SAMPLING AND ANALYSIS PLAN - VOLUME I
FIELD SAMPLING PLAN

FOR THE
GULFCO MARINE MAINTENANCE
SUPERFUND SITE
FREEPORT, TEXAS

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1.0 INTRODUCTION

The United States Environmental Protection Agency (EPA) named the former site of Gulfco Marine Maintenance, Inc. in Freeport, Brazoria County, Texas (the Site) to the National Priorities List (NPL) in May 2003. On July 27, 2005, the EPA issued a modified Unilateral Administrative Order (UAO), requiring the potentially responsible parties to conduct a Remedial Investigation and Feasibility Study (RI/FS) for the Site. This Field Sampling Plan (FSP) has been prepared as Volume I of a Sampling and Analysis Plan (SAP) in accordance with Paragraph 27.a of the Statement of Work (SOW) for the RI/FS included as an Attachment to the UAO. The FSP has been prepared by Pastor, Behling & Wheeler, LLC (PBW), on behalf of LDL Coastal Limited LP (LDL), Chromalloy American Corporation (Chromalloy) and The Dow Chemical Company (Dow) (collectively referred to as Respondents in the UAO).

The FSP format and elements have been developed in accordance with guidance developed by the United States Environmental Protection Agency (EPA, 1988). The plan presents specific sampling locations, equipment and procedures to be used during the RI/FS. A general description of RI/FS activities is provided in the RI/FS Work Plan (PBW, 2006a). Quality assurance/quality control (QA/QC) policies, organization, objectives, functional activities, and other specific QA/QC activities are described in Volume II of the SAP, the Quality Assurance Project Plan (QAPP) (PBW, 2006b).

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2.0 SITE BACKGROUND

2.1 SITE DESCRIPTION

The Site is located about three miles northeast of Freeport, Texas in Brazoria County at 906 Marlin Avenue (also referred to as County Road 756) (Figure 1). The Site consists of approximately 40 acres within the 100-year coastal floodplain along the north bank of the Intracoastal Waterway between Oyster Creek to the east and the Old Brazos River Channel to the west.

The Site is located between Galveston and Matagorda Bays and is situated along approximately 1,200 feet of shoreline on the Intracoastal Waterway. The Intracoastal Waterway is a coastal shipping canal that extends from Port Isabel to West Orange on the Texas Gulf Coast.

Marlin Avenue divides the Site into two areas (Figure 2). For the purposes of this work plan, it is assumed that Marlin Avenue runs due west to east. The property to the north of Marlin Avenue (the North Area) consists of undeveloped land and the closed impoundments, while the property south of Marlin Avenue (the South Area) was developed for industrial uses and will continue to be used for commercial/industrial purposes in the future. Adjacent property to the north, west and east of the northern portion of the Site is unused and undeveloped. Adjacent property to the east of the southern portion of the Site is developed and currently used for industrial purposes while to the west the property is currently vacant and previously served as a commercial marina. The Intracoastal Waterway bounds the Site to the south.

The South Area includes approximately 20 acres of upland that was created from dredged material from the construction of the Intracoastal Waterway. Some of the North Area is upland created from dredge spoil, while most of this area is considered wetlands (RI/FS Work Plan, Figure 3 (PBW, 2006a)). The wetlands on and north of the Site are estuarine, intertidal, emergent, persistent, and irregularly flooded.

The Intracoastal Waterway supports barge traffic and other boating activities. The area near the Site is regularly dredged and, as noted by the United States Fish and Wildlife Service (USFWS), shoreline habitat is limited (USFWS, 2005).

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2.2 SITE GEOLOGY AND HYDROGEOLOGY

The Site geology consists predominantly of Quaternary alluvium and "fill and spoil" from the construction of the Intracoastal Waterway (Barnes, 1987), as shown on Figure 3. The alluvium consists of clay, silt, sand and gravel, with organic material abundant in the soils. The fill and spoil material consist of dredged material "for raising land surface above alluvium and barrier island deposits and creating land" (Barnes, 1987). The spoil material is highly variable with mixed mud, silt, sand and shell, with the reworked spoil mostly sandy and moderately sorted (McGowen, 1976).

Underlying the alluvium unit is the Beaumont Formation, which consists of clayey soils with interconnected, alluvial sand channels and barrier island beach deposits encountered in the formation. The Beaumont Formation is about 100 feet thick. The Lissie and Willis Formations underlie the Beaumont Formation. The Lissie Formation consists of interbedded sands, silts, and clays and is about 200 feet thick, overlying the Willis Formation, which consists of gravel, sand silt, and clay. The Alta Loma Sand is part of the Willis Formation and is the thickest sand sequence in the Willis Formation. The base of the Alta Loma Sand in southeast Brazoria County is about 1,200 feet below mean sea level (MSL) (Sandeen, 1982).

The two primary hydrogeologic units beneath the Site are the Chicot and Evangeline Aquifers. The Chicot consists of the Willis, Lissie, and Beaumont Formations. The Evangeline Aquifer consists of sands of the Goliad and Fleming Formations. The Chicot Aquifer is subdivided into two zones: the Lower and Upper Chicot. The Lower Chicot in Brazoria County generally includes the Alta Loma Sand unit, which is about 400 feet thick in the Freeport area (Sandeen, 1987). The Upper Chicot is made up of interconnected sands that are found within 300 feet below ground surface.

The main source of groundwater in the area is from the Chicot Aquifer. The Lower Chicot can produce as much as 3,000 gallons per minute (gpm); however the water contains a large amount of slightly saline water (1,000 to 3,000 mg/L total dissolved solids (TDS)). The Upper Chicot is the most-widespread fresh-water aquifer in Brazoria County, and wells completed in Upper Chicot sands at least 50 feet thick can yield 500 to 1,000 gpm. However, in some areas along the coast the interbedding of saline water with fresh water has been encountered (Sandeen, 1987).

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The Site and vicinity currently receive water via pipeline from the City of Freeport. During the early operation at the Site, water was supplied for barge cleaning operations by two on-site water wells. It was reported that one of these wells was located adjacent to the front entrance gate south of Marlin Avenue (TNRCC, 2000b); however, neither of these wells could be located in July 2005.

The closest water well (TWDB ID 81-06-303) identified near the Site is located on the adjacent property west of the Site at a former marina. The total depth of the well is reported to be 199 feet below ground surface. Water quality from the well in 1969 showed a TDS concentration of 1,382 mg/L with the depth to water about 67 feet (TWDB, 2005). In July 2005 this well was observed to be present, but was abandoned with the drop pipe unsecured.

The previous monitoring wells installed at the Site were installed in shallow water-bearing sands less than 50 feet below ground surface. Three monitoring wells, HMW-1, HMW-2, and HMW-3 (Figure 2) that were installed in January 1989 were completed in a sand unit about nine feet thick, with the top of the sand encountered about nine feet below ground surface (Hercules, 1989).

2.3 POTENTIAL SOURCE AREAS (PSAs)

As detailed in Section 3.2 of the RI/FS Work Plan, 13 Potential Source Areas (PSAs) have been identified at the Site based on the Site operations history, previous investigations and existing data as described in the RI/FS Work Plan. These PSAs are listed below and shown on Figure 4.

Former Aboveground Storage Tank (AST) Tank Farm Area	Sand Blasting Areas	Former Product Storage Tank Area
Pipelines	Welding Area	Former Gasoline Storage Tank Area
Former Surface Impoundment Area	Dry Dock Area	Lot 21 Area
Former Wash Water Storage Tank Area	Surface Drainage Areas	
Electrical Shed	Former Septic Tank Areas	

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2.4 CONCEPTUAL SITE MODEL

As detailed in the RI/FS Work Plan Section 3.3, preliminary Conceptual Site Models (CSMs) were developed for both human health and ecological receptors for the Site. Using the CSMs, a list of site-wide chemicals of interest (COIs) was developed from the RI/FS Work Plan based on Site historical information regarding chemicals potentially used or handled at the Site, existing Site data, and discussions with EPA during the scoping phase meeting for this Site. As such, COIs for the Site generally include metals, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, and polychlorinated biphenyls (PCBs). It should be noted that the term COI has been used to indicate, in most PSAs, the full suite of analytes.

Based on an evaluation of the potentially complete pathways identified in the RI/FS Work Plan CSMs, and an analyses of the information needed to assess the completeness of these pathways, data needs were identified to satisfy the objectives of the RI/FS and to establish the objectives set forth in this FSP.

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3.0 SAMPLING PLAN

As described in the RI/FS WP, the overall objective to be addressed by the RI/FS is to evaluate the nature and extent of contamination at and from the Site, assess the risk from this contamination to human health and the environment, and evaluate potential remedial alternatives. The technical approach for meeting these objectives is described in detail in the RI/FS Work Plan. The objective of the RI/FS FSP is to define in detail the sampling and data gathering methods needed to obtain data that are representative of site conditions and will be used to define the nature and extent of contamination and provide input to the risk assessment.

Based on the Data Quality Objectives (DQOs) detailed in the QAPP, the sampling plan design for the RI/FS consists of both judgmental and systematic sampling to satisfy the project objective of defining the nature and extent of contamination. The samples per media required for this investigation are summarized in the Sample Design Collection Worksheet (Table 1). The worksheet contains the elements needed to support the decisions for RI sampling design to meet data requirements for the risk assessment.

The field activities detailed in this FSP will be conducted in a general phased approach as discussed for each media in the section below. The proposed sample locations detailed in this FSP are initial locations that may be modified based on field conditions. Additional samples may be needed for nature and extent based on the initial data obtained.

3.1 LOCATING PROPOSED SAMPLE STATIONS

Sample stations will be located in the field using the coordinates extrapolated from locations on the Site maps (Figure 5 for the North Area and Figure 6 for South Area). A differential global positioning satellite (GPS) receiver will be used to locate the proposed sampling sites in the field. The GPS unit will utilize real-time corrections to achieve the horizontal and vertical coordinates with sub-meter accuracy. Accuracy of the sample locations is important to mapping analytical results, so a relatively high degree of confidence is needed as to where each sample is collected, and if needed, the sample location can be reacquired for future efforts. The desired coordinates will be programmed into the GPS and the receiver can then guide the user to the desired coordinates. However, the proposed sampling locations may be modified in the field based on field conditions and professional judgment.

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3.2 FORMER SURFACE IMPOUNDMENT CAP EVALUATION

The objective of this evaluation is to assess the construction materials and thickness of the caps constructed on the former surface impoundments in order to evaluate the potential for transport of VOCs as discussed in the RI/FS Work Plan. The following activities shall be performed as part of this evaluation:

- Advance four soil borings within the former surface impoundments for a geotechnical evaluation, as shown on Figure 5. Borings will be drilled and continuously sampled to a depth of five feet or to the base of the cap material, whichever occurs first, as detailed in Section 5.4.3.
- Collect one representative soil sample from each boring for laboratory geotechnical analyses detailed on Table 2 (Percent Passing No. 200 Sieve, Atterburg Limits, and vertical hydraulic conductivity).
- Perform a field inspection of the cap area, including observation of desiccation cracks, erosion features and overall surface condition. The inspection will be documented following the field document procedures detailed in Section 6.3.

3.3 SURFACE GEOPHYSICS EVALUATION

The objective of this evaluation is to attempt to locate former pipelines at the Site that may have been used to transport product material or wash water associated with the barge cleaning process from the barges and former AST tank farm area to the former surface impoundments or the wash water storage area. An electromagnetic (EM) metal detector, Geonics EM-61 or equivalent meter, and an EM radiodetection (RD) meter will be used to record magnetic anomalies caused by buried metal. Transects will be surveyed across the PSAs as shown on Figure 7. Two areas have been identified for conducting the EM surveys:

- Pipeline corridor for pipeline from AST Area to Former Surface Impoundment Area; and
- Pipeline corridor between AST Area and Former Wash Water Tank Area.

Before conducting the EM-61 survey, the RD meter will be used to identify potential buried pipes. The EM-61 MK2 meter will be used to support the RD meter data and to survey larger areas. The EM-61 MK2 transects for the pipeline areas will be oriented perpendicular to the assumed pipeline layout. As an example, the pipeline that was believed to transport wash water

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from the barge cleaning process to the Former Surface Impoundment Area likely was oriented north-south. Therefore, the EM transects will be oriented east-west. The spacing of the EM transects for the pipeline surveys will be about 50 feet with readings collected approximately every 5 feet. Transects will be surveyed in the field using the GPS meter by recording northing and easting coordinates. If any anomalies are identified in the field, additional transects may be added to further identify and delineate the anomalies.

3.4 SOIL INVESTIGATION

The objective of the soil investigation is to evaluate the lateral and vertical extent of COIs in soils as detailed in the RI/FS Work Plan. Soil samples will be collected following the sampling procedures detailed in Section 5.4.

For the initial phase of the investigation, the following four sets of soil samples will be collected as part of this investigation:

- PSA-based soil sample locations;
- Random systematic grid-based soil sample locations;
- Residential surface soil investigation samples; and
- Soil fate and transport characterization samples.

In addition, background soil samples may also be collected if needed.

3.4.1 PSA-Based Samples

Soil samples will be collected at each PSA listed in Section 2.3 using both judgmental and random systematic grid-based locations. The proposed soil sample locations within each PSA are presented on Figures 5 and 6 and the total number of sampling stations and samples in each PSA are summarized in Table 2. At each soil sample location, samples will be collected from the following intervals:

- 0 to 6 inch and
- 12 to 24 inch depth intervals.

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Soil samples will be analyzed for the analytical suites presented on Table 2. Should any COIs in a soil sample from the 12 to 24 inch depth interval exceed their respective Preliminary Screening Values (PSVs) as detailed in the RI/FS Work Plan, then additional deeper soil samples will be collected as needed to define the vertical extent of that COI, but not to a depth below the water table or 5 feet below ground surface.

The proposed judgmental-based sample locations within the PSAs were selected using existing data or by identifying locations within the PSA where the potential for a release may be more likely (e.g., near the sump within the former AST tank farm area). The locations of the actual judgment-based sample stations may be adjusted based on field observations and professional judgment (e.g., an observed seep area below the former AST tank farm containment wall).

3.4.2 Random Systematic Grid-Based Soil Sample Locations

For any areas within a grid that are not sampled as part of the PSA sampling program described above, random systematic grid-based soil samples will be collected on a 200-foot grid spacing in the North Area (Figure 5) and on a 100-foot grid spacing in the South Area (Figure 6). Soil samples will not be collected from grid-based locations falling within the wetland areas (shown on Figure 3 of the RI/FS Work Plan) or obviously observed to be wetland areas during sampling. Rather, sediment samples will be collected from those locations as described in Section 3.8, below. At each soil sample location, samples will be collected from the following intervals:

- 0 to 6 inch and
- 12 to 24 inch depth intervals.

Soil samples will be analyzed for the analytical suites presented on Table 2. Should any COIs in a soil sample from the 12 to 24 inch depth interval exceed their respective PSVs as detailed in the RI/FS Work Plan, then additional deeper soil samples will be collected as needed to define the vertical extent of that COI, but not to a depth below the water table or 5 feet below ground surface.

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3.4.3 Background Soil Samples

Should background soil samples be needed for the PSV comparisons described in the RI/FS Work Plan, nine background soil samples will be collected on a grid spacing within the background soil sample area shown on Figure 8, with the condition that visibly disturbed areas associated with other industrial operations will not be sampled. These samples will be collected from the 0 to 6 inch depth interval and will be analyzed for the specific analytes for which a background characterization is needed.

3.4.4 Residential Surface Soil Investigation Samples

As part of the residential surface soil investigation program described in the RI/FS Work Plan, samples will be collected from the 0 to 1 inch depth interval at 3 judgment-based locations in the Lot 21 sand blasting area, 7 judgment-based locations along the western boundary of Lot 21 at the Site where a dust screen was formerly located, and 27 random locations within a 100-foot sample block grid on off-site Lots 19 and 20 (Figure 9). In addition, samples shall also be collected from the 0 to 1 inch depth interval on the seven residential properties on the west side of Snapper Lane, subject to acquisition of appropriate access agreements. For these residential properties, a five-point composite sample will be collected from the front yard of the property, a five-point composite sample will be collected from the back yard, and a four-point composite sample will be collected from the drip zone near the mid-point of each side of the residence on the property (for those properties containing a residence) in accordance with guidance in the EPA Superfund Lead-Contaminated Residential Sites Handbook (EPA, 2003). Composite samples will also be collected from any distinct play areas and gardens present on the residential properties to be sampled.

The residential surface soil investigation program will be performed in several steps. After analytical data from surface soil samples from Lot 21 have been obtained, samples will be collected from Lots 19 and 20 with the analyte list for these samples developed based on the PSV comparisons for the Lots 21, 22 and 23 sample data described in the RI/FS Work Plan. Samples will then be collected from the residential properties on the west side of Snapper Lane with the analyte list for these samples developed based on PSV comparisons to the Lot 19 and 20 samples. If there are no PSV and background exceedences in a given step, then the subsequent step would not be performed. Additional residential properties will be sampled if data from any of the

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residential properties on the west side of Snapper Lane exceed the PSVs and background and the exceedence is attributable to the Gulfco site.

3.4.5 Soil Fate and Transport Characterization Samples

In addition to the COI analyses described above, three representative soil samples from the North Area and three representative soil samples from the South Area (to be selected based on field observations) will be analyzed for bulk density, specific gravity, fraction organic carbon (foc), and pH to support evaluations of contaminant fate and transport. These samples will be collected from the 12-inch to 24-inch sample interval at a location where no visual evidence of contamination is observed.

3.5 WATER WELL SURVEY

The objective of this task is to provide supporting information for evaluating the potential for contaminant migration to water supply wells, as detailed in the RI/FS Work Plan. The following activities shall be performed during this phase of the investigation:

- An updated search of Texas Water Development Board (TWDB) and TCEQ records for all registered water wells located within ½-mile radius of the Site boundary will be performed.

- After the records search has been conducted, a field survey to confirm/update information obtained during the records search will be performed and attempts will be made to identify any unregistered water supply wells located within ½-mile radius of the Site boundary.

3.6 GROUNDWATER INVESTIGATION

The objective of the groundwater investigation is to evaluate the lateral and vertical extent of potential non-aqueous phase liquids (NAPLs) and COIs in groundwater as detailed in the RI/FS Work Plan. The following activities shall be performed as part of this investigation:

- Installation and development of 17 permanent groundwater monitoring wells in the vicinity of Site PSAs as shown on Figures 5 and 6 and listed below:

  a. Former AST Tank Farm Area – three monitoring wells around the containment area, with one well between this area and the adjacent barge slip (Figure 6);

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b. Pipelines – one monitoring well along path of pipeline from former AST Tank Farm Area to former surface impoundments (Figure 5), and one monitoring well between the former AST Tank Farm and the Intracoastal Waterway (Figure 6);

c. Former Surface Impoundment Area – four monitoring wells on impoundment perimeter (Figure 5);

d. Former Wash Water Storage Tank Area – one monitoring well on the south end of this area near the Intracoastal Waterway (Figure 6);

e. Sand Blast Areas – one monitoring well at each of the two sand blast areas, with one of the wells near the nearby barge slip (Figure 6);

f. Welding Area – one monitoring well on the south end of this area near the Intracoastal Waterway (Figure 6);

g. Surface Drainage Areas – one monitoring well in the east surface drainage area, near the Intracoastal Waterway (Figure 6);

h. Former Septic Tank Areas – one monitoring well at each of the two former septic tank areas (Figure 6); and

i. Former Product Storage Tank Area – one monitoring well (Figure 5).

These PSA-based wells include four locations immediately northwest of the Intracoastal Waterway and two near the Site barge slips that will provide an indication of groundwater conditions near likely points of discharge to surface water.

- Temporary piezometers will be installed at two locations southwest of the former surface impoundment area (Figure 5), four locations on the former impoundment perimeter (Figure 5), one location southwest of the former Dry Dock (Figure 6), and one location south of the western former Septic Tank Area (Figure 6).

- Two staff gauges will be installed at the Site; one in the wetlands in the North Area (Figure 5) and a second gauge along the shore of the Intracoastal Waterway (Figure 6). The proposed locations for the staff gauges are subject to modification based on field conditions.

Monitoring well locations may be modified in the field based on accessibility constraints or field observations. Details of the monitoring well and temporary piezometer installation, development, water level measurements (including NAPL measurements), and groundwater sampling are presented in Section 5.5. Groundwater samples will be collected using a peristaltic or bladder pump in accordance with low-flow sampling procedures detailed in Section 5.5.2. Groundwater samples will be analyzed for the suite of analyses listed in Table 2.

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The monitoring well and staff gauge locations will be surveyed by a licensed surveyor to Texas State Plane Coordinates. Top of casing elevations and staff gauge measurement points will be surveyed relative to mean sea level (MSL). In order to evaluate groundwater flow rates and directions, Site water level data with the well and staff gauge survey data will be used to construct potentiometric surface maps for the Site. In addition, the staff gauge readings will be used to correlate the surface water elevations with the groundwater elevations.

3.6.1 Hydraulic Testing

Wells for hydraulic testing will be selected based on lithologic data, water level measurements, and drawdown/recharge behavior during development and sampling. The goal is to select wells that represent the range of hydraulic conditions in the water-bearing unit to be evaluated. Hydraulic testing and associated data analysis procedures are detailed in the Section 5.5.3.

3.6.2 NAPL Delineation

The objective of this task, if proven necessary from the initial groundwater investigation, will be to define the lateral extent of NAPL in the affected water-bearing unit. A combination of direct push methods, auger drilled soil borings, and/or monitoring wells may be used in this effort. The lateral extent of NAPL will be defined by the absence of any field screening indications in a boring or direct push location, or the absence of detectable NAPL in a well. Any NAPL field screening techniques used in this effort will be subject to Demonstration of Method Applicability (DMA), which will be submitted to the EPA for review and approval following the initial monitoring well installation.

If the presence of NAPL is identified in any of the monitoring wells installed, the following actions will be taken:

- Attempts will be made to collect a sample of the NAPL from each well in which it is observed. NAPL samples will be analyzed for specific gravity, VOCs, SVOCs and pesticides as presented on Table 2.
- The use of possible field screening methods to evaluate NAPL presence will be evaluated following the initial monitoring installation. If a promising candidate method is identified, a pilot test of the method will be performed, and depending on the pilot test results, a DMA will be prepared.

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- The vertical extent of NAPL will be defined by advancing deeper borings (using direct push or auger methods) or installing deeper monitoring wells outside the perimeter of the identified NAPL zone to the base of the next underlying water-bearing unit, or within the NAPL zone if a surface isolation casing is used and a competent underlying confining unit is identified. The vertical extent of NAPL will be defined by the absence of any field screening indications in a boring or direct push location, or the absence of detectable NAPL in a well.

- Additional soil borings will be drilled to delineate the lateral extent of NAPL in the water-bearing zone(s).

3.6.3 Additional Groundwater Delineation

Should any groundwater sample locations at the perimeter of the Site exceed the PSVs, as detailed in the RI/FS Work Plan, then additional lateral groundwater delineation sampling will be conducted by using reconnaissance field methods (i.e., temporary piezometers). Additional vertical delineation will be conducted by collecting at least three groundwater samples from the next water-bearing zone below the affected water-bearing zone. These samples may be collected from permanent monitoring wells or temporary piezometers. It is likely that a surface or isolation casing may be installed prior to placement of the deeper well or piezometer. Hydraulic testing, as described in Section 3.6.1, will be performed for all affected water-bearing units.

3.6.4 Deep Lithologic Boring

In response to EPA requests, the subsurface stratigraphy from the ground surface to the top of the uppermost water supply aquifer will be evaluated through advancement of a mud-rotary pilot boring to an approximate depth of 200 feet. The location will be selected following delineation of the lateral extent of COIs exceeding PSVs to ensure the boring is not drilled in an area where Site contaminants might migrate to deeper water-bearing units. The pilot boring will be geophysically logged for the following geophysical logging signatures:

a. Spontaneous Potential (SP);

b. Resistivity (single point, short and long normal); and

c. Natural gamma.

The geophysical log signatures will be compared to the drill cuttings to correlate the lithology to the geophysical signatures. Details of the pilot hole drilling, geophysical logging, and abandonment procedures are provided in Section 5.6.

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3.7 SURFACE WATER INVESTIGATION

The objective of this task is to evaluate the lateral extent of potential COIs in surface water to evaluate potential human health and ecological risks listed in the RI/FS Work Plan. The following activities shall be performed as part of this investigation:

- On-Site Pond Sampling: The following surface water samples will be collected from each of the two ponds north of Marlin Avenue (Figure 5):
    - Three surface water samples will be collected from the Fresh Water Pond; and
    - Three samples will be collected from the Small Pond southeast of the Fresh Water Pond.

  The surface water samples will correspond with the pond sediment sampling locations discussed in Section 3.8 below.

- Intracoastal Waterway (ICWW) Sampling: One composite surface water sample will be collected from each of the four zones within the ICWW adjacent to the site as shown on Figure 10. Each composite will consist of three sub-samples. One sub-sample will be collected from approximately one foot below the water surface, the second sub-sample will be collected from mid-depth of the water column, and the third sub-sample will be collected from approximately one foot above the base of the water column.

- Wetlands Area Sampling: Surface water samples will be collected from 15 locations within the wetlands north of Marlin Avenue (including both on-site and off-site locations). The area that will be sampled is shown on Figure 11. These sample locations will be selected in the field based on drainage features and field observations.

- Background Sampling: Four composite background surface water samples will be collected from the background surface water sampling area shown on Figure 12. These composite samples will be collected in the same manner as the ICWW samples.

The surface water samples will be tested for the suite of analyses as presented on Table 2. Filtered and unfiltered samples will be collected for metals analyses. Sample collection procedures are specified in Section 5.7.

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3.8 SEDIMENT INVESTIGATION

The objective of this investigation is to evaluate the lateral extent of COIs in sediments to evaluate potential human health and ecological risks listed as detailed in the RI/FS Work Plan. Sediment samples will be collected from the 0 to 6-inch depth interval at all locations. Deeper sediment samples will be collected from the 12 to 24-inch depth interval at any locations in the North Area where, based on field observations, dry conditions at this depth are indicated. Sediment samples will be analyzed for the analytical suites listed on Table 2.

The following areas will be sampled during this phase of the investigation:

- Fourteen sediment samples will be collected using the random systematic method on a 200-ft grid within the wetland areas in the North Area. Proposed locations are presented on Figure 5; however, locations may be modified based on field observations.
- Five sediment samples will be collected within the Fresh Water Pond on Lot 55 of the Site (Figure 5).
- Three sediment samples will be collected from the small pond to the southeast of the Fresh Water Pond, (Figure 5).
- Sediment samples will be collected from 15 off-site locations within the wetlands north and east of the Site. The general area from where samples will be collected is shown on Figure 11. These sample locations will be selected at the time of sampling based on drainage features and field observations.
- Sediment samples will be collected from the Barge Slips and Intracoastal Waterway as shown on Figure 10 and detailed below:
    - Barge Slip 1 (western barge slip) – five locations;
    - Barge Slip 2 (eastern barge slip) – five locations;
    - Intracoastal Waterway – six locations; and
    - Background – nine locations (background area shown on Figure 12).

Sediment samples will be collected using the procedures outlined in Section 5.8.

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3.9 FISH TISSUE SAMPLING

Using the sediment data collected from the Intracoastal Waterway, the COIs for the fish tissue sampling will be established as detailed in the RI/FS Work Plan. The tissue from the following target fish (*species*) will be analyzed:

- red drum (*Sciaenops ocellatus*),
- spotted seatrout (*Cynoscion nebulosus*),
- southern flounder (*Paralichthys lethostigma*), and
- blue crabs (*Callinectes sapidus*).

If a sufficient number of specimens of the target species can not be collected at the Site during the sampling event, the following fish will serve as alternate species:

- Atlantic croaker (*Micropogonias undulates*);
- sheepshead (*Archosargus probatocephalus*), and/or
- black drum (*Pogonias cromis*)

No alternate shellfish species is proposed.

Finfish specimens will be collected using a combination of gill nets and baited hooks. Two sizes of gill net mesh will probably be used during the study (5 and 2 ¾ inch stretch mesh). Gill nets will be set at stations within four zones, as shown in Figure 10. Multiple nets and traps will be set in each sampling zone to ensure that a sufficient number of specimens of each species are collected in a short period of time. If composite samples are necessary, only tissue collected within a single zone will be composited. A total of 9 samples from each of the four target species (a total of 36 samples) will be collected and processed for analysis. One field duplicate will be processed for each species.

Background finfish/crab samples will also be collected at the area shown on Figure 12. Nine samples from each of the four species will be collected and sent to the laboratory. Laboratory analysis of the background samples will be conducted pending the results of the Site samples. The numbers of samples that are expected to be collected and analyzed are listed in Table 3. Fish tissue sampling procedures are presented in Section 5.9.

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Since the objective of this study is to evaluate edible tissues, only fish and crabs that can be legally harvested by recreational or commercial fishermen will be collected. The size limits for each species will be based on Texas Parks and Wildlife size limits for recreational fishermen. Size limits for this study are listed in Table 3.

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4.0 SAMPLE DESIGNATION

The station and sample numbering system for the project has been designed to uniquely identify each sampling station and sample according to the Site grid. This numbering system consists of grid column and row identification, sample media, a sequential sample location identifier, depth (if applicable), and QA/QC identifier (if applicable).

Two grid systems have been designed for the Site: a 200-foot grid for the North Area and a 100-foot grid for the South Area. The North Area grids will be assigned an "N" prefix and the South Area grids will be assigned an "S" prefix. Each column of each grid system will be assigned a letter (A, B, C...) and each row will be assigned a number (1, 2, 3...) as shown on Figures 5 and 6. Sediment and fish tissue samples collected from the Intracoastal Waterway will have an "IW" prefix and no grid designation.

Sample locations will be designated by sample type:

- soil boring (SB),
- monitoring well groundwater (MW),
- temporary piezometers (PZ),
- sediment (SE),
- surface water (SW)
- geotechnical (GT)
- surface soil (SS) or
- fish tissue and species (RD-red drum, ST-spotted seatrout, SF-southern flounder, BC-blue crab) (e.g., FTRD).

Following the sample type will be the sample location numbers. Generally, the samples for each media will be sequentially numbered, regardless if the sample station is a random or judgmental location. Depth intervals in feet below grade will be assigned to soil and sediment samples to designate the vertical sample location. As an example, the first sediment sample collected from 0 to 6 inches deep at a sample station north of Marlin Avenue at grid A1 for chemical analysis will be designated as follows:

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- Sample ID: NA1SE-001-(0-6)

Field quality control samples such as matrix spikes and matrix spike duplicates and field duplicates, which are detailed in the QAPP, will be designated with the primary sample identification and a quality control suffix as noted below. Quality control samples for geotechnical analyses will not be collected.

Quality Control	Suffix Description	Sample Frequency
MS/MSD	Matrix spike/duplicate	1 per 20 samples per media
FD	Field duplicate	1 per 20 samples per media
EB	Equipment rinsate blank	1 per day/team
FB	Field blank	1 per day/team

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5.0 SAMPLING EQUIPMENT AND PROCEDURES

5.1 FIELD EQUIPMENT

Various equipment will be used during the RI/FS field investigation. A partial list of possible equipment that will be used during the RI/FS are listed by investigation activity on Table 4. Additional equipment may be used as part of the RI depending 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, Section 3.8 (SAP Volume II). 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, Section 3.7 (SAP Volume II). The Field Supervisor is responsible for the proper functioning of field equipment.

5.2 LOCATING SAMPLING SITES

The proposed sample locations will be located in the field using the coordinates extrapolated from proposed sample locations on the Site maps. A differential GPS receiver, such as a Trimble GPS Pathfinder Pro XRS or equivalent, will be used to locate the proposed sampling sites 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. If a sampling site 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 buried utilities.

All sample stations will be marked in advance of sampling to minimize the collection of surface waters and sediments at sites where the area has been disturbed due to foot traffic. Navigation to a specific site will disturb the sediments in wetland areas, resulting in turbid surface water samples at those locations. Premarking the sample stations will aid in reducing this disturbance.

5.3 SURFACE GEOPHYSICAL SURVEY

As discussed in Section 3.3, a surface geophysics assessment using EM meters will be conducted to attempt to locate former pipelines at the Site. The assessment will be conducted with a Geonics EM-61 MK2 metal detector and an EM radiodetection (RD) meter.

The EM-61 MK2 is a time-domain metal detector which detects both ferrous and non-ferrous metals. A transmitter generates a pulsed primary magnetic field in the earth, which induces eddy currents in nearby metallic objects. The eddy current decay produces a secondary magnetic field measured by the receiver coil. By taking the measurement at a relatively long time after the start of the decay, the current induced in the ground has fully dissipated and only the current in the metal is still producing a secondary field. The responses are recorded and displayed by an integrated data logger (Geonics, 2005).

The RD meter, which operates similarly to the EM-61 MK2, detects the magnetic field created by alternating current flowing along a buried line. This alternating current creates a detectable magnetic field or signal because the current provides a magnetic field and an oscillating frequency of reversals. With both of these occurring, the pipe or line can be effectively located using the principles of electromagnetic induction. The RD meter can be operated in two modes: passive and active. The passive mode detects signals that are 'naturally' present. These signals can be produced by induction of electrical currents flowing from stray currents produced by power transmission systems and/or very low frequency long wave radio energy from distant transmitters. Active mode detection consists of applying an active signal directly to a line or by induction from a transmitter where the line can then be traced and located by the receiver (Radiodetection, 1994).

Both meters will be used in the field to identify and locate buried pipelines. The meters will be operated according to the operations manual for each meter.

5.4 SOIL INVESTIGATION METHODS

5.4.1 Soil Sampling

Shallow soil samples (0 to 2 feet bgs) may be collected using either plastic or stainless steel trowels, hand-auger, or by a split-spoon sampler driven by direct-push technology (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 may be collected using a butyrate-lined, split-spoon sampler. Soil borings that will be converted to monitoring wells may be drilled with hollow-stem auger methods and the borings for the temporary piezometers will be drilled using DPT methods. All sampling equipment will be decontaminated prior to and following each use, as detailed in Section 5.10.

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 EnCore® 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 Plan (Volume II).

For borings not converted to a monitoring well or a piezometer, the boring will be abandoned by filling 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 may 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 should 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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5.4.2 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 organic vapor meter (OVM)/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.

5.4.3 Impoundment Cap Sampling

Geotechnical soil samples may be obtained from the core using hollow-stem auger drill rig, direct push techniques (DPT), or from hand sampling devices. Soil samples to be analyzed for geotechnical analyses will be stored in sealed tubes or wrapped in aluminum foil and cellophane. Samples for moisture content must be sealed to preserve its natural moisture content. Undisturbed samples will be obtained with a thin-walled Shelby tube sampler and will be protected during shipping/transport. If materials are too consolidated and cannot be sampled with the Shelby tube, split spoon samples may be obtained and the sample will be wrapped in aluminum foil and plastic.

5.5 GROUNDWATER INVESTIGATION METHODS

The groundwater investigation will consist of installing and sampling groundwater from both permanent monitoring wells and temporary piezometers and conducting hydraulic testing on the uppermost water-bearing units at the Site. The equipment and procedures for these activities are discussed below.

5.5.1 Permanent and Temporary Well Installation

5.5.1.1 Permanent Monitoring Well Installation

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 5.4. 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. Soil cuttings generated

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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 the Site. Based on the boring logs for previous monitoring wells drilled at the Site, it is anticipated that these borings will be advanced to a maximum depth of 30 feet. If necessary, deeper borings will be advanced to underlying water-bearing units. Although these borings will be located away from areas where NAPL is present (if any), surface or 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 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 at the base of the uppermost water-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).

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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 NTU. At least five casing volumes of water will be removed from the well during development. If the turbidity is not below 10 NTU after 10 casing volumes of water are removed from the well, then the 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).

5.5.1.2 Temporary Piezometer Installation

Temporary piezometers will be installed at selected locations as discussed in Section 3.6. Temporary piezometers may be installed using DPT methods, or similar methods. If the temporary piezometers are to be installed with DPT, the initial soil boring drilled to describe the lithology and soil field screening will be plugged and the temporary piezometer will be installed in a second boring no closer than 3 feet from the original soil boring to the target depth.

The piezometers may be constructed of small diameter (0.5 to 1-inch), flush-joint-threaded Schedule 40 PVC with a prepacked screen assembly and riser casing. A temporary surface seal will be placed in the borehole annulus to prevent surface water from traveling into the borehole after piezometer installation.

Each temporary piezometer will be developed, and purged and sampled relatively soon after installation. Development of the temporary piezometers will consist of pumping the piezometers at less than 1 liter per minute until the turbidity is less than 10 NTUs. If after 10 casing volumes are removed and the turbidity is still greater than 10 NTUs or if the temporary piezometers pumps

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dry, the Field Supervisor will decide if additional development is necessary depending on the field conditions and professional judgment.

The height of the PVC casing above the ground surface will be measured. Within 48 hours of installation, the temporary piezometer will be plugged and abandoned using the procedures detailed in PBW SOP No. 2 – Supervision of Exploratory Borings (Appendix A).

5.5.2 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. Sampling of the temporary piezometers can be conducted shortly after installation and development. Before sampling, 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, 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. Investigative-derived waste (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:

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Field Measurement of Oxidation-Reduction Potential (ORP) and PBW SOP No. 12: Field Measurement of Dissolved Oxygen (DO) (Appendix A). Meters will be calibrated before sampling each day, using the manufacturer's procedure. Odor and color of the purge water will also be noted. 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. If the stabilized turbidity reading is greater than 10 NTU, the discharge from the pump will be filtered with an in-line 10 μm filter. The in-line filter will be purged with approximately 200 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 Site. Sample bottles that do not contain preservative should be rinsed with the sample water prior to filling. 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 (RI/FS SAP, Volume II (PBW, 2006b)).

Documentation will include groundwater sampling forms and any associated photographs.

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5.5.3 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 (slug-in test) or retracting (slug-out test) a slug of known volume. 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. 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 site, 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. The pressure 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.

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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).

5.6 DEEP BORING INSTALLATION AND GEOPHYSICAL LOGGING

Geophysical logging will be performed at one location in order to evaluate the subsurface lithology to the uppermost drinking water zone, estimated to be 200 feet below grade. The borehole will be drilled using wet-rotary drilling techniques and the drill cuttings will be described during the drilling operations. The soil boring will be documented per PBW SOP No. 2: Supervision of Exploratory Borings (Appendix A) using a detailed field lithologic log (Appendix A, Figure SOP-2-1). The lithology of the boring will be logged continuously for the total depth of the boring. The lithologic description of the log should include soil or rock type, color, grain size, and other pertinent information, which will be noted on the field lithologic log.

After the borehole has been drilled to the desired depth, the borehole will remain filled with the drilling fluid to provide a conductive medium for running the geophysical logging tools. The test hole will be geophysically logged for the following geophysical logging signatures:

a. Spontaneous Potential (SP);

b. Resistivity (single point, short and long normal); and

c. Natural gamma.

The geophysical log signatures will be compared to the boring log (or cuttings) to correlate the lithology to the geophysical signatures. After the borehole has been logged, the hole will be plugged by placing 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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5.7 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 in order 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. Within the wetland and pond areas, a single surface water sample is proposed for collection at each site (not including QA/QC samples collected at the frequency indicated in the QAPP). Composite depth samples will be collected from the ICWW locations as described in Section 3.7. Water depth will be recorded, and water chemistry parameters will be collected at all sample locations. These parameters will be collected using a multi-probe sonde that directly measures ambient:

- pH,
- conductivity,
- temperature,
- oxidation-reduction potential,
- salinity, and
- dissolved oxygen.

Surface water samples will be collected from the wetland and pond 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 5.11.

Surface water sample stations within the ICWW will be located using a sub-meter Global Positioning System (GPS) and site coordinates will be recorded. Sampling will be performed using a custom 20 ft. aluminum flat bottom boat as the sample platform. Wherever possible, the

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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 be positioned up current of the sampling point.

