-1, which is an Appendix to the SOW for AOI-1, as described in more detail in the RI/FS Work Plan (RI/FS WP) [Pastor, Behling and Wheeler, (PBW), 2015a].

The FSP format and elements have been developed in accordance with guidance developed by the EPA (EPA, 1988). The plan presents specific sampling locations, equipment, and procedures to be used during the RI/FS. A general description of the RI/FS activities is provided in the RI/FS WP. Quality assurance/quality control (QA/QC) policies, organization, objectives, functional activities, and other specific QA/QC activities are described in the Quality Assurance Project Plan (QAPP) (PBW, 2015b).

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A Health and Safety Plan (HASP) (PBW, 2015c) was also prepared and provides the results of a hazard assessment conducted for the prescribed work tasks, and the health and safety requirements and protocols that will minimize hazards to RI/FS field workers.

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2.0 SITE BACKGROUND

The following summary of the Site Description, Geologic and Hydrogeologic Framework, Potential Source Areas (PSV), Constituent of Potential Concern (COPC), and Preliminary Conceptual Site Model (PCSM) is taken from the RI/FS WP and is intended to provide a brief overview and context for the information provided further in this FSP. Refer to the RI/FS WP for additional detail.

2.1 SITE DESCRIPTION

The approximately 12.2 acre USOR Property was most recently used as a used oil processing and waste treatment facility by USOR LP. USOR LP began operations on the property around June 2003 and acquired the property in December 2003. Prior to 2004, multiple businesses operated on the property including chemical manufacturing companies (specializing in fertilizers and/or herbicides/pesticides), a cow hide exporter, and a leather tanner. Section 2.2 of the RI/FS WP contains a more detailed listing of the operational history of the property.

USOR LP had ceased operations in June of 2010, prior to the state-court appointed Receivership in July of 2010. An office building, security guard shack, and large warehouse (approximately 25,000 square feet in size) are present on the property. The warehouse includes a former laboratory, machine shop, parts warehouse, and a material processing area that included a filter press. More than 1,000 drums and poly totes containing various industrial wastes were present within the warehouse but have since been removed by contractors under the direction of the PRP Group. A tank farm with approximately 32 aboveground storage tanks (ASTs) and various sumps containing industrial wastes located within secondary containment is present at the north end of the warehouse. A large, concrete-walled aeration basin (also called the bioreactor) was formerly located west of the tank farm but was removed as part of an EPA-approved removal action. A stormwater containment pond is located west of the warehouse and south of the former aeration basin. Approximately 225 roll-off boxes are located on the USOR Property; however, wastes left in the roll-off boxes by USOR LP have been removed and properly disposed. An inactive rail spur enters the south-central part of the USOR Property from the south and extends north along the west side of the warehouse. A utility right-of-way with various pipelines is present within the southern part of the USOR Property and pipelines are also present outside of but adjacent to the USOR Property along the eastern and western sides.

Currently, the USOR Property is enclosed within a six-foot chain link security fence with locked gates.

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Security cameras have been installed and access is monitored by a security contractor.

2.2 GEOLOGIC AND HYDROGEOLOGIC FRAMEWORK

The soils at AOI-1 are mapped as Lake Charles-Urban Land complex (Lu) (USDA, 2014). The Lake Charles portion of the complex is described as clay soils (0 to 80 inches) that are moderately well drained with high runoff potential when thoroughly wet (hydrologic soil group D). Water movement through the soil is restricted or very restricted. The Urban Land portion of the complex applies to the developed portions of the USOR Property (i.e., the buildings and other improvements).

The surface geologic unit at AOI-1 is the Beaumont Formation (also known regionally as the Beaumont Clay) (Figure 3). In the vicinity of AOI-1, the Beaumont Formation is dominantly clay and mud of low permeability, high water-holding capacity, high compressibility, high to very high shrink-swell potential, poor drainage, level to depressed relief, low shear strength, and high plasticity (Barnes, 1982). The geologic units include interdistributary muds, abandoned channel-fill muds, and overbank fluvial muds (Barnes, 1982). The Beaumont Formation is estimated to be about 100 feet thick in the vicinity of AOI-1 (Baker, 1979; Lang and Winslow, 1950), although this depth should be considered very approximate given the lack of available data for the AOI-1 vicinity.

Previous soil borings completed at AOI-1 indicate that the shallow subsurface materials are consistent with the description of the Beaumont Formation from the literature. Three borings drilled in 1991 (Espey, Huston & Associates, Inc., 1991a) to a maximum depth of 16 ft. below ground surface (ft bgs) indicated that AOI-1 is underlain by clay, silty clay, sandy silt, and clayey silt. Fill materials were also encountered at one of the three boring locations. The top of the saturated zone in the clays and silts was approximately 11 to 12.5 ft bgs (Espey, Huston & Associates, 1991a) and groundwater was observed at approximately 10-11 ft bgs in open borings (EFEH & Associates, 2001). Numerous borings drilled to the south of AOI-1 at the location of a release of crude oil from a pipeline (Figure 2) in 2014 also indicate that clays with occasional silt, sand, and gravel are present to a depth of approximately 30 feet (URS, 2014).

Underlying the Beaumont Formation are the Montgomery and Bentley Formations (together referred to as the Lissie Formation). The Lissie Formation consists of interbedded sands, silts, and clays. Beneath the Lissie Formation is the Willis Sand, which consists of gravel, sand, silt, and clay. The Willis Sand is also the base of the Chicot Aquifer (see below) (Baker, 1979; Lang and Winslow, 1950). Quaternary alluvium is present at the surface to the north of AOI-1 across Vince Bayou. The Quaternary alluvium consists of

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clay, silt, and sand with abundant organic matter locally and includes point bar, natural levee, stream channel, backswamp, coastal marsh, mud-flat, and narrow beach deposits.

The Goliad Sand and Fleming Formation (also known as the Burkeville Confining System) underlie the Willis Sand. The Goliad Sand and Fleming Formation consist of clay, sand, and sandstone interbeds, with some occasional limestone encountered in the Goliad Sand. The sands consist of medium to coarse grained quartz and chert (Barnes, 1982). Beneath the Fleming Formation is the Oakville Sandstone formation (also known as the Jasper Aquifer) (Baker, 1979; Lang and Winslow, 1950).

The two primary hydrogeologic units in the vicinity of AOI-1 are the Chicot and Evangeline Aquifers. The Chicot consists of the Beaumont Formation, Lissie Formation, and Willis Sand. The upper part of the Chicot Aquifer consists of the Beaumont Formation and does not typically yield large volumes of groundwater to wells due to the presence of clay and silt and lack of interconnected sand units. The groundwater in the upper part of the Chicot Aquifer is also likely to be high in dissolved solids (i.e., "hard") (Lang and Winslow, 1950). Groundwater in the lower part of the Chicot Aquifer (Lissie and Willis) is of good quality, although the salinity increases toward the coast. The base of the Chicot Aquifer is estimated to occur at approximately 800 ft bgs in the vicinity of AOI-1 (Baker, 1979; Lang and Winslow, 1950).

The Evangeline Aquifer underlies the Chicot aquifer and consists of the Goliad Sand and the upper part of the Fleming Formation. The Evangeline Aquifer is estimated to be approximately 2,400 feet thick in the vicinity of AOI-1. The Chicot and Evangeline Aquifers are geologically similar, the main differentiating factor being differing hydraulic conductivity. The Evangeline Aquifer is thought to be one of the most prolific aquifers in the region, producing large amounts of good quality groundwater in the region. The salinity of the groundwater in the Evangeline Aquifer also increases toward the coast. The top of the Evangeline Aquifer in the vicinity of AOI-1 is approximately 800 ft bgs.

The general direction of groundwater flow within the Chicot and Evangeline Aquifers is from the northwest to the southeast (Kasmarek and Strom, 2002). Precipitation entering through the outcrop areas to the northwest of the Site flows downward and laterally through the aquifers toward the coast where it eventually discharges into coastal areas and into Galveston Bay (Kasmarek and Strom, 2002). Based on previously conducted site investigation activities, shallow groundwater was encountered 7 to 13 ft bgs and generally flows to the east-northeast (EPA, Preliminary Assessment Report, 2011b).

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2.3 POTENTIAL SOURCE AREAS AND CHEMICALS OF POTENTIAL CONCERN

The following Potential Source Areas (PSAs) were identified at AOI-1 based on the operations history, previous investigations, and existing data, as described above.

1) Drums;
2) Bioreactor (Aeration Basin);
3) Sumps;
4) Totes;
5) Containment Pond;
6) AST;
7) Roll-off Boxes/Frac Tanks;
8) Impacted Soil (including the former buried waste pit to the west of the warehouse that was identified in historical documents);
9) Unknown Subsurface Sources (Pits, Sumps, etc.); and
10) Pipelines.

PSAs 1-7 listed above represent the various vessels that were used to contain waste materials handled during USOR's operations at AOI-1, and were the vessels that were left at AOI-1 when USOR LP ceased operations at the property. Removal actions to address PSAs 1-7 have either been implemented or will be implemented at AOI-1. PSA 8 (Impacted Soil) is included as a PSA to address any release of COPCs that may have resulted from the use of PSAs 1-7 for waste containment, but that was not addressed as part of the removal actions. PSA 9 (Unknown Surface Sources) is included to address potential unknown sources of COPCs that were not addressed in previous investigations or referenced in historical documents. PSA 10 is included to address the potential release of COPCs from the various pipelines used during USOR's operations (e.g., the pipeline that connected AOI-1 to AOI-2, as described in Section 2.2.1 of the RI/FS WP).

As also mentioned in Section 2.2.4.3 of the RI/FS WP, removal actions to address PSAs 1-7 listed above are being developed and implemented. Some of these removal actions have been completed. Due to the nature of the remaining removal actions and the associated field work, there is the potential for interference with the performance of the activities described in this RI/FS WP. Consequently, the RI/FS schedule described in Section 6.0 of the RI/FS WP and shown on Figure 11 of the RI/FS WP coordinates the RI/FS activities with the planned removal action work so as to avoid any potential interference between these efforts.