At each station, physical and chemical parameters, and analytical water samples will be collected from three depth strata (1 foot below the water surface, mid-depth, and one foot above the surface of the sediment). 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 (YSI 63, YSI 55, and HF Scientific Micro TPW). The tip of the sample tubing and instrument probes will be attached to a weighted cable and lowered to sampling depths from the boat. Data and samples will be collected during a slack tide.

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. Water depth, turbidity, dissolved oxygen, pH, salinity, conductivity, and water temperature will be measured and recorded. A peristaltic pump will be engaged and the water collection apparatus will be purged for two (2) minutes. The sample collection apparatus will consist of pre-cleaned Teflon and C-flex tubing attached to a 5 micron (pre-filter) and a 0.45 micron 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.

5.8 SEDIMENT SAMPLING

Sediment sample stations will be selected in advance of the study based on investigation requirements. The objective of the station selection process will be to distribute sample stations evenly over the project area and to adequately represent all bottom types. The area includes high energy unvegetated shoreline (with and without bulkhead), and low energy sediment sumps

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(inside barge slips). A sample station map will be developed and the sample station coordinates will be determined before sampling is initiated.

Sampling will be conducted from a custom 20-foot aluminum boat. Sampling in the shallow Fresh Water Pond and smaller pond in the North Area will be conducted from a 14-foot aluminum skiff. Sampling in the intertidal marsh will be conducted by wading to the sample stations. A differential GPS receiver with sub-meter accuracy will be used to locate the stations and record actual coordinates, as detailed in Section 5.11. Sample station information, sample depth, and all other pertinent observations made during the study will be recorded on field data sheets.

Marsh Sediment

Sediment will be collected from the intertidal marsh by approaching the sample site 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 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®.

Grab Sampler

Soft surficial sediment samples from the Intracoastal Waterway, Fresh Water Pond, and Small Pond will 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.

A sediment sample will be acceptable if its depth is greater than 6 inches and the surface is relatively flat and undisturbed. If a sample is not acceptable it will be set aside (do not dump overboard), and a second sample will be collected. Unacceptable samples will be discharged overboard after an acceptable sample is collected.

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Prior to removing sediments from the sampler, overlying water will be drained by gently tilting it. A 0 to 6-inch sub-sample 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®.

Core Sampler

Samples of stiff sediment samples from the Intracoastal Waterway, Fresh Water Pond, and Small Pond 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 from 0-6 inches will be extruded into a stainless steel bowl and a sub-sample will be immediately removed with stainless steel spoon for volatile organic analysis. The remainder of the sample will then be homogenized and placed in containers for other analyses.

The empty sampler (Ekman or core) will be rinsed and decontaminated following the procedures presented in Section 5.10. The sampler and associated equipment will be decontaminated before use, and between sample sites. In addition, the sampler will be rinsed with Site water before samples are collected.

5.9 BIOLOGICAL SAMPLING

5.9.1 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

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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. Only legal size fish will be retained for analysis.

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).

Although gross morphological observations generally are not definitive indicators of fish health, they may be very useful in detecting pathological conditions in fishes. The examinations will be conducted as the specimens are sorted from the catch. Sampling crew members will be trained by a qualified fish biologist to identify the various kinds of pathological conditions that may be encountered. At least two pathological conditions (fin erosion and skin ulcers) can easily be confused with the external damage that fishes may suffer after they are caught in a gill net. For all suspected abnormalities that cannot be confirmed in the field, representative specimens will be archived for later evaluation by a qualified specialist.

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
- Photo log

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

5.9.2 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 sites and allowed to fish continuously until a sufficient number of crabs have been collected. Only tissue from crabs collected within a single zone will be composited. 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 and measured and assigned a sample number. Only crabs that can be legally harvested (i.e., ≥5 inch carapace width) will be used for this study. Both male and female blue crabs will be collected and combined for analysis. Female crabs can

be legally harvested unless they are gravid. If gravid female crabs are collected during this study, they will be released and not included in the samples. All specimens collected from a zone 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
- Photo log

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

5.9.3 Sample Collection Requirements

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

- Target finfish 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 must 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.

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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)).

A Chain of Custody document will be initiated for the samples, and the appropriate information will be recorded on both the field-log sheet and chain document, as detailed in Section 6.1.2.

Because the objective of the study is to determine the concentration of selected analytes in the edible tissues of specific fish and shellfish species, correct identification is essential. 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.

5.9.4 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).

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5.9.4.1 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 (e.g., red drum, black drum, croaker, seatrout, etc.) 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 then be placed in glass sample jars provided by the laboratory

Most fish samples will be taken from a single specimen, but if a single fish can not 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 placed in glass sample jars provided by the laboratory

Sample jars will be labeled with collection date, time, personnel, species, and station ID. The sample jar will then be placed in a Ziploc bag and stored at 4 degrees Celsius. A Chain of Custody will be completed following the procedures detailed in Section 6.1.2.

5.9.4.2 Blue Crab Tissue

Blue crabs will be weighed, measured, rinsed with 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.

The sample jar will then be placed in a Ziploc bag and stored at 4 degrees Celsius. A Chain of Custody will be completed for all samples collected.

5.10 DECONTAMINATION PROCEDURES

Site personnel will perform decontamination in accordance with PBW SOP No.13: Equipment Decontamination (Appendix A) will be performed for all equipment when brought on the Site, between sample locations, when necessary between sample intervals, and before removing it from the Site. 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;
- De-ionized (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:

- 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.

5.11 SURVEYING

Following completion of field activities, a licensed surveyor will survey the horizontal coordinates and vertical elevations of the monitoring wells and the staff gauges 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. Since the temporary piezometers will be installed for a short period of time (about 48 hours), the ground surface adjacent to the temporary piezometers will be surveyed. The top of casing elevation for the piezometers will be calculated based on the ground elevation and the height of the temporary casing above the ground surface. 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; extractable organics (including SVOCs and PCBs); pesticides; 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 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

Appendices A through D in the QAPP identifies 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.

6.1.2 Sample Chain-Of-Custody Forms and Custody Seals

Evidence of collection, shipment, and laboratory receipt must be documented on a Chain-of-Custody record by the signature of the individuals collecting, shipping and receiving each sample. A sample is considered in custody if it is:

- In a person's actual possession;
- In view, after being in physical possession;
- Sealed so that no one can tamper with it, after having been in physical custody; and/or
- In a secured area restricted to authorized personnel.

Chain-of-Custody Records will be used, by all personnel, to record the collection and shipment of all samples. The Chain-of-Custody 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 collector as relinquishing, with date/time.

The Chain-of-Custody procedure will be as follows:

1) The field technician collecting the sample shall be responsible for initiating the Chain-of-Custody Record. The names of all members of the sampling team will be listed on the Chain-of-Custody 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 Chain-of-Custody 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 Chain-of-Custody 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 Chain-of-Custody Record, and sign and date the record. Any discrepancies shall be noted on the Chain-of-Custody Record.

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) Chain-of-Custody Records, including waybills, if any, shall be maintained as part of the project records.

6.2 SAMPLE ANALYSIS

As presented on Table 5, samples with be analyzed using the analytical methods listed for each media. Following the EPA guidance document titled "Guidance for Data Usability in Risk Assessment" (EPA, 1991), Method Selection Worksheets were prepared for soil, groundwater, surface water, and sediment as provided in Appendix B as Tables B-1 through B-4, respectively. The tables list the COIs that will be analyzed for each media sampled, with the exception of fish tissue. The COIs for fish tissue will be established following the sediment sampling of the Intracoastal Waterway as detailed in the RI/FS Work Plan. The tables also list the PSVs, as defined in the RI/FS Work Plan, for each COI 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.

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Entries will be described in as much detail as possible to ensure that a particular situation could be reconstructed only from field entries. Entries will include the date, start time, weather, names of all sampling team members present, and the signature of the person making the entry will be entered. The names of individuals visiting the site or field sampling team and the purpose of their visit will also be recorded. All field measurements obtained and samples collected will be recorded on the appropriate forms. All entries will be made in ink, signed and dated. If an incorrect entry is made, the incorrect information will be crossed out with a single strike mark that is initialed and dated by the person making the erroneous entry. The correct information will be entered adjacent to the original entry.

Whenever a sample is collected or a measurement is made, a detailed description of the location will be recorded on the appropriate form. Photographs taken at a location, if any, will also be noted in the daily field form. All equipment used to obtain field measurement as well as the field calibration data will be recorded on the appropriate field forms.

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.

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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 the RI activities. The IDW will then be classified based on the analytical results and disposed of accordingly. An area at the Site 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 at the Site:

- 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 (recycling/disposal) facilities.

Upon completion of RI activities, the IDW will be transported to appropriate off-site waste management facilities 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.

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 Health and Safety Plan (HSP) (PBW, 2005), dated August 17, 2005.

The HSP applies to the field activities described in this FSP that will be performed during the RI/FS at the Site. The HSP 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 site workers.

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

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TABLES

TABLE 1 - SAMPLE DESIGN COLLECTION WORKSHEET

Medium	Exposure Routes	Number of Samples			
		Judgmental/ Random	Background	QC[2]	Medium Total
Soil	1. Inhalation of particulates in ambient air resulting from fugitive dust generation and/or contact with/ingestion of particles deposited on surface soil. 2. Exposure to soil via ingestion and dermal contact. 3. Ingestion of fish potentially containing COIs as a result of surface runoff of COIs from PSAs to surface water/sediments from PSAs and uptake by fish.	257	TBD[1]	65	322
Groundwater	1. Inhalation of vapors that have migrated from groundwater through the soil pore space and into ambient air. 2. Exposure to potable water through ingestion, dermal contact, ingestion of crops that were irrigated with water, and inhalation of vapors emitted from water as a result of COI leaching to groundwater.	25	TBD[1]	13	38
Sediment	1. Ingestion of and dermal contact with sediments as a result of surface runoff of COIs from PSAs. 2. Ingestion of fish potentially containing COIs as a result of surface runoff of COIs from PSAs to surface water/sediments from PSAs and uptake by fish.	56	9	17	82
Surface Water	1. Exposure via contact with surface water, and inhalation of vapors emitted from surface water as a result of surface runoff of COIs from PSAs. 2. Exposure via contact with surface water, and inhalation of vapors emitted from surface water as a result of COI leaching to groundwater, groundwater discharge to surface water.	25	4	13	42
Fish Tissue	1. Ingestion of finfish and crabs from the Intracoastal Waterway near the Site.	36	36[3]	4	76
	Column Totals	399	49	112	560
				Grand Total:	560

Notes:

1. TBD - To be determined. The need for background soil and groundwater water samples will be evaluated after initial Site data are obtained.
2. Number of QC Samples estimated (exact number of QC samples may change depending on field schedule).

   QC samples include: Matrix spike/duplicate: 1 per 20 samples per media.
   Field duplicate : 1 per 20 samples per media (except 1 per fish species sampled).
   Equipment rinsate blank : 1 per day/team for activities that require an equipment blank.
   Field blank : 1 per day/team.
   Trip blank (volatiles only) : 1 per sample cooler per day.
3. Analyses contingent on Site fish tissue data results.
4. Ecological pathways will be identified in the Ecological Problem Formulation Report.

TABLE 2 - MEDIA SAMPLE SUMMARY

Sample Area	Media	Number of Sample Stations[1]	Sample Quantity	Chemical Analysis								
				VOCs[2]	SVOCs	Metals	PCBs[3]	Pesticides	Fate & Transport[4]	TOC/ Grain Size	Anions/ Cations	Geotech[5]
Potential Source Areas												
Former Aboveground Storage Tank (AST) Tank Farm Area	Soil	7	14	X	X	X	X	X				
	Groundwater	3	3	X	X	X	X	X			X	
Pipelines	Soil	9	18	X	X	X	X	X				
	Groundwater	2	2	X	X	X	X	X			X	
Former Surface Impoundment Area	Soil	8	16	X	X	X	X	X				
	Geotechnical	4	4									X
	Groundwater	8	8	X	X	X	X	X			X	
Former Wash Water Storage Tank Area	Soil	3	6	X	X	X	X	X				
	Groundwater	1	1	X	X	X	X	X			X	
Electrical Shed	Soil	4	8				X					
Sand Blasting Areas	Soil	9	18	X	X	X	X	X				
	Groundwater	2	2	X	X	X	X	X			X	
Welding Area	Soil	20	40	X	X	X	X	X				
	Groundwater	1	1	X	X	X	X	X			X	
Dry Dock Area	Soil	7	14	X	X	X	X	X				
	Groundwater	1	1	X	X	X	X	X				
Surface Drainage Areas	Soil	5	10	X	X	X	X	X				
	Groundwater	1	1	X	X	X	X	X			X	
Former Septic Tank Areas	Soil	6	12	X	X	X	X	X				
	Groundwater	2	2	X	X	X	X	X			X	
Former Product Storage Tank Area	Soil	3	6	X	X	X	X	X				
	Groundwater	1	1	X	X	X	X	X			X	
Former Gasoline Storage Tank Area	Soil	2	4	X	X	X	X	X				
Lot 21 Area	Soil	15	30	X	X	X	X	X				
	Surface soil (0-1in)	10	10			X						
	Groundwater	1	1	X	X	X	X	X			X	
Other Areas												
Random Systematic Sample Locations	Soil	23	46	X	X	X	X	X	X			
	Sediment	17	17	X	X	X	X	X		X		
	Groundwater[6]	2	2	X	X	X	X	X			X	
Residential Surface Soil Investigation	Surface soil (0-1in)	49	49			X						
Wetlands (Off-Site)	Sediment	15	15	X	X	X	X	X		X		
	Surface water	15	15	X	X	X	X	X				
Fresh Water Ponds (Large and Small)	Sediment	8	8	X	X	X	X	X		X		
	Surface water	6	6	X	X	X	X	X				
Perimeter Groundwater Locations	Groundwater	7	7	X	X	X	X	X			X	
Intracoastal Waterway	Sediment	25	25	X	X	X	X	X		X		
	Surface Water[7]	8	8	X	X	X	X	X				
	Fish Tissue[8]	5	72	TBD[7]	TBD	TBD	TBD	TBD				
All Areas	NAPL	*[9]	*	X	X		X					

Notes:
1. Sample locations were counted more than once for stations locations used for multiple PSAs.
2. VOC analyses not performed on soil samples from the 0 to 6 inch depth interval.
3. PCB congeners will be analyzed on the soil samples collected from the Electric Shed, and on 10% of the samples collected site-wide.
4. Fate and transport characterization samples (foc, pH, bulk density) will be collected from three North Area sample station and three South Area sample station.
5. Geotech analyses will consist of sieve analysis, Atterberg Limits, and vertical hydraulic conductivity.
6. Two temporary piezometers will be installed in the areas southwest of the Former Surface Impoundments.
7. Surface water samples from the Intracoastal Waterway will be collected from four zones adjacent to the Site (one sample each) and from one background area (four samples).
8. Fish tissue will be analyzed for the suite of analyses to be determined (TBD) based on the Intracoastal Waterway sediment results. Fish tissue samples will be collected from four zones (36 samples) and from a background location (36 samples).
9. * If NAPL is detected in any of the monitoring wells at the Site, a sample will be collected and analyzed for the analytical suites marked.

TABLE 3 - TARGET FISH SPECIES AND LEGAL SIZE LIMITS

Species	Scientific Name	Legal Size and Target Length (in)	Number of Site Samples[1]	Organisms per Sample[2]
Red Drum	*Sciaenops ocellatus*	20 - 28	9	1
Spotted Sea Trout	*Cynoscion nebulosus*	15 - 25	9	1
Southern Flounder	*Paralichthys lethostigma*	14 – No Limit	9	1
Blue Crab	*Callinectes sapidus*	5 – No Limit	9	5-10

Note:
1 - Background samples will be archived at the laboratory with analysis pending the Site sample results.
2 – If a single fish can not provide the required sample volume, the fillets from multiple fish will be composited

TABLE 4 - FIELD EQUIPMENT

Task	Equipment[1]
Former Surface Impoundment Cap Evaluation	Hand Auger/Drill Rig
Surface Geophysical Survey	EM-61 Metal Detector RD-400 Radiodetection Meter RTK-GPS Unit
Soil Investigation	Organic Vapor Meter/Photoionization Detector Hand Auger/Drill Rig Trowel/Spade RTK-GPS Meter
Groundwater Investigation	Drill Rig Multi-parameter Meter (pH, conductivity, temperature, D.O., ORP, turbidity) Interface Probe Conductivity Probe for NAPL [2] Water Level Probe Peristaltic pump/flow-through cell Geophysical Logging Tool
Surface Water Investigation	Multi-parameter Meter (pH, conductivity, temperature, D.O., ORP, turbidity) Dipper, Bailer, or peristaltic pump Water line (for depth)
Sediment Investigation	Ekman dredge/piston corer Hand auger RTK-GPS Unit Mixing bowls, spoons, knives
Fish Tissue Investigation	Gill Nets (for finfish) Fishing Poles Fish Bags Crab traps (Blue crabs) Multi-parameter Meter (pH, conductivity, temperature, D.O., ORP, turbidity) for water RTK-GPS Meter

Note:

1. Additional or equivalent equipment may be used.
2. See RI/FS Work Plan

TABLE 5 - SUMMARY OF ANALYTICAL METHODS

SAMPLE TYPE	SAMPLE ANALYSES	ANALYTICAL METHOD[1]
Soil (cap)	Percent Passing No. 200 Sieve	ASTM D 1140[2]
	Atterburg Limits	ASTM D 4318[2]
	Vertical Hydraulic Conductivity	COE EM-1110-2-1906[3]
Soil	Volatile Organics	EPA 8260B
	Semi-volatile Organics	EPA 8270C
	Organochlorine Pesticides	EPA 8081A
	PCBs	EPA 8082
	Metals	EPA 6010B
	Mercury	EPA 7471A
	Moisture Content (Total Percent Solids)	Std. Methods 2540G[4]
Soil (fate & transport)	Soil Bulk Density	
	pH	EPA 9045
	Total Organic Carbon	EPA 415.1/9060
Groundwater	Volatile Organics	EPA 8260B
	Semi-volatile Organics	EPA 8270C
	Organochlorine Pesticides	EPA 8081A
	PCBs	EPA 8082
	Metals	EPA 6010B
	Mercury	EPA 7470A
Groundwater	Total Dissolved Solids	EPA 160.1[5]
	Total Suspended Solids	EPA 160.2[5]
	Major Anions (Ca, Mg, K, Na)	EPA 6010B or 6020
	Major Cations (SO_4, Cl)	EPA 9038 and 9251
	Alkalinity (Field)	Hach 8203[6]
NAPL	Specific Gravity	
	Volatile Organics	EPA 8260B
	Semi-volatile Organics	EPA 8270C
	Organochlorine Pesticides	EPA 8081A
Surface Water	Volatile Organics	EPA 8260B
	Semi-volatile Organics	EPA 8270C
	Organochlorine Pesticides	EPA 8081A
	PCBs	EPA 8082
	Metals (filtered and unfiltered)	EPA 6010B
	Mercury	EPA 7470A
	Hardness	EPA 220.7[5]
	Total Suspended Solids	EPA 160.2
Sediment	Volatile Organics	EPA 8260B
	Semi-volatile Organics	EPA 8270C
	Organochlorine Pesticides	EPA 8081A
	PCBs	EPA 8082
	Metals (filtered and unfiltered)	EPA 6010B
	Mercury	EPA 7470A
	Total Organic Carbon	EPA 415.1/9060
	Grain-Size Distribution	ASTM C-136[2]

TABLE 5 - SUMMARY OF ANALYTICAL METHODS

Notes:

1. Unless indicated otherwise, analytical methods are from EPA SW-846 "Test Methods for Evaluating Solid Waste."
2. Method from "ASTM 2005 Annual Book of Standards", Vol. 04.08.
3. Method from U.S. Army Corps of Engineers Manual, Appendix VII, 30 November 1970 (for falling-head tests).
4. Method from "Standard Methods for Examination of Water and Wastewater."
5. Method from EPA 600/4-79-020 "Methods for Chemical Analysis of Water and Wastes."
6. Method from Hach Water Analysis Handbook.

FIGURES

QUADRANGLE LOCATION

N

Scale in Feet

0 1000 2000

Source:
Base map taken from http://www.tnris.state.tx.us Freeport, Texas 7.5 min. U.S.G.S. quadrangle, 1974.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 1

SITE LOCATION MAP

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

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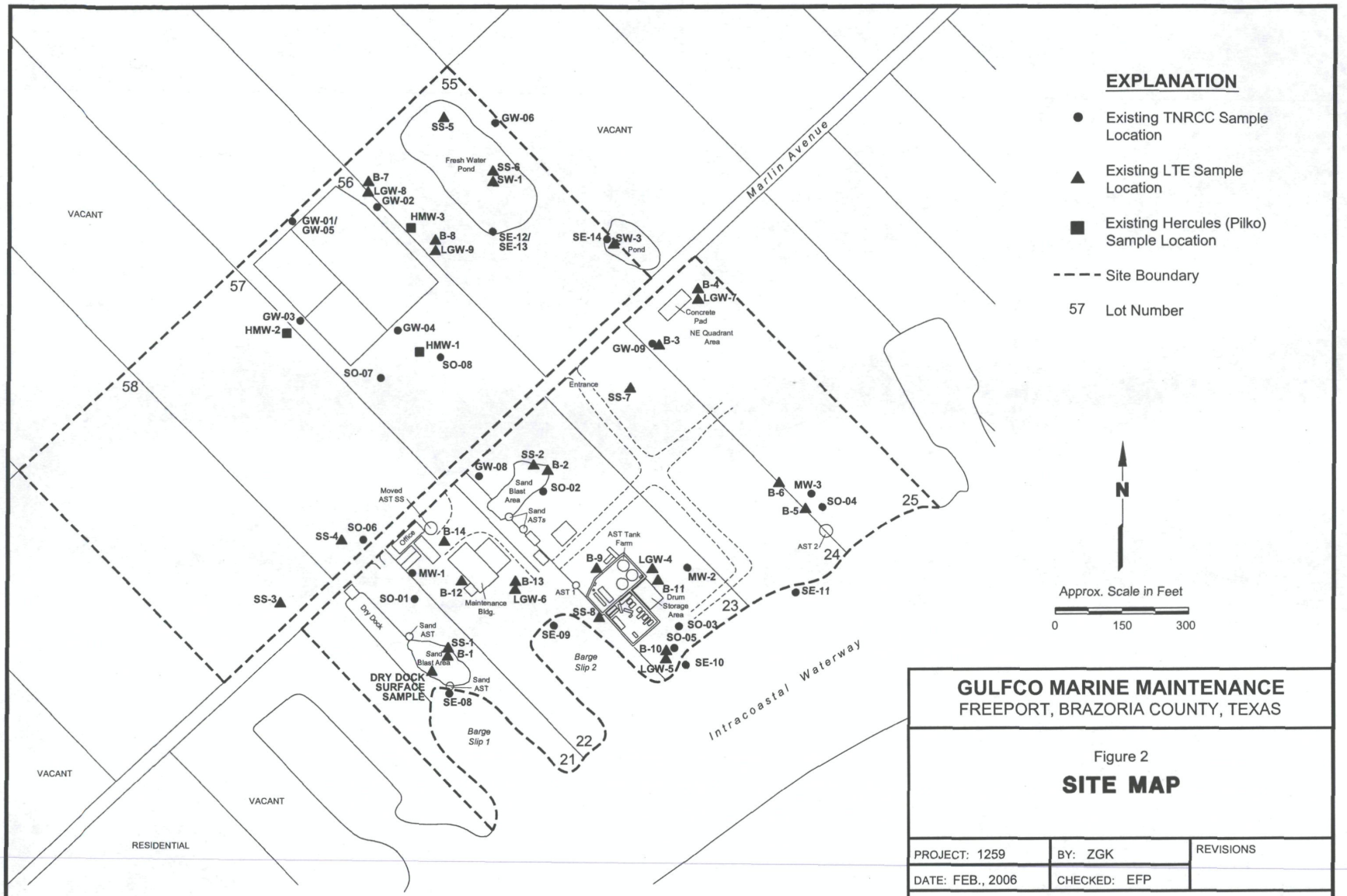
017023



GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 2
SITE MAP

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

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Source:
Base map taken from "Figure 2 - Site and Sample Location Map" in June 1999
Hercules Marine Service Site Characterization Report prepared by LT Environmental, Inc.

EXPLANATION

FS
Fill and Spoil

Holocene — QUATERNARY

Qal
Alluvium

Qbr
Beach-ridge and barrier-flat sand deposits

N

SCALE
0 — 1
Statute Miles

Source: Geologic Atlas of Texas, Beeville-Bay City Sheet, 1987.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 3

REGIONAL GEOLOGY MAP

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

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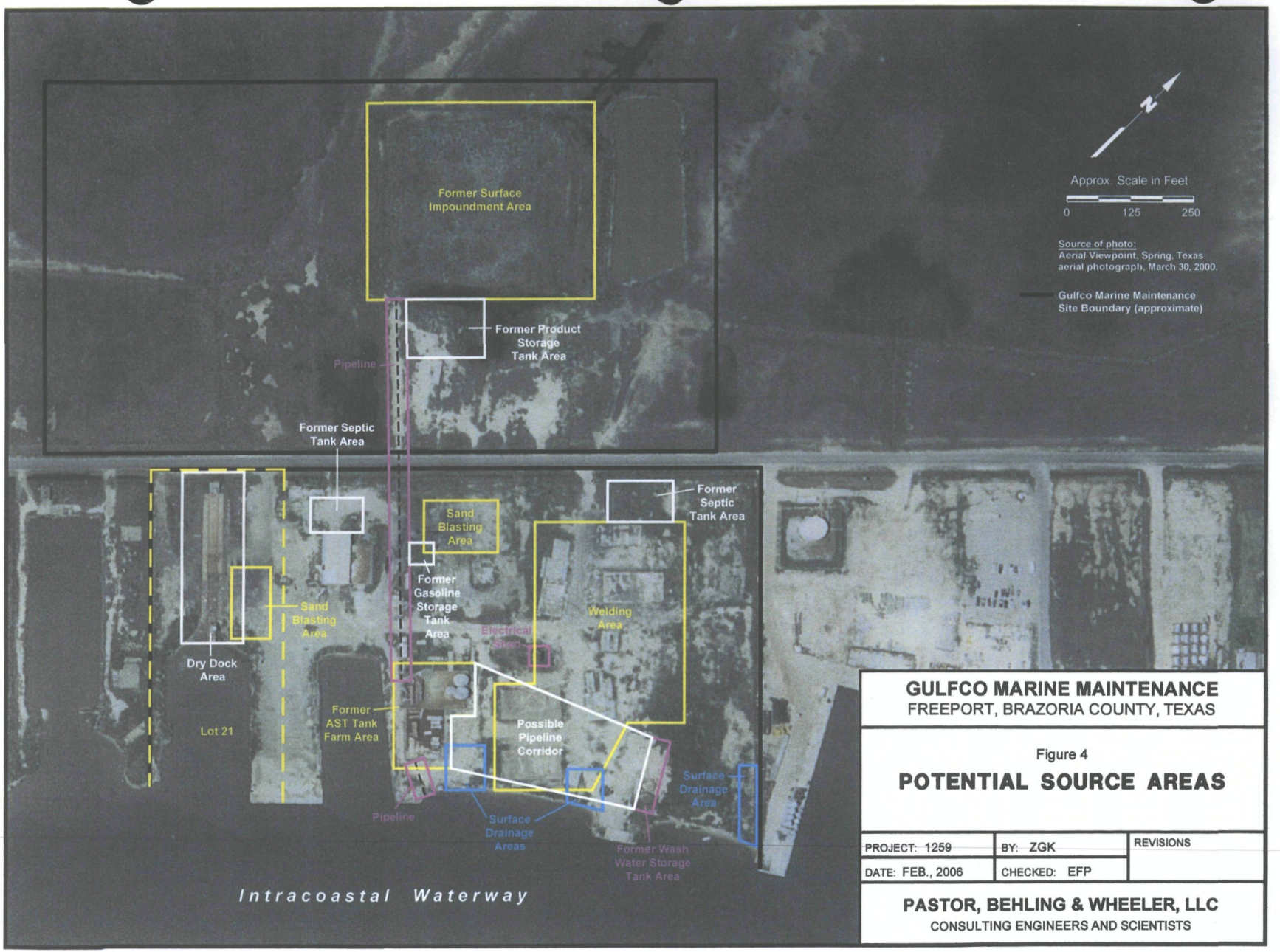

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 4

POTENTIAL SOURCE AREAS

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

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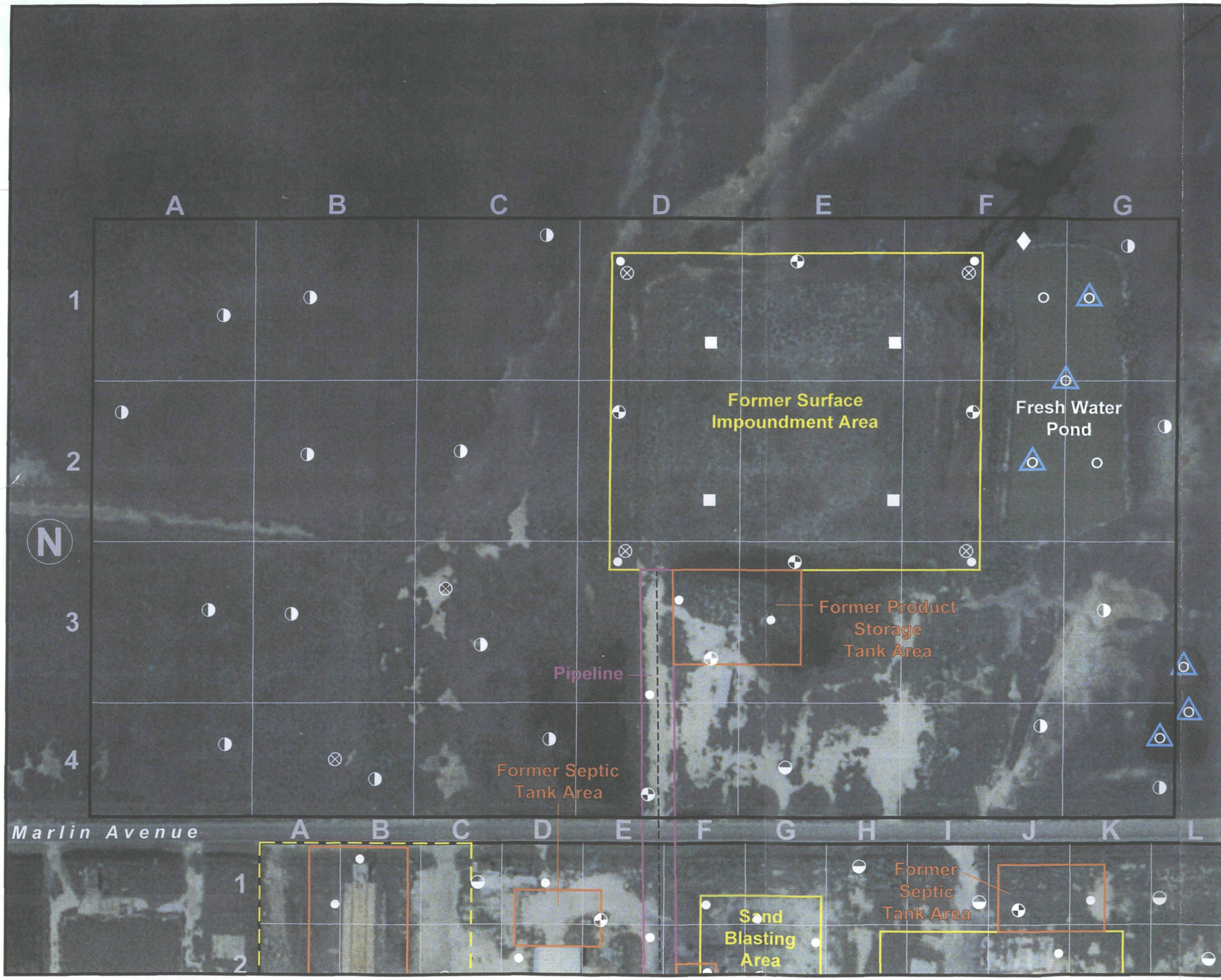

EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Judgmental Soil Sample (0-2 ft)
- Random Systematic Soil Sample (0-2 ft)
- Geotechnical Sample
- Monitoring Well / Judgmental Soil Sample (0-2 ft)
- Judgmental Sediment Sample (0-6 in)
- Random Systematic Sediment Sample (0-6 in)
- Temporary Piezometer
- Staff Gauge
- Surface Water Sample (Fresh Water and Small Pond)

N

Approx. Scale in Feet

0 60 120

Source of photo: Aerial Viewpoint, Spring, Texas aerial photograph, March 30, 2000.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 5

SAMPLE LOCATIONS NORTH AREA

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

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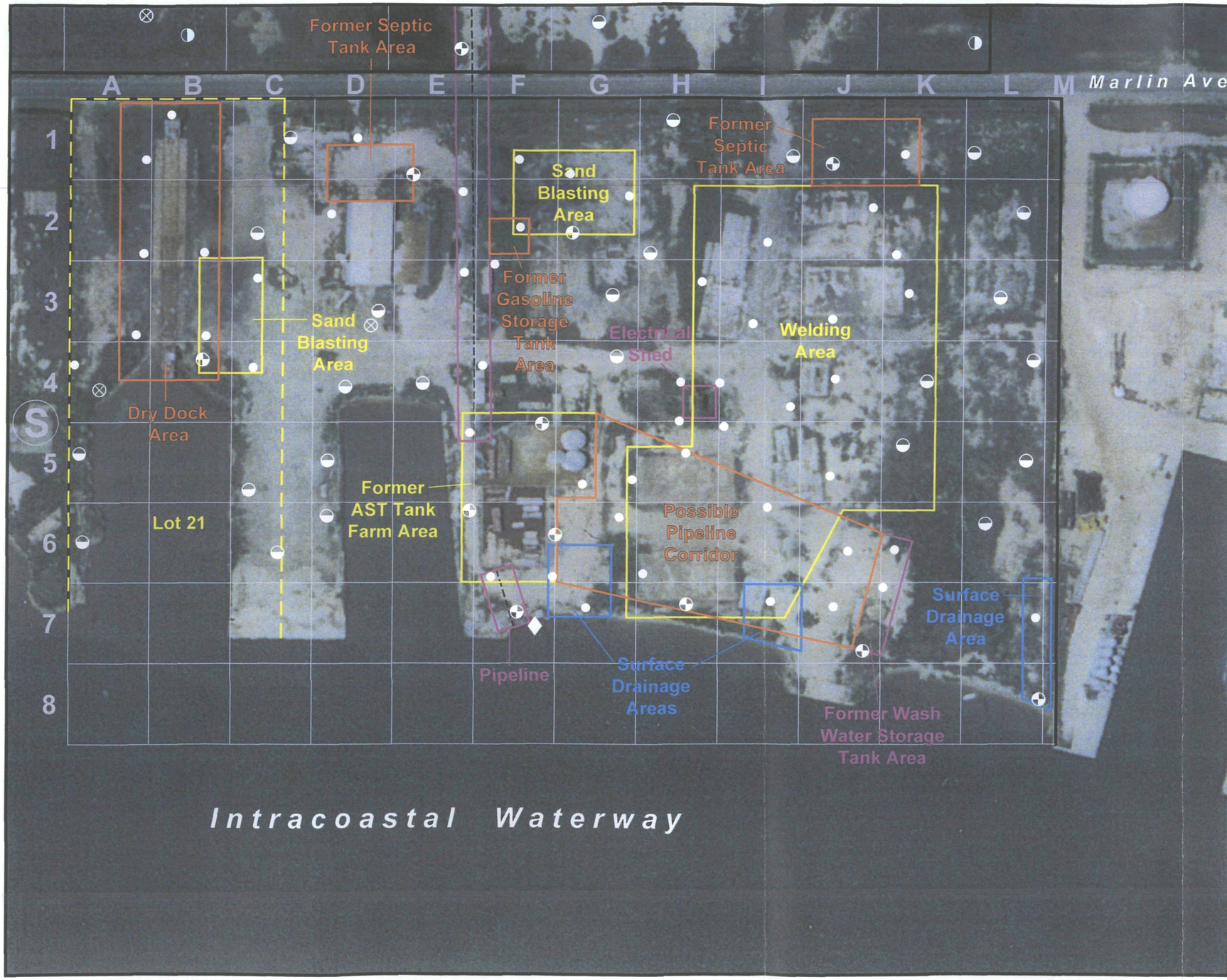

EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Judgmental Soil Sample (0-2 ft)
- Random Systematic Soil Sample (0-2 ft)
- Monitoring Well / Judgmental Soil Sample (0-2 ft)
- Random Systematic Sediment Sample (0-6 in)
- Temporary Piezometer
- Staff Gauge

N

Approx. Scale in Feet

0 60 120

Source of photo: Aerial Viewpoint, Spring, Texas aerial photograph, March 30, 2000.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 6
SAMPLE LOCATIONS SOUTH AREA

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

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EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

EM Survey Transect

N

Approx. Scale in Feet

0 100 200

Source of photo: Aerial Viewpoint, Spring, Texas aerial photograph, March 30, 2000.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 7

EM SURVEY TRANSECTS

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

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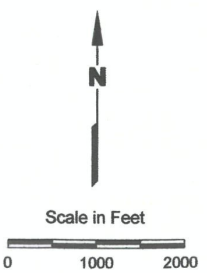
QUADRANGLE LOCATION



Source:
Base map taken from http://www.tnris.state.tx.us Freeport, Texas 7.5 min. U.S.G.S. quadrangle, 1974.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 8

BACKGROUND SOIL SAMPLE LOCATION

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

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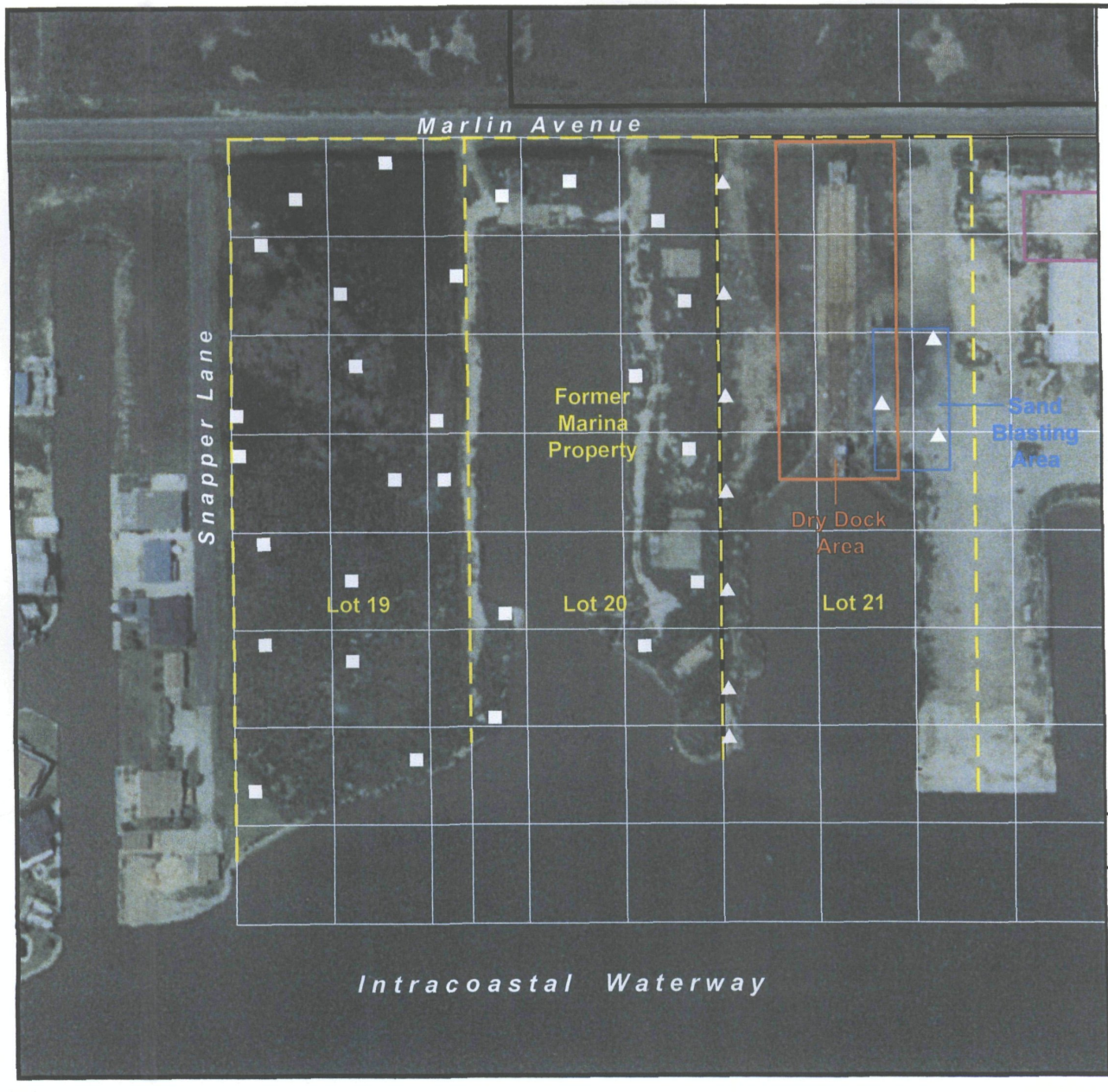

EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- ▲ Lot 21 Surface Soil Sample (0-1 in)
- ■ Lot 19/20 Surface Soil Sample (0-1 in)

Notes:
Soil sample locations subject to change based on field conditions. Composite samples also to be collected from residential properties on west side of Snapper Lane. Specific locations will be determined based on building locations and thus are not shown on this figure.

N

Approx. Scale in Feet

0 75 150

Source of photo: Aerial Viewpoint, Spring, Texas aerial photograph, March 30, 2000.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 9

RESIDENTIAL SURFACE SOIL INVESTIGATION SAMPLE LOCATIONS

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

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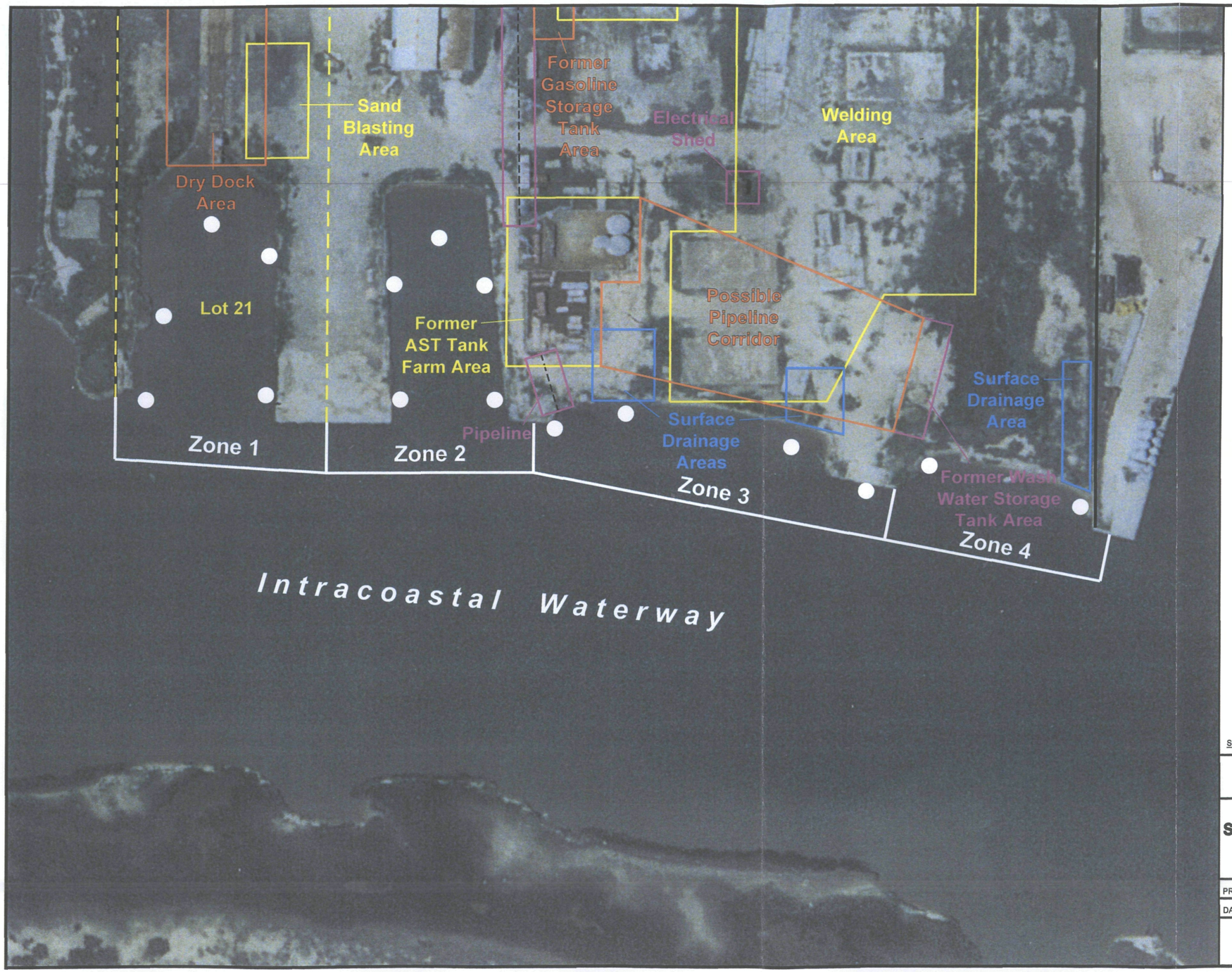

EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Sediment / Crab Tissue Sample Location
- Zone 1 — Surface Water / Fish Netting Station Zone

N

Approx. Scale in Feet

0 60 120

Source of photo: Aerial Viewpoint, Spring, Texas aerial photograph, March 30, 2000.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 10
SURFACE WATER/SEDIMENT/FISH TISSUE SAMPLE LOCATIONS-INTRACOASTAL WATERWAY

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

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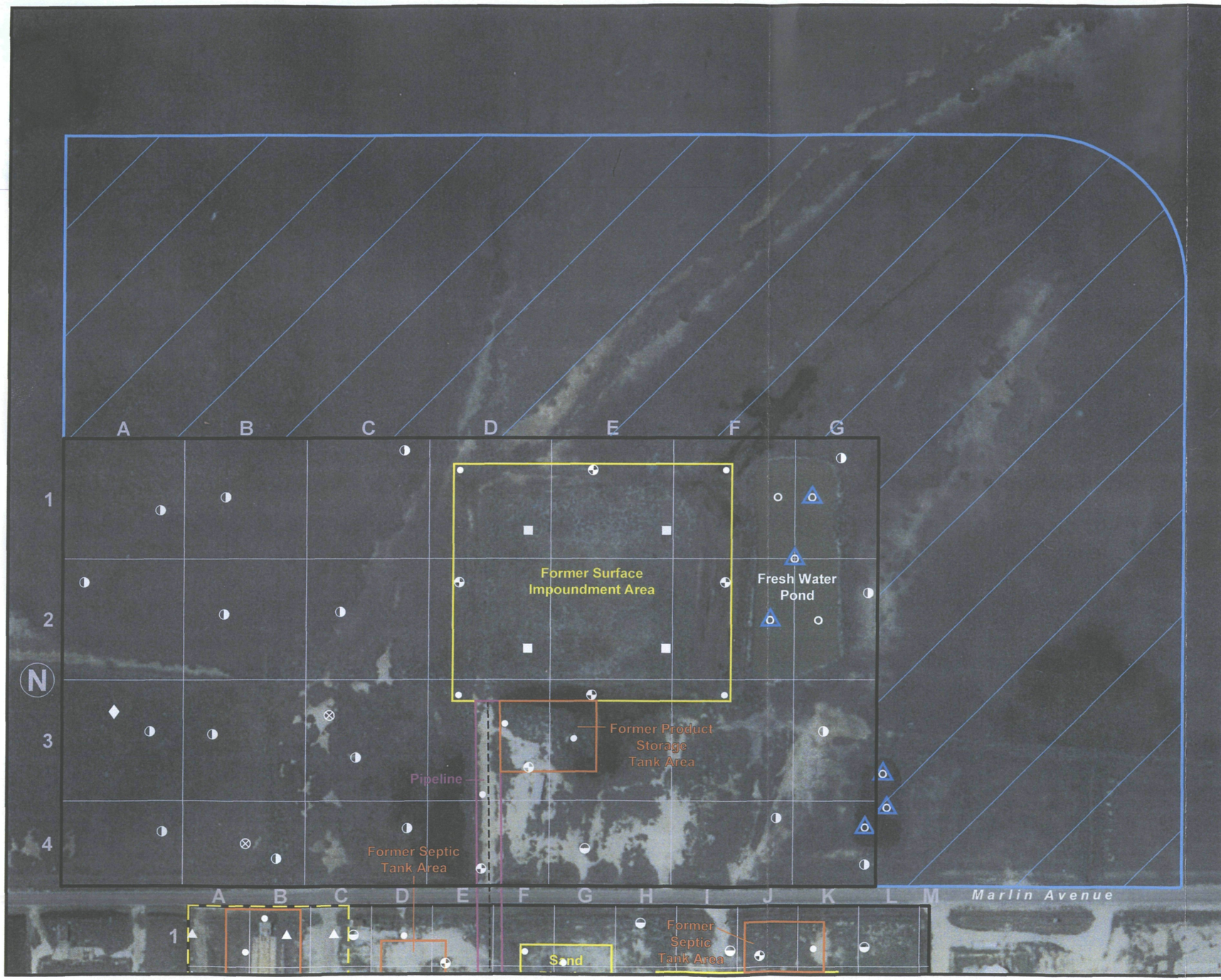

EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Judgmental Soil Sample (0-2 ft)
- Random Systematic Soil Sample (0-2 ft)
- Lot-21 Random Systematic and Judgmental Soil Sample (0-1 in)
- Geotechnical Sample
- Monitoring Well / Judgmental Soil Sample (0-2 ft)
- Judgmental Sediment Sample (0-6 in)
- Random Systematic Sediment Sample (0-6 in)
- Temporary Piezometer
- Surface Water Sample (Fresh Water and Small Pond)
- Off-Site Wetland Surface Water and Sediment

Approx. Scale in Feet

0 80 160

Source of photo: Aerial Viewpoint, Spring, Texas aerial photograph, March 30, 2000.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 11
OFF-SITE WETLAND SURFACE WATER AND SEDIMENT SAMPLE AREA

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

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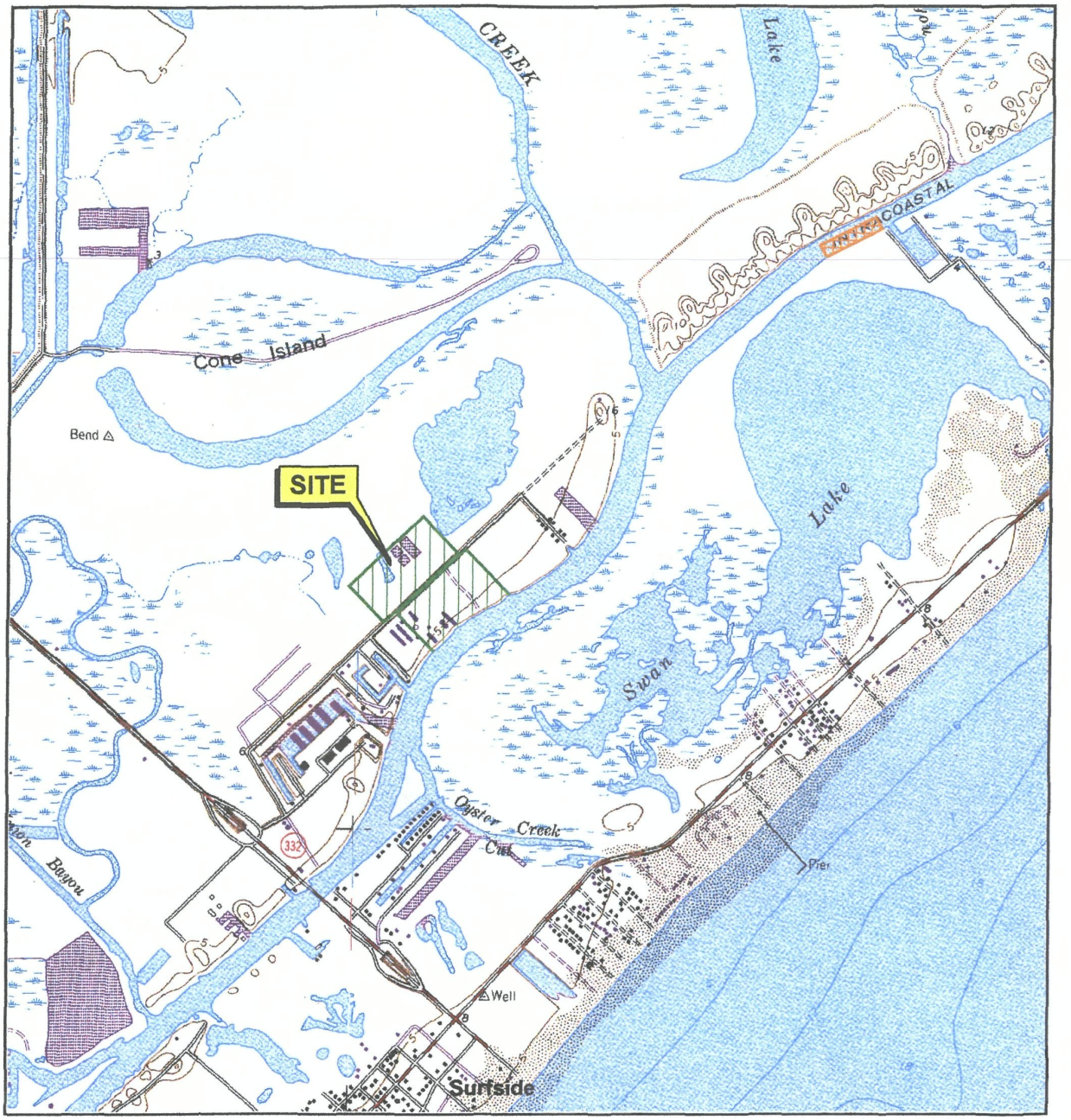

EXPLANATION

- Approx. Site Boundary
- Background Sediment/ Fish Tissue Sample Location

N

Scale in Feet

0 1000 2000

Source:
Base map taken from http://www.tnris.state.tx.us Freeport, Texas 7.5 min. U.S.G.S. quadrangle, 1974.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 12
BACKGROUND SURFACE WATER/ SEDIMENT/FISH TISSUE SAMPLE LOCATION

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

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APPENDIX A
STANDARD OPERATING PROCEDURES

PASTOR, BEHLING & WHEELER, LLC

LIST OF STANDARD OPERATING PROCEDURES

SOP Number	Title	Revision No. and Date
1	FIELD DOCUMENTATION	Rev No. 1 Sept. 2005
2	SUPERVISION OF EXPLORATORY BORINGS	Rev No. 2 Oct. 2005
3	FIELD ORGANIC VAPOR SCREENING METHODOLOGY FOR SOIL SAMPLES	Rev No. 1 Sept. 2005
4	GEOPHYSICAL LOGGING	Rev No. 0 Sept. 2005
5	SOIL AND SEDIMENT SAMPLING FOR CHEMICAL ANALYSIS	Rev No. 1 Oct. 2005
6	SAMPLE CUSTODY, PACKAGING AND SHIPMENT	Rev No. 0 Dec. 2002
7	INSTALLATION OF MONITORING WELLS AND PIEZOMETERS	Rev No. 1 Sept. 2005
8	MONITORING WELL DEVELOPMENT	Rev No. 0 Jan. 2005
9	WATER LEVEL, IMMISCIBLE LAYER AND WELL DEPTH MEASUREMENT	Rev No. 1 Sept. 2005
10	WATER QUALITY SAMPLING	Rev No. 1 Sept. 2005
11	FIELD MEASUREMENT OF OXIDATION-REDUCTION POTENTIAL (ORP)	Rev No. 0 Dec. 2002
12	FIELD MEASUREMENT OF DISSOLVED OXYGEN (DO)	Rev No. 0 Dec. 2002
13	EQUIPMENT DECONTAMINATION	Rev No. 0 Dec. 2002
14	STORAGE AND DISPOSAL OF SOIL, DRILLING FLUIDS, AND WATER GENERATED DURING FIELD WORK	Rev No. 0 Dec. 2002
15	HYDRAULIC TESTING	Rev No. 1 Sept. 2005
16	DATA VALIDATION (included in SAP Volume II – QAPP)	Rev No. 1 Oct. 2005

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 1

FIELD DOCUMENTATION

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol for documenting field activities. PBW field personnel shall document field activities on formatted field records and other appropriate data sheets. These formatted record and data sheets will be part of the PBW project file; all forms must be filled out carefully and completely by one of the personnel actually performing the field activities.

2.0 PROCEDURES

2.1 Daily Field Record

The PBW field representative will prepare a Daily Field Record form (Figure SOP-1-1) for each day of field work. As appropriate, documentation on the multiple-page form will include:

A. Project identification;

B. Date;

C. Time on job (beginning and ending time);

D. Weather conditions;

E. Activity description;

F. List of personnel and visitors on site;

G. Safety equipment used and monitoring performed;

H. Waste storage inventory (if any);

I. Chronological record of activities and events;

J. Comments and variances from project work plan;

K. Content of telephone conversations; and

L. Signature of the PBW field representative.

The PBW field representative will document details as necessary to recreate the day's activities and events at a later time, using as many additional sheets as needed. The Daily Field Record also can be used to document field activities that may not be specified on other field record forms. Other activity-specific documentation requirements that can be recorded on the Daily Field Record are discussed in the PBW Standard Operating Procedure (SOP) for each activity.

3.0 DOCUMENTATION

3.1 Field Record Forms

In addition to the Daily Field Record, PBW field personnel will complete specific PBW field record forms applicable to the field activities being conducted. The procedures for completion of activity-specific field record forms are presented in the applicable PBW Standard Operating Procedures. Some of the PBW field record forms include:

- Daily Field Record (SOP No. 1);
- Log of Boring (SOP No. 2);
- Chain-of-Custody Record and Request for Analysis (SOP No. 6);
- Monitoring Well Installation (SOP No. 7);
- Monitoring Well Development (SOP No. 8);
- Water Level Monitoring Record (SOP No. 9);
- Groundwater Sampling Record and Surface Water Sampling Record (SOP No. 10);
- Eh Data Sheet (SOP No. 11); and
- Slug Test Form (SOP No. 15).

3.2 Records Management

All original field forms will be filed with the appropriate project's records.

4.0 QUALITY ASSURANCE

4.1 Form Review and Filing

Completed field forms should be reviewed by the Project Manager or project designated QA/QC reviewer. Any necessary corrections will be made in pen with a single-line strike out that is initialed and dated.

FIGURE SOP-1-1. DAILY FIELD RECORD

DAILY FIELD RECORD	DATE:	PAGE 1 of _____

Project Number: Project Name:

Location: Time on Job: AM/PM to: AM/PM

Weather Conditions:

Activity:

PERSONNEL ON SITE

Name	Company	Time In	Time Out

VISITORS ON SITE

Name	Company/Agency	Time In	Time Out

PERSONAL SAFETY

	Protective Gloves		Hard Hat		Tyvek Coveralls
	Protective Boots		Safety Goggles/Glasses		Respirator (Half/Full)
	Hearing Protection				

Other Safety Equipment (describe):

SAFETY EQUIPMENT

Monitoring Equipment:	Serial / Rental No.	**Field Calibration:** Std.	Result

WASTE STORAGE INVENTORY

Container Type	Container ID	Description of Contents and Quantity	Location

SIGNATURE OF FIELD REPRESENTATIVE:

DATE:

Pastor, Behling & Wheeler, LLC
2201 Double Creek Drive, Suite 4004
Round Rock, Texas 78664

Phone: (512) 671-3434 Fax: (512) 671-3446

FIGURE SOP-1-1. DAILY FIELD RECORD

DAILY FIELD RECORD *(continued)*	DATE:	PAGE _____ of _____

TIME	DESCRIPTION OF DAILY ACTIVITIES & EVENTS

COMMENTS / COMMUNICATIONS:

SIGNATURE OF FIELD REPRESENTATIVE:	Pastor, Behling & Wheeler, LLC 2201 Double Creek Drive, Suite 4004 Round Rock, Texas 78664 Phone: (512) 671-3434 Fax: (512) 671-3446
DATE:	

Pastor, Behling & Wheeler, LLC.

STANDARD OPERATING PROCEDURE No. 2

SUPERVISION OF EXPLORATORY BORINGS

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed by Pastor, Behling & Wheeler, LLC (PBW) personnel during the drilling and logging of exploratory borings. Exploratory borings (pilot holes) may be drilled to obtain samples of the subsurface strata or to run borehole geophysical logs. Borings will be either backfilled with grout or completed as monitoring wells or piezometers.

The procedures presented herein are intended to be general in nature. As site-specific conditions become known, appropriate modifications to the procedures may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Drilling

For any site or drilling location, the selection of drilling methods will be based on: (1) availability and cost of the method; (2) suitability for the type of geologic materials at the site (e.g., consolidated, unconsolidated); (3) potential effects on sample integrity (influence by drilling fluids and potential for cross contamination between aquifers); or (4) or other site-specific considerations. Some commonly used drilling methods include hollow-stem auger method, cone penetrometer testing (CPT) method, direct-push geoprobe method, hydraulic rotary method, cable tool method, or casing-hammer air rotary method. Synthetic polymer drilling fluid additive should be used only if a boring: (1) will not be sampled for chemical analysis; (2) will not be completed as a monitoring well; or (3) if cuttings return and/or borehole integrity cannot be achieved by any other method.

Exploratory borings for monitoring wells and piezometers will be drilled in a manner that will minimize the potential for cross contamination between water-bearing units. The actual depth of

each exploratory boring will be specified by the PBW field supervisor assigned to the drill rig and will be based on the intended use of the boring. No solvents or petroleum-based products will be used for lubricating any drilling equipment (rods, bit, augers, mud pit, etc.) which will contact the borehole or the drilling fluid. For air rotary drilling, an air filter will be installed between the air compressor and the drill pipe to intercept oil droplets.

The drilling equipment in which fluid (including air) circulates, including drive samplers and bits, will be thoroughly steam cleaned before and after drilling of each exploratory boring. Only clean, potable water will be used as makeup water for drilling fluid and for decontamination of drilling equipment. An acid rinse (e.g., 0.1 N HCl) or solvent rinse (e.g., methanol or hexane) may be used to supplement these procedures if tarry or oily deposits are encountered during drilling. Drilling equipment cleaned in this manner will be thoroughly steam cleaned prior to reuse or leaving the site.

To ensure that the specified equipment has been provided by the drilling contractor, prior to drilling the PBW field supervisor will measure and record the outside diameter of the drill bit or augers and, when using the hollow stem auger method, the inside diameter of the augers.

During drilling, the PBW field supervisor may choose to periodically measure and record the depth to water within the drill casing. The position of the lead drill casing will be recorded each time a water level measurement is taken. When the total depth of a boring is reached, the water level within the drill casing will be measured.

If the boring is to be completed as a monitoring well or a piezometer, the final borehole diameter will be sufficiently large to allow placement of a specified type and size of well casing, screen and filter pack. The PBW field supervisor will measure and record the total depth of the final borehole at the completion of drilling.

The PBW field supervisor shall specify to the driller the penetration rate, depth of soil sample collection, method of sample retrieval, and any other matters which pertain to the satisfactory completion of the exploratory borings.

Soil cuttings and drilling fluid generated during drilling should be temporarily stored in steel drums or other approved containers. Final disposal of the soil cuttings and drilling fluid will be

conducted in accordance with all regulatory requirements and with procedures discussed in PBW SOP No. 14 entitled Storage and Disposal of Soil, Drilling Fluids, and Water Generated During Field Work.

2.2 Sampling and Logging

Representative samples of cores and/or drill cuttings may be obtained and evaluated. A detailed lithologic log of these samples should be made.

Selected samples may be retained for further physical analysis. Soil samples may also be obtained for chemical analysis. Sample collection and preservation for chemical analysis will be in accordance with PBW SOP No. 5 entitled Soil and Sediment Sampling For Chemical Analysis. Selected samples that illustrate specific geologic features may be retained and shall be labeled with boring number and appropriate sample interval.

2.2.1 Obtaining Samples

When samples are collected, they should be obtained by one or both of the following methods described below.

A. Coring -- Cores will be collected from selected intervals of the exploratory borings. Core barrels, Pitcher tubes, or other split-spoon drive samplers will be used to obtain the soil cores. As appropriate, the PBW field supervisor will carefully record on a boring log information which applies to the coring, such as rate of penetration, coring smoothness, core recovery, intervals of core loss, zones of lost circulation of drilling fluid, hammer weight, drop length and blow counts, as appropriate to the drilling method.

   Cores may be retained for future examination and/or preserved for chemical or geotechnical analysis. If they are retained, the cores may be stored and labeled to show project, boring number, date, and cored interval.

B. Collecting Cuttings -- The PBW field supervisor may collect cuttings from the drilling return fluid, air return from a cyclone separator, or the auger blade for every five-foot (or more frequent) increment of the exploratory boreholes. As appropriate, sampling and logging should be performed in accordance with the following procedures (Note: Items 2 through 6 do not apply to drilling methods that do not use a drilling fluid, e.g., hollow stem auger, push point sampler, etc.):

   1. The height of the drilling table above ground surface, lengths of the drill bit, sub and drill collars, and length of drill rods or augers should be taken into account in calculating the depth of penetration.

2. A small-diameter, fine-mesh hand screen or a shovel may be used to obtain a sample of the cuttings from the boring by holding the sampling device directly in the flow of the drilling return fluid or cyclone separator.

3. A sample will be obtained from the drilling return fluid or cyclone separator by leaving the sampling device in place only for the brief period required to collect an adequate sampling volume.

4. The most representative cuttings samples are usually obtained whenever the driller stops advancing the hole and circulates drilling fluid or air prior to adding another joint of drill rod.

5. Keep in mind that the deeper the hole, the longer cuttings at the drill bit take to reach the surface. The travel time for cuttings to reach the surface may be estimated each time the driller adds a new length of drill rod by timing the first arrival of cuttings after fluid or air circulation is resumed. This travel time should be used along with the depth of penetration to estimate the start and finish of each sampling interval.

6. In hydraulic rotary drilling, carefully wash the cutting sample in a bucket of fresh water by slowly shaking the screen while the sample is submerged, to wash away the drilling fluid.

7. For all drilling methods, place the cutting samples on a sampling table, labeled in consecutive order. If the sample is to be retained, place the sample in a plastic or cloth sample bag labeled with the boring number and sample interval. The retained samples will later be used during preparation of a detailed lithologic log.

2.3 Logging of Boreholes

The drill-rig operator and the PBW field supervisor should discuss significant changes in material penetrated by the drill bit, changes in drilling conditions, hydraulic pressure, drilling action, and drilling fluid circulation rate. The PBW field supervisor will be present during drilling of exploratory borings and will observe and record such changes by time and depth. When using a drilling method that does not involve the use of a wet drilling fluid, the PBW field supervisor should evaluate the relative moisture content of the samples and note zones that produce water. The PBW field supervisor may record such field notes to use later in preparing a detailed lithologic log.

Core samples and selected cuttings that are collected and retained during the drilling of the exploratory borings should be examined to evaluate the lithologic properties. A detailed lithologic log for the exploratory borings should be completed using PBW's Log of Boring (Figure SOP-2-1). The lithologic description of the log may include soil or rock type, color, grain

size, texture, hardness, degree of induration, calcareous content, indications of contamination, and other pertinent information. Color may be described using the Munsell Color Chart. Soil type should be described using the Unified Soil Classification System (USCS). When the Log of Boring form is used, it should include the method of sample collection (coring, cuttings) and the sample collection interval (Figure SOP-2-1), if any samples are collected.

Field personnel may also describe soil samples according to *Standard Practice for Description and Identification of Soils, Visual-Manual Procedure, ASTM D2488*. These procedures for lithology logging may include the following:

1) Measure entire sample length and record recovery (if applicable).

2) Mark lithologic changes on Field Log of Boring form (Figure SOP-2-1).

3) Separate a small, representative portion of each distinct soil type to be identified.

4) Describe the lithology, which may include soil or rock type, grain size, texture, hardness, degree of induration, calcareous content, indications of contamination, and other pertinent information.

5) Identify the color using a Munsell color chart.

6) Identify the soil type using the field tests outlined in ASTM 2488-84.

7) Record descriptions of the soil on the Field Log of Boring form (Figure SOP-2-1). The descriptions should be in the following order:
   a) Soil color;
   b) Soil type (USCS);
   c) Moisture content;
   d) Cementation;
   e) Consistency;
   f) Angularity and shape of particles (if sand or gravel);
   g) Dilatancy/dry strength
   h) Plasticity; and
   i) Miscellaneous descriptors (roots, nodules, odors, texture percentages).

8) Dispose all remaining soil samples and cuttings in secure containers and store in an access-controlled central storage area on the Site. The containers should be properly labeled with the generation date, drilling location, and matrix.

2.4 Geophysical Logs

PBW SOP No. 4 entitled Geophysical Logging discusses in detail the steps to be followed when performing geophysical logs of exploratory borings. Geophysical logging is generally performed

in uncased, fluid-filled boreholes. Following completion of the drilling, spontaneous potential, single-point resistance, lateral resistivity, natural gamma or other logs may be made for each exploratory boring immediately after the drilling fluid has been circulated to remove all of the cuttings. When performed, geophysical logging should be done as quickly and efficiently as possible, while the wall of the borehole is in good condition, to minimize the possibility of trapping or entangling the downhole probes. Instruments on the logging unit should be adjusted to give the maximum definition of strata boundaries.

2.5 Plugging and Abandonment

For borings (pilot holes) not used to install a monitoring well and/or piezometer, the exploratory borings will be abandoned by plugging the hole with cement grout or other approved sealing agents. The PBW field supervisor shall inspect the grout for adequate mixing prior to placement in the borehole.

If the borehole is dry and is less than 10-feet deep, the grout or other approved sealant may be poured slowly from the ground surface into the borehole. The grout should be added in one continuous pour before its initial set. If the borehole is greater than 10-feet deep, or if more than 2-feet of water is present in the borehole, the grout is typically placed in one continuous pour by pumping through a tremie hose or pipe. The tremie hose or pipe initially should be placed near the bottom of the bore hole and shall remain submerged in the grout during the entire grouting operation. Grout should continue to be pumped until return of fresh grout (uncontaminated by drilling fluid) is observed at the ground surface.

A typical grout mix is one (1) sack of Type I-II Portland cement, five (5) percent by weight of powdered bentonite, per 8.5 gallons of water. If a high-yield bentonite grout (trade names Quik-Gel, Super Gel X, etc.) is used, the powdered bentonite percentage may be reduced to two (2) percent. The grout mixture may be modified to meet local regulations or site-specific conditions or specifications.

2.6 Documentation and Records Management

Field notes recorded by the PBW field supervisor during the drilling of each exploratory boring should be recorded directly on or transferred to the log form (Figure SOP-2-1). The original logs

shall be placed in the PBW project file. A copy of the logs will be retained in the field file for the project. For preparation of the report, data from the field boring logs may also be transferred to another format.

3.0 QUALITY ASSURANCE

Field notes and field forms completed by the field supervisor shall be reviewed by the task manager and the PBW Project Manager or other designated QA officer before they are placed into project files. The QA review will be recorded on the reviewed originals by initials of reviewer and date.

Figure SOP-2-1

PBW

PASTOR, BEHLING & WHEELER, LLC
2201 DOUBLE CREEK DRIVE, SUITE 4004
ROUND ROCK, TEXAS 78664
(512) 671-3434 FAX: (512) 671-3446

FIELD LOG OF BORING: (Page ___ of ___)

Location:	Logged By:
Drilling Method:	Ground Elevation:
Drilling Company & Driller Lic. No.:	Date(s):
Sampler Type:	Drill Bit(s):

Project No.

Depth	Recovery	Sample	PID (ppm-v)		Description/Remarks USCS Description, Color; Moisture Structure: stratified, laminated, fissured, slickensided, blocky, lensed, homogenous

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 3

FIELD ORGANIC VAPOR SCREENING METHODOLOGY FOR SOIL SAMPLES

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed during field screening of soil samples for organic vapors using portable organic vapor meters (OVMs), such as a photoionization detector (PID) or a flame ionization detector (FID). Personnel responsible for the use of these instruments must be familiar with the manufacturer's use, calibration and maintenance instructions. The procedures presented herein are intended to be general in nature and, when warranted, appropriate revisions may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Equipment List

- OVM(s) (PID and/or FID);
- OVM calibration kit (refer to instrument manufacturer's instructions; may include calibration gas, tedlar bag, regulator, connectors);
- Indelible marker (SANFORD Sharpie®, space pen, or equivalent); and
- One-quart, zip-lock plastic bags.

2.2 Operational Factors

Common OVM operational factors which may affect performance during field vapor screening may include, but are not limited to, the following:

2.2.1 PID

A. Photoionization lamp requires periodic cleaning/changing.

B. Moist atmospheric conditions (i.e., rain) and high relative humidity (>90%) in the sample or ambient air can "quench" the signal resulting in high readings. If the ambient temperature is less than the soil temperature, water vapor can condense in the PID ion chamber. Ideal conditions for conducting PID analyses are dry

weather and ambient air temperatures greater than 50 degrees Fahrenheit (10 degrees Centigrade).

C. Dust particles may absorb ultraviolet light, which reduces the energy emitted. Constituents in the dust may ionize and cause erratic responses in PID's that do not have filters. Note that the ThermoEnvironmental Instruments Models 580A and 580B do have particulate filters.

D. Sampling from a source of limited air volume will restrict the instrument air flow and provide anomalously low instrument readings.

E. Responses may be affected by interference from nearby AC or DC power lines, transformers, high voltage equipment, or radio wave transmitters.

F. The PID does not detect methane or other alkanes, thus eliminating anomalous methane contributions to total concentration readings.

2.2.2 FID

A. Low oxygen levels can influence the instrument response or cause the flame to be extinguished.

B. Recommended ambient air temperature is greater than 40 degrees Fahrenheit (4 degrees Centigrade).

C. High winds may extinguish the flame.

D. The FID requires a relatively high sample flow rate for reliable readings. Restricting the flow rate can yield inaccurate results, erratic responses, and may extinguish the flame.

E. The FID detects the total concentration of many organic vapors and gases (methane, other alkanes and aromatics). It may yield anomalously high readings (false positives) when evaluating potential hydrocarbon contamination in situations where methane is present (i.e., wetlands, sewers, septic leach fields, decaying organic matter, etc.).

F. Hydrogen gas is required for operation.

2.3 Field Operations

OVM(s) should be calibrated and operated according to the manufacturer's specifications to yield total organic vapors (TOV) in parts per million (ppm) by volume.

2.3.1 Calibration and Testing

Use ambient air (background) where "zero" air is called for in the calibration procedure. Calibration should be performed at least once at the beginning of each work day and in accordance with the instrument manufacturer's instructions.

1. If using a PID with a filter, verify that the particulate filter is properly inserted, and that the filter is not dirty or clogged.

2. Measure concentration of TOV in background air in vicinity of location where screening will be done. If ambient air was used as the "zero" air in the calibration procedure, the background concentration should be approximately zero.

3. Measure concentration of TOV within empty plastic zip-lock bags.

   A. Remove a plastic zip-lock bag at random from its packaging;

   B. Open top of bag completely;

   C. Immediately insert OVM probe to middle of bag; and

   D. Record highest reading on the appropriate Field Logs.

4. Check operation of OVM(s) by holding the tip of an indelible marker, or other organic vapor source, approximately one-half inch away from the end of the OVM probe and observing for meter deflection. Any positive deflection of OVM is indicative of proper function. Verify that OVM(s) returns to background levels. This procedure should be performed periodically during the work day. Be careful not to get ink on the OVM probe.

5. Document calibration in the Daily Field Record where indicated on the form. The Daily Field Record is presented in PBW SOP No. 1 entitled Field Documentation.

2.3.2 Operation

1. Label each plastic zip-lock bag before the bag is used (it is much easier to write on the bag when it is empty and flat).

2. Fill bag approximately one-half full with the soil sample. Seal bag immediately under ambient conditions. Do not attempt to inflate or evacuate bag while closing. Crush the sample by squeezing sample through the bag with fingers to provide greater surface area for vapor outgassing. Agitate the sample for

approximately 15 seconds. The agitation period should be generally consistent for samples collected at the site in the same time period.

3. Allow headspace development for approximately 10 minutes at ambient air temperature. The headspace development period should be generally consistent for all samples collected from the site in the same time period.

4. Subsequent to headspace development, agitate the sample again for approximately 15 seconds. While holding top of plastic zip-lock bag, press end of OVM probe into corner of zip-lock closure and hold the remainder of zip-lock area closed around probe. Keep the end of the probe at approximately the center of the airspace within the bag. Exercise care to avoid uptake of water droplets or soil particulates into the OVM probe.

5. Record the highest reading obtained with the OVM. If using a ThermoEnvironmental Instruments Models 580A or 580B PID, the response time should be less than 2 seconds. If using different instrument(s), the manufacturer's specifications should be checked for the expected response time(s).

6. After screening each sample, verify that the OVM returns to previous background ambient air levels and/or record any changes. Record OVM measurements on a Log of Boring form (Figure SOP-2-1) or in a field notebook.

7. Discard the contents of the plastic zip-lock bag into container with other soil cuttings. Discard the zip-lock bag appropriately with other wastes.

2.4 Documentation and Record Management

Instrument calibration will be recorded with date, time and calibration results. OVM measurements for soil samples or borehole cuttings/cores will also be recorded with date, time and TOV results. This information may be included on the Daily Field Record form (Figure SOP-1-1), Log of Boring (Figure SOP-2-1) or in a field notebook.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

Instrument calibration results must demonstrate that the OVM is in good working condition and can provide TOV measurements within the range expected for soils at the designated sample locations. If the instrument operation is not confirmed through the calibration and testing procedure described in Section 2.3.1 then the instrument should be tagged as "Non-Operational/Defective" and repaired or replaced immediately.

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 4

GEOPHYSICAL LOGGING

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed for borehole geophysical logging. Borehole geophysical logs of exploratory borings may be run to aid in the interpretation and correlation of geologic units. The procedures include calibration, production, filing, and interpretation of the geophysical logs. The procedures presented herein are intended to be general in nature; when warranted, appropriate revisions may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Geophysical Well-Logging Equipment Operating Procedures

The geophysical well-logging equipment (GWLE) should be capable of performing single-point resistance, lateral resistivity, spontaneous potential, and natural gamma-ray logging as appropriate depending on project requirements.

2.1.1 GWLE Setup

The GWLE shall be arranged as follows at the borehole to be logged:

A. Place tripod over well or use pulley (sheave) suspended from drill rig.

B. Set cable reel and chart recorder sections near the borehole.

C. Attach power source (vehicle battery, generator, or line current) to GWLE.

D. Attach probe (spontaneous potential/resistance - resistivity, or gamma) to cable head.

E. Run probe and cable over tripod pulley or sheave suspended from drill rig and into the borehole.

F. Place electrical ground in mud pit or other suitable location (for spontaneous potential/resistance - resistivity logging only) in accordance with equipment specifications and project health and safety requirements.

The probe should be referenced to the ground surface elevation of the borehole by placing the probe reference mark at ground level and setting the depth counter on the cable reel section to zero.

The chart recorder section of the GWLE should be checked to determine the following:

A. Pens have sufficient ink to log the entire borehole;

B. Pen drives are working properly;

C. Chart paper is of sufficient quantity to log the entire borehole; and

D. Vertical scale is set at 1 inch = 10 feet or other suitable scale.

2.1.2 GWLE Calibration

The GWLE should be calibrated before starting both spontaneous potential/resistance - resistivity (SP/RES) and natural gamma ray (gamma) logging by following the detailed procedures in the GWLE operator manual.