A preliminary list of COPCs has been developed based on historical data for hazardous substances present at the USOR Property, waste materials previously handled or currently present at the USOR

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Property, and analytical laboratory results of samples of environmental media collected from the USOR Property and nearby off-property areas. Samples were collected by EPA and TCEQ (or their contractors) during release response actions prior to July 2010 or stabilization activities conducted by EPA (see Section 2.2.4 of the RI/FS WP). Prior to July 2010, samples were collected during release-related response actions including samples of liquids leaking from containment vessels, ponded liquids, and/or impacted soil. After July 2010, liquid, sludge and solid samples were collected from drums, the bioreactor, sumps, poly totes, above-ground storage tanks, the containment pond, and roll-off boxes. Samples were analyzed for VOCs, SVOCs, pesticides, metals, and TPH. As summarized in the HRS Documentation Record (EPA, 2011b), VOCs, SVOCs, pesticides, metals, and TPH were detected in the samples and are associated with the USOR Property. A review of past industrial operations at the USOR Property and the results of previous environmental investigations conducted at the USOR Property support the inclusion of VOCs, SVOCs, pesticides, herbicides, and metals on the initial list of COPCs for the RI/FS. For example, metals (arsenic), pesticides, and herbicides are included due to historic use of the property for the manufacture of arsenical pesticide products, and the blending and storage of pesticides and herbicides. Therefore, samples for the first iteration of data collection will be analyzed for VOCs, SVOCs, metals, pesticides, herbicides, and TPH. The specific analytes for each COPC group are listed in Tables 2 through 11 of the QAPP, including the method quantitation limit (MQL) for each analyte.

Based on the information provided in the Evaluation of Analytical Data Collected for PCBs and Dioxins, dated November 19, 2013 (PBW, 2013) and subsequent clarifying correspondence with the EPA, these two classes of contaminants are not included in the list of COPCs for USOR Operations. However, if unambiguous sources of PCBs and/or dioxins are discovered on property then this decision will be revisited.

The COPC list will be refined after each iteration of the RI/FS as USOR Property data are evaluated such that only those COPCs that originated at the USOR Property are moved forward in future iterations, as described more fully in Section 5.6 of the RI/FS WP.

2.4 PRELIMINARY CONCEPTUAL SITE MODEL

As detailed in the RI/FS WP, Preliminary Conceptual Site Models (PCSMs) were developed for both human health and ecological receptors for AOI-1 (Figures 7 and 8 of the RI/FS WP). Based on an evaluation of the potentially complete exposure routes identified in these PCSMs, and an analysis of the information needed to assess the completeness of these pathways, data needs were identified in the RI/FS Work Plan to satisfy the objectives of the RI/FS and to establish the objectives set forth in this FSP. The

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data needs for each potential exposure medium, including the RI/FS activity, approach, and data collection methods, are listed in the Data Needs Summary in Table 1.

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3.0 SAMPLING PLAN

3.1 SAMPLING OBJECTIVES

Consistent with the overall issue posed by AOI-1 and EPA guidance, the specific objectives of the RI/FS are to: (1) characterize site conditions; (2) evaluate the nature and extent of the contamination; (3) assess the risks to human health and the environment; (4) identify remedial action objectives for those chemicals and media posing an unacceptable risk; (5) develop preliminary remediation goals (PRGs) to address the remedial action objectives; (6) develop, screen and evaluate potential remedial technologies consistent with the PRGs; (7) examine the potential performance and cost of the remedial alternatives that are being considered; and (8) summarize and present the data so that an appropriate remedy consistent with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), can be selected by EPA, if warranted.

Consistent with EPA's expectations as noted in Paragraph 2 of the SOW, an "iterative" approach to data collection will be used during the RI/FS to maximize the overall investigative effectiveness and efficiency and assist in decision making. Also, consistent with the SOW and the Triad Approach (EPA, 2003), a streamlined data assessment and reporting process is proposed for the RI/FS. The iterative sampling program will start with the investigation of on-property (defined as the area inside the existing fence at the USOR Property) soil, groundwater, surface water and sediment and off-property (defined as the area outside of the existing fence at the USOR Property) soil and groundwater. The iterative sampling will then proceed to off-property sediment, surface water, and other environmental media as appropriate. This iterative program will use the data collected in previous phase(s) of investigation to help focus COPCs and investigation areas for subsequent sampling efforts. It is believed that this approach will help minimize the likelihood of making erroneous decisions with data that are difficult to interpret, do not support the performance or acceptance criteria defined in the RI/FS Work Plan, or do not support the overall project goal of identifying potential risks associated with past AOI-1 activities. Additional detail on the approach to data collection is provided in Section 5.6 of the RI/FS WP and in the sections below.

3.2 SAMPLING APPROACH

The PCSMs, the conceptual descriptions of RI/FS activities in the data needs summary table (Table 1), and the data quality objectives (DQOs) in the QAPP were used to develop the initial RI/FS data collection activities and sample locations described in the following sections. Historical information (e.g., maps, aerial photographs, previous investigation reports, reports of releases at AOI-1, and other documentation),

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property reconnaissance, and to a lesser degree the limited existing data, were used to guide the placement of initial investigation locations. Appendix D of the RI/FS WP provides a more detailed discussion of the rationale for each sample location for on-property media as well as off-property soil sample locations. These samples were selected to optimize the likelihood of detecting potential impacts from the USOR Property. Relative to a grid-based sampling program, these judgmental samples will more appropriately target site-specific potential risk, and as such this sampling approach will provide a higher degree of confidence in evaluating whether the COPC originated at the USOR Property. The number of samples and sample locations ultimately needed to satisfy overall RI/FS objectives will be determined by the USOR Property conditions and the data obtained during the several iterative phases of the RI/FS, as described below. However, consistent with the overarching objective of the RI/FS, sample numbers/locations are proposed herein for the initial investigation iteration (i.e., on-property soil, groundwater, surface water and sediment sampling and off-property soil and groundwater) to fill the identified data needs.

As noted previously, the first iteration of data collection will focus on on-property environmental media (i.e., on-property soil, on-property groundwater, on-property surface water and on-property sediment) and off-property soil and groundwater. This is due to the nature of the USOR Property where the source areas are located topographically higher than some of the potential receptors and potential impacts are primarily related to the movement of COPCs from the USOR Property to the receptors via surface drainage. Furthermore, receptors in Vince Bayou and Little Vince Bayou also are potentially impacted from the other documented industrial activities within the Vince Bayou and Little Vince Bayou watershed. In this regard, the determination of the impacts from the USOR Property, versus those from other sources of contaminants to Vince Bayou and Little Vince Bayou, must be carefully executed. This will be completed through the iterative progression of investigation activities beginning on the USOR Property and adjacent properties and working toward Vince Bayou and Little Vince Bayou and including a comprehensive background study for media of potential concern (see below). This approach will allow for the allocation of the relative contributions of COPCs to Vince Bayou and Little Vince Bayou among the multiple potential sources.

A data assessment meeting will be held after completing the data collection for each iteration to review the data, prior to proceeding with the next iteration of sampling.

Given that the number of samples, the locations of the samples, and analytes to be measured in the samples for the off-property sediment, surface water, and fish/shellfish cannot be determined until after

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the on-property media and off-property soil and groundwater data are evaluated, locations for off-property sediment, surface water, and fish/shellfish (or aquatic and fish dietary items) sampling activities that are described in the following sections cannot be determined at this time. Detailed descriptions of the RI data collection activities are provided below, including descriptions of data collection activities for all iterations of the RI/FS. In other words, even though a particular media will not be sampled in the first iteration of the RI/FS (e.g., off-property sediment), the proposed methods for collection of those particular media samples are included in this RI/FS WP. The specific locations, analytes, and other information required for data collection in Iterations 2 and 3, including the use of appropriate statistical methods, will be provided in work plan refinement notices (WRNs) and the proposed activities will not be initiated until after EPA approval of a specific WRN.

Depending on the results of the initial RI/FS sampling activities, it may be necessary to evaluate background concentrations of COPCs present in AOI-1 soil samples that may not be associated with historical AOI-1 industrial activities. Similarly, background concentrations of COPCs in surface water, sediment, and fish or other biota in Vince Bayou and Little Vince Bayou may also need to be evaluated. Background evaluations will be based on the likelihood of specific COPCs being present due to natural or anthropogenic factors unrelated to historical AOI-1 industrial activities. Additional details on background studies, as appropriate, are provided in the following sections. The full scope of the background studies will be developed in conjunction with the EPA, TCEQ, and trustee stakeholders, once it is determined that these studies are necessary, and will include the location(s) for sampling, the number of samples, the COPCs to be analyzed, the methods to be used to collect the samples, and the methods to be used to evaluate the data.

Additional information that becomes available during the RI/FS will be considered and the RI/FS WP, FSP, and QAPP updated, as appropriate (e.g., the addition of sampling locations at the location of a previously unknown release) through the WRN process described previously. Also, field observations made during the field investigation will be used to guide additional investigation efforts and/or sampling, as appropriate.

3.3 GENERAL INVESTIGATION ACTIVITIES

In addition to the pathway-based data needs identified through the PCSM process, several types of data/information are also necessary for completion of the RI/FS. These are listed at the end of Table 1 and include the following:

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1) Identification of the potential presence of threatened and endangered species in the USOR Property vicinity;
2) Location of subsurface utilities present at the USOR Property and off-property areas;
3) Evaluation of the erosion potential of soils;
4) Evaluation and analysis of climatic conditions (e.g., precipitation, wind direction, temperature, etc.) that may affect the RI and risk assessments;
5) Zoning and land use in the AOI-1 vicinity
6) Location of the flood plain at AOI-1 (on-property and off-property);
7) Identification of historic USOR Property ownership activities, deed records, restrictive covenants, or deed notices;
8) Evaluation of the presence of ecological habitat; and
9) A water well records search to identify registered water wells located within one mile of the USOR Property, including a walking survey of immediately adjacent properties to identify the potential presence of un-registered water wells.

Some of these activities have been completed or partially completed to prepare the RI/FS WP, FSP, and QAPP. As the RI/FS proceeds, these activities will continue and be updated as new data becomes available. Ultimately, the RI Report and risk assessments will utilize the information generated from these activities.