2.1.3 Setting Scales

After calibration, the probe is lowered to the bottom of the borehole. While lowering the probe, the proper SP/RES or gamma scales are selected as follows:

A. SP/RES Logging:

As the probe is lowered to the bottom of the borehole, the SP and RES scales and zero adjust controls should be adjusted so that the pen has maximum deflection without going off the chart paper.

B. Gamma Logging:

1. Set time constant switch on chart recorder to 3 seconds or other suitable setting.

2. Lower the probe to bottom of borehole and observe pen deflection. Select a "recorder output" setting (gamma scale) that gives maximum pen deflection without the pen going off the chart paper (to the right).

3. The time constant switch should be adjusted to give good definition of relatively thin geologic features without showing too much "background noise".

4. Selection of a time constant and gamma scale is generally possible only while logging the borehole. After the first borehole in the drilling program has been

logged, a gamma scale and time constant may be selected for gamma logging of subsequent holes.

The scale settings and the depth at which logging will start shall be recorded on the chart paper.

2.1.4 Logging Procedure

Log the boring in accordance with the following procedure:

A. For SP/RES and gamma logging, reel the probe(s) up at an even steady rate at the speed recommended in the detailed equipment procedures. Monitor the speed by observing the instrument's rate meter.

B. Reel probe to the ground surface (which should correspond to zero on the depth counter) and record on the chart paper the actual pen position at zero depth (as indicated by the depth counter). Also record the depth of fluid in the hole, as indicated by the SP and RES curves.

The spontaneous potential/resistance - resistivity and natural gamma traces on the chart paper shall be checked in the field by the PBW field supervisor for completeness of record, and rechecked to determine if the traces are representative of assumed subsurface conditions. If the traces on the chart paper appear to be non-representative or peculiar, the instrument shall be checked for a possible malfunction and the borehole re-logged.

2.2 Documentation and Records Management

The geophysical log furnished by a geophysical logging subcontractor should include the following items below (A through R) on the subcontractor's logging form. The following data should be recorded on the logging form soon after the logs have been run:

A. Project number;

B. Date;

C. Boring description/location;

D. Log type (e.g., single-point resistance, spontaneous potential, natural gamma);

E. Scale settings;

F. Starting and completion depths of geophysical logs;

G. Datum (measuring point, MP) of logs;

H. Borehole depth and diameter;

I. Casing depth(s) and diameter(s);

J. Ground surface elevation of well (if available);

K. Type of borehole fluid;

L. Temperature of borehole fluid;

M. Level of borehole fluid (datum is measuring point);

N. Resistivity or specific conductance of borehole fluid;

O. Logging speed;

P. Vertical scale of log;

Q. Name of operator of GWLE and name of witness (if any); and

R. Pertinent remarks.

The PBW field supervisor will document the logging activities on either the Daily Field Record (Figure SOP-1-1), Log of Boring form (Figure SOP-2-1), or the Well Completion form (Figure SOP-7-1). The original geophysical log (or a reproducible copy) should be filed in the PBW project files. Copies of the logs may be retained in the field.

2.3 Interpretive Procedure

The geophysical logs may be compared to and correlated with the lithologic log of the same exploratory boring in order to evaluate the accuracy and precision of the interpretation, refine the interpretive technique, evaluate the interpretive limits of the geophysical logging procedure, and aid in identifying the hydrostratigraphic units. Geophysical logs and lithologic logs of the cored intervals of borings will be compared in order to formulate a control group to be used for correlation of uncored borings.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

3.1 Cleaning of Equipment

The logging probes, electrical cable and all accessories that have been in contact with the drilling fluid or have entered the borehole should be thoroughly cleaned after each trip in and out of the borehole. See PBW SOP No. 13 entitled Equipment Decontamination for additional decontamination procedures.

3.2 Technical Review

Geophysical logs, lithologic logs, and interpretive reports based on those logs should be reviewed by a geologist with experience and training in geophysics. The technical review should be performed before interpretive results are reported and record of that review should be included in the project's files along with other documentation of geophysical logging.

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 5

SOIL AND SEDIMENT SAMPLING FOR CHEMICAL ANALYSIS

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocols to be followed when soil and sediment samples are collected for physical or chemical analysis. The procedures presented herein apply to: soil sampling from the surface, soil sampling when drilling boreholes, and sediment sampling from surface waters, wetlands, drainage structures, etc. These procedures are intended to be general in nature. Appropriate revisions may be made when approved by the PBW Project Manager to address site-specific conditions or project-specific protocols.

2.0 PROCEDURES

2.1 Surface Soil and Sediment Sample Collection

This section describes sampling of soils and sediment from near the land surface, including the bottom or sides of an excavation and the bottom of a surface water drainage course. The collected samples will be placed in appropriate sample containers, as designated by the laboratory, for the parameters to be analyzed.

2.1.1 Surface Soil Sampling

Soil will be removed using a spade and, if necessary, a post-hole digger to the top of the targeted sampling interval.

A. Direct Sampling Method -- A stainless-steel or, as appropriate, plastic instrument (trowel, scoop) will be used to recover the sample directly into appropriate containers provided by the analytical laboratory.

B. Manual Core Sampler Method -- A slide-hammer core sampler with brass or stainless steel liners may be used to recover a relatively undisturbed core sample. Extension sections may be added to reach deeper sampling intervals. This method is recommended for samples that will be analyzed for volatile organic compounds.

C. Hand Auger Method -- A hand auger with stainless-steel auger and sampler sections may be used to advance and sample the boring. Extension sections may be added to reach deeper sample intervals.

2.1.2 Sampling Sediment in a Surface Water Course

Sediment in a surface water course with little or no free water may be sampled by directly scooping the sample with a stainless steel or, as appropriate, plastic instrument (trowel, scoop). All sediments, including sediment submerged under water, may be sampled by the following methods:

A. Direct Sampling Method -- Fluid sediment may be collected directly using the sample container. If sampled under water, the container will be capped in place to avoid disturbance while surfacing.

B. Manual Core Sampler Method -- A slide-hammer core sampler with brass or stainless steel liners may be used to recover a relatively undisturbed core sample of the sediment. An extension section may be added to reach sediment intervals in deeper waters.

C. Remote Scoop Method -- A sampling cup or container attached to a pole may be used to collect a sediment sample in deeper water or where a longer reach is needed.

D. Bottom Sampling Dredge Method -- A sampling dredge attached to a cable also may be used to recover sediment samples in deeper waters.

2.2 Sample Collection During the Drilling of Borings

During borehole drilling, core samples may be collected for chemical analysis by lining the core barrel or drive sampler with clean brass or stainless steel liners. The procedures for obtaining soil cores are discussed in PBW SOP No. 2 entitled Supervision of Exploratory Borings. The drive sampler or core barrel will be steam cleaned or washed with a laboratory-grade detergent and water solution to remove dirt, rinsed with tap water, and then rinsed with distilled or deionized water prior to and between sampling. Upon disassembly of the soil sampler by the drilling contractor, the PBW field supervisor will take possession of the core. The core will be parted at the joints between the liners using a clean, sharp, stainless steel knife or spatula or similar implement. The most representative liner(s) in the drive sampler will be preserved for chemical analysis.

Methods for the collection and analysis of VOCs in soil or other solid matrices will be conducted to minimize volatile losses. An option for minimizing volatilization during soil sampling is to follow the general procedures detailed in the EPA Method 5035, Closed-System Purge-and-Trap Extraction for Volatile Organics in Soil and Waste Samples provided in the EPA SW-846, Update III dated June 1997. EPA SW-846 Method 5035 does not rigorously dictate specifics of field sample collection and laboratory sample handling protocols. The following procedures to minimize volatile losses in soil samples are suggested:

1. Samples are handled as intact soil cores in the field and laboratory.
2. Samples are stored in containers (i.e., EnCore® or similar sampling tools) which can be reliably sealed to prevent volatilization losses over the project specified analytical holding time.
3. Samples are analyzed or chemically (acid or methanol) preserved within 48 hours of collection, if any contaminant may undergo biodegradation. Longer holding times may be implemented by freezing the samples immediately after collection and during shipment to the laboratory.
4. Exposure of the sample core to the atmosphere in the field and laboratory should be minimized.

2.3 Sample Preservation

The soil or sediment sample shouldl be quickly inspected for color, appearance, and composition, then capped immediately. If brass or stainless steel liners are used, the ends of the tube will be covered with Teflon® sheeting and then capped with clean polyethylene slip caps. The capped ends will be sealed with duct tape. If samples will be placed in laboratory provided sample jars, the jar will be filled to the capacity of the jar and the lid will be securely tightened. The sample liner or jar will be placed in a plastic, ziplock bag and stored (in an ice-cooled, insulated chest, if necessary) until delivery to the laboratory.

2.4 Sample Labeling

The sample container should be labeled with self-adhesive tags. Each sample will be labeled with the following information in waterproof ink:

A. Project identification;

B. Sample identification;

C. Date and time sample was obtained;

D. Sample Depth Interval (feet below ground level); and

E. First initial and last name of sample collector(s).

2.5 Documentation and Record Management

2.5.1 Daily Field Record

A PBW field representative will document the activities of each day of field work chronologically in accordance with the procedures contained in PBW SOP No. 1 entitled Field Documentation. For soil sampling, the Daily Field Record (included in PBW SOP No. 1) or field notebook entries may include the following items:

A. Decontamination Record: Decontamination method, source of tap water or deionized water, type of detergent or other cleaning agent;

B. Sample Inventory Record: Sample identification, location, date and time of sampling, sample depth interval, analyses requested and analysis methods;

C. Sampling Location Map: Surface soil sampling only, include scale, orientation, sample locations tied into a permanent reference point and sample identifications; and

D. Sampling Equipment Record: Description of sampling methodology and equipment including unique equipment identification, if available.

Copies of these records will be placed in the project files. Sample location and depth information should also be included in any electronic database maintained for the project.

2.5.2 Log of Boring Activity

As appropriate, the depth intervals of the soil samples collected for chemical analysis, the sampling date and times, and the sample identifications will be documented by the PBW field supervisor on the Log of Boring forms (included in PBW SOP No. 2 entitled Supervision of

Exploratory Borings) in the portion of the boring log corresponding to the sample interval. The original Log of Boring will be placed in the PBW project file.

2.5.3 Sample Custody

A Chain-of-Custody and Request for Analysis (CC/RA) form should be filled out for every sampling event or shipment, whichever is more frequent. Sample custody procedures and CC/RA form are discussed in PBW SOP No. 6 entitled Sample Custody, Packaging and Shipment.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

3.1 Equipment Cleaning

The sampler, liners, polyethylene end caps, parting knife, and any tools used in the assembly and disassembly of the sampler should be cleaned before and after each use. Equipment should be cleaned by scrubbing with a stiff brush using a laboratory-grade detergent/water solution, followed by rinsing with clean, potable water, then rinsing with distilled or deionized water. Alternatively, the equipment may be steam cleaned followed by rinsing with distilled or deionized water. An acid rinse (0.1 N HCl) or solvent rinse (i.e., hexane or methanol) may be used to supplement these cleaning steps if tarry or oily deposits are encountered. The acid or solvent rinse will be followed by thoroughly rinsing with water and then with distilled or deionized water. After cleaning, equipment will be packaged and sealed in plastic bags or other appropriate containers to minimize contact with dust or other contaminants.

3.2 Record Review

The project manager or designated QA reviewer should check and verify that documentation has been completed and filed per this procedure and the other procedures referenced herein.

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 6

SAMPLE CUSTODY, PACKAGING AND SHIPMENT

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) generally describes the protocol to be followed for sample custody, packaging and shipment. Appropriate revisions may be made when approved by the PBW Project Manager.

This SOP applies to any liquid or solid sample that is being transported by the sampler, a courier or an overnight delivery service.

2.0 PROCEDURES

The objectives of this packaging and shipping SOP are: to minimize the potential for sample breakage, leakage or cross contamination; to provide for preservation at the proper temperature; and to provide a clear record of sample custody from collection to analysis.

2.1 Packaging Materials

The following is a list of materials that are typically needed to facilitate proper sample packaging:

- Chain-of-Custody Record forms (Figure SOP-6-1, or as provided by the laboratory);
- Coolers (insulated ice chests) or other shipping containers as appropriate to sample type;
- Transparent packaging tape;
- Zip-lock type bags (note: this is used as a generic bag type, not a specific brand name);
- Protective wrapping and packaging material; and
- Contained ice (packaged and sealed to prevent leakage when melted) or "Blue Ice".

2.2 Sample Custody from Field Collection to Laboratory

After samples have been collected, they will be maintained under chain-of-custody procedures. These procedures are used to document the transfer of custody of the samples from the field to the designated analytical laboratory. The same chain-of-custody procedures will be used for the transfer of samples from one laboratory to another, if required.

The field sampling personnel will complete a Chain-of-Custody Record and Request for Analysis (CC/RA) form (Figure SOP-6-1 or the CC/RA form provided by the laboratory) for each separate container of samples to be shipped or delivered to the laboratory for chemical or physical (geotechnical) analysis. Information contained on the form will include:

1. Project identification;
2. Date and time of sampling;
3. Sample identification;
4. Sample matrix type;
5. Sample preservation method(s);
6. Number and types of sample containers;
7. Sample hazards (if any);
8. Requested analyses;
9. Requested sample turnaround time;
10. Method of shipment;
11. Carrier/waybill number (if any);
12. Signature of sampling personnel;
13. Name of PBW Project Manager;
14. Signature, name and company of the person relinquishing and the person receiving the samples when custody is being transferred; and
15. Date and time of sample custody transfer.

The sampling personnel whose signature appears on the CC/RA form is responsible for the custody of a sample from time of sample collection until the custody of the sample is transferred to a designated laboratory, a courier, or to another PBW employee for the purpose of transporting a sample to the designated laboratory. A sample is considered to be in their custody when the custodian: (1) has direct possession of it; (2) has plain view of it; or (3) has securely locked it in a restricted access area.

Custody is transferred when both parties to the transfer complete the portion of the CC/RA form under "Relinquished by" and "Received by." Signatures, printed names, company names, and date and time of custody transfer are required. Upon transfer of custody, the PBW sampling personnel who relinquished the samples will retain a copy of the CC/RA form. When the samples are shipped by a common carrier, a Bill of Lading supplied by the carrier will be used to document the sample custody, and its identification number will be entered on the CC/RA form.

2.3 Packaging and Shipping Procedure

Be sure that all sample containers are properly labeled and all samples have been logged on the CC/RA form in accordance with the procedures explained above.

All samples should be packed in the cooler so as to minimize the possibility of breakage, cross-contamination and leakage. Before placing the sample containers into the cooler, be sure to check all sample bottle caps and tighten if necessary. Bottles made of breakable material (e.g., glass) should also be wrapped in protective material (e.g., bubble wrap, plastic gridding, or foam) prior to placement in the cooler. Place the sample containers upright in the cooler. Avoid stacking glass sample bottles directly on top of each other.

If required by the method, samples should be preserved to 4°C prior to the analysis. Water ice or "blue ice" may be used to keep the sample temperatures at 4°C. The ice may be placed in zip-lock bags between and on top of the sample containers to maximize the contact between the containers and the bagged ice.

If there is any remaining space at the top of the cooler, packing material (e.g., styrofoam pellets or bubble wrap) should be placed to fill the balance of the cooler. After filling the cooler, close the top and shake the cooler to verify that the contents are secure. Add additional packaging material if necessary.

When transport to the laboratory by the PBW sampler is not feasible, sample shipment should occur via courier or overnight express shipping service that guarantees shipment tracking and next morning delivery (e.g., Federal Express Priority Overnight). In this case, place the chain-of-custody records in a zip-lock bag and place the bag on top of the contents within the cooler. Tape the cooler shut with packaging tape. Packaging tape should completely encircle the cooler.

2.4 Documentation and Records Management

The CC/RA form, Daily Field Records, or a field notebook with field notes may be kept describing the packaging procedures and the method of shipments. Copies of all chain-of-custody records and CC/RA forms (Figure SOP-6-1) will be retained in the project files. CC/RA forms provided by the laboratory will be acceptable as well.

3.0 QUALITY ASSURANCE

The Project Manager or designated QA reviewer should check and verify that documentation has been completed and filed per this procedure.

FIGURE SOP-6-1. CHAIN-OF-CUSTODY RECORD AND REQUEST FOR ANALYSIS

CHAIN-OF-CUSTODY RECORD AND REQUEST FOR ANALYSIS

PBW, LLC. COC No. ______________

Round Rock Office
2201 Double Creek Drive, Suite 4004
Round Rock, TX 78664
TEL: (512) 671-3434
FAX: (512) 671-3446

PROJECT NO.: ______________ PROJECT NAME: ______________________________ PAGE: _____ OF: _____

SAMPLER (Signature): ______________ PROJECT MANAGER: ______________________ DATE: ____________

METHOD OF SHIPMENT: ______________ CARRIER/WAYBILL NO.: ______________ DESTINATION: ____________

SAMPLES														ANALYSIS REQUEST								
		Sample Collection			Preservation						Containers			Constituents/Methods					Handling			Remarks
Lab No.	Field Sample Identification	DATE	TIME	Matrix*	HCl	HNO_3	H_2SO_4	COLD		FILTRATION*	VOLUME (ml/oz)	TYPE*	NO.						HOLD	RUSH	STANDARD	
						TOTAL NUMBER OF CONTAINERS								LABORATORY COMMENTS/CONDITION OF SAMPLES								Cooler Temp:

RELINQUISHED BY:			DATE	TIME	RECEIVED BY:		
SIGNATURE	PRINTED NAME	COMPANY			SIGNATURE	PRINTED NAME	COMPANY
							LABORATORY

*KEY: Matrix: AQ - aqueous NA - nonaqueous SO - soil SL - sludge P - petroleum A - air OT - other Containers: P - plastic G - glass T - teflon B - brass OT - other Filtration: F - filtered U - unfiltered

DISTRIBUTION: PINK: Field Copy YELLOW: Laboratory Copy WHITE: Return to Originator

Pastor, Behling & Wheeler,

STANDARD OPERATING PROCEDURE No. 7

INSTALLATION OF MONITORING WELLS AND PIEZOMETERS

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed during installation of monitoring wells and piezometers by PBW. The procedures presented herein are intended to be general in nature. As site-specific conditions become known, appropriate modifications of the procedures may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Monitoring Well Installation

Each monitoring well will be designed to register the potentiometric surface and to permit water sampling of a specific depth zone encountered beneath the drill site. Separate monitoring wells may be completed, as necessary, in the different water-yielding zones underlying the site. The PBW field supervisor, in consultation with the PBW Project Manager as needed, will specify the exact depths of screened intervals using the lithologic log and geophysical log (if performed) for control. Drilling and logging of the exploratory borings for the monitoring wells will be conducted in accordance with PBW SOP No. 2 entitled Supervision of Exploratory Borings. Construction and completion of all monitoring wells will be in general conformance with the following procedures. Specific monitoring well completion requirements may vary in accordance with project-specific work plans and/or local regulatory agency guidance.

2.1.1 Screens and Riser Casing

The monitoring well assembly shall consist of flush joint, threaded casing composed of mild steel, stainless steel or polyvinyl chloride (PVC) Schedule 40 (minimum). The threaded joints will have O-ring seals. Steel casing joints may be welded rather than threaded. The inside diameter of both the perforated and unperforated casing will be sufficiently large to permit easy passage of an appropriate water-level probe, equipment for development and purging of wells, and for collection of groundwater samples.

The perforated casing (well screen) will be factory slotted. The perforations will be compatible in size with the selected filter material. These perforated casing sections are generally not intended to provide optimum flow but only to provide hydraulic connection between the pervious material in the water-yielding zone and the monitoring well.

Prior to well construction, the PBW field supervisor will inspect the blank and perforated casing delivered to the job site to verify that it meets the project specifications.

When the total depth of a boring has been reached, and prior to installation of the well casing, the PBW field supervisor will measure and record the depth to water in the borehole.

Upon completion of drilling and/or geophysical logging, the monitoring well casing and screen will be assembled and lowered to the bottom of the boring. The monitoring well assembly will be designed so that the well screen is approximately adjacent to the water-yielding zone that is to be monitored. The bottom of the screen will be approximately flush with the bottom of the well and will be closed with a threaded PVC cap or plug, or a slip cap secured with stainless steel screws. No PVC cement or other solvents are permitted to be used to fasten the joints of the casing or screen. Centralizers spaced at the top and bottom of the screened interval and not more than 40 feet apart along the casing may be used to center the well assembly in the borehole, unless the boring is drilled by a low annular space method and the well is installed with the drill casing in place. Wells installed prior to pulling low annular space drill casing will be centered by the inside walls of the drill casing.

If well casing assembly is being performed by a drilling subcontractor, the PBW field supervisor will observe and inspect the assembly, insuring that the bottom cap is threaded or secured with stainless steel screws, O-rings are properly placed in the joints, the joints are completely tightened, and the blank and perforated intervals are constructed as specified. The PBW field supervisor will measure the location of the top and bottom of the perforated interval by measuring the distances from the joint above the perforated interval to the top slot and from the base of the bottom cap to the bottom slot.

When using the mud rotary drilling technique, after the monitoring well assembly has been lowered to the specified depth, clean water may be circulated downward through the well casing and upward through the annular space between the borehole wall and the monitoring well casing. Circulation will continue until the suspended sediment in the return fluid has been thinned.

If the well is greater than 50 feet deep, the casing assembly will be held under tension prior to and during emplacement of the filter pack and seal.

2.1.2 Filter Material

Filter material will be a well-graded, clean sand with less than 2 percent by weight passing a No. 200 sieve and less than 5 percent by weight of calcareous material.

Filter sand will be placed in the annular space using a one-inch diameter (or larger) pipe, in a calculated quantity sufficient to fill the annular space to a level of about two feet above the top of the perforated casing. The required height of the filter pack above the top of the perforated casing may vary by jurisdiction. The depth to the top of the filter pack should be verified by measuring, using the tremie pipe or a weighted steel tape. When use of a tremie pipe is not feasible, the filter sand may be poured slowly between the well casing and the inside walls of the auger, and the drill casing may be removed in stages.

2.1.3 Seal

Once the depth to the top of the filter pack has been verified, a layer of bentonite pellets or chips will be emplaced by pouring the pellets into the annular space in a calculated quantity sufficient to fill the annular space to a level at least one foot above the top of the filter pack. The depth to the top of the bentonite pellets/chips layer should be verified by measuring, using the tremie pipe or a weighted steel tape. When the bentonite pellets/chips are placed above the zone of saturation, they should be hydrated, after they have been emplaced, by adding clean, potable water. Approximately 1 gallon of water should be added for every foot of bentonite pellets/chips, which should be slowly poured into the borehole annualus to hydrate the pellets/chips. More water may be required when completing a well in relatively permeable material. The bentonite pellets/chips should be hydrated in lifts no greater than 3 feet.

A bentonite/cement grout seal or other approved sealant should be emplaced above the bentonite pellet layer after it has been allowed to hydrate for a minimum of ½ hour. If the depth to the top of the bentonite pellet layer is dry and is less than approximately 10 feet deep, the grout may be poured slowly from the ground surface into the annular space. The grout should be added in one continuous pour before its initial set. If the depth is greater than approximately 10 feet deep, or if

more than two feet of water is present in the annular space, the grout should be placed in one continuous pour by pumping through a tremie hose or pipe. The tremie hose or pipe initially should be placed near the top of the bentonite seal and shall remain submerged in the grout during the entire grouting operation. When constructing a well or piezometer inside a low annular space drill casing, the drill casing may be used as a tremie pipe by pouring the grout down the annular space between the well casing and the inner wall of the drill casing. Grout should continue to be pumped until return of fresh grout is observed at the ground surface.

The bentonite/cement grout mix should generally consist of one (1) sack of Type I-II Portland cement, five (5) percent by weight (of cement) of powdered bentonite, per 8.5 gallons of water. If a high-yield bentonite (trade names Quik-Gel, Super Gel X, etc.) is used, the powdered bentonite percentage may be reduced to two (2) percent. An alternative grout mixture may be used if approved by the applicable regulatory agency and the PBW Project Manager. Only clean water from a potable supply will be used to prepare the grout. The grout seal will extend from the top of the bentonite seal to near the ground surface. After grouting, no work will be done on the monitoring well until the grout has set for a minimum of 24 hours.

When the casing hammer air rotary or similar method is used to complete the borehole for a monitoring well, the protective casing will be jacked out of the borehole gradually as the filter pack, bentonite seal, and cementing operations are in progress.

2.1.4 Capping Monitoring Well

Upon completion of the work, a suitable watertight, cap or plug will be fitted on the top of the well casing to prevent the entry of surface runoff or foreign matter. The well will be completed either: (1) above the ground surface using a locking, steel protective well cover set in concrete; or (2) below the ground surface using a watertight, traffic-rated valve-box with a bolt-down cover.

2.2 Piezometer Installation

The piezometer should be designed to register the potentiometric surface of a specific depth zone encountered beneath the drill site. The PBW field supervisor, in consultation with the PBW Project Manager, will specify the exact depths of the piezometers using the lithologic log and geophysical log (if performed) for control. Drilling and logging of the boreholes for the piezometers will be in conformance with PBW SOP No. 2 entitled SUPERVISION OF

EXPLORATORY BORINGS. Construction, completion and development of the piezometers will generally follow the same procedures as those for monitoring wells (see Section 2.0 above), except that a piezometer may be completed with casing material of less than two inches in diameter and may use a porous tip (ceramic or other material) in place of perforated casing.

2.3 Documentation and Records Management

The PBW field supervisor will complete a Well Construction Summary form for each monitoring well (Figure SOP-7-1). The completed form should be included in the project files. In addition to the information requested on the Well Construction Summary form, the PBW field supervisor should record the volumes and types of well construction materials (filter material, bentonite, cement, etc.) used for each well in their field notes. Also, the daily events and other items not covered in the Well Construction Summary form will be entered on a Daily Field Record form in accordance with the procedures contained in PBW SOP No. 1 entitled Field Documentation.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

3.1 Cleaning of Equipment Used in Drilling, Well Construction

The drilling equipment will be thoroughly steam cleaned before and after installation of each monitoring well or piezometer. Only clean, potable water will be used as makeup water for drilling fluid and for decontamination of drilling equipment. An acid rinse (0.1 N HCl) or solvent rinse (i.e., hexane or methanol) may be used to supplement the steam cleaning if tarry or oily deposits are encountered. Equipment cleaned in this manner will be thoroughly steam cleaned prior to reuse or leaving the site.

Well casing that is not factory cleaned and in a sealed container be steam cleaned thoroughly before it is installed. After cleaning, the casing will be covered with plastic to protect it from contact with dust or other contaminants.

Equipment should be cleaned by scrubbing with a stiff brush using a laboratory-grade detergent/water solution, followed by rinsing with clean, potable, municipal water, then rinsing with distilled or deionized water. Alternatively, the equipment may be steam cleaned followed by rinsing with distilled or deionized water. An acid rinse (0.1 N HCl) or solvent rinse (i.e., hexane or methanol) may be used to supplement these cleaning steps if tarry or oily deposits are encountered. The acid or solvent rinse will be followed by thoroughly rinsing with municipal water and then with distilled or deionized water. After cleaning, equipment will be packaged and sealed in plastic bags or other appropriate containers to minimize contact with dust or other contaminants.

3.2 Records Review

The Project Manager or designated QA reviewer should check and verify that documentation has been completed and filed per this procedure.

FIGURE SOP-7-1. WELL CONSTRUCTION SUMMARY FORM

Well Completion

WELL CONSTRUCTION SUMMARY

Well (number, ID, etc.) _____

Project: _____ Location: _____

Staff: Supervisor:

Elevation: Ground Level _____

Top of Casing:

DRILLING SUMMARY

Total Depth: _____ Borehole Dia.: _____

Driller: _____ Driller's Number: _____

Rig: _____ Bit(s): _____

Drilling Company: _____

Drilling Fluid:

WELL DESIGN:

Basis: Geologic Log _____ Geophysical Log _____

Casing String(s): C= CASING S= SCREEN

_____ - _____ _____ _____ - _____ _____

_____ - _____ _____ _____ - _____ _____

_____ - _____ _____ _____ - _____ _____

_____ - _____ _____ _____ - _____ _____

_____ - _____ _____ _____ - _____ _____

CASING: C1 _____

C2 _____

C3 _____

C4 _____

SCREEN: S1 _____

S2 _____

CENTRALIZERS: _____

FILTER MATERIAL: _____

BENTONITE SEAL: _____

CEMENT: _____

OTHER: _____

CONSTRUCTION TIME LOG

TASK	START		FINISH	
Drilling:				
Geoph. Logging:				
Casing:				
Filter Placement:				
Bentonite Seal:				
Grout:				
Development:				
Other:				
Surface Comp.:				

DECONTAMINATION: _____

COMMENTS: _____

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Pastor, Behling& Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 8

MONITORING WELL DEVELOPMENT

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed during the development of groundwater monitoring wells. Monitoring wells must be developed before they are used to collect groundwater samples. The procedures presented are intended to be general in nature. As site-specific conditions become known, appropriate modifications of the procedures may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Development Procedure

After construction of the monitoring well is complete, the well may be developed by surging, bailing and/or pumping (e.g., positive displacement hand pump, electric pump or pneumatic pump). Typically, at least 24 hours should pass between completion of grouting of the monitoring well and development to allow sufficient curing of the grout.

The total depth of the well should be measured in accordance with the procedures described in PBW SOP No. 9 entitled Water Level, Immiscible Layer and Well Depth Measurement. The presence of sediment at the bottom of the well may be checked using a stainless steel bailer or positive displacement hand pump. Water and sediment should first be removed from the bottom of the well to ensure that the entire screened interval is open for water to flow into the well. The well should be bailed or pumped until the water removed from the bottom of the well is relatively free of sediment. If a bailer is used, care must be taken to avoid breaking the bottom cap on the well casing.

After most of the sediment has been removed from the bottom of the well, a well development pump (positive displacement hand pump, electric pump or pneumatic pump) may be used to remove water from the well. Initially, the intake of the pump should be at the bottom of the well. The pump intake should be raised in two- to three-foot increments to the top of the water column after approximately one-half of a casing volume of water has been removed from each interval.

Next, a surge block constructed of non-reactive material (usually stainless steel or PVC) may be used to develop the well screen by forcing water in and out of the screened area. The surge block should be moved up and down in one-to two-foot increments creating a suction action on the upstroke and a pressure action on the downstroke. Development should begin at the top of the water column and move progressively downward to prevent the surge block from becoming sand locked. After surging to the bottom of the well, the surge block should be moved progressively upward to the top of the water column.

If necessary, water may be added to the well to facilitate surging. This water should be distilled deionized or "clean" potable water. The volume of de-ionized water added to the well should be noted on the Well Development Record form (Figure SOP-8-1).

After surging, the surge block should be removed and replaced with the pump or bailer. The intake of the pump or bailer should be at the bottom of the well to remove any sediment that may have collected in the bottom of the well. The pump intake should again be raised in two- to three-foot increments to the top of the water column after approximately one-half of a casing volume of water has been removed from each interval.

During development, the pH, specific conductance and temperature of the purge water may be periodically measured and documented on a Well Development Record form. Parameter readings should be collected and noted for every casing volume of water removed from the well.

The well may be alternately surged and pumped until the field water quality parameters have stabilized to within 10% for specific conductance, 0.05 pH units for pH, and 1EC for temperature, and the water is relatively clear and free of sediment.

Water removed during well development should be temporarily stored in steel drums, a portable storage tank or other approved storage container. Final disposal of all water generated during development procedures will be conducted in accordance with all legal requirements and with procedures discussed in PBW SOP No. 14 entitled Storage and Disposal of Soil, Drilling Fluids, and Water Generated During Field Work.

2.2 Documentation and Records Management

A Well Development Record should be filled out by the PBW Field Supervisor for each well developed. Also, the daily events and other items not covered in the Well Development Record

should be entered on a Daily Field Record form in accordance with the procedures contained in PBW SOP No. 1 entitled Field Documentation.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

3.1 Equipment Cleaning

All reusable equipment used in developing the monitoring well should be cleaned prior to and following use. Cleaning should be accomplished by either (1) washing with a laboratory-grade detergent/water solution, rinsing with clean, potable water, then rinsing with distilled or deionized water; or (2) steam cleaning followed by rinsing with distilled or deionized water. An acid rinse (0.1 N HCl) or solvent rinse (i.e., hexane or methanol) may be used to supplement these cleaning steps if tarry or oily deposits are encountered. The acid or solvent rinse will be followed by thoroughly rinsing with water. After final cleaning, equipment should be packaged and sealed in plastic bags or other appropriate containers to minimize contact with dust or other contaminant when not in use.

3.2 Records Review

The Project Manager or designated QA reviewer should check and verify that documentation has been completed and filed per this procedure.

FIGURE SOP-8-1. WELL DEVELOPMENT RECORD

WELL DEVELOPMENT RECORD

PAGE _____ of _____

Project Number: Project Name: Date:

Well Location (well ID, etc.):

Developed by:

Measuring Point (MP) of Well:

Screened Interval (ft. BGL):

Filter Pack Interval (ft. BGL):

Starting Water Level (ft. BMP): _____

Casing Stickup (ft.): _____

Starting Water Level (ft. BGL): _____

Total Depth (ft. BGL): _____

Casing Diameter (In ID): _____

Casing Volume (gal.):

QUALITY ASSURANCE

METHODS (describe):

Cleaning Equipment: _____

Purging: _____ Surge Equipment: _____

Disposal of Discharged Water:

INSTRUMENTS (Indicate make, model, I.d.)

Water Level: _____ Thermometer: _____

pH Meter: _____ Field Calibration: _____

Conductivity Meter: _____ Field Calibration: _____

Other:

DEVELOPMENT MEASUREMENTS

Time	Flow		Water Quality			Appearance		Remarks
	Cum. Vol. (gal. / L)	Purge Rate (gal. / L pm)	Temp. (°C)	pH	Spec. Cond. (µmhos/cm)	Color	Turbidity & Sediment	

Total Discharge (gallons):

Observations/Comments:

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Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 9

WATER LEVEL, IMMISCIBLE LAYER AND WELL DEPTH MEASUREMENT

1.0 SCOPE AND APPLICABILTIY

This Standard Operating Procedure (SOP) describes the protocol to be followed during measurement of water levels, immiscible layer and well depths in monitoring wells and piezometers. As the work progresses and when warranted, appropriate revisions may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

Before measuring fluid levels, the construction details and previous measurements for each well or piezometer shall be reviewed by the PBW field supervisor so any anomalous measurements may be identified. Well construction details and previous measurements shall be available in the field for review.

In general, fluid-level measurements shall be performed before groundwater is removed from the well by purging or sampling.

2.1 Equipment

Equipment that may be necessary to perform measurements includes:

- Well/piezometer construction details;
- Interface probe; and
- Fluid- Level Monitoring Record Sheet (From SOP 9-1);

2.2 Measuring Point

A measuring point (MP) shall be selected and marked for each monitoring well and piezometer in which water level measurements will be made. Generally, the MP will be the top of the well casing on the north side. The MP will be permanently marked using an indelible marker or a notch cut into the PVC casing. When the top-of-casing elevation of a monitoring well or piezometer is surveyed, the licensed surveyor should measure the MP elevation and reference this measurement to an appropriate datum (such as feet above mean sea level).

2.3 Fluid-Level Measurements

Fluid levels in all wells will be measured with an interface probe because of the presence or potential presence of non-aqueous phase liquid (NAPL) in the well. All fluid level measurements will be recorded to the nearest hundredth of one foot. Note the instrument used for each measurement on the Fluid Level Monitoring Record (Figure SOP-9-1).

The procedure for measuring water levels with an electric probe is as follows:

1. Switch on.
2. Lower the electric cable into the well until the ammeter or buzzer indicates a closed circuit. An intermittent beep indicates the presence of a light NAPL (LNAPL) or phase-separated hydrocarbons (PSH). A continuous beep indicates water.
3. With the cable in this fixed position, note the depth to the LNAPL (if encountered) and water from the Measuring Point (MP).
4. As necessary, check the total depth of the well below the MP using the interface probe by slowly lowering the probe to the bottom of the well and noting the depth.
5. If dense NAPL (DNAPL) is suspected to be present in the well, measure the bottom of the well with the interface probe in the "on" position and note if there is a change in the probe tone or blinking light..
6. If NAPL is not encountered, put an "NP" in the PSH column to indicate that NAPL (both LNAPL and DNAPL) was not present in the well.

Record the NAPL or PSH thickness in the "PSH Thickness" column of the Fluid Level Monitoring Record (Figure SOP-9-1). If LNAPL is not detected using the interface

probe, but the presence of LNAPL is suspected, the presence of a very thin layer or sheen (too thin to be measured) may also be checked using a bottom-filling transparent bailer. The presence of a thin LNAPL layer is checked by lowering the bailer into the well. Care must be taken to not completely submerge the bailer. Retrieve the bailer and visually examine the air/liquid interface for the presence of an immiscible light-phase layer or sheen. Note that the transparent bailer is not to be used to measure the thickness of LNAPL in a well.

3.0 DOCUMENTATION AND RECORDS MANAGEMENT

Fluid levels observed in wells selected for the groundwater monitoring network should be tabulated on a Fluid Level Monitoring Record form during each monitoring period (Figure SOP-9-1). The date and time of each measurement should also be recorded on the Fluid Level Monitoring Record. All fluid-level measurements should be recorded to the nearest 0.01 feet.

Fluid-level data should be recorded as feet below measuring point so that water level elevations should calculated from the depth-to-water measurement (from measuring point) and the surveyed elevation of the measuring point at each well or piezometer.

If LNAPL is encountered during water level measurement, the measured thickness or observation shall be recorded in the "Depth to Product" column. Each form or, as appropriate, individual measurement data, should be signed to indicate the originator.

4.0 QUALITY CONTROL

4.1 Equipment Decontamination/Cleaning

The interface probe should be cleaned before and after each measurement. Cleaning should be accomplished by washing with a laboratory-grade detergent/water solution, rinsing with clean, potable, water, wiping or spraying with isopropyl alcohol (if needed), then rinsing with distilled or deionized water. After cleaning, equipment will be packaged and sealed in plastic bags or other appropriate containers to minimize contact with dust or other contaminants.

4.2 Technical and Records Reviews

The project manager or designated QA reviewer should check and verify that documentation has been completed and filed per this procedure.

In addition, all calculations of water-level elevations and NAPL correction to water-level elevations (if necessary) should be reviewed before they are submitted to the project file and used to describe site conditions. Technical personnel familiar with this procedure should perform the calculation review. Evidence of the completed review and any necessary corrections to calculations should also be included in the project file.

FIGURE SOP-9-1. FLUID LEVEL MONITORING RECORD

FLUID LEVEL MONITORING RECORD		DATE:
Project No.	Project Name:	PAGE ____ of ____
Weather Conditions:		
Measuring Device:	Datum (MSL, NGVD, etc.):	
Observations/Comments:		

Well ID	Time	MP Elevation (ft.)	Depth to Product (ft. BMP)	Depth to Water (ft. BMP)	PSH Thickness (ft.)	Total Depth (ft. BMP)	Water Elevation (ft)	Remarks

Measured By:	**Pastor, Behling & Wheeler, LLC** **2201 Double Creek Drive, Suite 4004** **Round Rock Texas** **Phone: (512) 671-3434 Fax: (512) 671-3446**
Checked By:	

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 10

WATER QUALITY SAMPLING

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed during sampling of groundwater. Appropriate revisions may be made to accommodate site-specific conditions or project-specific protocols when they are approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Groundwater Sample Collection

Individual samples from wells should be collected as follows:

A. The depth to water and the thickness or presence of a Non-Aqueous Phase Liquid (NAPL) in a well should be measured using the procedures discussed in the PBW SOP No. 9 (Water Level, Immiscible Layer and Well Depth Measurement).

B. As appropriate based on project requirements, a low-flow purge method or "micopurge" method should be used for sample collection. Wells should be purged at a low pumping rate to minimize agitation of water in the well and minimize drawdown. The goal is to limit drawdown in the well to less than 10 percent of the length of the saturated well screen. If the initial water level is above the top of the screen, then the goal is to limit drawdown due to purging so that the water level in the well does not drop below the top of the screened interval. Wells should be purged by pumping water at a rate less than 1 L per minute using a peristaltic pump. Bailers will not be used for purging of sampling wells. If during low-flow sampling the turbidity remains greater than 10 NTUs, the discharge from the pump will be filtered with an in-line 10 μm filter during sample collection. The in-line filter will be purged with approximately 200 mL of sample water before the laboratory container is filled.

C. At each well, the sample should be collected through a section of new, clean, flexible tubing.

D. For sampling active hydrocarbon recovery systems, the recovery pumps should be pulled from the well before sampling.

E. The sampling intake should be placed near the center of the well's screened interval or deeper if this reduces the chance of pumping LNAPL while purging the well.

F. Prior to collecting samples from a well, a clean plastic apron may be placed adjacent to or around the well to prevent equipment and sample containers from coming into contact with surface materials. Alternatively, a clean field table may be set up near the well. If used, the table will be cleaned before and after use at each well.

G. Sample containers prepared specifically for the required analyses by the analytical laboratory or their supplier should be used for sample collection. Glass sample bottles for non-volatile analyses should be filled to near the top. To account for slight expansion due to temperature changes, leave headspace approximately equivalent to the volume of liquid that would fill the bottle's cap. Plastic sample bottles should be filled completely. Splashing of the water in the sample container and exposure to the atmosphere should be minimized during sampling. The container cap should be screwed on tightly immediately after filling the sample container.

   Sample bottles that do not contain preservative should be rinsed with the sample water prior to filling.

H. Where more than one well within a specific field or site is to be sampled, the sampling sequence should begin with the well having the lowest suspected level of contamination. Successive samples should be obtained from wells with increasing suspected contamination. If the relative degree of suspected contamination at each well cannot be reasonably assumed, sampling should proceed from the perimeter of the site towards the center of the site. The sampling sequence should be arranged such that wells are sampled in order of increasing proximity to the suspected source of contamination, starting from the wells up-gradient of the suspected source.

I. Sampling activity for each monitoring well should be recorded on a Groundwater Sampling Record (Figure SOP-10-1).

2.2 Sample Filtration

When a filtered surface water sample is required, a sample should be collected using a disposable, in-line 0.45 μm filter. The water sample will be pumped through the filter using a peristaltic pump and a section of polyvinylchloride tubing or other appropriate method. An aliquot of approximately 200 ml of sample will be run through the tubing and filter prior to collection into the sampling containers. Both the filter and tubing will be disposed of between samples.

2.3 Sample Containers and Volumes

Sample containers and volumes should be selected based on the target analytical suite for each sample.

2.4 Sample Labeling

Sample containers will be labeled with self-adhesive tags. Each sample will be labeled with the following information using waterproof ink.

A. Project identification;

B. Sample identification;

C. Date and time samples were obtained;

D. Requested analyses and method;

E. Treatment (preservative added, filtered, etc.); and

F. Initials of sample collector(s).

2.5 Sample Preservation and Storage

As required based on the target analytes, water samples submitted for chemical analysis should be stored at 4° C in ice-cooled, insulated containers immediately after collection. The samples may be delivered to the laboratory soon after they are collected, in which case the water samples may not have had sufficient time to cool to 4° C. In these

instances, the samples will be considered properly preserved as long as they were placed on ice immediately after they were collected.

2.6 Sample Custody

Samples should be handled and transported according to the sample custody procedures discussed in PBW SOP No. 6 entitled Sample Custody, Packaging, and Shipment. The sample collector shall document each sample on the Chain-of-Custody and Request for Analysis form (Figure SOP-6-1).

2.7 Field Measurements

Specific conductance, pH, temperature and turbidity measurements may be performed on water samples at the time of sample collection. Data obtained from these (or other) field water quality measurements will be recorded on the appropriate sampling records. Separate aliquots of water shall be used to make field measurements (i.e., sample containers for laboratory analysis shall not be reopened).

For groundwater samples, at least three field measurements should be taken during the course of micro-purging the well. If the parameters have not stabilized at that time, field measurements and purging will continue until two consecutive readings have stabilized to within the following limits:

- Temperature: +/-1° C
- pH: +/-0.1 pH units
- Specific conductance: +/-10%
- Turbidity: +/- 10%

The procedures for collecting the listed field parameters are discussed in the following sections.

2.7.1 Temperature Measurement

Temperature should be measured directly from the water source or from a separate sample aliquot. Temperature measurements should be made with a mercury-filled thermometer, bimetallic-element thermometer or electronic thermistor (usually included with the pH and/or conductivity meter). Measurements should be recorded in degrees Celsius (°C).

2.7.2 pH Measurement

A pH measurement should be made by dipping the probe directly into the water source or into a separate sample aliquot. The preferable method is to collect measurements through a flow-thru cell. Prior to measurement, the container in which the field parameter sample will be collected should be acclimated to the approximate temperature of the sample. This can be accomplished by immersing the container in water removed from a well during the purging process. The pH measurement should be made within a few minutes after collection of the field parameter sample using a pH electrode. The value displayed on the calibrated instrument should be recorded after the reading has stabilized. If the value falls outside of the calibrated range, then the pH meter should be recalibrated using the appropriate buffer solutions.

2.7.3 Specific Conductance Measurement

Specific conductance should be measured by dipping the probe directly into the water source or into a separate sample aliquot. The probe must be immersed to the manufacturer's recommended depth. Specific conductance is reported in micromhos/cm at 25° C.

The value displayed on the calibrated instrument should be recorded after the reading has stabilized. If the value falls outside of the calibrated "range" set by the range dial on the instrument, then the range setting should be changed to a position that gives maximum definition. If the specific conductance value falls outside of the calibrated range of the

conductivity standard solution, then the instrument should be recalibrated using the appropriate standard prior to measurement.

2.7.4 Turbidity

The turbidity meter will be operated according to the manufacturer's instructions. Turbidity measurements are taken in nephelometric turbidity units (NTUs), which are generally read to the nearest 0.1 NTUs, if possible. When using a turbidimeter, make sure the glass sample vial is very clean, does not have condensation on it, and that there are few, if any, air bubbles present in the sample. These factors can all interfere with turbidity readings. In addition, if soluble compounds in the sample begin to precipitate out of solution (e.g., dissolved iron or manganese), then the turbidity measurements may be artificially high. If a turbidimeter is not available, turbidity can be measured qualitatively by indicating whether the sample has very little turbidity, moderate turbidity or is very turbid, or by a similar descriptive method. Keep in mind that this is a subjective and qualitative way to measure turbidity.

2.7.5 Equipment Calibration

Equipment used to measure field parameters should be calibrated by PBW personnel according to manufacturer's instructions. Calibration checks should be performed at least once prior to and at least once following each day of instrument use in the field and the results should be documented on the Sampling Record for each sampling station.

3.0 DOCUMENTATION

When the sampling activity is completed, the sampling records (Groundwater Sampling Record (Figure SOP-10-1) or Surface Water Sampling Record (Figure SOP-10-2)) should be checked by the PBW Project Manager or his/her designee, and the original record placed in the PBW project file. The following sections discuss the information that should be documented during groundwater or surface water sampling activities.

3.1 Groundwater Sampling Record

Each sampling event for each monitoring well will be recorded on a separate Groundwater Sampling Record form (Figure SOP-10-1). The documentation should include the following:

A. Project identification;

B. Location identification;

C. Sample identification(s) (including quality control samples);

D. Date and time of sampling;

E. Purging and sampling methods;

F. Sampling depth;

G. Name(s) of sample collector(s);

H. Inventory of sample bottles collected including sample preservation (if any), number, and types of sample bottles;

I. Total volume of water purged;

J. Results of field measurements and observations (time and cumulative purge volume, temperature, pH, specific conductance, turbidity, sediment, color, purge rate);

K. Equipment cleaning record;

L. Description and identification of field instruments and equipment; and

M. Equipment calibration record.

3.2 Surface Water Sampling Record

Activities for each surface water sample collected will be recorded on a separate Surface Water Sampling Record form (Figure SOP-10-2). The documentation should include the following:

A. Project identification;

B. Name(s) of sample collector(s);

C. Weather conditions (current and previous 48 hours);

D. Location identification and type of water body;

E. Sample identification(s) (including quality control samples);

F. Date and time of sampling;

G. Sampling methods;

H. Size, configuration of the water body sampled;

I. Flow estimates, if necessary;

J. Sampling depth, depth of water body;

K. Results of field measurements and observations (time, temperature, pH, specific conductance, turbidity, suspended sediment, color; conductivity/salinity, etc.);

L. Inventory of sample bottles collected including sample preservation (if any), number, and types of sample bottles;

M. Total volume of water purged;

N. Equipment cleaning record;

O. Description and identification of field instruments and equipment; and

P. Equipment calibration record.

4.0 QUALITY CONTROL

4.1 Chain-of-Custody and Request for Analysis Form

A Chain-of-Custody and Request for Analysis form (CC/RA form) should be filled out as described in PBW SOP No. 6.

4.2 Equipment Cleaning

Sample bottles and bottle caps should be cleaned and prepared by the analytical laboratory or their supplier using standard EPA-approved protocols. Sample bottles and

bottle caps will be protected from dust or other contamination between time of receipt by PBW and time of actual usage at the sampling site.

4.3 Records Review

The PBW Project Manager or designated QA reviewer should check and verify that documentation has been completed and filed per this procedure.

FIGURE SOP-10-1. GROUNDWATER SAMPLING RECORD

GROUNDWATER SAMPLING RECORD

PAGE _____ of _____

Project Number: Project Name: Date:

Sample Number:
Sampling Location (well ID, etc.):
Sampled by:
Measuring Point (MP) of Well:
Screened Interval (ft. BGL):
Filter Pack Interval (ft. BGL):

Starting Water Level (ft. BMP):
Casing Stickup (ft.):
Starting Water Level (ft. BGL):
Total Depth (ft. BGL):
Casing Diameter (In ID):
Casing Volume (gal.):

QUALITY ASSURANCE

METHODS (describe):
Cleaning Equipment:
Purging: Sampling:
Disposal of Discharged Water:

INSTRUMENTS (Indicate make, model, I.d.)

Water Level: Thermometer:
pH Meter: Field Calibration:
Conductivity Meter: Field Calibration:
Filter / Filter Size: Other:

SAMPLING MEASUREMENTS

Time	Cum. Vol. (gal. or L)	Purge Rate (gal. or L /m)	Temp. (oC)	pH	Spec. Cond. (mmhos/cm)	D.O.	Redox (mV)	Turbidity & Color	Water Depth (ft BMP)

Water Level (ft. BMP) at End of Purge: Sample Intake Depth (ft. BMP):

SAMPLE INVENTORY

Bottles Collected				Filtration (Y / N)	Preservation	Remarks (quality control sample, other)
Time	Volume	Composition (G, P)	No.			

Comments:

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FIGURE SOP-10-2. SURFACE WATER SAMPLING FORM

SURFACE WATER SAMPLING RECORD

SAMPLE NUMBER:

Project No:_____ Project Name:_____ Page _____ of: _____

Sampled by _____ Date: _____

Weather (@ sampling): _____ Weather (past 48 hrs.) _____

Sampling Location (i.d., description): _____

Water Body (describe type, flow):

QUALITY ASSURANCE

METHODS (describe):

Cleaning Equipment: _____

Sampling: _____

INSTRUMENTS (indicate make, model, i.d.):

Flow Measurement: _____ Thermometer: _____

pH Meter: _____ Field Calibration: _____

Conductivity Meter: _____ Field Calibration: _____

Filtration: Other:

SAMPLING MEASUREMENTS

Time	Sampling Depth (ft.)	Water Quality Data				Appearance		Remarks (debris, sheen, etc.)
		Temp. (°C)	pH	Specific Conductance (μmhos/cm) @ Field Temp.	Specific Conductance (μmhos/cm) @ 25° C.	Color	Turbidity & Sediment	

Flow @ Sampling Point (units): Total Depth @ Sampling Point (Ft.):

SAMPLE INVENTORY

Bottles Collected				Filtration (Y/N)	Preservation (type)	Remarks (quality control sample, other)
Time	Volume	Composition (glass, plastic)	Quantity			

SAMPLING LOCATION MAP

(ref. permanent landmarks, indicate scale, approx. North, flow)

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STANDARD OPERATING PROCEDURE No. 11

FIELD MEASUREMENT OF OXIDATION-REDUCTION POTENTIAL (ORP)

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed for the field measurement of oxidation-reduction potential in water samples. If necessary to accommodate specific field conditions, modifications of these procedures may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Explanation of Method

The potential difference measured between an indicator electrode and a reference electrode in a water sample is the oxidation-reduction potential (ORP) of the water. Indicator electrodes are typically made of platinum and reference electrodes are commonly either calomel or Ag/AgCl electrodes with a KCl electrolyte solution. The reference electrode provides a constant electrode potential for comparison to the potential at the platinum electrode.

The oxidation-reduction potential of water samples is most commonly reported relative to the standard hydrogen electrode, as Eh. Therefore, the oxidation-reduction potential of a water sample measured using a platinum indicator electrode and reference electrode must be corrected for the half-cell potential of the reference electrode in order to provide an Eh estimate for the water.

2.2 Instrumentation and Equipment

Typically, measurement of ORP requires the following equipment:

1. pH meter reading millivolts **OR** ORP meter such as Orion Model 98-75

2. Combination ORP electrode (Pt electrode with reference electrode) **OR** Reference electrode[1] (calomel or Ag/AgCl) and platinum electrode

3. Reference electrode filling solution, as required for some combination ORP electrodes[2]

4. Calibration standard (Zobell or Light's solution)

5. Clean (e.g., deionized) water for probe cleaning

6. Squeeze bottle for clean water

7. Clean container for sample water during measurement

8. Electrode cleaning solution

2.3 Instrument Checks

It is not possible to calibrate ORP electrodes over a range of conditions. Instead, standard solutions of known redox potential for specific indicator electrodes (i.e., Pt electrode) are used to check the electrode response at the temperature of measurement. Calibration checks should be performed and recorded on the Eh Data Sheet (Figure SOP-11-1) prior to each sample measurement as follows:

1. Assemble meter with either combination ORP electrode or set of platinum and reference electrodes.

2. If needed, select appropriate filling solution and fill reference electrode with fresh solution.

3. Place standard solution in clean container.

4. Measure and record temperature of standard solution (T_1) in degrees C.

5. For Zobell's solution, calculate the theoretical potential at the measured temperature using the following equation:

$$Eh_{(Zobell)} = 428 + 2.2*(25 - T) = \_\_\_\_\_ \text{ mV}$$

---

1 The reference electrode and the filling solution must be recorded with ORP measurements.

2 If a combination ORP electrode is used, it may be possible to select the appropriate electrolyte filling solution for the reference electrode. For sample waters of low ionic strength (< 10,000 mg/L TDS), use the filling solution that matches the potential of a calomel electrode. For higher ionic strength waters (> 10,000 mg/L TDS), use 4N KCl saturated with Ag/AgCl.

6. For Light's solution, the theoretical potential at 25°C is **675 mV**. *(note: no temperature correction data available for Light's solution)*

7. Measure and record the potential of the standard solution in mV.

8. Correct the measured potential of Zobell's solution for the half-cell potential of the reference electrode using the potential of the reference electrode for the temperature of measurement (T_1) given in Table 1 below.

$Eh_{(Standard)} = E_{(Standard)}$, observed + $E_{(ref.\ electrode)}$, at T_1 = _____ mV

Table 1. Half-Cell Potential of Reference Electrode at T

Temperature (°C)	Calomel	4N KCl saturated Ag/AgCl
10	251 mV	214 mV
20	244 mV	204 mV
25	241 mV	199 mV
30	238 mV	194 mV

9. Compare the corrected, measured potential of the standard solution (step 8) to the theoretical potential at the measured temperature (calculated in step 5 or 6). If the values are more than ±10 mV different, the meter and electrode functions should be checked as follows:

   (a) recheck temperature of standard solution
   (b) replace electrode filling solution
   (c) clean electrodes (refer to Section 4.1)
   (d) replace standard with new mix of solution

   Note: If the temperature of the standard solution is much higher or lower than 25°C (i.e., ± 15 degrees C), then the half-cell potential of the reference electrode may deviate significantly from the values given in Table 1. In this case, the proper function of the ORP measurement system cannot be verified.

   Alternate procedures are available to check the function of the ORP measurement system but require two reference electrodes, one that is known to be functioning properly. Refer to APHA Method 4500-H, Section 5.b. for a description of the alternate procedures.

10. Check initial measurement of standard solution. Measurements should agree within 10 mV. If the measurements do not agree, the meter and electrode functions should be checked as described in step 9.

2.4 Sample Measurement

After measurement of the standard solution confirms the electrode function, measure the redox potential of the water sample as follows:

1. Thoroughly clean the outside of the electrode(s) with deionized water prior to introducing to the sample water.

2. Measure and record sample temperature (T_2) in degrees C.

   Note: If the sample temperature is more than approximately 10 degrees C higher or lower than the temperature of the standard solution previously measured, the sample measurement may require additional time to stabilize due to drift in the reference electrode potential. Efforts should be made to maintain the standard solution at approximately the same temperature as the sample waters to be measured.

3. Immerse the ORP electrode(s) in the sample water.

4. Wait 2 minutes and then record the measured potential in mV.

5. Correct the measured potential of the sample solution for the half-cell potential of the reference electrode at the temperature of measurement (T_2) (refer to Table 1):

$$Eh_{(Sample)} = E_{(Sample)}, \text{ observed} + Eh_{(ref.\ electrode)}, \text{ at } T_2 = \_\_\_\_\_ \text{ mV}$$

These steps must be documented on the attached Eh Data Sheet for each sample measurement.

2.5 Documentation and Record Management

Calibration information should be recorded on the Eh Data Sheet. ORP measurements will also be recorded on the Eh Data Sheet (Data Record, page 2 of 2) with associated calculations to compute Eh from ORP measurements. ORP measurements should not be reported as Eh data without first performing the correction calculations.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

3.1 Electrode Maintenance and Storage

Contamination of the electrode surface, salt bridge, or internal electrolyte solution in the case of reference electrodes can lead to excessive drift, poor electrode response, and artifact potentials (electrode "poisoning").

3.2 Routine Maintenance for Intermittent Use

The reference electrode should be cleaned for storage following each series of measurements or daily, as follows:

> Empty reference electrode of filling solution and rinse thoroughly with distilled water. The electrode should be stored filled with distilled water and should be labeled as so. If salt deposits have formed on the outside of the electrode casing, clean with a dilute acid or detergent solution and rinse thoroughly with distilled water.

The Pt indicator electrode should be cleaned daily by rinsing with distilled water and should be stored in distilled water between uses.

3.3 Long-term Maintenance

Follow manufacturer's instructions for long-term maintenance, cleaning and rejuvenation of electrodes. If excessive drift occurs or erratic performance of electrodes is observed in a standard solution after appropriate cleaning, refilling or regeneration procedures, discard the faulty electrode and use a new one.

3.4 Records Review

Calculations should be checked before any ORP or Eh data are reported for use on a project. The calculation check should be documented by the reviewer's initials and date of review on the Eh Data Sheet.

4.0 REFERENCES

American Public Health Association (APHA), 1995. *Standard Methods for the Examination of Water and Wastewater, 19th Edition.* Published by APHA, American Water Works Association, and Water Environment Association.

American Society for Testing and Materials (ASTM), 1993. *Standard Practice for Oxidation-Reduction Potential of Water, D-1498-93.*

Orion Research, Inc., 1983. *Instruction Manual for Platinum Redox Electrodes.*

USGS, 1976. *Guidelines for Collection and Field Analysis of Ground-Water Samples for Selected Unstable Constituents.* Techniques of Water-Resources Investigations, Book 1, Chapter D2.Eh DATA SHEET.

Eh DATA SHEET

DATE:
LOCATION:

Project Number:	Project Name:	Sample No.

Sampler(s):

Meter (Model No.):	Reference Electrode:	Filling Solution:

Standard: Zobell _____ Date Mixed: _____ (Discard after 6 months)
Light's _____

MEASUREMENTS/CALCUATIONS

A) Temperature of Standard Solution, T_1 (°C)

B) $Eh_{Standard;}$ theoretical
For Zobell: $Eh_{Zobell;}$ theoretical = 428 + 2.2 (25 – T) (mV)
For Light's: $Eh_{Lights;}$ theoretical = 675 mV

C) $E_{(Standard);}$ measured (mV)

D) $Eh_{(ref.\ electrode)}$ at T_1 (mV) for the appropriate reference electrode

Temperature (°C)	Calomel	4N KCl saturated Ag/AgCl
10	251	214
20	244	204
25	241	199
30	238	194

E) $Eh_{(Standard)} = E_{(standard);}$ measured + $E_{(ref.\ electrode)}$ (mV) E = C + D

F) Difference between theoretical and measured Eh of standard

$Eh_{(standard);}$ theoretical – $Eh_{(standard)} > \pm 10$ mV? B – E > ± 10 mV?

If yes, then: 1) check temperature
2) replace electrode filling solution
3) replace standard

G) Temperature of sample, T_2 (°C)

H) $E_{(Sample);}$ measured (mV)

I) $Eh_{(ref.\ electrode)}$ at T_2 for the appropriate reference electrode

Temperature (°C)	Calomel	4N KCl saturated Ag/AgCl
10	251	214
20	244	204
25	241	199
30	238	194

J) $Eh_{(Sample)} = E_{(Sample)} + Eh_{(ref.\ electrode)}$ (mV) J = H + I

REFERENCES:
1. American Society for Testing and Materials (ASTM), 1981. Standard Practice for Oxidation-Reduction Potential of Water, D1498.
2. Orion Research, Inc, 1982. Instruction Manual for Platinum Redox Electrodes.
3. USGS, 1976. Guidelines for Collection and Field Analysis of Ground-Water Samples for Selected Unstable Constituents. Techniques of Water-Resources Investigations, Book 1, Chapter D2.

DATA RECORD

Date	Time	Location or Sample	T_1 (°C)	$Eh_{(standard)}$ (mV)	$E_{(standard)}$ (mV)	$Eh_{(ref. electrode)}$ (mV)	$Eh_{(standard)}$ (mV)	Check value (mV)	T_2 (°C)	$E_{(sample)}$ (mV	$Eh_{(ref. electrode)}$ (mV)	$Eh_{(sample)}$ (mV)
			A	B	C	D	E (=C+D)	F (=B-E)	G	H	I	J (=H+I)
8/15/02	1500	Example 1	10°C	461	240	214	454	7	12°C	150	214	+364mV

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STANDARD OPERATING PROCEDURE No. 12

FIELD MEASUREMENT OF DISSOLVED OXYGEN (DO)

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed for the field measurement of dissolved oxygen in water samples. If necessary to accommodate specific field conditions, modifications to the procedure may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Explanation of Dissolved Oxygen and Methodology

Dissolved oxygen (DO) refers to the volume of oxygen that is contained in water. Oxygen enters the water by photosynthesis of aquatic biota and by the transfer of oxygen across the air-water interface. The amount of oxygen that can be held by the water depends on the water temperature, salinity, and pressure. Gas solubility increases with decreasing temperature (i.e., colder water holds more oxygen). Gas solubility increases with decreasing salinity (i.e., freshwater holds more oxygen than does saltwater). Both the partial pressure and the degree of saturation of oxygen will change with altitude. Finally, gas solubility decreases as pressure decreases. Thus, the amount of oxygen in water decreases as altitude increases because of the decrease in relative pressure.

Flowing water is more likely to have high dissolved oxygen levels than stagnant water because of the water movement at the air-water interface. In flowing water, oxygen-rich water at the surface is constantly being replaced by water containing less oxygen as a result of turbulence, creating a greater potential for exchange of oxygen across the air-water interface. Because stagnant water undergoes less internal mixing, the upper layer of oxygen-rich water tends to stay at the surface, resulting in lower dissolved oxygen levels throughout the water column. Oxygen losses readily occur when water temperatures rise, when plants and animals respire, and when microbes aerobically decompose organic matter.

The Membrane Electrode Method (such as that used on the YSI Model 55) is ideal for field dissolved oxygen (DO) testing. Polarographic or galvanic oxygen-sensitive membrane electrodes are composed of two metal electrodes in contact with a supporting electrolyte that is separated from the test solution by a selective membrane. Indicator electrodes are typically made of platinum and reference electrodes are commonly either calomel or Ag/AgCl electrodes with a KCl electrolyte solution. The reference electrode provides a constant electrode potential for comparison to the potential at the platinum electrode. A thin permeable membrane, stretched over the sensor, isolates the electrodes from the environment while allowing gases to enter. When a polarizing voltage is applied to the sensor electrodes oxygen, which has passed through the membrane, reacts at the cathode causing a current flow. The membrane passes oxygen at a rate proportional to the pressure difference across it. Since oxygen is rapidly consumed at the cathode, it can be assumed that the oxygen pressure inside the membrane is zero. Hence, the force causing the oxygen to diffuse through the membrane is proportional to the partial pressure of oxygen outside the membrane. As oxygen partial pressure varies, so does the oxygen diffusion through the membrane. This causes the probe current to change proportionally.

2.2 Instrumentation and Equipment

Typically, obtaining a field DO measurement requires the following equipment:

1. Membrane Electrode-type Dissolved Oxygen meter
2. Platinum indicator electrode and reference electrodes of either calomel or Ag/AgCl
3. KCl reference electrode filling solution
4. Clean (e.g., deionized) water for probe cleaning
5. Squeeze bottle of clean water
6. Membrane/O-ring & KCl kit for probe cleaning and replacement

2.3 Instrument Checks and Calibration

2.3.1 Probe Operation and Precautions

Membrane life depends on usage. Membranes will last a long time if installed properly and treated with care. Erratic readings are a result of loose, wrinkled, damaged, or fouled membranes,

or from large (more than ½ inch dia.) bubbles in the electrolyte reservoir. If erratic readings or evidence of membrane damage occurs, replace the membrane and the KCl solution. The average replacement interval is two to four weeks.

1. If the membrane is coated with oxygen consuming material (e.g., bacteria) or oxygen evolving organisms (e.g., algae), erroneous readings may occur.

2. Chlorine, sulfur dioxide, nitric oxide, and nitrous oxide can affect readings by behaving like oxygen at the probe. If you suspect erroneous readings, it may be necessary to determine if these gases are present.

3. Avoid any environment that contains substances that may attack the probe materials. Examples of some of these substances are concentrated acids, caustics, and strong solvents. Probe materials that come in contact with the sample include FEP Teflon, acrylic plastic, EPR rubber, stainless steel, epoxy, polyetherimide and the polyurethane cable covering.

4. For correct probe operation, the gold cathode must always be bright. If it is tarnished, which can result from contact with certain gases, or plated with silver, which can result from extended use with a loose or wrinkled membrane, the gold surface must be restored. To restore the cathode you may either return the instrument to the factory, or clean it using a meter-specific reconditioning kit. Never use chemicals or abrasives not supplied with the kits.

5. It is also possible for the silver anode to become contaminated, which will prevent successful calibration. To clean the anode, remove the O-ring and membrane and soak the probe overnight in a 3% ammonium hydroxide solution. Next, rinse the sensor tip and KCl reservoir with deionized water, add new KCl solution, and install a new membrane and O-ring. Turn the instrument on and allow the system to stabilize for at least 30 minutes. If, after several hours, you are unable to calibrate, return the instrument to the manufacturer for service.

6. If the sensor O-ring is worn or loose, replace it with an appropriate O-ring.

7. To keep the electrode from drying out, store the probe in the instrument calibration chamber with a small piece of moist towel or sponge.

8. Consult the operations manual of the electrode instrument for the correct, instrument-specific calibration procedure.

2.4 Sample Measurement Procedures for Groundwater

Dissolved oxygen measurements should be taken during well purging and immediately before and after sample acquisition using a direct-reading meter. Because most well purging techniques allow aeration of collected groundwater samples, it is important to minimize potential aeration by taking the following precautions.

1) Purge well with a peristaltic pump to prevent downhole aeration of the sample in wells screened across the water table. Well drawdown should be kept to a minimum as described in PBW SOP No. 10 entitled (Water Quality Sampling). The pump tubing should be immersed alongside the dissolved oxygen probe beneath the water level in the sampling container (i.e., a flow-through cell). This will minimize aeration and keep water flowing past the dissolved oxygen probe's sampling membrane. If bubbles are observed in the tubing during purging, the flow rate of the pump must be slowed.

2) Dissolved oxygen measurements can be used as a stabilizing parameter in conjunction with other indicator parameters (i.e., pH, temperature, conductivity, etc.) to distinguish between formation water and stagnant casing water. Once these parameters have stabilized (typically ± 10% for DO), a representative DO measurement can be recorded from the in-line flow cell. Of the stabilization indicator parameters used above, DO usually requires the longest time for stabilization.

2.5 Documentation

All measurement results should be recorded according to procedures outlined in PBW SOP No. 1 entitled Field Documentation. The instrument manufacturer, model number and unique identification number should also be recorded with the measurement data.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

Field measurements will be reviewed prior to their use on a project. The project manager or designated reviewer should verify the DO data and also confirm that documentation has been completed per this procedure.

4.0 REFERENCES

EPA, 1995. Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures.

YSI Inc., 1994. Operations Manual for YSI Model 55 Handheld Dissolved Oxygen System (Membrane Electrode Instrument).

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STANDARD OPERATING PROCEDURE No. 13

EQUIPMENT DECONTAMINATION

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the methods to be used for the decontamination of reusable field equipment that could become contaminated during use or during sampling. The equipment may include split spoons, bailers, trowels, shovels, hand augers or any other type of equipment used during field activities.

Decontamination is performed as a quality assurance measure and a safety precaution. It prevents cross contamination between samples and also helps to maintain a clean working environment.

Decontamination is achieved mainly by rinsing with liquids which may include: soap and/or detergent solutions, tap water, distilled weak acid solution, and/or methanol or other solvent. Equipment may be allowed to air dry after being cleaned or may be wiped dry with chemical-free towels or paper towels if immediate re-use is necessary.

At most project sites, decontamination of equipment that is re-used between sampling locations will be accomplished between each sample collection point. Waste produced by decontamination procedures, including waste liquids, solids, rags, gloves, etc., should be collected and disposed of properly, based upon the nature of contamination. Specific details for the handling of decontamination wastes are addressed in PBW SOP No. 14 entitled Storage and Disposal of Soil, Drilling Fluids and Water Generated During Field Work or may be specified by a project plan.

2.0 PROCEDURES

2.1 Responsibilities

It is the responsibility of the field supervisor to ensure that proper decontamination procedures are followed and that all waste materials produced by decontamination are properly managed. It is the responsibility of the project safety officer to draft and enforce safety measures which provide the best protection for all persons involved directly with sampling and/or decontamination.

It is the responsibility of any subcontractors (i.e., drilling contractors) to follow the proper, designated decontamination procedures that are stated in their contracts and outlined in the Site-Specific Health and Safety Plan. It is the responsibility of all personnel involved with sample collection or decontamination to maintain a clean working environment and ensure that any contaminants are not negligently introduced to the environment.

2.2 Supporting Materials

1. Cleaning liquids: soap and/or detergent solutions (Alconox, etc.), tap water, distilled water, methanol, weak nitric acid solution, etc.
2. Personal protective safety gear as defined in the Site-Specific Health and Safety Plan.
3. Chemical-free towels or paper towels.
4. Disposable, nitrile gloves.
5. Waste storage containers: drums, boxes, plastic bags, etc.
6. Cleaning containers: plastic and/or stainless steel pans and buckets.
7. Cleaning brushes.
8. Aluminum foil.

2.3 Methods

The extent of known contamination will determine the degree of decontamination required. If the extent of contamination cannot be readily determined, cleaning should be done according to the assumption that the equipment is highly contaminated. Decontamination procedures should account for the types of contaminants known or suspected to be present. In general, high levels of organic contaminants may include an organic solvent wash step, and high levels of metals contamination may include a weak acid rinse step.

The procedures listed below constitute the full field decontamination procedure. If different or more elaborate procedures are required for a specific project, they may be specified in sampling and analysis or work plan. Such variations in decontamination protocols may include all, part or an expanded scope of the decontamination procedure stated herein.

1. Remove gross contamination from the equipment by dry brushing, and rinse with tap water.

2. Wash with soap or laboratory-grade detergent solution.

3. Rinse with tap water.

4. Rinse with methanol (optional, for equipment contaminated by organic compounds).

5. Rinse with acid solution (optional, for equipment contaminated by metals).

6. Rinse with distilled or deionized water.

7. Repeat entire procedure or any parts of the procedure as necessary.

8. Air dry.

As appropriate, decontaminated equipment should be stored in sealable containers, such as Ziplock-type plastic bags or cases or boxes with lids.

3.0 DOCUMENTATION

Field notes will be kept describing the decontamination procedures followed. The field notes will be recorded according to procedures described in PBW SOP No. 1 entitled Field Documentation.

4.0 QUALITY CONTROL

To assess the adequacy of decontamination procedures, field rinsate blanks may be collected. The specific number of rinsate blanks will be defined in a sampling and analysis or work plan or by the PBW project manager. In general, at least one field rinsate blank should be collected per sampling event or per day.

Rinsate blanks with elevated or detected contaminants should be evaluated by the Project Manager, who will relay the results to the site workers. Such results may be indicative of inadequate decontamination procedures that require corrective actions (e.g., retraining).

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 14

STORAGE AND DISPOSAL OF SOIL, DRILLING FLUIDS, AND WATER GENERATED DURING FIELD WORK

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed for the storage, testing, and disposal of soil, drilling fluids, and water generated during any field operations performed by PBW. The procedures presented herein are intended to be of a general nature. Appropriate modifications to the procedures may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Material Storage and Labeling

Potentially-contaminated materials should be collected and stored in water-tight, secured containers pending determination of their hazards. The containers should be stored temporarily at the site of origin. All steel drums used for storage will be Department of Transportation (DOT)-approved, so that hazardous materials may be transported in these drums if necessary. A daily inventory of the materials generated and the containers in which they are stored should be recorded on the Daily Field Record form. The Daily Field Record is presented in PBW SOP No. 1 entitled Field Documentation.

2.2 Well Purging and Development Water

Water extracted from potentially-contaminated wells or piezometers for the purpose of development, sampling, or hydraulic testing should be stored in sealed, 55-gallon, steel drums or in portable, watertight storage tanks. The containers should be labeled with an indelible marking including the: date; well or piezometer number(s); and "development water" if the water was extracted for development or "purge water" if the water was extracted for sampling or hydraulic testing, in addition to the other labeling requirements included Section 3.0 of this SOP.

2.3 Drilling Fluid

As appropriate based on site data, drilling fluid generated by hydraulic rotary drilling operations may be either spread out on the site or stored in sealed, 55-gallon, steel drums or in portable, watertight storage tanks depending on the contaminant distribution, if any, at the site. The containers should be labeled with an indelible marking including the date; boring, well, or piezometer number(s); and "drilling fluid," in addition to the other labeling requirements included in Section 3.0 of this SOP.

2.4 Soil Cuttings

Soil cuttings generated by drilling operations should be stored in sealed, 55-gallon, steel drums or in soil boxes with roll-top, lockable covers. The containers should be labeled with an indelible marking including the: date; boring, well or piezometer number(s); and "cuttings," in addition to the other labeling requirements included in Section 3.0 of this SOP.

2.5 Wash Water

Water used to decontaminate equipment, by steam cleaning or other methods, that was used in potentially contaminated borings, wells or piezometers should be stored in sealed, 55-gallon steel drums or in portable, watertight storage tanks. The containers should be labeled with an indelible marking including the: date; boring, well or piezometer number(s); and "wash water," in addition to the other labeling requirements included Section 3.0 of this SOP.

2.6 Criteria for Hazard Determination

Analyses for hazard determination should be conducted by a laboratory certified by the applicable agency in the state in which the project site is located. Waste classification should be based on the criteria detailed in the applicable state and federal regulations.

2.6.1 Drilling Fluid and Cuttings from Exploratory Soil Borings and Well or Piezometer Installation

Evaluation of the hazard status for drilling fluid and cuttings from each boring, well or piezometer may be based upon the results of chemical analyses of the soil and groundwater samples collected from each boring, well or piezometer. Alternatively, representative samples of the drilling fluid and cuttings may be collected and analyzed.

2.6.2 Well Purging and Development Water

Evaluation of the hazard status for well purging and development water from each well or piezometer may be based upon the results of chemical analysis of the groundwater sample subsequently collected from each well or piezometer. Alternatively, representative samples of the purging and development water may be collected and analyzed.

2.7 Labeling

All drums containing waste should be labeled using self-adhesive labels placed on the side of the drums. The labels should be placed in a location on the drum such that the label can be easily read. At a minimum, the following information should be placed on the label using an indelible pen:

- Generator (client) name;
- Drum identification number (when more than one drum present);
- Description of contents, including boring, well or piezometer number(s), as appropriate;
- Date of generation;
- Technical contact (generally the name and phone number of PBW Project Manager); and
- PBW project number.

Local hazardous material storage regulations should also be reviewed for labeling requirements in addition to those listed above.

Appropriate hazardous waste labels should be used when analytical results indicate that the contents are hazardous waste.

2.8 Documentation

All of the information recorded on the drum labels should also be recorded in field notes completed at the work site. This information will be copied to the project file.

3.0 QUALITY CONTROL

3.1 Treatment and Disposal of Contaminated Materials

Soil, drilling fluid and water containing hazardous constituents should be treated and/or disposed of in accordance with all local, state and federal regulations. The appropriateness of on-site treatment versus off-site treatment and/or disposal should be evaluated by the PBW Project Manager based on the hazard determination.

3.2 On-Site Treatment of Contaminated Materials

Soil, drilling fluid, and water of known hazardous composition may be treated on-site provided: (1) such treatment is conducted in accordance with all local, state, and federal regulations based upon location, level of contamination, and volume of material; and (2) permission has been obtained as part of a site access agreement. On-site treatment may be feasible and economical if an on-site soil and/or groundwater treatment system is planned.

3.3 Transport and Disposal of Contaminated Materials

Hazardous waste that requires off-site disposal should be transported by certified hazardous material haulers to approved disposal sites in accordance with state and federal transportation regulations.

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 15

HYDRAULIC TESTING

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed during performance of a constant-discharge pumping test or a "slug test." The procedures presented herein are intended to be general in nature; as the work progresses and when warranted, appropriate revisions may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Constant-Discharge Test

The performance of a constant-discharge pumping test involves three phases: 1) pre-test measurements; 2) pumping portion of the test; and 3) recovery portion of the test. Pre-test measurements include water level measurements which indicate water level trends in the test area. These effects must be accounted for when test data are analyzed. The pumping portion of the test involves monitoring water levels in the pumping well and observation wells while the discharge in the pumping well is kept fairly constant. Groundwater samples may be collected during this phase. The recovery portion of the test occurs after pumping is stopped and involves the measurement of recovery water levels in the pumped well and observation wells.

2.1.1 Pre-Test Measurements

2.1.1.1 Water Level Measurements

Prior to conducting a pumping test, water level measurements should be taken in the pumped well and all observation wells (other monitoring wells and piezometers) to be monitored during the test to describe the pre-test potentiometric surface and its natural variability (refer to PBW SOP No. 9 entitled Water Level, Immiscible Layer and Well Depth Measurement). Measurements in both the pumped well and observation wells should be taken at least every 4 hours for a minimum of three days before the pumping test begins. More frequent water level measurements in one or more wells using a continuous recording device may be used to substitute for the 4-hour measurement requirement in the pumped well and all observation wells.

Prior to beginning the pumping test, watches, the datalogger and other timing devices to be used in the test should be synchronized.

The water level measurements may be made with an electric water level probe, steel surveyors' tape or continuous recording device (Stevens recorder or pressure transducer/recorder). Accuracy of water level measurements prior to and during the aquifer test should be to within plus or minus 0.02-foot in the observation wells.

An observation well may be monitored continuously with a Stevens Type F water level recorder or a pressure transducer/recorder.