3.4 ANALYTICAL METHODS AND ANALYTES

The historic USOR Property ownership, information about past releases and operations at the property, previous environmental sampling conducted to-date at the property, and waste sampling conducted during emergency response activities together indicate that various metals, petroleum hydrocarbons, pesticides and herbicides, VOCs, and SVOCs have potentially impacted AOI-1. Based on the COPCs described above, samples for the first iteration of data collection will be analyzed for the following list of COPCs using the methods listed in the following table:

COPC	ANALYTICAL METHODS AQUEOUS	ANALYTICAL METHOD SOLIDS
VOCs	SW Method 8260B	SW Method 5035/8260B
SVOCs	SW Method 8270D	SW Method 8270D
Metals	SW Methods 6010D/6020B/7470A	SW Methods 6010D/6020B/7471B
Pesticides	SW Method 8081B	SW Method 8081B
Herbicides	SW Method 8151A	SW Method 8151A
TPH	TX 1005	TX 1005

Additional information regarding the specific COPCs for each analytical group, the analytical methods to be used, and the QA/QC procedures to be used during the RI/FS is provided in the QAPP.

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The COPCs for off-property sediment, surface water and biota will be developed based on the results from the previous iterations of the investigation and whether the COPC was shown to originate at the USOR Property. Sample collection techniques, analytical method details, and other analyses that will be conducted on selected samples [e.g., total organic carbon (TOC), total dissolved solids (TDS), bulk density, grain size, etc.] are described in detail in Section 4 of this FSP and in the QAPP.

3.5 ITERATION 1 – AOI-1 ON-PROPERTY AND OFF-PROPERTY SOIL INVESTIGATION

The objective of Iteration 1 is to characterize on-property soil, ground water, surface water and sediment and off-property soil and groundwater to evaluate the lateral and vertical extent of COPCs. Background soil samples may also be collected, if needed. The general approach to Iteration 1 sampling activities is provided in the following sections. A Sample Design Collection Worksheet that links media, exposure routes, and proposed samples for Iteration 1 is provided in Table 2. A summary of samples by media and the chemical analyses to be performed for Iteration 1 is provided in Table 3. Methods for sample collection are described in Section 5 of the FSP for the various exposure media.

3.5.1 Soil Sampling

Soil samples will be collected at locations based on historical industrial activities and/or releases and areas that receive drainage from potential source areas. Further discussion of the sampling rationale is provided in Appendix D of the RI/FS WP. The proposed soil sample locations are presented on Figure 4. The locations of the actual sample stations may be adjusted based on field observations, access issues, and/or professional judgment. At each soil sample location, samples may be collected from the following intervals:

- Surface soil (0 to 0.5 ft bgs);
- Shallow soil (0.5 to 5.0 ft bgs) – actual sample interval will be selected based on field conditions such as organic vapor meter (OVM) readings or potential indications of contamination (e.g. staining, odor, etc.), or from the 4.0 to 5.0 ft bgs interval if potential indications of contamination are not observed in the field; and
- Subsurface soil (greater than 5.0 ft bgs) - actual sample interval will be selected based on field conditions such as OVM readings or other signs of contamination (e.g. staining, odor, etc.), or from the one-foot interval above the saturated zone if potential indications of contamination are not observed in the field.

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From the soil sample intervals listed above, actual samples will be collected based on the location and purpose of the particular sample. For samples located within areas of current or historical industrial activity and/or releases, all three sample intervals will be collected. Samples collected within areas that receive runoff from potential source areas will be collected from the uppermost two intervals of the three intervals described above.

Soil samples will be collected in accordance with the methods described in Section 5.3 of this FSP. Soil samples will be analyzed for the initial list of COPCs (Table 3). Should any COPCs in a soil sample from the deepest interval of a boring, but above the uppermost saturated zone, exceed their respective PSVs as detailed in the QAPP, then additional deeper soil samples will be collected as needed to define the vertical extent of that COPC. In the event that the uppermost saturated zone is impacted by COPCs above PSVs, soil samples from below the uppermost saturated zone (e.g., in unsaturated soil beneath the uppermost saturated zone), may be collected, if necessary based on the data.

3.5.2 Background Soil Sampling

As mentioned above, preliminary background sample locations and a sampling approach are provided herein for the soil investigation. A background soil sample was previously collected by EPA in 2009 in the City of Pasadena Memorial Park (approximately 3,700 feet south of AOI-1) during an investigation of a release from AOI-2 (ATSDR, 2009). The location of Memorial Park is shown on Figure 2. The concentrations of metals and several organic compounds were consistent with what would be expected for an urban area (Tables 3 and 4 of the RI/FS WP). Therefore, a background soil sample area is proposed at Memorial Park, located along Vince Bayou approximately 3,000 feet (0.60 miles) south of the USOR Property boundary (see Figure 2). Per historical imagery available from Google Earth, this area has been either undeveloped or a recreational park since 1944 (the earliest date that aerial photograph coverage is available). The park has included walking/jogging trails, picnic areas, basketball courts, soccer fields, baseball fields, a skate park, etc. through its history. This location was also chosen due to its proximity to Vince Bayou and, therefore, will include an area that is tidally influenced and an upland area that is not tidally influenced. Collection of samples from this area will require access permission from the City of Pasadena.

A preliminary sampling approach is as follows:

- Within the Memorial Park background area, 10 samples will be collected from the upland area and 10 samples will be collected from a tidally-influenced area at the background sampling area;
- Samples will be collected from surface soil (0 to 0.5 ft bgs); and

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- Samples will be collected using the same sampling methods as those used for samples at the USOR Property as outlined in the FSP.

The full scope of the background study will be developed in conjunction with the EPA, TCEQ, and trustee stakeholders, including the exact location(s) for sampling, the COPCs to be analyzed, and the methods to be used to evaluate the data.

3.5.3 Soil Fate and Transport Characterization Samples

Representative samples will be collected to evaluate fate and transport characteristics for COPCs in soil. Locations for samples for fate and transport characterization will be selected based on the types of COPCs exceeding the preliminary screening values (PSVs) and will be analyzed for COPC-specific fate and transport parameters such as bulk density, specific gravity, fraction organic carbon (foc), porosity, and pH, as determined during the RI/FS. Additional detail is provided on Table 3 of this FSP.

3.6 ITERATION 1 – AOI-1 ON-PROPERTY AND OFF-PROPERTY GROUNDWATER INVESTIGATION

The objective of the groundwater investigation is to evaluate the lateral and vertical extent of COPCs in the uppermost groundwater-bearing unit and the potential presence of non-aqueous phase liquids (NAPLs). The groundwater investigation will consist of an initial high-resolution site characterization (HRSC) phase that will be used to refine monitoring well placement and completion details. In addition, hydraulic testing will be conducted in selected wells to estimate the hydraulic conductivity of the uppermost groundwater-bearing unit.

3.6.1 High-Resolution Site Characterization

Concepts of the HRSC will be incorporated into the on-property groundwater investigation, as appropriate based on AOI-1 conditions. Initially, a series of vertical subsurface profiles using cone penetrometer testing (CPT) and/or the rapid optical screening tool (ROST) will be conducted perpendicular to the direction of groundwater flow (presumed to be to the northeast toward Vince Bayou, based on previous investigations at AOI-1) (Figure 4). These profiles will allow for the collection of a large amount of subsurface data in a short period of time. The CPT/ROST locations will be advanced to the base of the uppermost groundwater-bearing unit. Although limited information is available on the subsurface stratigraphy, it is likely that the uppermost groundwater-bearing unit is no deeper than 30 feet bgs; therefore, the CPT/ROST investigation will be conducted to depths sufficient to evaluate the underlying

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confining unit of the uppermost groundwater-bearing unit. At most of the transect locations, only the CPT tool will be advanced to provide stratigraphic information (i.e., soil type – sand, silt, or clay). At locations in the central part of the USOR Property around the warehouse, the CPT and ROST tool will be advanced. The ROST tool provides information on soil type and the potential presence of NAPL in soils. If the presence of NAPL is observed at any location, advancement of the CPT/ROST tool will be halted and the borehole will be immediately sealed to minimize the potential of downward migration of NAPL. If evidence of NAPL is not observed, the CPT/ROST boring will continue until the base of the uppermost groundwater-bearing unit.

The CPT/ROST borings will be ground-truthed using direct-push technology (DPT) soil borings. After review of the CPT/ROST data, DPT borings will be conducted at a subset of the CPT/ROST boring locations (Figure 4). For the DPT borings, soil will be collected for visual inspection for the entire length of the boring. Furthermore, the CPT/ROST borings will be completed prior to the on-property soil investigation described above. Information from the CPT/ROST borings may be used to revise the locations, sampling intervals, etc. for the on-property soil borings.

Additional HRSC techniques will be evaluated as the investigation proceeds and as warranted.

Results of the HRSC assessment, in conjunction with information from the monitoring wells (stratigraphy, water levels, etc.) will allow for assessment of the potential hydrogeologic connection between USOR Property groundwater and Vince Bayou.

Detailed procedures for the groundwater HRSC program are provided in Section 5.4 of this FSP.

3.6.2 Monitoring Well Installation and Groundwater Sampling

Monitoring wells will be installed within areas of current and/or historical industrial activities and areas receiving drainage from potential source areas. Proposed locations for on-property groundwater sampling are presented on Figure 4. Selected CPT and CPT/ROST borings will be ground-truthed with an adjacent soil boring to confirm the accuracy of the CPT and/or CPT/ROST data (see SB-4 on Figure 4, for example). Monitoring well locations may be modified in the field based on accessibility constraints, field observations, and/or data collected during the HRSC phase. Methods for monitoring well installation, development, water-level measurement (including NAPL measurements, if any NAPL is present), and groundwater sampling are presented in Section 5.4 of this FSP. Groundwater samples will be collected

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using a peristaltic or bladder pump in accordance with low-flow sampling procedures detailed in Section 5.4. Groundwater samples will be analyzed for the suite of analytes listed in Table 3 of this FSP.

The locations for off-property groundwater monitoring wells, if warranted, will be developed based on the data collected from the 1) on-property and off-property soil investigation (i.e., presence of source areas, COPCs in soil, NAPL, etc.), 2) the on-property monitoring wells (i.e., the presence of COPCs in groundwater samples, groundwater flow directions, hydraulic characteristics of the groundwater-bearing unit(s), and 3) other information collected during the initial stages of the RI/FS.