If water levels are measured by hand, all pre-test water level measurements for the pumping well and observation wells should be recorded on a Pumping Test Record form (Figure SOP-15-1). The same form should be used during the pumping portion of the pumping test.

2.1.1.2 Barometric Measurements

A record of barometric changes in the vicinity of the pumping test site should be obtained for the pre-test and test period. This record will be used to monitor changes in water levels caused by barometric effects. A recording barograph or record from a nearby weather station is acceptable.

2.1.2 <u>Pumping Portion of Test</u>

2.1.2.1 Measurements to be Taken

During the pumping portion of the pumping test, the following measurements should be made: 1) water levels in both the pumped well and the observation wells; 2) instantaneous and cumulative discharge from the pumped well; and 3) time at which these measurements are made. Samples of the discharge water may also be collected periodically during the test for chemical analysis or field testing. All should be recorded on the Pumping Test Record form (Figure SOP-15-1) for the appropriate well.

2.1.2.2 Water Levels

Pumped Well:

The water level measurements in the pumped well should be taken according to the time schedule outlined below. More or less frequent measurements may be used.

Time Since Pumping Started			Time Intervals
0	-	10 minutes	0.5- 1 minute
10	-	15 minutes	1 minutes
15	-	60 minutes	5 minutes
60	-	300minutes	30 minutes
300	-	1440 minutes	60 minutes
1440	-	shut down of pump	480 minutes (8 hours)

Observation Wells:

Stevens Type F continuous recorders or pressure transducer/datalogger may be installed in the observation wells. Water level measurements may be taken in these wells using an electric water level probe or steel surveyors' tape for calibration when the Stevens recorder or transducer/recorder is installed, and whenever the recorder chart paper is changed or the recorder is adjusted in any way. If a continuous recorder or pressure transducer/datalogger is not used, then water level measurements may be taken using an electric water level probe or steel surveyor's tape according to the following schedule:

Time Since Pumping Started			Time Intervals
0	-	60 minutes	1 minute
60	-	120 minutes	5 minutes
120	-	240 minutes	10 minutes
240	-	360 minutes	30 minutes
360	-	1440 minutes	60 minutes
1440	-	shut down of pump	480 minutes (8 hours)

The time of measurements and water level measurement should be entered in the appropriate columns of the Pumping Test Record form (Figure SOP-15-1) for the pumped well and observation wells. If a Stevens recorder or pressure transducer/recorder is used, water level calibration and pertinent notes should be entered on the Pumping Test Record form.

2.1.2.3 Discharge Rate

Discharge from the pumped well should be measured using either of the following methods: 1) totalizing flow meter and stopwatch; 2) circular orifice meter; 3) Venturi meter; 4) Parshall flume; or 5) calibrated container and stopwatch. The discharge reading and time of reading should be entered on the Pumping Test Record form for the pumped well.

Discharge should be maintained within plus or minus 5 percent of the designated rate by means of a globe valve or other throttling device. Discharge should be checked and adjusted, if necessary, every 10 minutes during the first hour of pumping, at 30-minute intervals for the following 5 hours, and at one-hour intervals thereafter. Time of measurement and rate of discharge should be entered on the Pumping Test Record form for the pumped well (Figure SOP-15-1). If the pump is driven directly by an engine, the engine speed (in RPM) should be checked and noted every hour during the test. If the pump is run by an engine or a generator, the fuel level and the oil level in the engine or generator should be checked periodically, and fuel and/or lubricating oil added when necessary.

2.1.3 Sampling of Discharge Water

Samples of discharge water from the pumped well may be collected at time intervals specified by the Project Manager, provided such sampling does not interfere with water level measurements. The temperature, pH, and specific conductance of the samples may be measured in the field when the samples are collected. The samples should be preserved for subsequent chemical analysis by an authorized laboratory in accordance with PBW SOP No. 10 entitled Water Quality Sampling. The time the samples were collected and field measurements of water quality parameters should be recorded on the Pumping Test Record form (Figure SOP-15-1) for the pumped well.

2.1.4 Duration of Pumping

The target duration of the pumping portion of each pumping test should be established prior to beginning the test. During the test, time-drawdown and/or distance-drawdown curves for the observation wells may be plotted on semi-logarithmic paper to assist in evaluating if the test is running well and deciding on the time that the pump should be shut off. If the plots indicate steady-state conditions (e.g., the interception of a recharge source), the test may be ended before its target duration. The pumping portion of the test may be extended, at the discretion of the Project Manager, to evaluate hydrologic boundaries or other transient conditions.

2.1.5 Aborted Test

Failure of pumping operations for a period greater than one (1) percent of the elapsed pumping time may require suspension of the test until the water level measured in the pumped well has recovered to within two (2) percent of the total drawdown in the pumped well during pumping. Recovery in the pumped well should be considered complete after the well has not been stressed for a period at least equal to the elapsed pumping time of the aborted test, or if any three successive water level measurements, at least 30 minutes apart, show no further rise in the water level in the pumped well. When recovery is complete, the pumping portion of the test may be resumed.

2.1.6 Recovery Portion of Test

After the pumping portion of the test has been completed, the pump should be shut off. Water level measurements may then be taken in the pumped well and observation wells in accordance with the approximate schedule presented below:

Time Since Pumping Stopped			Time Intervals	
0	-	15 minutes	1	minute
15	-	60 minutes	5	minutes
60	-	300 minutes	30	minutes
300	-	1440minutes	60	minutes
1440	-	End of test	480	minutes (8 hours)

Water level measurements should continue in the pumped well and observation wells until the water level in the pumped well has recovered to its pre-pumping level, or until a length of time equal to the pumping period has elapsed.

The water level data (water level below MP) and time at which measurement is made for each well should be entered on a Pumping Test Record form (Figure SOP-15-1), using the columns for the recovery portion of the test.

2.1.7 Pump Discharge

The water discharged from the pumped well should be prevented from entering the water-yielding zone being tested. If concentrations of chemicals in the discharged water are suspected to be above regulatory limits for discharge to natural water courses, the water from the pumped well should be collected for appropriate treatment and/or disposal.

2.2 Slug Tests

Falling-head or rising-head tests ("slug tests") may be performed on piezometers and monitoring wells to estimate the lateral hydraulic conductivity of the water-bearing strata. Although the radius of influence (i.e., portion of the water-yielding zone tested) is smaller for a slug test than for long-term pumping tests, this testing method is often selected due to the low productivity and/or small available drawdown in wells. Another important consideration is that many locations can be evaluated with the slug test method for the same level of effort and cost of one pumping test.

2.2.1 Testing Equipment

A slug test consists 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 should be performed by rapidly submerging (slug-in test) or retracting (slug-out test) a slug of known volume. A typical slug used in 2-inch wells is constructed of a sealed, 1-inch diameter, stainless steel pipe. The displacement volume of the slug should be measured prior to the test program.

A pressure transducer with an appropriate operating range should be used to measure the water levels during the slug tests. The pressure readings should be recorded and converted to feet of water above the transducer using a datalogger. The datalogger should be programmed to record the water levels at one-second intervals at the beginning of a test and to logarithmically increase the sampling interval to several minutes toward the end of the test.

2.2.2 Testing Procedure

Upon arrival at a test well site, the static water level and total depth of the well should be measured with an electric water level probe or steel surveyors' tape (see PBW SOP No. 9 entitled Water Level, Immiscible Layer and Well Depth Measurement). The pressure transducer is then secured in the well to a depth below the lowest point to which the slug will be lowered. Before starting the test, sufficient time should 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 should be monitored electronically using the datalogger and measured periodically with the electric water level probe or steel surveyors' tape to confirm that static water level conditions exist. Next, the

slug should 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 should be examined to monitor trends and the progress of the test. Manual water level measurements also should be taken during the test to confirm the transducer readings and documented on the Slug Test Form (Figure SOP-15-2). Each test should proceed until the water level attains at least 95 percent recovery from the slug displacement. Following completion of the slug-in test, a slug-out test should be performed by rapidly pulling the slug out of the water and monitoring the recovery of water level 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.

2.2.3 Equipment Decontamination

Prior to the first slug test and between each test, the slugs, transducer, cable and water level probe (or steel tape) should be decontaminated in accordance with PBW SOP No. 13 entitled Equipment Decontamination.

2.3 Data Analysis

2.3.1 Data Processing

The data collected by the datalogger are stored in the memory of the datalogger and then transferred to a cassette tape or to a computer in the field. If not transferred directly to a computer, these data are subsequently transferred to a computer for field data quality checks and data analysis. When transferred to computer, the data sets are transferred to files in comma-delineated ASCII format. The contents of each data file are imported to a spreadsheet program which allows the data manipulation and graphical presentation needed to calculate the hydraulic parameters of the water-yielding zone.

2.3.2 Slug Test Data Analysis

Slug tests in confined zones should be analyzed primarily by the method described by Cooper, Bredehoeft and Papadopulos (1967), whereas slug tests in semi-confined to unconfined water-yielding zones should be analyzed by the method discussed by Bouwer and Rice (1976). The Bouwer and Rice (1976) method is also applicable to confined aquifers and may be used to compare the results of the Cooper et al. (1967) method for confined aquifers.

Summary of Cooper, Bredehoeft and Papadopulos Method

Cooper et al. (1967) derived a solution using a partial differential equation for radial flow for the response of a finite-diameter well to an instantaneous "slug" of water. The method of analysis involves plotting the results of the slug test as H/H_o versus log t (time), where:

H = head inside the well above or below the initial head at time t after injection or removal of the slug.

H_o = head inside the well above or below the initial head at the instant of injection or removal of the slug.

The slug test plot is then compared against a set of "Type Curves" derived and published by Cooper et al. (1967) and Papadopulos, Bredehoeft and Cooper (1973), using a curve matching method, such that curves are moved parallel to H/H_o to match each other. When the best match between the data plot and type curves is obtained, a value of t is selected at the $Tt/r_c^2 = 1$ match point. The transmissivity (T) is then calculated using the following equation:

$$T = \frac{r_c^2}{t}$$

where: r_c = radius of the well casing.

The hydraulic conductivity (K) is obtained from the T value by:

$$K = \frac{T}{b}$$

where: b = thickness of water-yielding zone.

This method assumes that the water-yielding zone is homogeneous, isotropic, and of uniform thickness, and that the tested well is screened throughout the thickness of the water-yielding zone.

Summary of Bouwer and Rice Method

Bouwer and Rice (1976) presented a procedure for analysis of slug test data from an unconfined aquifer. Based on an electrical analog, Bouwer and Rice provided a convenient set of curves relating the effective radius (R_e) to the other well dimensions. This procedure is based on a modification of the Theim equation for steady state groundwater flow.

$$K = \frac{r_c^2 \ln(R_e / r_w)}{2L} \frac{1}{t} \frac{\ln Y_0}{Y_t}$$

where:

K	=	Hydraulic conductivity
L	=	Screen length
Y_o	=	Head of water at time (o)
Y_t	=	Head of water at time (t)
t	=	Time
r_c	=	Inside radius of casing
r_w	=	Radius of casing plus thickness of filter pack
R_e	=	Effective radius (value of R_e obtained from the set of curves given by Bouwer and Rice)

This method estimates the hydraulic conductivity without calculating transmissivity. The results of the slug tests are plotted as a semi-logarithmic graph of Y_t versus t. The values of Y_t, Y_o, and t are obtained from the straight-line portion of the graph, and the value of K is calculated.

If the water level fluctuates within the screened interval or below the base of the bentonite seal in the well, the following correction will be made to include the porosity of the filter pack in the cross-sectional area of the well (Bouwer and Rice (1976)):

$$r_c = \left\{r^2 + n\left(R^2 - r^2\right)\right\}^{0.5}$$

where:

r_c	=	radius of the well including estimated filter pack porosity
r	=	radius of the well screen
n	=	estimated porosity of the filter pack
R	=	radius of the bore hole

3.0 QUALITY ASSURANCE

3.1 Calculation Check

All data and calculations recorded on the Pumping Test Record should be reviewed prior to use. The reviewer should be a technically qualified hydrologist or hydrogeologist, as designated by the PBW Project Manager. Record of the calculation review should be made by the reviewer's initials and date of review on the original Pumping Test Record form.

3.2 Records Review

The project manager or designated QA reviewer should check and verify that documentation has been completed and filed per this procedure.

4.0 REFERENCES

Bouwer, Herman and R. C. Rice, 1976. *A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells.* Water Resources Research, Vol. 12, No. 3, pp. 423-428, June.

Bouwer, Herman, 1989 *The Bouwer and Rice Slug Test - An Update*: Ground Water, Vol. 27, No. 3, pp. 304-309, May-June.

Bouwer, Herman, 1989. *Discussion of "The Bouwer and Rice Slug Test - An Update*: Ground Water, Vol. 27, No. 5, pp. 715, September - October.

Cooper, Hilton H. (Jr.), John D. Bredehoeft, and Istavros S. Papadopulos, 1967. *Response of a Finite-diameter Well to an Instantaneous Charge of Water.* Water Resources Research, Vol. 3, No. 1, pp. 263-269.

Papadopulos, Istavros S., John D. Bredehoeft, and Hilton H. Cooper (Jr.), 1973, *On the Analysis of 'Slug Test' Data.* Water Resources Research, Vol. 9, No. 4, pp. 1087-1089, August.

FIGURE SOP-15-1. PUMPING TEST RECORD

PUMPING TEST RECORD

☐ OBSERVATION WELL _____
☐ PUMPING WELL _____

PAGE _____ OF _____

PROJECT AND LOCATION				PROJECT NO.	DATE
PUMPING WELL		OBSERVATION WELL		TIME STARTED	TIME FINISHED
RADIUS	DEPTH	DEPTH	DISTANCE (OBS TO PUMP)	MEASURING POINT (ELEV)	CASING HEIGHT
SCREEN INTERVAL		PUMP SETTING		DATALOGGER	
PUMP/ELECTRICAL EQUIPMENT				PERSONNEL	
COMMENTS					

			WATER LEVEL DATA			PUMPING DATA			WATER QUALITY			REMARKS
DATE AND TIME	TIME SINCE START OF PUMPING, t (MIN)	TIME SINCE PUMPING STOPPED , t' MIN)	WATER LEVEL BELOW MP (FEET)	DRAWDOWN, s (FEET)	RESIDUAL DRAWDOWN, s' (FEET)	PUMPING RATE) (GPM) (BY	CUMULATIVE DISCHARGE) (GAL) (BY	METER READING (GAL)	TEMPERATURE (°C)	pH	SPECIFIC CONDUCTANCE (umhos/cm)	

PASTOR, BEHLING & WHEELER, LLC
2201 Double Creek Drive, Suite 4004
Round Rock, Texas 78664
(512) 671-3434
Fax (512) 671-3446

FIGURE SOP-15-2. SLUG TEST FORM

SLUG TEST FORM		**Pastor, Behling & Wheeler, LLC**
Date Tested:	Well No.:	**2201 Double Creek Drive, Suite 4004**
Slug IN or OUT:	Measuring Point (MP):	**Round Rock, Texas 78664**
Well Diameter (in.):	MP Height (ft. above ground level):	**Phone: (512) 671-3434 Fax: (512) 671-3446**

Well Depth (ft. BGL):	Slug Type (stainless, PVC, Teflon):
Screen Interval (ft. BGL):	Slug Length (ft.):
Starting WL (ft. BMP):	Slug Diameter (ft.):
Decon. Procedures:	Slug Volume (cu. ft.):
	Expected Well Response (+/- ft.):
Start Time: End Time:	Performed by:

Minutes Since Start	Water Level (ft. BMP)	Minutes Since Start	Water Level (ft. BMP)	Minutes Since Start	Water Level (ft. BMP)	Minutes Since Start	Water Level (ft. BMP)

k:\forms\field\Slug Test Form.xls

Benchmark Ecological Services, Inc.
Standard Operating Procedures

SOP Number	Title	Revision Date
	Sediment Sampling	
SOP-BESI-101	Sediment Sampling Using a Ponar Grab, Ekman Grab or Equivalent Sampling Device for Saltwateror Freshwater Sediment	9/14/2003
SOP-BESI-102	Collecting Sediment Samples with a Piston Corer	9/14/2005
	Biota Sampling	
SOP-BESI-303	Collection of Finfish and Crabs Using Gill Nets	9/14/2003
SOP-BESI-304	Collection of Blue Crabs Using Commercial Crab Traps	9/14/2005
	Field Collection Instruments	
SOP-BESI-401	YSI 55 Handheld Dissolved Oxygen and Temperature Meter Calibration and Operation Procedures	9/14/2005
SOP-BESI-402	YSI 63 Handheld pH, Conductivity, Salinity and Temperature Meter Calibration and Operation	9/14/2005
SOP-BESI-403	Locating and Recording Sample Stations Using a Trimble GEO XT Global Positioning System	9/14/2005
	Sample Processing & Handling	
SOP-BESI-502	Sample Shipping and Freezing Procedures	3/01/06
SOP-BESI-503	Compositing Sediment Samples	9/14/2005
SOP-BESI-506	Measuring Crab Carapace Width and Wet Weight	9/14/2005
SOP-BESI-507	Crab Tissue Processing	9/14/2005
SOP-BESI-508	Measuring Fish Length and Wet Weight	9/14/2005
SOP-BESI-509	Fish Tissue Processing	9/14/2005
SOP-BESI-600	Water Sampling via Peristaltic Pump	3/01/06
SOP-BESI-601	Decontamination of Tubing and Filters for Water Sampling	3/01/06

017127

STANDARD OPERATING PROCEDURE
SOP-BESI-101

TITLE: Sediment Sampling Using a Ponar Grab, Ekman Grab or Equivalent Device

The attached Standard Operating Procedure was revised by:

Name	Signature	Date
Katy Garcia		09/14/05

The attached Standard Operating Procedure was reviewed by:

Name	Signature	Date
David Marhofer		09/14/05

Revision No. 1

017128

COLLECTING SEDIMENT SAMPLES WITH A PONAR GRAB, ECKMAN GRAB OR EQUIVALENT DEVICE

1.0 PURPOSE AND APPLICABILITY

This SOP describes the proper procedures for operating a sediment sampler to collect surficial sediment (0-6 inches deep), and handling sediment samples after collection. The purpose is to obtain surficial sediment samples using a Ponar Grab, Ekman Grab or equivalent sampling device.

2.0 DEFINITIONS

Surficial sediment – Material from the top layers of sediment. Sediment from the 0-6 inches layer are generally considered surficial. The depth to be sampled must be specified.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves and approved safety glasses should be worn when conducting this procedure to reduce exposure to contaminants that may be present in the water or sediment.

3.2 If volatile chemicals are expected in samples, respirators (with proper cartridge) must be worn.

3.3 Proper lifting techniques should be utilized when handling heavy objects.

3.4 General boat safety criteria should be practiced at all times, including awareness of other ship activities, wearing life jackets, monitoring marine radio, etc.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is conducted.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure and provide all the necessary information and data sheets to conduct the study. The task manager has responsibility for assuring that:

- All necessary equipment is available
- Health and safety precautions are taken
- Enough information has been provided to locate sample area and stations.

6.0 EQUIPMENT AND MATERIALS

- Ponar grab sampler
- Ekman grab sampler
- Messenger
- Rope or Stainless Steel Pole
- Tub (to receive filled sampler)
- Stainless steel bowl
- Stainless steel or Teflon® spoons
- Sample jars

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7.0 TRAINING

Prior to conducting this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 A Ponar grab, Ekman grab (or equivalent) will be used to collect surficial sediments. Grab samplers generally have an open or screened top to allow water to pass through the sampler as it descends, reducing forward wake, which can disturb surface sediment. The grab sampler is attached to a low-stretch rope or stainless steel pole.

8.2 The clean sampler is placed in a clean tub or on another clean surface on the deck of the boat. If the sampler has a safety pin, it will be removed when the sampler is safely over the sample station. To prevent forward wake, the sampler should not descend faster than 0.2 m/sec when as it nears the bottom. If the sampling depth is shallow, the grab will be lowered at approximately 0.2 m/sec until it enters the sediment. In deep water, the descent can be faster but must be slowed to about 0.2 m/sec several meters before it enters the sediments. If sampler requires a trigger/messenger, attach messenger to the line and release.

8.3 Retrieval of the sampler, after it has settled into the sediment, must be slow to ensure proper closure of the jaws. The sampler should be retrieved at a speed of 0.3 m/sec. The sampler should be lifted slowly from the water and quickly secured to prevent swinging. Rapid retrieve or swinging may disturb surface sediments. The retrieved sampler will be lowered into a clean tub or tray, and secured in an upright position to prevent sediment sloshing.

8.4 A sample is acceptable if it is covered with water (indicates the sampler is not leaking), and surface sediment is relatively flat and undisturbed. Because of the action of the closing jaws, some samples may be flat and undisturbed only in the center. If a sample is not acceptable it should be set aside (do not dump overboard), and a second sample should be collected. Unacceptable samples can be discharged overboard after an acceptable sample is collected.

8.5 Samples may also be considered unsuitable if there is less than 6 inches of sediment in the sampler. If necessary, the sample station may be relocated and the change documented in the sample log.

8.6 If measurements are to be taken from water overlying the sediment sample, they must be taken before the sample is disturbed or overlying water must be collected for the measurements.

8.7 Prior to removing sediments from the sampler, the overlying water will be siphoned off with a piece of tubing, or the grab sampler will be drained by gently tilting it.

8.8 If sub-samples are needed, they may be collected from the top of the closed sampler using a spoon, scoop, or core tube. Sediment for chemical and biological analyses will be removed using pre-cleaned stainless steel spoons and composited using 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.

8.9 The empty sampler should be rinsed and decontaminated using water and Alconox®' or an

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equivalent cleaning chemical, and rinsed with deionized water. The sampler and associated equipment is decontaminated before use and between sample sites. In addition, the sampler will be rinsed with site water before samples are collected. Equipment used for sample collection, sub-sampling, and sample mixing (i.e., spoons, knives, scoops) will be stainless steel or Teflon®.

9.0 QUALITY CONTROL CHECKS

Clean gloves will be worn at all times when handling the sampling equipment in order to reduce the chance of contaminating the sediment sample.

10.0 DOCUMENTATION

Document the water depth, sediment depth, basic sediment characteristics, station coordinates, sample time and processing time.

General descriptive information on the sediments and appropriate field data should be entered in the field data log (SOP-BESI). Observations may include the following:

- Characteristics of sample, including texture, color, biological structures (e.g., shells, benthic infauna), debris (wood chips, human artifacts), odors (oil, gas, hydrogen sulfide),
- Approximate depth or aerobic and anaerobic sediment layers,
- Penetration depth of the sampler and/or general depth of sample taken (i.e., top 2 cm, 2-10 cm, etc.), and,
- Comments that relate to sample quality such as leakage, winnowing, disturbance.

NOTE:

FOLLOW ONLY THE MOST RECENT ISSUE OF THIS SOP.

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STANDARD OPERATING PROCEDURE
SOP-BESI-102

TITLE: Collecting Sediment Samples with a Piston Corer

The attached Standard Operating Procedure was revised by:

Name	Signature	Date
Katy Garcia		09/14/05

The attached Standard Operating Procedure was reviewed by:

Name	Signature	Date
David Marhofer		09/14/05

Revision No. 1

017132

COLLECTING SEDIMENT SAMPLES WITH A PISTON CORER

1.0 PURPOSE AND APPLICABILITY

To collect sediment samples with a piston corer in a safe and efficient way.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves and approved safety glasses should be worn when conducting this procedure in order to protect personnel from possible contaminants that may be present in the water or sediment.

3.2 Proper lifting techniques should be utilized when handling heavy objects.

3.3 General boat safety criteria should be practiced at all times and includes awareness of other ship activities, wearing life jackets, monitoring marine radio, etc.

3.4 Respirators may be required when sampling sediment contaminated with toxic volatiles. Respirators must fit properly and the appropriate cartridges must be available.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is conducted.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure and provide all the necessary information and data sheets to conduct the study. The task manager has responsibility for assuring that:

- All necessary equipment is available
- Health and safety precautions are taken
- Enough information has been provided to locate sample area and sample stations.

6.0 EQUIPMENT AND MATERIALS

- Piston corer head and rope
- Pistons (minimum of 2)
- Depth weight and rope
- Sufficient length of piston corer poles
- Wire-lock pins for the piston corer pole extensions
- Sufficient number of pre-cleaned core tubes
- Drill bit for punching holes in core tube
- Clamps for the core tube connection to the piston head (minimum of 2)
- Flat head screw driver or nut driver
- Core stoppers
- Nitrile gloves
- Safety glasses
- Paper towels
- Core tube brush

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- Core tube cutter
- Measuring tape
- Alconox
- Global Positioning System (GPS)
- Data Sheets
- Sample Platform
- Extruding Device (if cuts are required)

7.0 TRAINING

Prior to conducting this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Site location and positioning

8.1.1 Sample personnel will locate sample stations using maps, GPS (SOP-BESI-403), and/or field markers.

8.1.2 Once sample stations have been identified in the field, the sampling platform may be held on station with the use of anchors, tying off to existing structures and/or the sample platform motor.

8.1.3 Mark and record the sample station with the GPS (SOP-BESI-403).

8.2 Collecting sediment with the piston corer (Figure 2)

8.2.1 Determine water depth from the sample platform to the surface of the sediment by lowering a weight from the sample platform. When the weight contacts the sediment surface the rope is calibrated by tying it off to the sample platform. Raise and remove the weight from the calibrated rope.

8.2.2 Insert piston rope through a pre-cleaned core tube and connect piston to rope.

8.2.3 Attach core head to core tube using at least one clamp.

8.2.4 Connect piston rope to sediment depth-calibrated rope.

8.2.5 Lower the core tube into the water at least 2/3 the length of the core tube allowing water to enter the core tube before pulling the piston into the core tube.

8.2.6 Attach pole extension(s) to the core head and lower the core tube and pole extension(s) into the water. Continue to attach pole extensions as the core tube is lowered.

8.2.7 When the core tube hits the sediment surface, the calibrated depth rope fixed to the sample platform will pull the piston up through the core tube as the core tube is pushed into the sediment.

8.2.8 Continue to push the core tube into the sediment until point of refusal or the core tube has been fully inserted into the sediment.

8.2.9 Raise the core tube and remove pole extensions as the piston corer is brought to the sample platform.

8.2.10 Prior to bringing the core tube onto the deck of the sample platform, place a pre-cleaned core stopper on deck

8.2.11 Quickly raise the core tube onto the deck and set it down on top of the pre-cleaned core stopper.

8.2.12 Secure the core tube on the deck and drain the water above and below the piston by placing holes in the core tube.

8.2.13 Allow the water to drain, and remove the piston from the core tube.

8.2.14 The core is now ready to be processed by either extruding the sediment out of the

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top of the core tube or dumping the sediment out of the bottom of the core tube.

8.2.15 Record the water depth, sediment core depth, station coordinates, and sample times onto appropriate data sheets.

9.0 QUALITY CONTROL CHECKS

Clean gloves will be worn at all times when handling the core tube, piston and core head in order to reduce the chance of contaminating the sediment sample.

10.0 DOCUMENTATION

Document the water depth, sediment core depth, basic sediment characteristics, station coordinates, sample time and processing time.

NOTE:

FOLLOW ONLY THE MOST RECENT ISSUE OF THIS SOP.

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STANDARD OPERATING PROCEDURE
SOP-BESI-303

TITLE: Collection of Finfish and Crabs Using Gill Nets

The attached Standard Operating Procedure was revised by:

Name	Signature	Date
Katy Garcia		09/14/05

The attached Standard Operating Procedure was reviewed by:

Name	Signature	Date
David Marhofer		09/14/05

Revision No. 1

017136

Collection of Finfish and Crabs Using Gill Nets

1.0 PURPOSE AND APPLICABILITY

The purpose of this standard operating procedure is to obtain finfish and shellfish specimens from shallow aquatic habitats using gill nets. This SOP describes the proper procedures for using gill nets to collect finfish and crabs from shallow aquatic habitat. Gill nets are usually used in shallow water near the shoreline, but may be used in deeper water if properly weighted and anchored. Gill nets with different mesh sizes can be used to target specific sized fish.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves and approved safety glasses should be worn when conducting this procedure in order to protect personal from possible contaminants that may be present in the water.

3.2 Proper lifting techniques should be utilized when handling heavy objects.

3.3 General boat safety criteria should be practiced at all times and includes awareness of other ship activities, wearing life jackets, monitoring marine radio, etc.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is conducted.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure and provide all the necessary information and data sheets to conduct the study. The task manager has responsibility for assuring that:

- All necessary equipment is available
- Health and safety precautions are taken
- Enough information has been provided to locate sample area and stations.

6.0 EQUIPMENT AND MATERIALS

- Monofilament gill nets
- Wooden poles (2x2)
- Inertia driver (for wooden poles)
- Concrete anchors
- Polypropylene or nylon rope (3/8-1/2 in diameter)
- Styrofoam floats
- Net picks
- Net tags
- Nitrile gloves
- Measuring board
- Re-sealable plastic bags
- Labels
- Permanent marker pens
- Ice chest with ice

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7.0 TRAINING

Prior to conducting this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Gill nets can be purchased with many different mesh sizes and monofilament line strength. The size and strength of the primary target specie, or species will determine which mesh size and line strength should be used.

8.2 According to Texas law, gill netting is an illegal fishing method and may not be used unless persons using the nets are permitted by TPWD to use such methods. All gill nets must be tagged with the name of the user and the users TPWD permit number. Persons using gill nets must be in possession of a copy of the TPWD permit while the nets are in use.

8.3 Gill nets are used by vertically suspending the outstretched nets in areas where fish activity or traffic is heavy. Fish are caught in the nets as they attempt to swim through the mesh. Fish that are too large to pass through the mesh, will attempt to back out and will be snared by strands of the monofilament mesh under gills, scales, or spines.

8.4 Gill nets can be stretched across a fish pass or stream mouth, perpendicular to a shoreline, or parallel to a line of shoreline cover. Gill nets are set in an area used as a fish path or in an area that contains habitat utilized by the target fish species. Fish moving through or into the area may be caught in the net. A gill net is a passive fishing device and requires that the fish swim into it.

8.5 Gill nets are used by stretching the net across the area to be fished. An anchor should be attached to each end of the lead line of the net. Anchors hold the net down on the bottom and prevent it from being moved by water currents. Ends of the top line (float line) must be tied to structure (e.g., tree limbs, stumps, pilings) or a wooden stake driven into the bottom. For safety reasons, the stake should be visible above the waters surface.

8.6 Gill nets may be fished at any time the target fish are active, but they are generally most effective when set in the evening and fished through the night. Fish caught in the net will usually die quickly and should be removed from the net as soon as possible to prevent tissue deterioration. High water temperatures accelerate tissue deterioration.

8.7 A net is checked by raising it out of the water and removing captured fish from the mesh. Nets should be checked by starting at one end, and working toward the other end. Fish are removed from the net by hand; a net pick may be used to remove the fish. Nitrile gloves are worn to protect the hands of personnel and prevent contamination of the sample.

8.8 Gill nets are generally set and checked from the deck of a boat, but in water less than 3 ft, it may be more efficient to check the net by wading. If waders or hip-boots are worn, a personal flotation vest should be worn.

8.9 Fish removed from the nets should be placed in a fish basket or plastic tub until they are evaluated. Non-target species that are still alive must be returned to the water immediately.

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8.10 Fish should be put in a labeled plastic bag and placed on ice in an insulated cooler.

8.11 Catch data should be recorded on data sheets.

9.0 QUALITY CONTROL CHECKS

Clean gloves will be worn at all times when handling the sampling equipment and samples.

10.0 DOCUMENTATION

General descriptive information of the sample site, catch, and field data should be entered in the field data log (SOP-BESI). Observations may include the following:

- Characteristics of the sample area, bottom type, vegetation, and water depth,
- Location of the area sampled,
- List of species collected, and,
- Number and/or weight of organisms collected,
- Water temperature, salinity, and conductivity.

NOTE:

FOLLOW ONLY THE MOST RECENT ISSUE OF THIS SOP.

017139

STANDARD OPERATING PROCEDURE
SOP-BESI-304

TITLE: Collection of Blue Crabs Using Commercial Crab Traps

The attached Standard Operating Procedure was revised by:

Name	Signature	Date
Katy Garcia	Katy M. Garcia	09/14/05

The attached Standard Operating Procedure was reviewed by:

Name	Signature	Date
David Marhofer	David Marhofer	09/14/05

Revision No. 1

017140

Collection of Blue Crabs Using Commercial Crab Traps

1.0 PURPOSE AND APPLICABILITY

This SOP describes the proper procedures for collecting legal size Blue Crabs with commercial crab traps.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves and approved safety glasses should be worn when conducting this procedure in order to protect personnel from possible contaminants that may be present in the water.

3.2 Proper lifting techniques should be utilized when handling heavy objects.

3.3 Personnel will be trained on how to handle blue crabs to avoid cuts caused by chelae or shells.

3.4 General boat safety criteria should be practiced at all times and includes awareness of other ship activities, wearing life jackets, monitoring marine radio, etc.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is conducted.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure and provide all the necessary information and data sheets to conduct the study. The task manager has responsibility for assuring that:

- All necessary equipment is available
- Health and safety precautions are taken
- Enough information has been provided to locate sample area and sample stations.

6.0 EQUIPMENT AND MATERIALS

- Commercial Crab Traps
- Floats and Ropes
- Bait
- Permit Tags
- Plastic bucket or tub (sorting container)
- Re-sealable plastic bags
- Labels
- Permanent marker pens
- Ice chest with ice

7.0 TRAINING

Prior to conducting this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

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8.1 A rope greater then the depth of the water where sampling will occur should be attached to the top of the crab trap. The opposite end of the rope may have a float attached to it when sampling in open water. If sampling next to structures or land the rope may not need a float. Permit tags should be secured to the crab traps.

8.2 Crab traps will be baited with commercial crab bait (when available) or bait fish captured from established 'clean' areas.

8.3 Traps will be placed in water so as to insure they are set right side up. It may be necessary to weight down or tie traps off in areas of high current or when set close to heavy ship traffic.

8.4 The catch should be placed in a bucket or tub for sorting. After target organisms are removed, the remainder should be returned to the water.

8.5 Collected Blue Crabs will be placed in labeled re-sealable plastic bags, and put on ice in a cooler.

9.0 QUALITY CONTROL CHECKS

Clean gloves will be worn at all times when handling the sampling equipment and samples.

10.0 DOCUMENTATION

General descriptive information on the sample site, catch, and field data should be entered in the field data log. Observations may include the following:

- Characteristics of the sample area, bottom type, vegetation, and water depth,
- Size of the area sampled,
- List of species collected, and,
- Number and/or weight of organisms collected,
- Water temperature, salinity, and conductivity.

NOTE:

FOLLOW ONLY THE MOST RECENT ISSUE OF THIS SOP.

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STANDARD OPERATING PROCEDURE
SOP-BESI-401

TITLE: YSI 55 Handheld Dissolved Oxygen and Temperature Meter Calibration and Operation Procedures

The attached Standard Operating Procedure was revised by:

Name	Signature	Date
Katy Garcia		09/14/05

The attached Standard Operating Procedure was reviewed by:

Name	Signature	Date
David Marhofer		09/14/05

Revision No. 1

017143

YSI 55 Handheld Dissolved Oxygen and Temperature Meter Calibration and Operation Procedures

1.0 PURPOSE AND APPLICABILITY

The purpose of this standard operating procedure is to calibrate and measure dissolved oxygen and temperature parameters.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEAL TH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when taking measurements in potentially contaminated water.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is conducted.

5.0 RESPONSIBILITIES

Personnel conducting the procedure must have read and understood the owner's manual for the YSI 55 attached to this SOP.

6.0 EQUIPMENT AND MATERIALS

- 6 AA-size alkaline batteries
- Distilled water
- Nitrile gloves

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP and the attached YSI 55 owner's manual.

8.0 METHODS

8.1 Calibration

Before you calibrate the YSI Model 55, complete the procedures discussed in the Preparing the meter and preparing the Probe in the attached owners manual. The following procedure is taken from the YSI Model 55 owners manual.

To accurately calibrate the YSI Model 55, you will need to know the following information:

- The approximate altitude of the region of which you are located.
- The approximate salinity of the water you will be analyzing. Fresh water has a salinity of approximately zero. Seawater has a salinity of approximately 35 parts per thousands (ppt). If you are not sure about the salinity use the YSI 63 (SOP-BESI-402) to determine it.

8.1.1 Ensure that the sponge inside the instrument's calibration chamber is wet. Insert the probe into the calibration chamber.

8.1.2 Turn the instrument on by pressing the ON/OFF key on the front of the instrument. Wait for the dissolved oxygen and temperature readings to stabilize (usually 15 minutes is required after turning the instrument on).

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8.1.3 To enter the calibration menu, use two fingers to press and release both the UP ARROW and DOWN ARROW keys at the same time.

8.1.4 The LCD will prompt you to enter the local altitude in hundreds of feet. Use the arrow keys to increase or decrease the altitude. Example: entering 1 here = 100 feet.

8.1.5 When the proper altitude appears on the LCD, press the ENTER key. The Model 55 should now display CAL in the lower left of the display, the calibration value should be displayed in the lower right of the display and the current DO reading (before calibration) should be on the main display.

8.1.6 Make sure that the DO reading (large display) is stable, then press the ENTER key. The LCD will prompt you to enter the approximate salinity of the water you are about to analyze. You can enter any number from 0 to 40 parts per thousand (ppt) of salinity. Use the arrow keys to increase or decrease the salinity setting. When the correct salinity appears on the LCD, press the ENTER key. The instrument will return to normal operation.

For best results:

- Each time the Model 55 is turned off, re-calibrate before taking measurements
- Calibrate at a temperature within ±10°C of the sample temperature.

8.2 Taking Readings

8.3.1 After the system has been set up, it is ready to take readings. Turn the instrument on and allow it to complete the self-test procedure.

8.3.2 Rinse the probe with distilled water.

8.3.3 Completely immerse the probe into the sample matrix.

8.3.4 You can move back and forth from reading dissolved oxygen in the mg/L mode or the % air saturation mode by pressing the MODE key.

8.3.5 After recording all your parameters for that sampling event, rinse the probe with distilled water.

9.0 QUALITY CONTROL CHECKS

Inspect the sample probe and meter prior to calibration and operation as designated in the owner's manual located in the Benchmark Ecological Services, Inc. library.

10.0 DOCUMENTATION

Record calibrations and readings on the appropriate data sheets and/or in designated notebooks.

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STANDARD OPERATING PROCEDURE
SOP-BESI-402

TITLE: YSI 63 Handheld pH, Conductivity, Salinity and Temperature Meter Calibration and Operation Procedures

The attached Standard Operating Procedure was revised by:

Name	Signature	Date
Katy Garcia	[illegible]	09/14/05

The attached Standard Operating Procedure was reviewed by:

Name	Signature	Date
David Marhofer	[illegible]	09/14/05

Revision No. 1

017146

YSI 63 Handheld pH, Conductivity, Salinity and Temperature Meter Calibration and Operation Procedures

1.0 PURPOSE AND APPLICABILITY

The purpose of this standard operating procedure is to calibrate and measure for conductivity, salinity, temperature and pH using a YSI 63 handheld meter.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEAL TH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when conducting the calibrations and when taking measurements in potentially contaminated water.

3.2 Avoid inhalation, skin contact, eye contact or ingestion of pH buffer and conductivity solution.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is conducted.

5.0 RESPONSIBILITIES

Personnel conducting the procedure must have read and understood the owner's manual for the YSI 63 located in the Benchmark Ecological Services, Inc. library.

6.0 EQUIPMENT AND MATERIALS

- 6 AA-size alkaline batteries
- Plastic 100 mL graduated cylinder
- pH buffers 4, 7, 10
- Distilled water
- Conductivity standard solution(s)
- Nitrile gloves
- Clean glass beaker

7.0 TRAINING

Prior to conducting this SOP, responsible personnel (task manager and technicians) must read and understand this SOP and the YSI 63 owners manual located in the Benchmark Ecological Services, Inc. library.

8.0 METHODS

8.1 pH Calibration

The following procedures are taken from the YSI 63 meter owner's manual.