Assuming property owner permission is obtained, a staff gauge will be installed at an appropriate location within Vince Bayou to evaluate the potential for groundwater-surface water interactions between shallow groundwater at AOI-1 and Vince Bayou.

The monitoring well and staff gauge locations will be surveyed by a Texas-licensed surveyor using Texas State Plane Coordinates. Top of casing elevations for the monitoring wells (and measurement point elevation for the staff gauges) will be surveyed relative to mean sea level (MSL).

Detailed procedures for groundwater monitoring well installation/sampling and staff gauge installation are provided in Section 5.4 of this FSP.

3.6.3 Hydraulic Testing

Hydraulic testing (i.e. slug testing) will be conducted in selected wells to estimate the hydraulic conductivity of the groundwater bearing unit(s). Wells for hydraulic testing will be selected based on lithologic data, water-level measurements, drawdown/recharge behavior during development and sampling, etc. The goal is to select wells that represent the range of hydraulic conditions in the water-bearing unit to be evaluated. These data will be used to establish groundwater classification (in conjunction with TDS concentrations), estimate groundwater flow velocities, evaluate contaminant transport, etc. Detailed procedures for hydraulic testing and data analysis are provided in Section 5.4 of this FSP.

3.6.4 Additional Groundwater Delineation

Additional delineation of the lateral or vertical extent of COPCs in groundwater will be conducted by installing additional monitoring wells, as needed. The scope of additional groundwater delineation

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activities will be developed after the on- and off-property groundwater investigations have been conducted and the data assessed. This information will be provided in a WRN submitted to EPA and the proposed activities will not be initiated until after EPA approval of the WRN.

3.6.5 Water Well Survey

As described in Section 2.1.3.2 of the RI/FS WP, based on a search of water well records, no active water supply wells were identified within one mile of AOI-1. Furthermore, the potential for use of shallow groundwater for other purposes within the one-mile vicinity is very low. To confirm these initial findings, a field (walking or windshield) survey of the properties within 500 feet of the USOR Property boundary will be conducted to confirm/update information obtained from the water well records and to identify any water supply or other non-registered wells.

3.7 ITERATION 1 – AOI-1 ON-PROPERTY SURFACE WATER INVESTIGATION

The objective of this task is to evaluate the extent of potential COPCs in surface water present at AOI-1 to evaluate potential human health and ecological risks. Samples of surface water will be collected from the two areas in the southwestern portion of AOI-1 as shown on Figure 4. Collection of samples from these areas depends on conditions during the investigation since these areas likely do not always contain standing water. The samples will be analyzed for the initial list of COPCs. For the metals, analysis will be conducted for total and/or dissolved concentrations depending on the specific COPC. Many of the aquatic life surface water criteria for metals are based on the dissolved fraction. Criteria specific to the dissolved fraction are noted on TCEQ's surface water benchmark table for aquatic life (TCEQ, 2014; Table 3.2).

3.8 ITERATION 1 – AOI-1 ON-PROPERTY SEDIMENT INVESTIGATION

The objective of this investigation is to evaluate the lateral extent of COPCs in on-property sediments to evaluate potential human health and ecological risks. Sediment samples will be collected from the 0 to 6-inch depth interval from two areas of water accumulation in the southwestern portion of AOI-1. Proposed on-property sediment samples are presented on Figure 4. The samples will be analyzed for the initial list of COPCs and other parameters such as TOC, grain size, etc.

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3.9 ITERATION 2 – AOI-1 OFF-PROPERTY SURFACE WATER AND SEDIMENT INVESTIGATION

Iteration 2 consists of a program for the evaluation of COPCs from USOR Property-related activities in Vince Bayou (and possibly Little Vince Bayou) surface water and sediment. A working "data assessment" meeting will be held with the EPA, TCEQ and Trustees stakeholders where the data from Iteration 1 are reviewed and decisions are made regarding: 1) COPCs that will be carried forward and COPCs that can be eliminated from subsequent iterations of the RI/FS; and 2) locations of off-property surface water and sediment samples for the Iteration 2 of the RI/FS. A WRN with the agreed-upon recommendations for the Iteration 2 sampling will be prepared for EPA approval and will not be initiated until after EPA approval of that WRN. As shown on Table 1, information on the watershed flow paths, surface water/sediment hydrodynamics, and other potential sources of COPCs to Vince Bayou and Little Vince Bayou will be reviewed during the development of this program. General sampling procedures for Iteration 2 sampling are described in Sections 5.5 and 5.6 of this FSP, but may be revised prior to performance of the Iteration 2 investigation, as necessary.

As mentioned above and described in detail in Section 5.6 of the RI/FS WP, preliminary background sample locations are provided herein for the off-property surface water and sediment investigation. Background surface water and sediment sample areas are proposed at three areas as shown on Figure 2, as follows:

- Background Surface Water/Sediment Area 1 is located in Sims Bayou, upstream (west) of Vince Bayou along the Houston Ship Channel (HSC). This location is tidally influenced and is therefore potentially impacted by the HSC. Sims Bayou is similar in size, salinity, and urban/industrial influences to Vince Bayou.
- Background Surface Water/Sediment Area 2 is just upstream of the confluence of Little Vince Bayou and Vince bayou (near the SED-01 sample collected for EPA (Weston, 2011). This location would receive urban runoff as well as input from other industrial activities in the area that may have impacted Vince Bayou. It is known that fish kills have occurred in Little Vince Bayou as a result of various releases, and general water quality has been shown to be impacted in this area. This location is tidally influenced and is therefore potentially impacted by the HSC.
- Background Surface Water/Sediment Area 3 is located in Vince Bayou approximately 2,200 feet (0.42 miles) south (upstream) of AOI-1 in Vince Bayou adjacent to Memorial Park. This location would receive urban runoff from the area neighborhoods, but would not have been influenced by industrial activities at AOI-1. This location is tidally influenced and is therefore potentially impacted by the HSC.

The full scope of the surface water and sediment background study in Vince Bayou will be developed in conjunction with the EPA, TCEQ, and trustee stakeholders, including the exact location(s) for sampling,

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the COPCs to be analyzed, and the methods to be used to evaluate the data. Sample collection methods are provided in the FSP.

3.10 ITERATION 3- OFF-PROPERTY FISH/SHELLFISH INVESTIGATION

Iteration 3 consists of a program for the evaluation of COPCs from USOR Property-related activities in Vince Bayou (and possibly Little Vince Bayou) fish, shellfish, and/or other biota. Sampling of fish/shellfish in Vince Bayou (and Little Vince Bayou) may be conducted if the results of previous RI/FS data collection iterations show that USOR Property-related COPCs are present in surface water and/or sediment at concentrations above screening levels (including background) or if bio-accumulative COPCs are present above applicable thresholds.

Prior to sampling fish/shellfish in Vince Bayou or Little Vince Bayou, sediment and surface water data from Iteration 2 will be evaluated to determine the COPCs that should be included in the fish/shellfish sampling program per recommendations and procedures identified in in the guidance document *Determining PCLs for Surface Water and Sediment* (TCEQ, 2002). TCEQ, 2002 is largely based on EPA procedures for evaluating potential impacts from the fish ingestion pathway when establishing surface water quality standards. Fish and shellfish will be sampled and analyzed for the COPCs that were carried forward from Iteration 2. After data validation, the sample concentrations will be compared to the PSVs. A working "data assessment" meeting will be held with the EPA, TCEQ and Trustees stakeholders where the data comparisons are reviewed and decisions are made regarding the need for Iteration 3 sampling. General procedures for fish and shellfish sampling are provided in Section 5.7 of this FSP, but these procedures may be modified based on data collected during Iterations 1 and 2 and the specific objectives of the Iteration 3 sampling program, as defined at the appropriate time.

A WRN will be developed that describes the appropriate species for sampling, the methods for sampling, the COPCs to be analyzed, etc., and the proposed activities will not be initiated until EPA approval of that WRN.

As mentioned above, background concentrations of COPCs in fish, shellfish, or other biota in Vince Bayou, Little Vince Bayou, and/or other appropriate locations may also need to be evaluated. The scope of a background study, if necessary, will be developed in conjunction with the EPA, TCEQ, and trustee stakeholders, once it is determined that these studies are necessary, and will include the location(s) for

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sampling, the number of samples, the COPCs to be analyzed, the methods to be used to collect the samples, and the methods to be used to evaluate the data.

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4.0 SAMPLE DESIGNATION

Each sample collection location will be assigned a unique station identifier (StationID). StationIDs are generated using a station group code, which indicates the investigation unit from which the sample was collected (i.e., source area/industrial activities investigation unit [IA], off-property investigation unit [OP], drainage area investigation unit [DA], ponded water investigation unit [PW], Vince Bayou/Little Vince Bayou investigation unit [VB], temporary well [TW], monitoring well [MW], etc.) and the matrix type (i.e., groundwater [GW], sediment [SD], soil [SB], waste [WT], surface water [SW], etc.), followed by an integer unique to that station group. For example, StationID "IASB06" corresponds to soil boring SB-06 for the collection of soil within the on-property source area/industrial activities. StationID MWGW01 corresponds to a groundwater sample from monitoring well MW-01. It should be noted that the integer component of the station group code numbering may not always be consecutive. In the case of additional sample locations in a particular investigation unit, the integer sequence will continue from the last used integer.

Each sample will be assigned a unique sample identifier (SampleIDs). SampleIDs will include a sample group code, which links the station group code and the date sampled. Soil, sediment, and/or investigation –derived waste (IDW) samples will also include the sample depth. For example, the sample identifier for a surface soil sample collected from StationID IASB06 on January 1, 2015 at a depth of 0.5 feet bgs would be IASB06-005-150101 (YYMMDD), while the sample identifier for a soil sample collected at a depth of 15 feet bgs would be IASB06-150-150101. The sample identifier for a groundwater sample collected from StationID MWGW-01 on December 25, 2014 would be MWGW01-141225.

QA/QC samples will be designated in the station identifier. The station group code for QA/QC samples includes equipment blanks (EB), field duplicates (FD), and trip blanks (TB). QA/QC SampleIDs will include the sample group code for the QA/QC sample, the station group code for the investigation unit, and the date sampled. For example, the sample identifier for a trip blank sample collected December 26, 2014 with the groundwater samples would be TBGW01-141226. The sample identifier for an equipment blank sample collected with soil samples on January 1, 2015 would be EBSB01-150101.

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5.0 SAMPLING EQUIPMENT AND PROCEDURES

5.1 FIELD EQUIPMENT

Various types of equipment will be used during the RI/FS field investigation. A preliminary list of equipment that will be used during the RI/FS separated by investigation activity are provided on Table 4. Additional equipment may be used as part of the RI/FS if additional investigative techniques are necessary to achieve the project objectives.

At a minimum, field equipment will be cleaned, inspected, calibrated (if required), and tested prior to each day's use, or every month, whichever comes first. Equipment calibration guidelines are discussed in the QAPP. All equipment will be inspected visually and functionally by testing the equipment in accordance with the operator manual for each piece of equipment. Moving parts, seals, fasteners, and switches will be inspected and adjusted or replaced as necessary. All cables, tapes, and attachments will be inspected for damage or kinks. For equipment that requires standard solutions and buffers for calibration, those standards and buffers will be checked for expiration date and replaced if necessary. Preventative maintenance for the field equipment is discussed in the QAPP. The Field Investigation Manager is responsible for the proper functioning of field equipment. The standard operating procedures (SOPs) in Appendix A contain more specific information on individual equipment calibration procedures, where applicable.

5.2 LOCATING SAMPLING SITES

The proposed sample locations (stations) will be located in the field using the coordinates extrapolated from the sample locations maps (Figure 4). A differential global positioning system (GPS) receiver, such as a Trimble GPS GeoXH or equivalent, will be used to locate the proposed sampling station in the field. Operation of the GPS receiver will follow the procedures detailed in the operation manual for the specific equipment.

Once a sample station is located according to the GPS coordinates, the station will be marked with a stake and brightly colored survey flagging material or pin flag, as appropriate. If a sampling station is not accessible, an alternate location will be selected as near to the original point as practical. The alternate location will be marked with a stake, flagged, and the coordinates recorded. A utility locating service such as Texas One Call or Dig Tess will be contacted to check the proposed locations for the presence of

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buried utilities. A private utility locating service, such as a ground-penetrating radar (GPR) contractor, may also be used to clear drilling locations for underground utilities.

5.3 SOIL INVESTIGATION METHODS

5.3.1 Soil Sampling

Soil samples will be collected using either plastic or stainless steel trowels, hand-augers, or split-spoon samplers driven by DPT techniques or a drill rig. Soil borings drilled with DPT will be advanced using a hydraulic ram or hammer to drive the soil samplers, and the soil samples will be collected using a lined (butyrate or other material), split-spoon sampler. Soil borings that will be converted to monitoring wells will be drilled with hollow-stem auger methods. All sampling equipment will be decontaminated prior to and following each use, as detailed in Section 5.8.

Soil borings will be documented per PBW SOP No. 2: Supervision of Exploratory Borings (Appendix A) using a detailed field lithologic log (Figure SOP-2-1). The lithology of the boring will be logged continuously for the total depth of each boring and soil samples will be collected. The method of sample collection and the sample collection interval will also be noted on the field lithologic log.

Soil samples collected at each location will be collected in accordance with the PBW SOP No. 5: Soil and Sediment Sampling for Chemical Analysis (Appendix A). For soil samples that will be analyzed for VOCs, samples will be collected using the SW-846 5035 Method by utilizing the Terracore® or equivalent sampling equipment. The 5035 Method procedures are detailed in PBW SOP No. 5. Field QA/QC procedures will be followed by collecting the necessary field duplicates and blanks as described in the QAPP.

For borings not converted to a monitoring well or a piezometer, the boring will be abandoned by backfilling the hole. If the boring is less than 2 feet deep, it can be filled with bentonite pellets. If the borehole is dry and is less than 10-feet deep, Portland/bentonite grout will be poured slowly from the ground surface into the borehole to the ground surface. If the borehole is greater than 10-feet deep, or if more than 2-feet of water is present in the borehole, the grout will be placed in one continuous pour by pumping through a tremie hose or pipe. Specific procedures on plugging of borings are provided in PBW SOP No. 2: Supervision of Exploratory Borings (Appendix A).

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5.3.2 Field Screening

Soil samples from the monitoring wells and temporary piezometers will be collected and screened in the field for total organic vapor concentrations using an OVM or photoionization detector (PID). Field screening will be conducted following the procedures detailed in the PBW SOP No. 3: Field Organic Vapor Screening Methodology for Soil Samples (Appendix A) and documented on the field lithologic log.

5.4 GROUNDWATER INVESTIGATION METHODS

The groundwater investigation will consist of CPT and CPT/ROST borings, installing/sampling groundwater from permanent monitoring wells, and conducting hydraulic testing on selected monitoring wells. The equipment and procedures for these activities are discussed below.

5.4.1 High-Resolution Site Characterization (CPT and CPT/ROST)

Borings will be advanced using CPT and/or CPT in combination with ROST. The methods for CPT and CPT/ROST are similar to the methods for normal soil borings using DPT, except that the drilling rig advances a CPT or ROST tool in the boring.

5.4.2 Monitoring Well Installation and Development

Soil borings for monitoring wells will be advanced using hollow stem auger drilling methods. Soil samples will be collected continuously from each boring and will be logged in the field for lithology and sedimentary structure as described in Section 5.3. As possible, soil headspace samples will be collected every two feet and screened in the field for total organic vapor concentrations. In addition, soil core samples will be visually inspected for NAPL presence or other potential indications of contamination. Soil cuttings generated from the drilling activities will be stored and disposed of following the procedures detailed in Section 7.0.

Soil borings that will be used for monitoring well installation will be advanced as necessary to identify the top and base of the uppermost water bearing-unit at AOI-1. If COPCs are greater than screening levels in the uppermost groundwater-bearing unit, then, as appropriate, deeper borings will be advanced to underlying water-bearing units. Although these borings will be specifically located away from areas

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where NAPL is suspected to be present (if any), surface (isolation) casing may be installed prior to penetration of any low permeability confining unit. In no case will a boring in which field indications of a NAPL are noted be advanced through an underlying low permeability confining unit.

Permanent monitoring wells will be constructed after the total depth of the borehole is reached. Monitoring wells will be constructed using 2-inch diameter, flush-joint-threaded Schedule 40 polyvinyl chloride (PVC) casing and 0.010-inch slotted PVC screen. The specific well design will be determined in the field based on the observed lithology with the goal of screening the well to the base of the uppermost groundwater-bearing unit. It is anticipated that each well screen will be approximately 10 to 15 feet in length and where possible will extend above the observed groundwater table. After the boring is completed to the total depth, the casing and screen will be lowered into the borehole through the augers.

Once the casing and screen are in place, the remaining well materials (filter sand, bentonite pellets, and cement/bentonite grout) will be added to the hole as the augers are slowly removed. Depths to the top of the annular materials will be measured with a weighted, calibrated tape and recorded on the Well Completion Log (Appendix A, Figure SOP-7-1). A bentonite seal layer will be installed on top of the filter sand and will be a minimum of 2 feet in thickness. The remainder of the borehole annulus will be filled with a Portland/bentonite grout (or bentonite pellets). Each well will be completed with either an at-grade surface completion with a 3-foot by 3-foot pad or above grade within a protective casing on a 4-foot-by-4-foot concrete pad. After construction, the position and elevation of each monitoring well will be surveyed relative to Texas State Plane Coordinates and mean sea level. Procedures for monitoring well installations are outlined in PBW SOP No. 7: Installation of Monitoring Wells and Piezometers (Appendix A).

A minimum of 24 hours shall elapse after well construction and before well development to allow for bentonite hydration and grout set. Development will consist initially of surging and bailing or pumping; however, the specific development method will ultimately be decided by the field personnel based on the specific conditions encountered. Temperature, pH, specific conductivity, and turbidity will be monitored during purging. Development will continue until the well produces water with stable field parameter readings (i.e., temperature, pH, conductivity) and turbidity is below 10 Nephelometric Turbidity Units (NTUs). At least five casing volumes of water will be removed from the well during development, if possible. For wells that will not provide five casing volumes (i.e., go dry during purging), the wells will be developed until the well produces water with stable field parameter readings, as noted above. If the turbidity is not below 10 NTU after five casing volumes of water are removed from the well, then the

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final turbidity will be recorded and more aggressive development procedures such as air lifting may be considered. General procedures for monitoring well development are outlined in PBW SOP No. 8: Monitoring Well Development (Appendix A).

Documentation of well installation and development will include field boring logs, monitoring well installation forms, well development forms, and any photographs, as described in PBW SOP No. 1 Field Documentation (Appendix A).

5.4.3 Groundwater Sampling

General procedures for groundwater sampling are outlined in PBW SOP No. 10: Water Quality Sampling (Appendix A). Groundwater samples will be collected from each of the monitoring wells no sooner than 24 hours after the completion of well development. Before sampling, and a sufficient time after development to allow water level stabilization, a complete set of water levels (including an evaluation of the possible presence of NAPL using an interface probe, conductivity probe and/or bailer) will be measured in all wells. In the event that NAPL is observed in a well, an attempt will be made to collect a NAPL sample for possible future analysis.

Groundwater wells and piezometers will be purged and samples will be collected using a peristaltic or bladder pump in accordance with low-flow sampling procedures. Purging will be accomplished in such a way as to minimize disturbance of sediments at the bottom of the well, and therefore minimize turbidity of the water samples. Typically, this is accomplished by purging at a low flow rate (less than one liter per minute) with the pump intake near the middle of the screened interval. If the yield of the well is low such that it can be pumped dry, then the recharged groundwater in the well will be considered representative of the formation groundwater, since all standing water in the well has been replaced by recharge from the water-yielding zone. IDW (decontamination and purge water) will be placed and stored in drums at a designated staging area for off-site disposal, as detailed in Section 7.0.