8.1.1 Turn the instrument on by pressing the ON/OFF key. Press the mode key until pH is displayed.

8.1.2 Rinse the probe with distilled water, then carefully dry the probe (or rinse it with some of the pH buffer solution to be used for calibration).

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8.1.3 Place 30 to 35 mL of the pH buffer you have chosen to calibrate the system with (pH 7) in the 100 mL graduated cylinder. Immerse the probe making sure that both the pH & temperature sensors are covered by the solution.

8.1.4 To enter the calibration menu, use two fingers to press and release both the UP ARROW and DOWN ARROW keys at the same time. The display will show CAL at the bottom, STAND will be flashing and the pH reading will show 7.00.

8.1.5 Press the ENTER key. The display will show CAL at the bottom, STAND will stop flashing and the pH calibration value is shown with the middle decimal point flashing. Flashes until reading is stable.

8.1.6 When the reading is stable, the decimal point will stop flashing. Press and hold the ENTER key to save the calibration point. The model 63 will flash SAVE on the display along with OFS to indicate that the offset value has been saved.

8.1.7 SLOPE will now appear on the display and be flashing. This indicates that the slope is ready to be set using a second pH buffer. The system is now calibrated at a single point. If you are only performing a single point calibration, press the MODE key to return to normal.

8.1.8 Rinse the probe with distilled water.

8.1.9 If performing a 2-point or 3-point calibration, fill a clean container with the second value (pH 4) pH buffer and immerse the probe into the solution. Make sure the temperature sensor is immersed.

8.1.10 Press the ENTER key. The display should now show CAL at the bottom, SLOPE will stop flashing and the pH calibration value is shown with one of the decimal points flashing.

8.1.11 When the reading is stable, the decimal point will stop flashing. Press and hold the ENTER key to save the fist slope. The display will flash SAVE along with SLP to indicate that the fist slope value has been saved.

8.1.12 SLOPE will start flashing again indicating that the slope is ready to be set using the third buffer.

8.1.13 The system is now calibrated for 2-points. If you are only performing a 2-point calibration, press the MODE key to return to normal.

8.1.14 Rinse probe with distilled water.

8.1.15 If performing a 3-point calibration, fill clean container with the third buffer (pH 10) and immerse the probe into the buffer.

8.1.16 Press the ENTER key. The display will show CAL at the bottom, SLOPE will stop flashing and the pH calibration value is shown with one of the decimal points flashing. The right decimal point should be flashing.

8.1.17 When the reading is stable, the decimal point will stop flashing. Press and hold the ENTER key to save the second SLOPE. The display will flash SAVE along with SLP to indicate that the second slope has been saved.

8.1.18 The system will return to normal. Rinse the probe with distilled water.

8.2 Conductivity Calibration

The following procedure is taken from the YSI 63 meter owner's manual.

8.2.1 Turn the instrument on and allow it to complete the self-test procedure.

8.2.2 Select a calibration solution that is most similar to the sample you will be measuring.

- For sea water choose a 50 μS/cm conductivity standard
- For fresh water choose a 1 μS/cm conductivity standard
- For brackish water choose a 10 μS/cm conductivity standard

8.2.3 Place about 7 inches into a clean plastic container or glass beaker. Do not use

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graduated cylinder.

8.2.4 Use the MODE key to advance the instrument to display conductivity.

8.2.5 Insert the probe into the solution deep enough to completely cover the probe. Both conductivity ports must be submerged.

8.2.6 Allow at least 60 seconds for the temperature reading to become stable.

8.2.7 Move the probe vigorously from side to side to dislodge any air bubbles from the electrodes.

8.2.8 Press and release the UP ARROW and DOWN ARROW keys at the same time. The CAL symbol will appear at the bottom left of the display to indicate that the instrument is in Calibration mode.

8.2.9 Use the UP ARROW and DOWN ARROW key to adjust the reading on the display until it matches the value of the calibration solution you are using.

8.2.10 Once the display reads the exact value of the calibration solution being used, press the ENTER key. The word SAVE will flash across the display for a second indicating that the calibration has been accepted. The instrument will hold that calibration until the next calibration. Therefore, there is no reason to recalibrate the instrument after changing the batteries.

8.3 Calibrating Salinity

8.3.1 Calibration is not an option for salinity, check to make sure the meter is reading correctly by completely immersing the probe in DI or Distilled water. The salinity reading should read zero.

8.4 Taking Readings

8.4.1 After the system has been calibrated, it is ready to take readings.

8.4.2 Rinse the probe with distilled water.

8.4.3 Completely immerse the probe into the sample matrix.

8.4.4 Shake the probe to dislodge any air bubbles from the probe.

8.4.5 Use the MODE key to scroll through the parameters to record your readings.

8.4.6 After recording all your parameters for that sampling event, rinse the probe with distilled water.

9.0 QUALITY CONTROL CHECKS

Inspect the sample probe and meter prior to calibration and operation as designated in the attached owners manual.

10.0 DOCUMENTATION

Record calibrations and readings on the appropriate data sheets and/or in designated notebooks.

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STANDARD OPERATING PROCEDURE
SOP-BESI-403

TITLE: Locating and Recording Sample Stations Using a Trimble GEO XT Global Positioning System

The attached Standard Operating Procedure was revised by:

Name	Signature	Date
Katy Garcia	[illegible]	09/14/05

The attached Standard Operating Procedure was reviewed by:

Name	Signature	Date
David Marhofer	[illegible]	09/14/05

Revision No. 1

017150

Station Positioning Using Global Positioning System

1.0 PURPOSE AND APPLICABILITY

This SOP covers the procedures for locating and recording the sampling stations and/or sites using a Trimble GEO XT Global Positioning System (GPS).

2.0 DEFINITIONS

Global Positioning Systems (GPS) are multi-functional navigation systems that use satellites to calculate latitude and longitude. By computing the distance between three or more satellites and the ground receiver, the GPS system generates an accurate current location. When a sample station/site is selected, the GPS will aid in navigation to the exact latitude and longitude position.

3.0 HEALTH AND SAFETY CONSIDERATIONS

Do not us a GPS unit as the sole method of navigation.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is performed.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure. The task manager has responsibility for assuring that:

- All necessary equipment is available; and
- All personnel use this procedure to locate and record sampling stations and/or sites.

6.0 EQUIPMENT AND MATERIALS

- GPS (fully charged or external power source)

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 In order to navigate to a station, follow the procedures outlined in Tutorial Section of the TerraSync operation guide stored at the Benchmark Ecological Services, Inc. Library.

8.2 When recording a sample station, follow the procedures outlined in Tutorial Section of the TerraSync operation guide stored at the Benchmark Ecological Services, Inc. Library.

9.0 QUALITY CONTROL CHECKS

No quality control checks are necessary for locating and recording the sampling stations and/or sites using a Trimble GEO XT Global Positioning System (GPS).

10.0 DOCUMENTATION

See electronic copy of documents: Geo_300_GSG_46506-30-ENG.pdf, PathFinderOffice280_Vol3B_Eng.pdf, and TerraSync operations manual.pdf

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STANDARD OPERATING PROCEDURE
SOP-BESI-502

TITLE: Sample Shipping and Freezing Procedures

The attached Standard Operating Procedure was revised by:

Name	Signature	Date
Neil Heathorne	Neil Heathorne	3-1-06

The attached Standard Operating Procedure was reviewed by:

Name	Signature	Date
William Quast	William Quast	3-1-06

Revision No. 2

017152

Sample Shipping and Freezing Procedures

1.0 PURPOSE AND APPLICABILITY

To ensure that samples are properly stabilized prior to shipment.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when performing this procedure.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must be also available before this procedure is performed.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure. The task manager has responsibility for assuring that:

- All necessary equipment is available; and
- Prior to sample collection, the laboratory conducting analyses should be contacted by the Study Director, Project Manager, Field Crew Leader, or a designee to verify that the laboratory is prepared to accept the samples.

6.0 EQUIPMENT AND MATERIALS

- Cooler, freezer, or refrigerator
- Ice for cooler
- COC's
- Pen
- Sharpie

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Preparation of Samples Prior to Shipment:

8.1.1 In the field, samples shall be stored on ice.

8.1.2 Depending on the desired sample analysis, the sediment, tissue and water samples shall be either placed in freezers or coolers containing ice, or placed inside a refrigerator set at 4°C, until sample shipment occurs.

8.1.3 Fill out chain of custody (COC) form according to project SAP. Put COC form in plastic bag and tape to the inside top or lid of the sample shipment cooler, or placed with sample containers in their storage area.

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8.1.4 If in an environment where people other than project staff can access samples, seal the freezer or cooler with a chain-of-custody label or lock to protect against tampering.

8.2 Shipping Instructions:

8.2.1 All samples are to be a hand delivered or shipped via overnight courier to the laboratory.

8.2.2 If water, tissue, or sediment samples are held for over 24-hours they should generally be kept on ice, or at a minimum, refrigerated prior to shipment. Check the project Sampling and Analysis for project-specific requirements.

9.0 QUALITY CONTROL CHECKS

There are no specific Quality Control Checks for this SOP

10.0 DOCUMENTATION

There are no specific Quality Control Checks for this SOP

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STANDARD OPERATING PROCEDURE
SOP-BESI-503

TITLE: Compositing Sediment Samples

The attached Standard Operating Procedure was revised by:

Name	Signature	Date
Katy Garcia		09/14/05

The attached Standard Operating Procedure was reviewed by:

Name	Signature	Date
David Marhofer		09/14/05

Revision No. 1

017155

Compositing Sediment Samples

1.0 PURPOSE AND APPLICABILITY

The purpose of this standard operating procedure is to ensure that proper mixing of sediment samples occurs when compositing is required. This standard operating procedure describes the procedures for compositing sediment samples. After the samples are composited, they are split into different containers.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when performing this procedure.

3.2 Safety glasses should be worn when performing this procedure.

3.3 If volatile chemicals are expected in samples, respirators (with proper cartridge) must be worn.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is performed.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure. The task manager has responsibility for assuring that:

- All necessary equipment is available; and
- All samples are prepared according to this procedure.

6.0 EQUIPMENT AND MATERIALS

- Nitrile Gloves
- Stainless steel bowls
- Stainless steel spoons (Large and Small)
- Clean, labeled sample jars
- Clean, labeled VOCs jars

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Prior to splitting samples for analytical testing, representative samples must be taken for analysis of VOCs and semi VOCs.

8.1.1 Use a small stainless steel spoon to take sediment samples that collectively represent the sample.

8.1.2 Take representative samples until the VOC jar is filled.

8.1.3 Cap or close the container and handle according to SOP-BESI-502.

Note: You are dealing with volatile gases, therefore this must be completed in a timely manner.

8.2 The sediment must be homogenized in a thorough manner. Compositing is necessary when

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samples are collected.

8.2.1.1 Thoroughly mix the sediments together with a large clean stainless steel utensil.

8.2.1.2 Mixing should occur for approximately 3-5 minutes per sample. To ensure the best possible results, mixing should be conducted in various clockwise, counterclockwise and chopping motions with emphasis being placed on folding the sediment from the outer edges of the container to the center.

8.2.1.3 After the sediment is homogenized, collect sub-samples from the sample and place them into the container until completely filled.

8.2.1.4 Cap or close the containers and handle according to SOP-BESI-502.

9.0 QUALITY CONTROL CHECKS

Gloves should be worn at all times while handling the sample.

10.0 DOCUMENTATION

General descriptive information on the sediments and appropriate field data should be entered in the field data log (SOP-BESI). Observations may include the following:

- Characteristics of sample, including texture, color, biological structures (e.g., shells, benthic infauna), debris (wood chips, human artifacts), odors (oil, gas, hydrogen sulfide),
- Approximate depth or aerobic and anaerobic sediment layers.

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STANDARD OPERATING PROCEDURE
SOP-BESI-506

TITLE: Measuring Crab Carapace Width and Wet Weight

The attached Standard Operating Procedure was revised by:

Name	Signature	Date
Katy Garcia		09/14/05

The attached Standard Operating Procedure was reviewed by:

Name	Signature	Date
David Marhofer		09/14/05

Revision No. 1

017158

MEASURING CRAB CARAPACE WIDTH AND WET WEIGHT

1.0 PURPOSE AND APPLICABILITY

This procedure provides the basic methodologies for measuring crab carapace width and wet weight prior to tissue processing for chemical analysis.

2.0 DEFINITIONS

Carapace - Large shell that forms protective covering on most crabs.
Carapace width - Lateral distance across the carapace from tip of spine to tip of spine.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when performing this procedure.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is performed.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure. The task manager has responsibility for assuring that:

- All necessary equipment is available; and
- All samples are prepared according to this procedure.

6.0 MATERIALS

- Measuring Board
- Electronic balance
- Labels
- Marking pens
- Chain-of-Custody forms

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Sample Preparation

Prior to handling any crab samples, all staff must wear nitrile gloves and all table surfaces should be scrubbed with a cleanser and covered with solvent rinsed aluminum foil. Next, remove the crab from the sample containers or bags and wipe clean of all external debris (e.g., sand, plant material, etc.) using a Kimwipe or other clean paper product. The following sections describe the specific procedures to be followed for measuring and weighing the crab.

8.2 Crab Carapace Width Measurement

1. Place the crab on a fish measuring board that it is upright exposing the carapace.
2. Measure and record the distance in millimeters across the carapace from tip of spine to tip of spine.

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8.3 Crab Wet Weight

Note -These procedures assume the top loading balance has already been properly calibrated according to its respective SOP.

1. Place a piece of clean aluminum foil onto the weighing plate of a top loading balance and tare the balance to read, "zero".
2. Next, remove any excess water from the crab shell by patting dry with a Kimwipe.
3. Place the crab on the tared scale making sure that the entire organism is on the aluminum foil.
4. Record the weight of the crab in grams to the appropriate significant digit {balance dependant) on the data log forms.
5. Discard the aluminum foil after each separate crab sample is weighed, and, if necessary, remove the weighing plate from the top loading balance and wash with soap (Alconox) and warm water, followed by deionized water.

9.0 QUALITY CONTROL CHECKS

Ensure that the top loading balance has been accurately calibrated.

10.0 DOCUMENTATION

Detailed records should be kept to document routine calibration of the balance prior to each use as well as routine servicing by qualified technicians.

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STANDARD OPERATING PROCEDURE
SOP-BESI-507

TITLE: Crab Tissue Processing

The attached Standard Operating Procedure was revised by:

Name	Signature	Date
Katy Garcia		09/14/05

The attached Standard Operating Procedure was reviewed by:

Name	Signature	Date
David Marhofer		09/14/05

Revision No. 1

017161

CRAB TISSUE PROCESSING

1.0 PURPOSE AND APPLICABILITY

This procedure provides the basic methodologies for laboratory preparation of edible crab tissue samples for analysis.

2.0 DEFINITIONS

Carapace – Large shell that forms protective covering on most crabs.

3.0 HEAL TH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when performing this procedure.

3.2 Safety glasses should be worn while using methanol, hexane, or 5 percent nitric acid.

3.3 Use of methanol or hexane should be under a fume hood.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is performed.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure. The task manager has responsibility for assuring that:

- All necessary equipment is available; and
- All samples are prepared according to this procedure.

6.0 EQUIPMENT AND MATERIALS

- Scalpels
- Top loading balance (0.1 gm)
- Stainless Steel Crackers
- Sample Container
- Freezer (chest or upright)
- Spatulas -stainless steel or Teflon coated
- Decontamination materials: DI water, soap, ultra-pure hexane, or methanol
- Labels
- Marking pens
- Chain-of-Custody forms

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Pre-Preparation

Unwrap and thoroughly rinse each crab with DI water to remove any gross field contaminants. Measure and weigh each crab according to SOP-BESI-506.

8.2 Claw Tissue Removal Procedure

Remove both claws from the body by breaking the joint between the basal segment (attached to the body) and the first leg segment. This will prevent the loss of muscle tissue from inside the body.

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Crush the terminal segment of each claw (largest segment) with stainless steel claw cracker. Be careful not to crush the muscle tissue inside the claw. With gloved hands, remove the muscle with a spatula or scissors. Place the tissue directly into a sample container. The sample container should be on the balance and tared prior to processing the crab.

8.3 Body Tissue Removal Procedure

The first step is to remove the shell by flipping the crab over on the table or in the palm of the hand and locating the point where the rear of the carapace meets the underside of the crab. The crab's tail should be seen folding towards the front of the shell (will be narrow and pointed in males and wide and round in females). Grasp the end of the tail and pull towards the rear of the crab. Once the tail is lifted, a small gap should appear providing a finger hold for grasping the rear of the carapace and tearing it from the rest of the crab's body. Removal of the upper carapace will expose the gills (white spongy tissue at the perimeter of the body}, and the digestive gland (yellow to brown tissue in the center of the body) .The gills and digestive gland should be removed by scraping with a spatula or scalpel. The remaining body half should be rinsed with deionized water. After the gills and digestive gland are removed, a series of muscle filled chambers (separated by thin shell) will be seen on both sides of the body. Remove the shell covering the chambers with the scissors and scrape out the muscle tissue with a spatula or scalpel. Place the tissue in the sample jar on the balance along with the claw muscle. Record the weight of all the tissue removed from the crab.

8.4 Decontamination Procedures

Decontamination of the equipment used should follow this general sequence:

1. Rinse with tap water and brush away large pieces of tissue.
2. Clean apparatus with soapy water and brush.
3. Rinse soap away first with tap water and then with DI water.
4. Rinse thoroughly with ultra-pure hexane or methanol (for organics; or 5% nitric).
5. Finally, triple rinse with DI water.

8.5 Equipment Storage

After use of all equipment thoroughly decontaminate and wrap or cover all items with clean hexane-rinsed aluminum foil. Store equipment in an appropriate location.

8.6 Sample Handling and Shipment

Store samples in secure cold storage. Ship frozen samples in coolers to the analytical laboratory via overnight carrier.

9.0 QUALITY CONTROL CHECKS

Quality control checks required for crab tissue processing may consist of rinsate blanks to ensure the processing equipment (i.e., scissors) are free of chemical contamination. If required, rinsate blanks shall be collected by first decontaminating the equipment using the appropriate procedure for the analyses being conducted. Next, the equipment will be either soaked or rinsed with deionized water and collected for chemical analysis.

10.0 DOCUMENTATION

When sending tissue samples to the analytical laboratory, follow the appropriate SOP for chain-of-custody and shipping documentation requirements. Indicate in laboratory logbook that samples have been prepared and sent to the analytical laboratory for analysis. Sign and date all chart forms and logbook pages, as appropriate.

STANDARD OPERATING PROCEDURE
SOP-BESI-508

TITLE: Measuring Fish Length and Wet Weight

The attached Standard Operating Procedure was revised by:

Name	Signature	Date
Katy Garcia		09/14/05

The attached Standard Operating Procedure was reviewed by:

Name	Signature	Date
David Marhofer		09/14/05

Revision No. 1

017164

FISH LENGTH AND WEIGHT PROCEDURES

1.0 PURPOSE AND APPLICABILITY

The purpose of this procedure is to accurately measure the length and weight of fish prior to tissue processing and chemical analyses. Whole fish samples will be collected in the field for chemical analysis. As soon as possible after collection, and prior to tissue removal and processing, accurate measurements of fish length and weight should be recorded. If possible, these measurements should occur on the sample vessel immediately after collection to prevent weight changes resulting from fluid loss after the organisms die.

2.0 DEFINITIONS

Caudal Fin - posterior-most unpaired fin (i.e., tail).

Total Length - length from anterior-most point of nose to the tip of the longest caudal fin ray when the lobes of the caudal fin are compressed dorsoventrally.

Standard Length - length from the anterior-tip of the nose to the posterior tip of the hypural plate.

Fork Length - length from the anterior-most point of the nose to the notch in the tail fin of fork-tailed fishes.

3.0 HEAL TH AND SAFETY CONSIDERATIONS

No specific health and safety considerations are necessary other than the general procedures outlined in the health and safety plan.

4.0 QUALITY ASSURANCE PLANNING CONSIDERA TIONS

No study-specific variances from this sap are anticipated.

5.0 RESPONSIBILITIES

It is the field study manager's responsibility to ensure that all field staff is familiar with this SOP.

6.0 TRAINING/QUALIFICA TIONS

No special training or qualifications other than knowledge of this sap are needed to accurately measure and weigh fish.

7.0 REQUIRED MATERIALS

The following materials are necessary for this procedure:

- Deionized water
- Electronic balance
- Measuring board
- Data log forms
- Decontamination materials
- Aluminum foil.

8.0 METHODS

8.1 Sample Preparation

Prior to handling any fish samples, all staff must wear powder-free latex gloves and all table surfaces should be scrubbed with a cleanser and covered with solvent rinsed aluminum foil. Next, remove the fish from the sample containers or bags and wipe clean of all external debris (e.g., sand, plant material, etc.) using a Kimwipe or other clean paper product. The following sections describe the specific procedures to be followed for measuring and weighing the fish.

8.2 Fish Measurement

1. Place the fish on the measuring board on its side so that the tip of its nose (anterior) is touching the stop plate at the beginning of the tape measure.
2. Slide the measuring scale to the point on the fish corresponding to the desired measurement (i.e., total length, fork length, standard length) and record the value on the data log forms.

8.3 Fish Wet Weight

Note -These procedures assume the top loading balance has already been properly calibrated according to its respective SOP.

1. Place the fish on the tared scale and record the weight of the fish to the appropriate significant digit (balance dependant) on the data log forms.
2. Clean and tare scale prior weighing the next sample.

9.0 QUALITY CONTROL CHECKS AND ACCEPTANCE CRITERIA

Ensure that the top loading balance has been accurately calibrated.

10.0 DOCUMENTATION

Detailed records should be kept to document routine calibration of the balance prior to each use as well as routine servicing by qualified technicians.

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STANDARD OPERATING PROCEDURE
SOP-BESI-509

TITLE: Fish Tissue Processing

The attached Standard Operating Procedure was revised by:

Neil Henthorne	Neil Henthorne	11/16/06
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

David Marhofer	David Marhofer	11/16/06
Name	**Signature**	**Date**

Revision No. 2

017167

FISH TISSUE PROCESSING

1.0 PURPOSE AND APPLICABILITY

This procedure provides the basic methodologies for laboratory preparation of edible fish tissue samples for analysis.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when performing this procedure.

3.2 Safety glasses should be worn while filleting tissue and while using hexane.

3.3 Use of hexane should be under a fume hood or in a well ventilated area.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is performed.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure. The task manager has responsibility for assuring that:

- All necessary equipment is available; and
- All samples are prepared according to this procedure.

6.0 EQUIPMENT AND MATERIALS

- Nitrile gloves
- Fish scaler
- Aluminum foil
- Electric fillet knife, fillet knife
- Stainless steel fillet blades
- Cutting board
- Top loading balance (0.01 gm)
- Cooler (chest or upright)
- Decontamination materials: DI water, soap, ultra-pure hexane
- Labels
- Marking pens
- Freezer grade Zip Loc
- Finfish processing forms
- Chain-of-Custody forms

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Pre-Preparation

Unwrap and thoroughly rinse each fish with DI water to remove any gross field contaminants. Measure, weigh, and label each fish according to appropriate SOP (SOP-BESI-508).

8.2 Fish Scale Removal Procedure

Remove fish scales from fish so as scales will not be processed into the edible tissue sample. Wear nitrile gloves and safety glasses when scaling fish. Once the fish has been scaled, rinse the fish with DI water, and store on ice until the sample can be filleted.

8.3 Body Tissue Removal Procedure

Fillet the fish with your choice of pre-cleaned utensils (electric fillet knife, regular fillet knife). Sample fillet should represent the edible portion of each fish. Record the weight of the tissue removed from each fish. Place tissue sample into pre-cleaned sample jar, double-bag the sample jar in re-sealable Ziploc bags, and place in secure cold storage.

8.4 Decontamination Procedures

Decontamination of the equipment used should follow this general sequence:

1. Rinse with tap water and brush away large pieces of tissue.
2. Clean apparatus with soapy water and brush.
3. Rinse soap away first with tap water and then with Dl water.
4. Rinse thoroughly with ultra-pure hexane.
5. Finally, triple rinse with DI water.

8.5 Equipment Storage

After use of all equipment thoroughly decontaminate and wrap or cover all items with clean hexane-rinsed aluminum foil. Store equipment in an appropriate location.

8.6 Sample Handling and Shipment

Store samples in secure cold storage until shipment. Ship samples in coolers to the analytical laboratory via overnight carrier.

9.0 QUALITY CONTROL CHECKS

Quality control checks required for fish tissue processing may consist of rinsate blanks to ensure the processing equipment (i.e., fillet knives) are free of chemical contamination. If required, rinsate blanks shall be collected by first decontaminating the equipment using the appropriate procedure for the analyses being conducted. Next, the equipment will be either soaked or rinsed with deionized water and collected for chemical analysis.

10.0 DOCUMENTATION

When sending tissue samples to the analytical laboratory, follow the appropriate SOP for chain-of-custody and shipping documentation requirements. Indicate in laboratory logbook that samples have been prepared and sent to the analytical laboratory for analysis. Sign and date all chart forms and logbook pages, as appropriate.

STANDARD OPERATING PROCEDURE
SOP-BESI-600

TITLE: Water Sampling via Peristaltic Pump

The attached Standard Operating Procedure was revised by:

Name	Signature	Date
Neil Heathcote	Neil Heathcote	3-1-06

The attached Standard Operating Procedure was reviewed by:

Name	Signature	Date
Bill Quast	William Quast	3-1-06

Revision No. 2

017170

Water Sampling via Peristaltic Pump

1.0 PURPOSE AND APPLICABILITY

This procedure provides the basic methodologies for conducting water sampling via peristaltic pump.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when performing this procedure.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is performed.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure. The task manager has responsibility for assuring that:

- All necessary equipment is available; and
- All samples are prepared according to this procedure.

6.0 EQUIPMENT AND MATERIALS

- Nitrile gloves
- Peristaltic pump
- C-Flex^R tubing
- Cable ties
- Filter
- 12 Volt battery
- Boat
- Pre cleaned sample bottles

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Pre-Preparation

All tubing and filters should be pre-cleaned prior to sampling using the cleaning procedures described in SOP-BESI-601. The pump may be used to circulate the cleaning solutions and rinsate through the tubing.

8.2 Set Up Procedures

Set up the peristaltic pump by attaching the peristaltic pump to the battery. Insert a predetermined length of C-Flex^R tubing into the pump head and secure the pump head with the adjustment knob. The length of the C-Flex^R tubing will be determined by the depth at which the water sample will be collected. If required connect a filter downstream of the peristaltic pump. Filter requirements and sizes will be listed in the SAP.

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8.3 Tube Purging Procedures

After lowering the intake end of the tubing to the desired collection depth, purge the system for a minimum of one minute by pumping site water through the tubing. The purge time may be increased depending on the depth of sampling and the length of the tubing. If analytes require filtration the filter should be connected to the tubing before purging. Project Manager should designate the purge time prior to field collection.

8.4 Sampling Procedures

Filtered samples are collected directly into pre-cleaned bottles, sealed and placed on ice for shipment to the laboratory for analysis. Unfiltered samples will be collected after the filter is removed from the tubing. Unfiltered samples will be collected into pre-cleaned bottles, sealed and placed on ice for shipment to the laboratory for analysis.

8.5 Labeling Procedures

The sample containers will be labeled according to project requirements. Chain of Custody forms will be completed immediately after sample collection.

8.6 Sample Storage for Shipment

The water sample is then placed in a resealable Ziploc^{R} bag and placed in the sample holding container on ice according to SOP-BESI-502.

8.7 In-situ Measurement Procedures

In-situ measurements will be taken at the time of sample collection using a YSI 55 Meter and a YSI 63 Meter, in accordance with SOP-BESI-401 and SOP-BESI-402, respectively.

8.8 Field Data Recording Procedures

General descriptive information and the appropriate field data should be entered onto the field data log.

9.0 QUALITY CONTROL CHECKS

Quality control checks required for water sampling via peristaltic pump may consist of rinsate blanks to ensure the processing equipment (i.e., tubing and filters) are free of chemical contamination. If required, rinsate blanks shall be collected by first decontaminating the equipment using the appropriate procedure for the analyses being conducted. Deionized water (DI water) will be pumped through the tubing and filter(s) to be used during the field collection. The DI water will be collected in appropriate sample containers and placed on ice for shipment to the laboratory for analysis.

10.0 DOCUMENTATION

When sending water samples to the analytical laboratory, follow the appropriate chain-of-custody and shipping documentation requirements.

STANDARD OPERATING PROCEDURE
SOP-BESI-601

TITLE: Decontamination of Tubing and Filters for Water Sampling

The attached Standard Operating Procedure was revised by:

Name	Signature	Date
Neil Henthorne	Neil Henthorne	3-1-06

The attached Standard Operating Procedure was reviewed by:

Name	Signature	Date
William Quast	William Quast	3-1-06

Revision No. 2

017173

Decontamination of Tubing and Filters for Water Sampling

1.0 PURPOSE AND APPLICABILITY

This procedure provides the basic methodologies for conducting decontaminating tubing and filters used in water sampling studies.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when performing this procedure.

3.2 Work under an air hood or in a well ventilated room when working with HCL.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is performed.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure. The task manager has responsibility for assuring that:

- All necessary equipment is available; and
- All samples are prepared according to this procedure.

6.0 EQUIPMENT AND MATERIALS

- Nitrile gloves
- Peristaltic pump
- C-Flex^R tubing
- Cable ties
- Filter(s)
- 12 Volt battery
- 10 % HCL Solution
- Deionized Water

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Pre-Preparation

Mix a 10% HCL Solution with Laboratory Grade HCL and Deionized (DI) Water.

8.2 Set Up Procedures

Set up the peristaltic pump by attaching the peristaltic pump to the battery. Insert C-Flex^R tubing into the pump head and secure the pump head with the adjustment knob. The length of the C-Flex^R tubing will be determined by the project or may be pre-cut for specific sample stations. If required for the field study, connect filter(s) downstream of the peristaltic pump. Filter requirements and filter sizes will be determined by the analyte list and the analytical methods.

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8.3 Tube and Filter Cleaning

Pump 10% HCL solution through the tubing and filter(s) for five minutes. Clear the tubing and purge the tubing and filter(s) with DI Water for 5 minutes.

8.4 Packaging Clean Tubing and Filter(s)

If tubing has not been cut for specific sample stations then cut tubing to desired length for each of the sample stations. Once the tubing has been cut and clean filters (if needed) are properly connected, place the tubing ends inside a clean Ziploc bag. In most cases the entire length of tubing will not fit inside a Ziploc, use a cable tie to seal the Ziploc bags around the tubing ends. Place the tubing and filter(s) inside of two clean kitchen bags.

8.5 Labeling Procedures

Label the outside of sealed kitchen bags with your initials, date, and sample station.

9.0 QUALITY CONTROL CHECKS

Do not use tubing or filters that have been exposed to potential contamination sources. Inspect tubing prior to sampling

10.0 DOCUMENTATION

Document decontamination date and personnel on field mobilization sheets.

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APPENDIX B
METHOD SELECTION WORKSHEETS

TABLE B-1 - METHOD SELECTION WORKSHEET - SOIL

Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	Routine Available Methods
METALS								
Aluminum	7429-90-5	Y	Soil	ID+Q	5.00E+01	2.70E+00	mg/Kg	SW-846 6010B
Antimony	7440-36-0	Y	Soil	ID+Q	2.70E-01	3.30E-01	mg/Kg	SW-846 6010B
Arsenic	7440-38-2	Y	Soil	ID+Q	1.80E+01	5.30E-01	mg/Kg	SW-846 6010B
Barium	7440-39-3	Y	Soil	ID+Q	3.30E+02	3.30E-01	mg/Kg	SW-846 6010B
Beryllium	7440-41-7	Y	Soil	ID+Q	1.00E+01	7.00E-02	mg/Kg	SW-846 6010B
Boron	7440-42-8	Y	Soil	ID+Q	5.00E-01	1.10E+00	mg/Kg	SW-846 6010B
Cadmium	7440-43-9	Y	Soil	ID+Q	3.60E-01	7.00E-02	mg/Kg	SW-846 6010B
Chromium	7440-47-3	Y	Soil	ID+Q	4.00E-01	1.30E-01	mg/Kg	SW-846 6010B
Chromium (VI)	18540-29-9	Y	Soil	ID+Q	3.00E+01	6.70E-01	mg/Kg	SW-846 6010B
Cobalt	7440-48-4	Y	Soil	ID+Q	1.30E+01	1.30E-01	mg/Kg	SW-846 6010B
Copper	7440-50-8	Y	Soil	ID+Q	6.10E+01	1.30E-01	mg/Kg	SW-846 6010B
Iron	7439-89-6	Y	Soil	ID+Q	2.30E+04	1.30E+00	mg/Kg	SW-846 6010B
Lead	7439-92-1	Y	Soil	ID+Q	1.10E+01	2.00E-01	mg/Kg	SW-846 6010B
Lithium	7439-93-2	Y	Soil	ID+Q	2.00E+00	6.70E-01	mg/Kg	SW-846 6010B
Manganese	7439-96-5	Y	Soil	ID+Q	5.00E+02	2.00E-01	mg/Kg	SW-846 6010B
Mercury	7439-97-6	Y	Soil	ID+Q	1.00E-01	7.00E-03	mg/Kg	SW-846 7471A
Molybdenum	7439-98-7	Y	Soil	ID+Q	2.00E+00	4.00E-01	mg/Kg	SW-846 6010B
Nickel	7440-02-0	Y	Soil	ID+Q	3.00E+01	5.30E-01	mg/Kg	SW-846 6010B
Selenium	7782-49-2	Y	Soil	ID+Q	1.00E+00	4.40E-01	mg/Kg	SW-846 6010B
Silver	7440-22-4	Y	Soil	ID+Q	2.00E+00	1.30E-01	mg/Kg	SW-846 6010B
Strontium	7440-24-6	Y	Soil	ID+Q	3.07E+04	1.30E-01	mg/Kg	SW-846 6010B
Thallium	7791-12-0	Y	Soil	ID+Q	1.00E+00	2.70E-01	mg/Kg	SW-846 6010B
Tin	7440-31-5	Y	Soil	ID+Q	5.00E+01	1.30E+00	mg/Kg	SW-846 6010B
Titanium	7440-32-6	Y	Soil	ID+Q	1.00E+06	1.30E+00	mg/Kg	SW-846 6010B
Vanadium	7440-62-2	Y	Soil	ID+Q	2.00E+00	2.70E-01	mg/Kg	SW-846 6010B
Zinc	7440-66-6	Y	Soil	ID+Q	1.20E+02	2.70E-01	mg/Kg	SW-846 6010B
PESTICIDES								
4,4'-DDD	72-54-8	Y	Soil	ID+Q	2.40E+00	8.00E-04	mg/Kg	SW-846 8081A
4,4'-DDE	72-55-9	Y	Soil	ID+Q	1.70E+00	1.30E-03	mg/Kg	SW-846 8081A
4,4'-DDT	50-29-3	Y	Soil	ID+Q	1.70E+00	1.30E-03	mg/Kg	SW-846 8081A
Aldrin	309-00-2	Y	Soil	ID+Q	2.90E-02	7.00E-04	mg/Kg	SW-846 8081A
alpha-BHC	319-84-6	Y	Soil	ID+Q	9.00E-02	7.00E-04	mg/Kg	SW-846 8081A
beta-BHC	319-85-7	Y	Soil	ID+Q	3.20E-01	1.30E-03	mg/Kg	SW-846 8081A
alpha-Chlordane	5103-71-9	Y	Soil	ID+Q	9.17E-01	7.00E-04	mg/Kg	SW-846 8081A
delta-BHC	319-86-8	Y	Soil	ID+Q	2.85E+00	7.00E-04	mg/Kg	SW-846 8081A

TABLE B-1 - METHOD SELECTION WORKSHEET - SOIL

Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	Routine Available Methods
Dieldrin	60-57-1	Y	Soil	ID+Q	3.20E-05	5.00E-04	mg/Kg	SW-846 8081A
Endosulfan I	959-98-8	Y	Soil	ID+Q	4.65E+01	7.00E-04	mg/Kg	SW-846 8081A
Endosulfan II	33213-65-9	Y	Soil	ID+Q	2.72E+02	1.30E-03	mg/Kg	SW-846 8081A
Endosulfan sulfate	1031-07-8	Y	Soil	ID+Q	3.85E+02	1.30E-03	mg/Kg	SW-846 8081A
Endrin	72-20-8	Y	Soil	ID+Q	8.69E+00	1.30E-03	mg/Kg	SW-846 8081A
Endrin aldehyde	7421-93-4	Y	Soil	ID+Q	1.94E+01	1.30E-03	mg/Kg	SW-846 8081A
Endrin ketone	53494-70-5	Y	Soil	ID+Q	1.86E+01	1.30E-03	mg/Kg	SW-846 8081A
gamma-BHC (Lindane)	58-89-9	Y	Soil	ID+Q	4.40E-01	1.00E-03	mg/Kg	SW-846 8081A
gamma-Chlordane	57-74-9	Y	Soil	ID+Q	7.30E+00	1.30E-03	mg/Kg	SW-846 8081A
Heptachlor	76-44-8	Y	Soil	ID+Q	1.10E-01	7.00E-04	mg/Kg	SW-846 8081A
Heptachlor epoxide	1024-57-3	Y	Soil	ID+Q	5.30E-02	1.30E-03	mg/Kg	SW-846 8081A
Methoxychlor	72-43-5	Y	Soil	ID+Q	2.69E+02	6.70E-03	mg/Kg	SW-846 8081A
Toxaphene	8001-35-2	Y	Soil	ID+Q	4.40E-01	6.67E-02	mg/Kg	SW-846 8081A
PCBs								
Aroclor-1016	12674-11-2	Y	Soil	ID+Q	3.93E+00	2.33E-02	mg/Kg	SW-846 8082
Aroclor-1221	11104-28-2	Y	Soil	ID+Q	2.22E-01	2.33E-02	mg/Kg	SW-846 8082
Aroclor-1232	11141-16-5	Y	Soil	ID+Q	2.22E-01	2.33E-02	mg/Kg	SW-846 8082
Aroclor-1242	53469-21-9	Y	Soil	ID+Q	2.22E-01	2.33E-02	mg/Kg	SW-846 8082
Aroclor-1248	12672-29-6	Y	Soil	ID+Q	2.22E-01	2.33E-02	mg/Kg	SW-846 8082
Aroclor-1254	11097-69-1	Y	Soil	ID+Q	2.22E-01	2.33E-02	mg/Kg	SW-846 8082
Aroclor-1260	11096-82-5	Y	Soil	ID+Q	2.22E-01	2.33E-02	mg/Kg	SW-846 8082
VOCs								
1,1,1,2-Tetrachloroethane	630-20-6	Y	Soil	ID+Q	3.00E+00	1.70E-03	mg/Kg	SW-846 8260B
1,1,1-Trichloroethane	71-55-6	Y	Soil	ID+Q	8.10E+01	1.70E-03	mg/Kg	SW-846 8260B
1,1,2,2-Tetrachloroethane	79-34-5	Y	Soil	ID+Q	3.80E-01	1.70E-03	mg/Kg	SW-846 8260B
1,1,2-Trichloroethane	79-00-5	Y	Soil	ID+Q	8.40E-01	1.70E-03	mg/Kg	SW-846 8260B
1,1-Dichloroethane	75-34-3	Y	Soil	ID+Q	4.62E+02	1.70E-03	mg/Kg	SW-846 8260B
1,1-Dichloroethene	75-35-4	Y	Soil	ID+Q	2.50E+00	1.70E-03	mg/Kg	SW-846 8260B
1,1-Dichloropropene	563-58-6	Y	Soil	ID+Q	6.72E+00	1.70E-03	mg/Kg	SW-846 8260B
1,2,3-Trichloropropane	96-18-4	Y	Soil	ID+Q	1.40E-03	7.00E-04	mg/Kg	SW-846 8260B
1,2,4-Trichlorobenzene	120-82-1	Y	Soil	ID+Q	2.00E+01	1.70E-03	mg/Kg	SW-846 8260B
1,2,4-Trimethylbenzene	95-63-6	Y	Soil	ID+Q	5.20E+01	1.70E-03	mg/Kg	SW-846 8260B
1,2-Dibromo-3-chloropropane	96-12-8	Y	Soil	ID+Q	8.73E-02	1.70E-03	mg/Kg	SW-846 8260B
1,2-Dibromoethane	106-93-4	Y	Soil	ID+Q	1.03E-02	1.70E-03	mg/Kg	SW-846 8260B
1,2-Dichlorobenzene	95-50-1	Y	Soil	ID+Q	2.80E+02	1.70E-03	mg/Kg	SW-846 8260B