Purging of the wells and piezometers will be accomplished by purging at a rate between 0.1 and 1 liters per minute while monitoring the following field parameters every 5 to 10 minutes: specific conductance, pH, temperature, dissolved oxygen (DO), oxidation-reduction potential (ORP), and turbidity. Procedures for taking ORP and DO measurements are detailed in PBW SOP No. 11: Field Measurement of ORP and PBW SOP No. 12: Field Measurement of Dissolved Oxygen (Appendix A). Meters will be calibrated

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before sampling each day, using the manufacturer's procedure. The field measurements will be recorded on the groundwater sampling record (Appendix A, Figure SOP-10-1).

Each monitoring well and piezometer will be purged until a minimum of five readings for the following parameters have been recorded and three consecutive readings have stabilized to within the following limits:

- Specific conductance: +/- 10 percent
- pH: +/- 0.1 units
- Temperature: +/- 1 degree Celsius
- Turbidity: +/- 10 percent (or less than 10 NTUs)

After purging, groundwater samples will be collected from the discharge of the pump tubing. If the stabilized turbidity reading is greater than 10 NTU, the discharge from the pump will be filtered with an in-line 10 micron (μm) filter during the collection of the samples for metals analyses only. The in-line filter will be purged with approximately 200 milliliter (mL) of sample water before the laboratory container is filled. Filters and tubing will be used for only one sample and subsequently disposed.

Sample bottles will be prepared specifically for the required analyses by the analytical laboratory. Any required preservatives will be placed in the sample bottles by the laboratory prior to shipment to the sampling personnel. Field QA/QC procedures will be followed by collecting the necessary field duplicates and blanks, and samples will be handled, packaged, and transported as described in the QAPP. Documentation will include groundwater sampling forms and any associated photographs.

5.4.3 Hydraulic/Slug Testing

Falling-head or rising-head tests ("slug tests") will be performed in the monitoring wells to estimate the lateral hydraulic conductivity of the water-bearing strata. Slug tests will consist of instantaneously raising or lowering the water level in a well and then monitoring the change of the water level through time. The slug tests will be performed by rapidly submerging (rising-head or "slug-in" test) or retracting (falling-head or "slug-out" test) a slug of known volume. Depending on hydrogeologic characteristics of the uppermost-water bearing zone (e.g., if the water level in the wells is within the screened interval of the well indicating unconfined conditions), the slug-in test may not be performed. The method provided below assumes that both the slug-in and slug-out tests are performed.

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A typical slug used in two-inch wells is constructed of a sealed, one-inch diameter, PVC or stainless-steel pipe filled with sand. The displacement volume of the slug will be measured prior to the test program.

A pressure transducer or electric water line with an appropriate operating range may be used to measure the water levels during the slug tests. If a transducer is used, the pressure readings will be recorded and converted to feet of water above the transducer using a datalogger. The datalogger is programmed to record the water levels at one-second intervals at the beginning of a test and logarithmically increased to several minutes toward the end of the test. Upon arrival at each test well location, the static water level and total depth of the well will be measured with an electric water level interface probe. In the event NAPLs are encountered in the well, the hydraulic testing may be terminated. If a pressure transducer is used, the transducer will then be secured in the well to a depth below the lowest point to which the slug will be lowered. Before starting the test, sufficient time will be allowed for the water level in the well to adjust to the displacement caused by the transducer and cable, and for the transducer to equilibrate to the water temperature. During this period, the water level in the well will be monitored electronically using the datalogger and measured periodically with the electric water level probe to confirm that static water level conditions exist. Next, the slug will be lowered to a point just above the water level in the well and then rapidly submerged to begin the test. As data are collected, the water levels displayed by the datalogger will be examined to monitor trends and the progress of the test. Manual water level measurements also may be taken during the test to confirm the transducer readings.

Each test will proceed until the water level attains at least 90 percent recovery from the falling head test and rising head test. Following completion of the slug-in test, a rising-head or slug-out test will be performed by rapidly pulling the slug out of the water and monitoring the water level recovery in the same manner as for the slug-in test. In some cases, more than one slug-in and/or slug-out test may be performed to provide additional confirmation of the results.

The data collected by the datalogger are stored in the memory of the datalogger and then transferred to a computer in the field. When transferred to computer, the data sets are generally saved as comma-delineated ASCII format files. The contents of each data file are imported to a spreadsheet program that allows the data manipulation and graphical presentation needed to calculate the hydraulic parameters of the water-yielding zone. Slug test data will be analyzed by the methods discussed in PBW SOP No. 15: Hydraulic Testing (Appendix A).

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5.5 SURFACE WATER SAMPLING

When both sediment and surface water paired samples will be collected, the surface water samples will be collected prior to sampling of submerged sediments to reduce disturbance of the surface waters prior to their collection for chemical analyses. It is preferred that surface water samples be collected without entering the water or from a distance to minimize disturbance of sediments at the location where the surface water is to be collected. For on-property surface water, a single surface water grab sample is proposed for collection at each sample station (not including QA/QC samples collected at the frequency indicated in the QAPP). The depth(s) of surface water samples to be collected from Vince Bayou and/or Little Vince Bayou locations will be provided in a WRN to be developed prior to Iteration 2 of the RI/FS, as described in Section 3.0 and below. For all samples, total water depth, the depth of sample collection, and field water chemistry parameters will be collected. These parameters will be collected using a multi-probe sonde that directly measures the following:

- pH,;
- Conductivity;
- Temperature;
- ORP; and
- DO.

Surface water samples will be collected from the on-property ponded water areas using either a dipping bucket on an extended pole or using a pole with attached peristaltic pump tubing to pump samples directly to the sample containers. The sample will be collected from the top quarter of the water column. Once sufficient water volume has been collected for each sample station, the sample will be placed into the respective sample containers for the analyses to be conducted. Surface water samples analyzed for metals will be collected in two samples: filtered and unfiltered. PBW SOP No. 10: Water Quality Sampling (Appendix A) provides details for the specific protocols for sampling of surface waters, including filtering procedures. The surface water sample stations will be surveyed using the differential GPS receiver, as detailed in Section 5.9.

Surface water sample stations within Vince Bayou or Little Vince Bayou, as applicable, will be located using a sub-meter GPS equipment and coordinates will be recorded. Sampling will be performed using a custom 20 ft aluminum flat bottom boat as the sample platform. Wherever possible, the sample platform will be positioned on station by tying off to shoreline structures to avoid using anchors that could disturb the sediment at the sample site. If anchors are required to stabilize the sample platform, anchors will not

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be positioned up current of the sampling point. If multiple surface samples are collected, collection will proceed from downstream to upstream areas of the bayou.

At each station, physical and chemical parameters, and analytical water samples will be collected from each sampling point. Water samples will be collected using a variable speed peristaltic pump fitted with pre-cleaned sample tubing. Physical and chemical parameters will be measured using portable field grade instruments. The tip of the sample tubing and instrument probes will be attached to a weighted cable and lowered to sampling depths from the boat.

At each station, the sample tubing and instrument probes (attached 1 foot above the weight) will be slowly lowered until the weight touches the surface of the sediment and will then be slightly retracted. Field water quality parameters as described above will be measured and recorded. A peristaltic pump will be engaged and the water collection apparatus will be purged for approximately two minutes. The sample collection apparatus will consist of pre-cleaned Teflon and C-flex tubing attached to a 5 μm pre-filter and a 0.45 μm final filter. Following the system purge, a filtered water sub-sample (1/3 total volume) will be collected directly into a sample container. This process will be repeated at the two remaining sample depths to complete the filtered water sample.

The water filters will be removed from the sample tubing and an unfiltered water sub-sample (1/3 total volume) will be collected at each sample depth. A sample of unfiltered water will also be collected at each depth for total suspended solids (TSS). A clean sample collection apparatus will be used at each station.

5.6 SEDIMENT SAMPLING

Sediment sample locations for Iteration 1 sampling are provided on Figure 4. Sediment sample stations for Iteration 2 (i.e. sediment samples locations in Vince Bayou or Little Vince Bayou, as applicable) will be selected in advance of Iteration 2 based on the results of Iteration 1.

5.6.1 Iteration 1 Sediment Sampling

During Iteration 1, sediment will be collected from the on-property ponded water sediment by approaching the sample location on foot, being careful not to impact the area to be sampled. The sample will be collected using a stainless steel scoop or spoon, and will be placed in a stainless steel bowl for homogenization except for samples for VOC analyses, which will not be homogenized. Aliquots of the

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sample will be removed from the bowl and placed in pre-cleaned labeled sample jars. Equipment used for sample collection, sub-sampling, and sample mixing (i.e., spoons, knives, scoops) will be stainless steel or Teflon®.

5.6.1 Iteration 2 Sediment Sampling

The following methods for collection of sediment from Vince Bayou or Little Vince Bayou are provided in advance of the development of the actual scope of work for Iteration 2 sampling. Although these methods are generally applicable to the type of sampling likely to occur, modifications to the methods may be proposed in the WRN to be prepared prior to Iteration 2 sampling.

Access and Sample Location

Sediment sampling during Iteration 2 in Vince Bayou or Little Vince Bayou, as applicable, will be conducted from an aluminum boat. GPS equipment with sub-meter accuracy will be used to locate the sample stations and record the actual coordinates, as detailed in Section 5.9. Sample station information, sample depth, and all other pertinent observations made during the study will be recorded on field data sheets.

Grab Sampler

Soft surficial sediment samples from Vince Bayou or Little Vince Bayou, as applicable, may be collected using an Ekman grab (or equivalent). The jaws of the sampler will be locked open and the sampler will be lowered to the bottom on a cable or attached to a stainless steel pole. To prevent forward wake, the sampler will not be lowered faster than 0.3 m/sec as it nears the bottom. The sampler will be retrieved slowly to ensure proper jaw closure. The retrieved sampler will be lowered into a clean tub or tray, and secured in an upright position to prevent sediment movement.

Prior to removing sediments from the sampler, overlying water will be drained by gently tilting the sampler. A sub-sample of the appropriate depth (to be determined) will be collected from the top of the closed sampler using a pre-cleaned spoon, scoop, or core tube. Sediment will be removed using pre-cleaned spoons and composited in pre-cleaned stainless steel bowls. Only the sediment from the center of the grab sampler (i.e., no sediment touching the walls of the sampler) will be used. Equipment used for sample collection, sub-sampling, and sample mixing (i.e., spoons, knives, scoops) will be stainless steel or Teflon®.

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Core Sampler

Samples of stiff sediments from Vince Bayou or Little Vince Bayou, as applicable, may be collected using a piston-coring device if the grab sampler is not effective at collecting a representative sample. The coring device consists of a 3-inch diameter polycarbonate core tube attached to the end of an aluminum pole. The coring device will be manually driven into the sediment until firm resistance is detected. In the event that a single core does not provide the volume of material required by the analytical laboratory (approximately 1 liter), additional cores will be collected at that station to provide the required sediment. All cores samples from the same station will be combined and homogenized before aliquots are removed.

Sediment will be extruded into a stainless steel bowl and a sub-sample will be immediately removed with a stainless steel spoon for volatile organic analysis. The remainder of the sample will then be homogenized and placed in containers for other analyses. Samples will be collected from downstream to upstream locations to avoid sediment sample mixing.

The empty sampler (Ekman or core) will be rinsed and decontaminated following the procedures presented in Section 5.8. The sampler and associated equipment will be decontaminated before use, and between sample locations. In addition, the sampler will be rinsed with water before samples are collected.

5.7 FISH/SHELLFISH SAMPLING

The following methods for collection of fish/shellfish from Vince Bayou or Little Vince Bayou are provided in advance of the development of the actual scope of work for Iteration 3 sampling. Although these methods are generally applicable to the type of sampling likely to occur, modifications to the methods may be proposed in the WRN to be prepared prior to Iteration 3 sampling. Specifically, the methods below address sampling and tissue processing of finfish and shellfish (blue crabs). Other biota may be sampled as the PCSMs are revised or specific risk issues arise during the RI/FS and initial risk assessments. For example, whole body fish sampling (as opposed to fish tissue) may be necessary for evaluation of risk to certain ecological receptors.

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5.7.1 Fish Samples

To optimize fish capture rates, gill net placement will be timed to coincide with periods of highest fish activity (i.e., dusk to dawn). Nets will be set in the study area and background area in the late afternoon and fished through the night. To ensure that fish are removed from the nets as soon after capture as possible, the collection devices will be checked and fish will be removed once every eight hours. Fish will be removed more frequently if water temperature exceeds 28°C. As soon as individual fish specimens are removed from the collection device, they will be rinsed in ambient water to remove any foreign material. Individual specimens of the target species will be grouped by species and general-size class and placed in clean holding pans onboard the boat to prevent potential contamination.

Fish collected for this project will be examined for morphological abnormalities. The examination will consist of an assessment of four gross morphological conditions associated with pathological disorders. The characteristics that will be evaluated are:

- Fin erosion;
- Skin ulcers;
- Skeletal anomalies; and
- Neoplasms (i.e., tumors).

Specimens selected for this study will be weighed and measured, and assigned a sample number. A sample number tag will be attached to the lower jaw of each fish. After labeling, all of the fish from a sample zone will be placed together in a watertight plastic bag and sealed. The bags will be placed in an insulated cooler with ice for temporary storage and transport to the sample processing area. Plastic bags will be labeled with station ID, date, and time. Data sheets will be used to record (at a minimum) the following information:

- Gear type;
- Water depth;
- Set date;
- Set time;
- End date;
- End time;
- Field personnel;
- Station ID; and
- Photo log.

Additional procedures for collecting fish samples are provided in SOP-BESI-303: Collection of Finfish and Crabs Using Gill Nets (Appendix A).

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5.7.2 Blue Crab Samples

Adult blue crabs (*Callinectes sapidus*) will be collected in baited commercial type crab traps (i.e., vinyl covered wire mesh). Bait will be commercial crab bait (i.e., frozen menhaden). Blue crabs captured in gill nets may also be used as samples. Traps will be placed at the selected sample locations and allowed to fish continuously until a sufficient number of crabs have been collected. The number of crabs required to provide a minimum sample volume will depend on crab size and analytical requirements.

Immediately following collection, blue crabs will be rinsed in ambient water to remove any foreign material and inspected to ensure that their exoskeletons have not been cracked or damaged during collection. Damaged specimens will be discarded. After being rinsed, blue crab specimens will be grouped by general-size class and placed in clean holding tubs to prevent contamination.

Specimens selected for this study will be weighed, measured, and assigned a sample number. Both male and female blue crabs will be collected and combined for analysis. Female crabs can be legally harvested unless they are gravid (i.e., carrying eggs or young). If gravid female crabs are collected during this study, they will be released and not included in the samples. All specimens collected will be sealed in a watertight plastic bag with a sample number tag, and placed in an insulated cooler with ice for transport to the processing area. Plastic bags will be labeled with station ID, date, and time. Data sheets will be used to record (at a minimum) the following information:

- Gear type;
- Water depth;
- Set date;
- Set time;
- End date;
- End time;
- Field personnel;
- Station ID; and
- Photo log.

Additional procedures for collecting crab samples are provided in SOP-BESI-304: Collection of Blue Crabs Using Commercial Crab Traps (Appendix A).

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5.7.3 Sample Collection Requirements

The following procedures will be observed when passive collection devices (i.e., gill nets, crab traps) are deployed:

- Target fish will be removed from the passive-collection device (i.e., nets) at frequent intervals (less than 8 hours) during sample collection periods.
- Crabs captured in crab traps will be removed from the traps at an interval not to exceed 24 hours.
- All target species captured using passive collection devices will be alive at the time of removal from the sampling equipment. If they are not alive, they will be discarded.

All fish and crabs collected will be identified, counted, and logged into the field logbook. To be consistent with the convention used by most fisheries biologists in the United States, the total length of fish and carapace width of crabs selected for inclusion in the study will be measured in millimeters (*Measuring Fish Length and Wet Weight* (SOP-BESI-508) and *Measuring Crab Carapace Width and Wet Weight* (SOP-BESI-506) (Appendix A)).

Total length of a fish is defined as the length from the anterior-most part of the nose of fish to the tip of the longest caudal fin ray (when the lobes of the caudal fin are compressed dorso-ventrally). Since the caudal fin of finfish is often damaged during capture, standard length will also be measured. Standard length of a fish is defined as the length from the anterior-most part of the nose of fish to the end of the caudal peduncle (caudal tip of the spine). Carapace width of a crab is defined as the distance from the tip of lateral carapace spine to the tip of the opposite spine.

The weight in grams of finfish and crabs selected for inclusion in the study will be measured immediately after capture. Fish and crab weights will be obtained according to the appropriate SOP (*Measuring Fish Length and Wet Weight* (SOP-BESI-508), and *Measuring Crab Carapace Width and Wet Weight* (SOP-BESI-506) (Appendix A)).

Species identification will be conducted by experienced personnel knowledgeable of the taxonomy of aquatic species in the Project area. Taxonomic keys, appropriate for the central Texas gulf coast, will be onboard the sample vessel and will be consulted if necessary.

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5.7.4 Tissue Processing

Fish and crab samples will be processed within 24 hours of collection. Samples will be processed on-site to reduce the amount of time between fish and crab collection, and tissue removal. Removal of edible tissue will follow the procedures described in the SOPs *Fish Tissue Processing* (SOP-BESI-509), and *Crab Tissue Processing* (SOP-BESI-507) (Appendix A).

Please note that the methods below apply to processing of fish and shellfish tissue. If whole-body samples of fish or shellfish (or other biota) are required during the RI/FS, the methods will be provided in a WRN.

5.7.4.1 Finfish Tissue

Finfish will be weighed, measured, scaled, and rinsed with DI water. Data will be recorded on tissue processing data sheets. Once a fish has been scaled it will be placed in clean plastic bags and stored on ice until all samples have been scaled. Edible tissue filets (with skin) will be processed on pre-cleaned Teflon cutting boards with pre-cleaned stainless steel filet knives. EPA Guidance (EPA, 2000) recommends that the fillets of scaled finfish be analyzed with the skin intact. Edible filets will be collected from both sides of the fish, placed on hexane-rinsed aluminum foil, and weighed in grams. The filets will be double wrapped in hexane-rinsed aluminum foil.

Most fish samples will be taken from a single specimen, but if a single fish cannot provide the required sample volume, the fillets from multiple fish will be composited. If more than one organism is to be composited to complete a sample, the individual organisms will be filleted, filets will be weighed, and the filets will be combined and double wrapped in hexane-rinsed aluminum foil.

Foil wrapped filet samples will be placed in a Ziploc bag labeled with collection date, time, personnel, species, and station identification (ID). The sample will then be placed in another Ziploc bag and stored at 4 degrees Celsius. A Chain of Custody will be completed following the procedures detailed in Section 6.1.

5.7.4.2 Blue Crab Tissue

Blue crabs will be weighed, measured, rinsed with de-ionized (DI) water, and placed on pre-cleaned Teflon cutting boards. Data will be recorded on tissue processing data sheets. Edible blue crab tissue (i.e., muscles inside chelipeds and musculature for periopods) will be removed using pre-cleaned scalpels and placed on hexane rinsed aluminum foil for weighing.

In order to provide the analytical laboratory with a sufficient quantity of tissue for all analyses, the edible tissue from five adult blue crabs from the same zone will be composited for each sample. The weight of edible tissue will be recorded for each individual crab and for the total edible tissue per sample. A pre-cleaned sample jar will be labeled with the collection date, time, personnel, species, and station ID.

Sealed samples will be placed in a Ziploc bag labeled with collection date, time, personnel, species, and station ID. The sample will then be placed in another Ziploc bag and stored at 4 degrees Celsius. A Chain of Custody will be completed for all samples collected.

5.8 DECONTAMINATION PROCEDURES

Project personnel will perform decontamination in accordance with PBW SOP No.13: Equipment Decontamination (Appendix A) will be performed for all equipment when brought to AOI-1, between sample locations, when necessary between sample intervals, and before removing it from AOI-1. Certain disposal equipment meant to be used only once and discarded will be decontaminated prior to use, unless the equipment is properly packaged and sealed. All non-disposable components of the sampling equipment that will not have direct contact with the samples collected (i.e., augers, probe rods, drill pipe, etc.) will be decontaminated as follows:

- Potable water rinse;
- Liqui-nox® detergent wash;
- Potable water rinse;
- DI water rinse (3 times); and
- Air dry.

All sampling equipment that contacts the soils, groundwater, sediments, or surface waters that will be submitted for analyses (i.e. coring equipment, compositing bowls, scoops and spoons) will be decontaminated as follows:

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- Potable water rinse;
- Liqui-nox® detergent wash;
- DI water rinse;
- Liqui-nox® detergent wash;
- DI water rinse (3 times); and
- Air dry.

A methanol or hexane rinse may be used if evidence of organic staining is found after equipment has been cleaned. Equipment rinsate blank samples will be collected as specified in the QAPP to document the effectiveness of decontamination. Following decontamination, the sampling equipment will be placed in bags or sealed to keep the equipment clean during storage.

All liquids generated as a result of decontamination processes will be containerized and handled as IDW as detailed in Section 7.0.

5.9 SURVEYING

Following completion of field activities, a Texas-licensed surveyor will survey the horizontal coordinates and vertical elevations of the monitoring wells and staff gauge(s) with a vertical accuracy of 0.01 feet at each sampling location. Other sampling stations (soil borings, surface water sampling stations, sediment stations, and fish tissue sampling stations) will be surveyed in the field with the differential GPS meter. All horizontal coordinates will be referenced to the Texas State Plane Coordinate System, North American Datum from 1983, and elevations will be surveyed relative to the National Geodetic Vertical Datum of 1988.

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6.0 SAMPLE HANDLING AND ANALYSIS

6.1 SAMPLE HANDLING

To prevent misidentification of samples, labels will be affixed to each sample container. Information will be written on the label with a permanent marker. The labels will be sufficiently durable to remain legible even when wet and will contain the following information:

- Project identification number;
- Sampling station identification name;
- Name or initials of collector;
- Date and time of collection;
- Analysis required (if space on label allows); and
- Preservative inside bottle, if applicable.

Sample aliquots will be containerized in order of decreasing analyte volatility. Sample containers will be filled in the following sequence: VOCs; SVOCs; pesticides and herbicides; and then metals and other analyses.

Samples will be placed in shipping coolers containing bagged, cubed ice immediately following collection. The samples will be grouped in the shipping cooler by the order in which the samples are collected. Samples will be shipped to the laboratory via an overnight courier or laboratory courier service, generally on the day they are collected. The only exceptions to this procedure will be for samples collected after the courier service has picked up the shipment for the day and samples collected on a Sunday or holiday. In these instances, the samples will be shipped on the next business day. Specific protocols are included in PBW SOP-6: Sample Custody, Packaging and Shipment (Appendix A).

6.1.1 Sample Preservation

Tables 18 and 19 in the QAPP identify the requirements for the number of containers, container volume, container type (material of construction), preservation, and holding time periods for each of the analytical methods.

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6.1.2 Sample Chain-Of-Custody Forms and Custody Seals

Chain-of-custody (COC) procedures are intended to maintain and permanently document sample possession from the time of collection to disposal. A sample is considered to be under a person's custody if:

- It is in that person's possession.
- It is in that person's view, after being in that person's possession.
- It was in that person's possession and was locked up by them to mitigate tampering.
- It has been placed in a designated secure area by that person.

Sample custody procedures are summarized below.

COC records will be used, by all personnel, to record the collection and shipment of all samples. The COC record may specify the analyses to be performed and should contain at least the following information:

- Name and address of originating location of samples;
- Name of laboratory where samples are sent;
- Any pertinent directions/instructions to laboratory;
- Sample type (e.g., aqueous);
- Listing of all sample bottles, size, identification, collection date and time, and preservative, if any, and type of analysis to be performed by the laboratory;
- Sample ID;
- Date and time of sample collection; and
- Signature of person relinquishing, with date/time.

The COC procedure will be as follows:

1) The person collecting the sample shall be responsible for initiating the COC Record. Samples can be grouped for shipment on a common form.
2) Each time responsibility for custody of the samples changes, the receiving and relinquishing custodians will sign the record and note the date and time.
3) The COC Record shall be sealed in a watertight container, placed in the shipping container, and the shipping container sealed prior to giving it to the carrier. The carrier waybill shall serve as an extension of the COC Record between the final field custodian and receipt in the laboratory. The commercial carrier is not considered part of the COC chain and is not required to sign the COC.
4) Upon receipt in the laboratory, a designated individual shall open the shipping containers, measure and record cooler temperature, compare the contents with the COC Record, and sign and date the record. Any discrepancies shall be noted on the COC Record.

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5) If discrepancies occur, the samples in question shall be segregated from normal sample storage and the project manager will be notified for clarification.
6) COC Records, including waybills, if any, shall be maintained as part of the project records.

6.2 SAMPLE ANALYSIS

As presented on Table 3 and in the QAPP (Tables 2 through 11), samples will be analyzed using the analytical methods listed for each media. The tables in the QAPP list the COPCs that will be analyzed for each media sampled, with the exception of off-property surface water, sediment, and fish/shellfish tissue. The COPCs for off-property sediment and surface water and fish/shellfish tissue will be established following Iteration 1 and Iteration 2, respectively. The tables also list the PSVs, as defined in the RI/FS Work Plan, for each COPC, with the required method detection limits.

6.3 FIELD DOCUMENTATION

Field data will be recorded on standard forms (e.g., stratigraphic logs), as detailed in PBW SOP No. 1 – Field Documentation. Field data primarily will be direct observations, hand measurements, direct-readings from field meters. These data will be tabulated and included in project reports or submittals, as appropriate. Appropriate field forms will be used to record field data collection activities.

Samples will be collected following the sampling procedures documented in this FSP. The equipment used to collect samples, time of sample collection, sample description, volume and number of containers, preservatives added (if applicable) will be recorded on the appropriate field forms. The field forms will be filed in the PBW Office project files.

6.4 FIELD QUALITY CONTROL

6.4.1 Trip Blanks

Trip blanks are prepared prior to the sampling event by the analytical laboratory in the actual sample container using Type II reagent-grade water. Trip blanks are assigned a field identification as described in Section 4 of this FSP and are kept with the investigative samples throughout the sampling event. They are then packaged for shipment with the investigative samples and sent for analysis. At no time after their preparation are the sample containers to be opened before they reach the laboratory. To minimize the number of coolers containing trip blanks, VOC samples will be aggregated into a minimum number of

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coolers. If multiple shipments of samples are required, trip blanks are to be provided per shipment but not per cooler. Trip blanks are only analyzed for VOCs.

6.4.2 Equipment Blanks

Equipment blanks are defined as samples that are obtained by running deionized water over/through non-disposable, reusable sample collection equipment after it has been cleaned (i.e., rinse water will be poured from the bailer, pumped through the sample pump and tubing, or poured over the augers). Deionized water will be obtained from the laboratory or an equivalent from a commercially available source. These samples will be used to determine if decontamination procedures were adequate. One equipment blank will be collected each day sampling activities occur. Equipment blanks are collected for each matrix sampled and are assigned a field identification as described in Section 4 of this FSP. Equipment blanks are analyzed for metals, herbicide, pesticide, TPH, SVOC, and VOC analytes, if associated with the sampling event. Equipment blanks are not collected for dedicated or disposable (one use only) equipment.

6.4.3 Field Duplicates

Field duplicate samples are two or more samples collected simultaneously or in immediate succession from the same location under identical conditions. One duplicate sample will be collected for each batch of 10 or fewer field samples. The duplicate sample provides a measure of precision, or reproducibility of the sample collection process. Field duplicate precision is measured as RPD using the formula contained in the QAPP. Field duplicate samples are analyzed for metals, herbicides, pesticides, TPH, SVOC, and VOC analytes associated with the sampling event.

6.4.4 Matrix/Matrix Spike Duplicate Samples

Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples are spiked and analyzed by the laboratory to facilitate identification of effects of the matrix on analytical results, particularly biasing of results. Sufficient sample volume will be collected (triple the normal sample volume for aqueous samples) for at least one sample in each batch of 20 or fewer field samples of the same matrix so that MS/MSD samples can be prepared for analysis.

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7.0 MANAGEMENT OF INVESTIGATIVE-DERIVED WASTE

IDW generated from borings or monitoring wells will be placed in Department of Transportation (DOT)-approved drums and managed for off-site disposal. These wastes will be characterized following RI activities. The IDW will then be classified based on the analytical results and disposed accordingly. A covered area at AOI-1 will be designated by the Field Supervisor for the staging of drums awaiting characterization and disposal. Management of IDW is further described in PBW SOP No. 14: Storage and Disposal of Soil, Drilling Fluid, and Water Generated During Field Work (Appendix A). The following general parameters will be followed to characterize the IDW generated during the RI/FS at AOI-1:

- Use process knowledge and data from environmental media samples to assist in the evaluation and classification of IDW, where possible (e.g., groundwater sample data can be used to evaluate classification of well development and purge water).
- Collect composite samples from specific IDW waste streams, where environmental media data are not available (e.g., water collected after decontamination of drilling equipment).
- Analyze each sampled IDW waste stream in accordance with applicable state and federal regulations, and in accordance with any facility-specific requirements of potential waste management facilities.

Upon completion of RI activities, the IDW will be transported to appropriate off-site waste management facilities approved by EPA or otherwise managed in accordance with all applicable state and federal regulations. All records documenting the IDW characteristics, waste classifications, quantities, final management locations, and waste manifest forms will be filed in the project files.

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8.0 FIELD HEALTH AND SAFETY PROCEDURES

The overall health and safety objective is to perform the field tasks in a manner that minimizes the potential for accidents or injuries, and minimizes the potential for worker exposure to hazardous chemicals. Details of the health and safety procedures are provided in the Site-Specific HASP (PBW, 2014c).

The HASP applies to the field activities described in this FSP that will be performed during the RI/FS at AOI-1. The HASP was prepared to comply with the requirements of 29 CFR 1910.120 (b)(4). The primary purpose of the plan is to provide the results of a hazard assessment conducted for the prescribed work tasks, and the health and safety requirements and protocols that will minimize hazards to RI/FS workers.

A copy of the HASP will be kept at AOI-1 at all times during field activities. All personnel will complete the Safety Compliance Agreement provided in Appendix A of the HASP. Other health and safety documentation are detailed in the HASP.

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TABLES

FIGURES

APPENDICES

APPENDIX A

STANDARD OPERATING PROCEDURES