TABLE B-1 - METHOD SELECTION WORKSHEET - SOIL

Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	Routine Available Methods
1,2-Dichloroethane	107-06-2	Y	Soil	ID+Q	3.50E-01	1.70E-03	mg/Kg	SW-846 8260B
1,2-Dichloropropane	78-87-5	Y	Soil	ID+Q	3.50E-01	1.70E-03	mg/Kg	SW-846 8260B
1,3,5-Trimethylbenzene	108-67-8	Y	Soil	ID+Q	2.10E+01	1.70E-03	mg/Kg	SW-846 8260B
1,3-Dichlorobenzene	541-73-1	Y	Soil	ID+Q	6.16E+01	1.70E-03	mg/Kg	SW-846 8260B
1,3-Dichloropropane	142-28-9	Y	Soil	ID+Q	3.22E+00	1.70E-03	mg/Kg	SW-846 8260B
1,4-Dichlorobenzene	106-46-7	Y	Soil	ID+Q	3.20E+00	1.70E-03	mg/Kg	SW-846 8260B
2,2-Dichloropropane	594-20-7	Y	Soil	ID+Q	6.04E+00	1.70E-03	mg/Kg	SW-846 8260B
2-Butanone	78-93-3	Y	Soil	ID+Q	1.46E+03	1.70E-03	mg/Kg	SW-846 8260B
2-Chloroethylvinyl ether	110-75-8	Y	Soil	ID+Q	1.44E-01	3.30E-03	mg/Kg	SW-846 8260B
2-Chlorotoluene	95-49-8	Y	Soil	ID+Q	1.60E+02	1.70E-03	mg/Kg	SW-846 8260B
2-Hexanone	591-78-6	Y	Soil	ID+Q	5.60E+01	1.70E-03	mg/Kg	SW-846 8260B
4-Chlorotoluene	106-43-4	Y	Soil	ID+Q	2.47E+00	1.70E-03	mg/Kg	SW-846 8260B
4-Isopropyltoluene	99-87-6	Y	Soil	ID+Q	2.47E+03	1.70E-03	mg/Kg	SW-846 8260B
4-Methyl-2-pentanone	108-10-1	Y	Soil	ID+Q	2.47E+02	1.70E-03	mg/Kg	SW-846 8260B
Acetone	67-64-1	Y	Soil	ID+Q	2.14E+03	8.30E-03	mg/Kg	SW-846 8260B
Acrolein	107-02-8	Y	Soil	ID+Q	1.00E-01	8.30E-03	mg/Kg	SW-846 8260B
Acrylonitrile	107-13-1	Y	Soil	ID+Q	1.67E-01	8.30E-03	mg/Kg	SW-846 8260B
Benzene	71-43-2	Y	Soil	ID+Q	6.60E-01	1.70E-03	mg/Kg	SW-846 8260B
Bromobenzene	108-86-1	Y	Soil	ID+Q	7.30E+01	1.70E-03	mg/Kg	SW-846 8260B
Bromodichloromethane	75-27-4	Y	Soil	ID+Q	1.00E+00	1.70E-03	mg/Kg	SW-846 8260B
Bromoform	75-25-2	Y	Soil	ID+Q	3.16E+01	1.70E-03	mg/Kg	SW-846 8260B
Bromomethane	74-83-9	Y	Soil	ID+Q	3.90E+00	3.30E-03	mg/Kg	SW-846 8260B
Butanol	71-36-3	Y	Soil	ID+Q	2.63E+02	8.30E-03	mg/Kg	SW-846 8260B
Carbon disulfide	75-15-0	Y	Soil	ID+Q	6.79E+02	1.70E-03	mg/Kg	SW-846 8260B
Carbon tetrachloride	56-23-5	Y	Soil	ID+Q	2.40E-01	1.70E-03	mg/Kg	SW-846 8260B
Chlorobenzene	108-90-7	Y	Soil	ID+Q	4.00E+01	1.70E-03	mg/Kg	SW-846 8260B
Chloroethane	75-00-3	Y	Soil	ID+Q	3.00E+00	1.70E-03	mg/Kg	SW-846 8260B
Chloroform	67-66-3	Y	Soil	ID+Q	2.50E-01	1.70E-03	mg/Kg	SW-846 8260B
Chloromethane	74-87-3	Y	Soil	ID+Q	1.30E+00	1.70E-03	mg/Kg	SW-846 8260B
cis-1,2-Dichloroethene	156-59-2	Y	Soil	ID+Q	1.24E+01	1.70E-03	mg/Kg	SW-846 8260B
cis-1,3-Dichloropropene	10061-01-5	Y	Soil	ID+Q	3.32E-01	1.70E-03	mg/Kg	SW-846 8260B
Dibromochloromethane	124-48-1	Y	Soil	ID+Q	1.00E+00	1.70E-03	mg/Kg	SW-846 8260B
Dibromomethane	74-95-3	Y	Soil	ID+Q	5.65E+01	1.70E-03	mg/Kg	SW-846 8260B
Dichlorodifluoromethane	75-71-8	Y	Soil	ID+Q	9.40E+01	1.70E-03	mg/Kg	SW-846 8260B
Ethylbenzene	100-41-4	Y	Soil	ID+Q	2.30E+02	1.70E-03	mg/Kg	SW-846 8260B

TABLE B-1 - METHOD SELECTION WORKSHEET - SOIL

Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	Routine Available Methods
Hexachlorobutadiene	87-68-3	Y	Soil	ID+Q	6.20E+00	3.30E-03	mg/Kg	SW-846 8260B
Isopropylbenzene (Cumene)	98-82-8	Y	Soil	ID+Q	3.70E+02	1.70E-03	mg/Kg	SW-846 8260B
Methyl acetate	79-20-9	Y	Soil	ID+Q	2.44E+03	3.30E-03	mg/Kg	SW-846 8260B
Methyl iodide	74-88-4	Y	Soil	ID+Q	5.68E+00	1.70E-03	mg/Kg	SW-846 8260B
Methylcyclohexane	108-87-2	Y	Soil	ID+Q	1.40E+02	1.70E-03	mg/Kg	SW-846 8260B
Methylene chloride	75-09-2	Y	Soil	ID+Q	6.54E-01	3.30E-03	mg/Kg	SW-846 8260B
Naphthalene	91-20-3	Y	Soil	ID+Q	1.20E+02	1.70E-03	mg/Kg	SW-846 8260B
n-Butylbenzene	104-51-8	Y	Soil	ID+Q	1.40E+02	1.70E-03	mg/Kg	SW-846 8260B
n-Propylbenzene	103-65-1	Y	Soil	ID+Q	1.40E+02	1.70E-03	mg/Kg	SW-846 8260B
o-Xylene	95-47-6	Y	Soil	ID+Q	2.80E+02	1.70E-03	mg/Kg	SW-846 8260B
sec-Butylbenzene	135-98-8	Y	Soil	ID+Q	1.10E+02	1.70E-03	mg/Kg	SW-846 8260B
Styrene	100-42-5	Y	Soil	ID+Q	1.63E+02	1.70E-03	mg/Kg	SW-846 8260B
tert-Butyl methyl ether (MTBE)	1634-04-4	Y	Soil	ID+Q	1.70E+01	1.70E-03	mg/Kg	SW-846 8260B
tert-Butylbenzene	98-06-6	Y	Soil	ID+Q	1.30E+02	1.70E-03	mg/Kg	SW-846 8260B
Tetrachloroethene	127-18-4	Y	Soil	ID+Q	5.50E-01	1.70E-03	mg/Kg	SW-846 8260B
Toluene	108-88-3	Y	Soil	ID+Q	2.00E+02	1.70E-03	mg/Kg	SW-846 8260B
trans-1,2-Dichloroethene	156-60-5	Y	Soil	ID+Q	2.45E+01	1.70E-03	mg/Kg	SW-846 8260B
trans-1,3-Dichloropropene	10061-02-6	Y	Soil	ID+Q	1.79E+00	1.70E-03	mg/Kg	SW-846 8260B
trans-1,4-Dichloro-2-butene	110-57-6	Y	Soil	ID+Q	1.70E-01	1.70E-03	mg/Kg	SW-846 8260B
Trichloroethene	79-01-6	Y	Soil	ID+Q	4.30E-02	1.70E-03	mg/Kg	SW-846 8260B
Trichlorofluoromethane	75-69-4	Y	Soil	ID+Q	3.90E+02	1.70E-03	mg/Kg	SW-846 8260B
Trichlorotrifluoroethane	76-13-1	Y	Soil	ID+Q	5.60E+03	1.70E-03	mg/Kg	SW-846 8260B
Vinyl acetate	108-05-4	Y	Soil	ID+Q	4.30E+02	1.70E-03	mg/Kg	SW-846 8260B
Vinyl chloride	75-01-4	Y	Soil	ID+Q	1.50E-01	1.70E-03	mg/Kg	SW-846 8260B
Xylene (total)	1330-20-7	Y	Soil	ID+Q	2.10E+02	3.30E-03	mg/Kg	SW-846 8260B
SVOCs								
1,2Diphenylhydrazine/Azobenzen	122-66-7	Y	Soil	ID+Q	6.10E-01	1.10E-01	mg/Kg	SW-846 8270C
2,4,5-Trichlorophenol	95-95-4	Y	Soil	ID+Q	4.00E+00	1.10E-01	mg/Kg	SW-846 8270C
2,4,6-Trichlorophenol	88-06-2	Y	Soil	ID+Q	1.00E+01	1.10E-01	mg/Kg	SW-846 8270C
2,4-Dichlorophenol	120-83-2	Y	Soil	ID+Q	1.76E+01	1.10E-01	mg/Kg	SW-846 8270C
2,4-Dimethylphenol	105-67-9	Y	Soil	ID+Q	1.62E+02	1.10E-01	mg/Kg	SW-846 8270C
2,4-Dinitrophenol	51-28-5	Y	Soil	ID+Q	4.68E+00	5.50E-01	mg/Kg	SW-846 8270C
2,4-Dinitrotoluene	121-14-2	Y	Soil	ID+Q	2.66E-01	1.10E-01	mg/Kg	SW-846 8270C
2,6-Dinitrotoluene	606-20-2	Y	Soil	ID+Q	2.40E-01	1.10E-01	mg/Kg	SW-846 8270C
2-Chloronaphthalene	91-58-7	Y	Soil	ID+Q	3.90E+03	1.10E-01	mg/Kg	SW-846 8270C

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Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	Routine Available Methods
2-Chlorophenol	95-57-8	Y	Soil	ID+Q	6.40E+01	1.10E-01	mg/Kg	SW-846 8270C
2-Methylnaphthalene	91-57-6	Y	Soil	ID+Q	2.52E+02	2.20E-02	mg/Kg	SW-846 8270C
2-Nitroaniline	88-74-4	Y	Soil	ID+Q	1.10E+00	5.50E-01	mg/Kg	SW-846 8270C
2-Nitrophenol	88-75-5	Y	Soil	ID+Q	6.73E+00	1.10E-01	mg/Kg	SW-846 8270C
3,3'-Dichlorobenzidine	91-94-1	Y	Soil	ID+Q	1.10E+00	2.20E-01	mg/Kg	SW-846 8270C
3-Nitroaniline	99-09-2	Y	Soil	ID+Q	1.28E+00	5.50E-01	mg/Kg	SW-846 8270C
4,6-Dinitro-2-methylphenol	534-52-1	Y	Soil	ID+Q	4.69E+00	5.50E-01	mg/Kg	SW-846 8270C
4-Bromophenyl phenyl ether	101-55-3	Y	Soil	ID+Q	2.68E-01	1.10E-01	mg/Kg	SW-846 8270C
4-Chloro-3-methylphenol	59-50-7	Y	Soil	ID+Q	2.26E+02	1.10E-01	mg/Kg	SW-846 8270C
4-Chloroaniline	106-47-8	Y	Soil	ID+Q	2.23E+01	1.10E-01	mg/Kg	SW-846 8270C
4-Chlorophenyl phenyl ether	7005-72-3	Y	Soil	ID+Q	1.54E-01	1.10E-01	mg/Kg	SW-846 8270C
4-Nitroaniline	100-01-6	Y	Soil	ID+Q	2.84E+00	5.50E-01	mg/Kg	SW-846 8270C
4-Nitrophenol	100-02-7	Y	Soil	ID+Q	4.99E+00	5.50E-01	mg/Kg	SW-846 8270C
Acenaphthene	83-32-9	Y	Soil	ID+Q	2.00E+01	2.20E-02	mg/Kg	SW-846 8270C
Acenaphthylene	208-96-8	Y	Soil	ID+Q	3.78E+03	2.20E-02	mg/Kg	SW-846 8270C
Acetophenone	98-86-2	Y	Soil	ID+Q	4.12E+02	1.10E-01	mg/Kg	SW-846 8270C
Aniline	62-53-3	Y	Soil	ID+Q	1.83E+01	1.10E-01	mg/Kg	SW-846 8270C
Anthracene	120-12-7	Y	Soil	ID+Q	1.77E+04	2.20E-02	mg/Kg	SW-846 8270C
Atrazine (Aatrex)	1912-24-9	Y	Soil	ID+Q	1.25E+00	2.20E-01	mg/Kg	SW-846 8270C
Benzaldehyde	100-52-7	Y	Soil	ID+Q	2.40E+02	2.20E-01	mg/Kg	SW-846 8270C
Benzidine	92-87-5	Y	Soil	ID+Q	5.46E-04	6.70E-02	mg/Kg	SW-846 8270C
Benzo(a)anthracene	56-55-3	Y	Soil	ID+Q	6.20E-01	2.20E-02	mg/Kg	SW-846 8270C
Benzo(a)pyrene	50-32-8	Y	Soil	ID+Q	6.20E-02	2.20E-02	mg/Kg	SW-846 8270C
Benzo(b)fluoranthene	205-99-2	Y	Soil	ID+Q	6.20E-01	1.10E-01	mg/Kg	SW-846 8270C
Benzo(g,h,i)perylene	191-24-2	Y	Soil	ID+Q	1.78E+03	1.10E-01	mg/Kg	SW-846 8270C
Benzo(k)fluoranthene	207-08-9	Y	Soil	ID+Q	6.20E+00	1.10E-01	mg/Kg	SW-846 8270C
Benzoic acid	65-85-0	Y	Soil	ID+Q	3.54E+02	5.50E-01	mg/Kg	SW-846 8270C
Benzyl alcohol	100-51-6	Y	Soil	ID+Q	8.79E+02	1.10E-01	mg/Kg	SW-846 8270C
Biphenyl	92-52-4	Y	Soil	ID+Q	6.00E+01	1.10E-01	mg/Kg	SW-846 8270C
Bis(2-Chloroethoxy)methane	111-91-1	Y	Soil	ID+Q	5.88E-01	1.10E-01	mg/Kg	SW-846 8270C
Bis(2-Chloroethyl)ether	111-44-4	Y	Soil	ID+Q	1.05E-01	1.05E-01	mg/Kg	SW-846 8270C
Bis(2-Chloroisopropyl)ether	108-60-1	Y	Soil	ID+Q	9.50E+00	1.10E-01	mg/Kg	SW-846 8270C
Bis(2-Ethylhexyl)phthalate	117-81-7	Y	Soil	ID+Q	3.50E+01	2.20E-02	mg/Kg	SW-846 8270C
Butyl benzyl phthalate	85-68-7	Y	Soil	ID+Q	2.40E+02	1.10E-01	mg/Kg	SW-846 8270C
Caprolactam	105-60-2	Y	Soil	ID+Q	1.67E+02	2.20E-01	mg/Kg	SW-846 8270C

TABLE B-1 - METHOD SELECTION WORKSHEET - SOIL

Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	Routine Available Methods
Carbazole	86-74-8	Y	Soil	ID+Q	2.40E+01	1.10E-01	mg/Kg	SW-846 8270C
Chrysene	218-01-9	Y	Soil	ID+Q	6.20E+01	1.10E-01	mg/Kg	SW-846 8270C
Dibenz(a,h)anthracene	53-70-3	Y	Soil	ID+Q	6.20E-02	2.20E-02	mg/Kg	SW-846 8270C
Dibenzofuran	132-64-9	Y	Soil	ID+Q	1.50E+02	1.10E-01	mg/Kg	SW-846 8270C
Diethyl phthalate	84-66-2	Y	Soil	ID+Q	1.00E+02	1.10E-01	mg/Kg	SW-846 8270C
Dimethyl phthalate	131-11-3	Y	Soil	ID+Q	2.00E+02	1.10E-01	mg/Kg	SW-846 8270C
Di-n-butyl phthalate	84-74-2	Y	Soil	ID+Q	2.00E+02	1.10E-01	mg/Kg	SW-846 8270C
Di-n-octyl phthalate	117-84-0	Y	Soil	ID+Q	1.29E+03	1.10E-01	mg/Kg	SW-846 8270C
Fluoranthene	206-44-0	Y	Soil	ID+Q	2.30E+03	1.10E-01	mg/Kg	SW-846 8270C
Fluorene	86-73-7	Y	Soil	ID+Q	3.00E+01	2.20E-02	mg/Kg	SW-846 8270C
Hexachlorobenzene	118-74-1	Y	Soil	ID+Q	3.00E-01	1.10E-01	mg/Kg	SW-846 8270C
Hexachlorocyclopentadiene	77-47-4	Y	Soil	ID+Q	7.16E+00	1.10E-01	mg/Kg	SW-846 8270C
Hexachloroethane	67-72-1	Y	Soil	ID+Q	3.50E+01	1.10E-01	mg/Kg	SW-846 8270C
Indeno(1,2,3-cd)pyrene	193-39-5	Y	Soil	ID+Q	6.20E-01	1.10E-01	mg/Kg	SW-846 8270C
Isophorone	78-59-1	Y	Soil	ID+Q	1.50E+02	1.10E-01	mg/Kg	SW-846 8270C
Nitrobenzene	98-95-3	Y	Soil	ID+Q	4.39E+00	1.90E-02	mg/Kg	SW-846 8270C
n-Nitrosodimethylamine	62-75-9	Y	Soil	ID+Q	1.84E-03	6.50E-02	mg/Kg	SW-846 8270C
n-Nitrosodi-n-propylamine	621-64-7	Y	Soil	ID+Q	1.76E-02	2.20E-02	mg/Kg	SW-846 8270C
n-Nitrosodiphenylamine	86-30-6	Y	Soil	ID+Q	2.00E+01	1.10E-01	mg/Kg	SW-846 8270C
Pentachlorophenol	87-86-5	Y	Soil	ID+Q	1.80E-03	1.30E-01	mg/Kg	SW-846 8270C
Phenanthrene	85-01-8	Y	Soil	ID+Q	1.71E+03	2.20E-02	mg/Kg	SW-846 8270C
Phenol	108-95-2	Y	Soil	ID+Q	3.00E+01	1.10E-01	mg/Kg	SW-846 8270C
Pyrene	129-00-0	Y	Soil	ID+Q	1.70E+03	1.10E-01	mg/Kg	SW-846 8270C
Pyridine	110-86-1	Y	Soil	ID+Q	3.45E+00	1.10E-01	mg/Kg	SW-846 8270C

Notes:
NV - No value established

TABLE B-2 - METHOD SELECTION WORKSHEET - GROUNDWATER

Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	Routine Available Methods
METALS								
Aluminum	7429-90-5	Y	Groundwater	ID+Q	2.40E+01	6.70E-02	mg/L	SW-846 6010B
Antimony	7440-36-0	Y	Groundwater	ID+Q	6.00E-03	6.00E-03	mg/L	SW-846 6010B
Arsenic	7440-38-2	Y	Groundwater	ID+Q	1.00E-02	1.00E-02	mg/L	SW-846 6010B
Barium	7440-39-3	Y	Groundwater	ID+Q	2.00E+00	3.00E-03	mg/L	SW-846 6010B
Beryllium	7440-41-7	Y	Groundwater	ID+Q	4.00E-03	2.00E-03	mg/L	SW-846 6010B
Boron	7440-42-8	Y	Groundwater	ID+Q	4.90E+00	3.33E-01	mg/L	SW-846 6010B
Cadmium	7440-43-9	Y	Groundwater	ID+Q	5.00E-03	2.00E-03	mg/L	SW-846 6010B
Chromium	7440-47-3	Y	Groundwater	ID+Q	1.00E-01	3.00E-03	mg/L	SW-846 6010B
Chromium (VI)	18540-29-9	Y	Groundwater	ID+Q	4.96E-02	8.00E-03	mg/L	SW-846 6010B
Cobalt	7440-48-4	Y	Groundwater	ID+Q	1.50E+00	3.00E-03	mg/L	SW-846 6010B
Copper	7440-50-8	Y	Groundwater	ID+Q	3.60E-03	2.00E-03	mg/L	SW-846 6010B
Ferric Iron	MET-002	Y	Groundwater	ID+Q	NV	3.30E-02	mg/L	SW-846 6010B
Iron	7439-89-6	Y	Groundwater	ID+Q	NV	3.30E-02	mg/L	SW-846 6010B
Lead	7439-92-1	Y	Groundwater	ID+Q	5.30E-03	3.00E-03	mg/L	SW-846 6010B
Lithium	7439-93-2	Y	Groundwater	ID+Q	4.90E-01	1.70E-02	mg/L	SW-846 6010B
Manganese	7439-96-5	Y	Groundwater	ID+Q	1.20E+00	5.00E-03	mg/L	SW-846 6010B
Mercury	7439-97-6	Y	Groundwater	ID+Q	1.10E-03	2.00E-04	mg/L	SW-846 7470A
Molybdenum	7439-98-7	Y	Groundwater	ID+Q	1.20E-01	1.70E-02	mg/L	SW-846 6010B
Nickel	7440-02-0	Y	Groundwater	ID+Q	1.31E-02	2.00E-03	mg/L	SW-846 6010B
Selenium	7782-49-2	Y	Groundwater	ID+Q	5.00E-02	1.30E-02	mg/L	SW-846 6010B
Silver	7440-22-4	Y	Groundwater	ID+Q	1.20E-01	2.00E-03	mg/L	SW-846 6010B
Strontium	7440-24-6	Y	Groundwater	ID+Q	1.50E+01	1.70E-02	mg/L	SW-846 6010B
Thallium	7791-12-0	Y	Groundwater	ID+Q	2.00E-03	2.90E-03	mg/L	SW-846 6010B
Tin	7440-31-5	Y	Groundwater	ID+Q	1.50E+01	8.00E-03	mg/L	SW-846 6010B
Titanium	7440-32-6	Y	Groundwater	ID+Q	1.20E+04	3.30E-02	mg/L	SW-846 6010B
Vanadium	7440-62-2	Y	Groundwater	ID+Q	1.70E-01	7.00E-03	mg/L	SW-846 6010B
Zinc	7440-66-6	Y	Groundwater	ID+Q	8.42E-02	7.00E-03	mg/L	SW-846 6010B
PESTICIDES								
4,4'-DDD	72-54-8	Y	Groundwater	ID+Q	2.50E-05	2.50E-05	mg/L	SW-846 8081A
4,4'-DDE	72-55-9	Y	Groundwater	ID+Q	1.40E-04	3.00E-05	mg/L	SW-846 8081A
4,4'-DDT	50-29-3	Y	Groundwater	ID+Q	1.00E-06	1.80E-05	mg/L	SW-846 8081A
Aldrin	309-00-2	Y	Groundwater	ID+Q	5.40E-05	2.00E-05	mg/L	SW-846 8081A
alpha-BHC	319-84-6	Y	Groundwater	ID+Q	1.50E-04	2.00E-05	mg/L	SW-846 8081A
alpha-Chlordane	5103-71-9	Y	Groundwater	ID+Q	2.60E-03	2.00E-05	mg/L	SW-846 8081A

TABLE B-2 - METHOD SELECTION WORKSHEET - GROUNDWATER

Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	Routine Available Methods
beta-BHC	319-85-7	Y	Groundwater	ID+Q	5.10E-04	2.00E-05	mg/L	SW-846 8081A
delta-BHC	319-86-8	Y	Groundwater	ID+Q	5.10E-04	2.00E-05	mg/L	SW-846 8081A
Dieldrin	60-57-1	Y	Groundwater	ID+Q	2.00E-06	1.50E-05	mg/L	SW-846 8081A
Endosulfan I	959-98-8	Y	Groundwater	ID+Q	9.00E-06	9.00E-06	mg/L	SW-846 8081A
Endosulfan II	33213-65-9	Y	Groundwater	ID+Q	9.00E-06	2.40E-05	mg/L	SW-846 8081A
Endosulfan sulfate	1031-07-8	Y	Groundwater	ID+Q	9.00E-06	9.00E-06	mg/L	SW-846 8081A
Endrin	72-20-8	Y	Groundwater	ID+Q	2.00E-06	2.50E-05	mg/L	SW-846 8081A
Endrin aldehyde	7421-93-4	Y	Groundwater	ID+Q	7.30E-03	3.00E-05	mg/L	SW-846 8081A
Endrin ketone	53494-70-5	Y	Groundwater	ID+Q	7.30E-03	3.00E-05	mg/L	SW-846 8081A
gamma-BHC (Lindane)	58-89-9	Y	Groundwater	ID+Q	1.60E-05	1.60E-05	mg/L	SW-846 8081A
gamma-Chlordane	57-74-9	Y	Groundwater	ID+Q	2.60E-03	3.00E-05	mg/L	SW-846 8081A
Heptachlor	76-44-8	Y	Groundwater	ID+Q	4.00E-06	1.40E-05	mg/L	SW-846 8081A
Heptachlor epoxide	1024-57-3	Y	Groundwater	ID+Q	3.60E-06	2.20E-05	mg/L	SW-846 8081A
Methoxychlor	72-43-5	Y	Groundwater	ID+Q	3.00E-05	3.00E-05	mg/L	SW-846 8081A
Toxaphene	8001-35-2	Y	Groundwater	ID+Q	2.00E-07	8.25E-04	mg/L	SW-846 8081A
PCBs								
Aroclor-1016	12674-11-2	Y	Groundwater	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
Aroclor-1221	11104-28-2	Y	Groundwater	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
Aroclor-1232	11141-16-5	Y	Groundwater	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
Aroclor-1242	53469-21-9	Y	Groundwater	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
Aroclor-1248	12672-29-6	Y	Groundwater	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
Aroclor-1254	11097-69-1	Y	Groundwater	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
Aroclor-1260	11096-82-5	Y	Groundwater	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
VOCs								
1,1,1,2-Tetrachloroethane	630-20-6	Y	Groundwater	ID+Q	3.50E-02	1.70E-03	mg/L	SW-846 8260B
1,1,1-Trichloroethane	71-55-6	Y	Groundwater	ID+Q	2.00E-01	1.70E-03	mg/L	SW-846 8260B
1,1,2,2-Tetrachloroethane	79-34-5	Y	Groundwater	ID+Q	4.60E-03	1.70E-03	mg/L	SW-846 8260B
1,1,2-Trichloroethane	79-00-5	Y	Groundwater	ID+Q	5.00E-03	1.70E-03	mg/L	SW-846 8260B
1,1-Dichloroethane	75-34-3	Y	Groundwater	ID+Q	2.40E+00	1.70E-03	mg/L	SW-846 8260B
1,1-Dichloroethene	75-35-4	Y	Groundwater	ID+Q	7.00E-03	1.70E-03	mg/L	SW-846 8260B
1,1-Dichloropropene	563-58-6	Y	Groundwater	ID+Q	9.10E-03	1.70E-03	mg/L	SW-846 8260B
1,2,3-Trichloropropane	96-18-4	Y	Groundwater	ID+Q	1.30E-04	7.00E-04	mg/L	SW-846 8260B
1,2,4-Trichlorobenzene	120-82-1	Y	Groundwater	ID+Q	2.20E-02	1.70E-03	mg/L	SW-846 8260B
1,2,4-Trimethylbenzene	95-63-6	Y	Groundwater	ID+Q	2.17E-01	1.70E-03	mg/L	SW-846 8260B
1,2-Dibromo-3-chloropropane	96-12-8	Y	Groundwater	ID+Q	2.00E-04	3.00E-04	mg/L	SW-846 8260B

TABLE B-2 - METHOD SELECTION WORKSHEET - GROUNDWATER

Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	Routine Available Methods
1,2-Dibromoethane	106-93-4	Y	Groundwater	ID+Q	5.00E-05	4.00E-04	mg/L	SW-846 8260B
1,2-Dichlorobenzene	95-50-1	Y	Groundwater	ID+Q	5.91E-01	1.70E-03	mg/L	SW-846 8260B
1,2-Dichloroethane	107-06-2	Y	Groundwater	ID+Q	5.00E-03	1.70E-03	mg/L	SW-846 8260B
1,2-Dichloroethene(Total)	540-59-0	Y	Groundwater	ID+Q	6.80E-01	3.30E-03	mg/L	SW-846 8260B
1,2-Dichloropropane	78-87-5	Y	Groundwater	ID+Q	5.00E-03	1.70E-03	mg/L	SW-846 8260B
1,3,5-Trimethylbenzene	108-67-8	Y	Groundwater	ID+Q	1.20E+00	1.70E-03	mg/L	SW-846 8260B
1,3-Dichlorobenzene	541-73-1	Y	Groundwater	ID+Q	1.42E-01	1.70E-03	mg/L	SW-846 8260B
1,3-Dichloropropane	142-28-9	Y	Groundwater	ID+Q	9.10E-03	1.70E-03	mg/L	SW-846 8260B
1,4-Dichlorobenzene	106-46-7	Y	Groundwater	ID+Q	7.50E-02	1.70E-03	mg/L	SW-846 8260B
2,2-Dichloropropane	594-20-7	Y	Groundwater	ID+Q	1.30E-02	1.70E-03	mg/L	SW-846 8260B
2-Butanone	78-93-3	Y	Groundwater	ID+Q	1.50E+01	1.70E-03	mg/L	SW-846 8260B
2-Chloroethylvinyl ether	110-75-8	Y	Groundwater	ID+Q	8.30E-04	8.00E-04	mg/L	SW-846 8260B
2-Chlorotoluene	95-49-8	Y	Groundwater	ID+Q	4.90E-01	1.70E-03	mg/L	SW-846 8260B
2-Hexanone	591-78-6	Y	Groundwater	ID+Q	1.50E+00	1.70E-03	mg/L	SW-846 8260B
4-Chlorotoluene	106-43-4	Y	Groundwater	ID+Q	4.90E-01	1.70E-03	mg/L	SW-846 8260B
4-Isopropyltoluene	99-87-6	Y	Groundwater	ID+Q	2.40E+00	1.70E-03	mg/L	SW-846 8260B
4-Methyl-2-pentanone	108-10-1	Y	Groundwater	ID+Q	2.00E+00	1.70E-03	mg/L	SW-846 8260B
Acetone	67-64-1	Y	Groundwater	ID+Q	2.20E+01	8.30E-03	mg/L	SW-846 8260B
Acrolein	107-02-8	Y	Groundwater	ID+Q	1.00E-02	8.30E-03	mg/L	SW-846 8260B
Acrylonitrile	107-13-1	Y	Groundwater	ID+Q	1.70E-03	1.70E-03	mg/L	SW-846 8260B
Benzene	71-43-2	Y	Groundwater	ID+Q	5.00E-03	1.70E-03	mg/L	SW-846 8260B
Bromobenzene	108-86-1	Y	Groundwater	ID+Q	4.90E-01	1.70E-03	mg/L	SW-846 8260B
Bromodichloromethane	75-27-4	Y	Groundwater	ID+Q	1.50E-02	1.70E-03	mg/L	SW-846 8260B
Bromoform	75-25-2	Y	Groundwater	ID+Q	1.20E-01	1.70E-03	mg/L	SW-846 8260B
Bromomethane	74-83-9	Y	Groundwater	ID+Q	3.40E-02	1.70E-03	mg/L	SW-846 8260B
Butanol	71-36-3	Y	Groundwater	ID+Q	2.40E+00	3.80E-02	mg/L	SW-846 8260B
Carbon disulfide	75-15-0	Y	Groundwater	ID+Q	2.40E+00	1.70E-03	mg/L	SW-846 8260B
Carbon tetrachloride	56-23-5	Y	Groundwater	ID+Q	5.00E-03	1.70E-03	mg/L	SW-846 8260B
Chlorobenzene	108-90-7	Y	Groundwater	ID+Q	1.00E-01	1.70E-03	mg/L	SW-846 8260B
Chloroethane	75-00-3	Y	Groundwater	ID+Q	9.80E+00	1.70E-03	mg/L	SW-846 8260B
Chloroform	67-66-3	Y	Groundwater	ID+Q	2.40E-01	1.70E-03	mg/L	SW-846 8260B
Chloromethane	74-87-3	Y	Groundwater	ID+Q	7.00E-02	1.70E-03	mg/L	SW-846 8260B
cis-1,2-Dichloroethene	156-59-2	Y	Groundwater	ID+Q	7.00E-02	1.70E-03	mg/L	SW-846 8260B
cis-1,3-Dichloropropene	10061-01-5	Y	Groundwater	ID+Q	1.70E-03	1.70E-03	mg/L	SW-846 8260B
Dibromochloromethane	124-48-1	Y	Groundwater	ID+Q	1.10E-02	1.70E-03	mg/L	SW-846 8260B

TABLE B-2 - METHOD SELECTION WORKSHEET - GROUNDWATER

Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	Routine Available Methods
Dibromomethane	74-95-3	Y	Groundwater	ID+Q	1.20E-01	1.70E-03	mg/L	SW-846 8260B
Dichlorodifluoromethane	75-71-8	Y	Groundwater	ID+Q	4.90E+00	1.70E-03	mg/L	SW-846 8260B
Ethylbenzene	100-41-4	Y	Groundwater	ID+Q	5.00E-01	1.70E-03	mg/L	SW-846 8260B
Hexachlorobutadiene	87-68-3	Y	Groundwater	ID+Q	3.20E-04	4.00E-04	mg/L	SW-846 8260B
Isopropylbenzene (Cumene)	98-82-8	Y	Groundwater	ID+Q	2.40E+00	1.70E-03	mg/L	SW-846 8260B
Methyl acetate	79-20-9	Y	Groundwater	ID+Q	2.40E+01	1.70E-03	mg/L	SW-846 8260B
Methyl iodide	74-88-4	Y	Groundwater	ID+Q	3.40E-02	1.70E-03	mg/L	SW-846 8260B
Methylcyclohexane	108-87-2	Y	Groundwater	ID+Q	1.20E+02	8.00E-03	mg/L	SW-846 8260B
Methylene chloride	75-09-2	Y	Groundwater	ID+Q	5.00E-03	3.30E-03	mg/L	SW-846 8260B
Naphthalene	91-20-3	Y	Groundwater	ID+Q	2.50E-01	1.70E-03	mg/L	SW-846 8260B
n-Butylbenzene	104-51-8	Y	Groundwater	ID+Q	9.80E-01	1.70E-03	mg/L	SW-846 8260B
n-Propylbenzene	103-65-1	Y	Groundwater	ID+Q	9.80E-01	1.70E-03	mg/L	SW-846 8260B
o-Xylene	95-47-6	Y	Groundwater	ID+Q	1.00E+01	1.70E-03	mg/L	SW-846 8260B
sec-Butylbenzene	135-98-8	Y	Groundwater	ID+Q	9.80E-01	1.70E-03	mg/L	SW-846 8260B
Styrene	100-42-5	Y	Groundwater	ID+Q	1.00E-01	1.70E-03	mg/L	SW-846 8260B
tert-Butyl methyl ether (MTBE)	1634-04-4	Y	Groundwater	ID+Q	2.40E-01	1.70E-03	mg/L	SW-846 8260B
tert-Butylbenzene	98-06-6	Y	Groundwater	ID+Q	9.80E-01	1.70E-03	mg/L	SW-846 8260B
Tetrachloroethene	127-18-4	Y	Groundwater	ID+Q	5.00E-03	1.70E-03	mg/L	SW-846 8260B
Toluene	108-88-3	Y	Groundwater	ID+Q	9.50E-01	1.70E-03	mg/L	SW-846 8260B
trans-1,2-Dichloroethene	156-60-5	Y	Groundwater	ID+Q	1.00E-01	1.70E-03	mg/L	SW-846 8260B
trans-1,3-Dichloropropene	10061-02-6	Y	Groundwater	ID+Q	9.10E-03	1.70E-03	mg/L	SW-846 8260B
trans-1,4-Dichloro-2-butene	110-57-6	Y	Groundwater	ID+Q	1.40E-01	1.70E-03	mg/L	SW-846 8260B
Trichloroethene	79-01-6	Y	Groundwater	ID+Q	5.00E-03	1.70E-03	mg/L	SW-846 8260B
Trichlorofluoromethane	75-69-4	Y	Groundwater	ID+Q	7.30E+00	1.70E-03	mg/L	SW-846 8260B
Trichlorotrifluoroethane	76-13-1	Y	Groundwater	ID+Q	7.30E+02	1.70E-03	mg/L	SW-846 8260B
Vinyl acetate	108-05-4	Y	Groundwater	ID+Q	2.40E+01	1.70E-03	mg/L	SW-846 8260B
Vinyl chloride	75-01-4	Y	Groundwater	ID+Q	2.00E-03	1.70E-03	mg/L	SW-846 8260B
Xylene (total)	1330-20-7	Y	Groundwater	ID+Q	8.50E-01	3.30E-03	mg/L	SW-846 8260B
SVOCs								
1,2Diphenylhydrazine/Azobenzen	122-66-7	Y	Groundwater	ID+Q	1.10E-03	1.10E-03	mg/L	SW-846 8270C
2,4,5-Trichlorophenol	95-95-4	Y	Groundwater	ID+Q	1.20E-02	3.30E-03	mg/L	SW-846 8270C
2,4,6-Trichlorophenol	88-06-2	Y	Groundwater	ID+Q	6.10E-02	3.30E-03	mg/L	SW-846 8270C
2,4-Dichlorophenol	120-83-2	Y	Groundwater	ID+Q	7.30E-02	3.30E-03	mg/L	SW-846 8270C
2,4-Dimethylphenol	105-67-9	Y	Groundwater	ID+Q	4.90E-01	1.00E-02	mg/L	SW-846 8270C
2,4-Dinitrophenol	51-28-5	Y	Groundwater	ID+Q	4.90E-02	1.67E-02	mg/L	SW-846 8270C

TABLE B-2 - METHOD SELECTION WORKSHEET - GROUNDWATER

Analytes		Reporting Requirement (Y or N)	Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.			ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
2,4-Dinitrotoluene	121-14-2	Y	Groundwater	ID+Q	1.30E-03	1.30E-03	mg/L	SW-846 8270C
2,6-Dinitrotoluene	606-20-2	Y	Groundwater	ID+Q	1.30E-03	1.30E-03	mg/L	SW-846 8270C
2-Chloronaphthalene	91-58-7	Y	Groundwater	ID+Q	2.00E+00	3.30E-03	mg/L	SW-846 8270C
2-Chlorophenol	95-57-8	Y	Groundwater	ID+Q	1.20E-01	3.30E-03	mg/L	SW-846 8270C
2-Methylnaphthalene	91-57-6	Y	Groundwater	ID+Q	6.00E-02	3.30E-03	mg/L	SW-846 8270C
2-Nitroaniline	88-74-4	Y	Groundwater	ID+Q	7.30E-03	7.30E-03	mg/L	SW-846 8270C
2-Nitrophenol	88-75-5	Y	Groundwater	ID+Q	4.90E-02	3.30E-03	mg/L	SW-846 8270C
3,3'-Dichlorobenzidine	91-94-1	Y	Groundwater	ID+Q	2.00E-03	2.00E-03	mg/L	SW-846 8270C
3-Nitroaniline	99-09-2	Y	Groundwater	ID+Q	7.30E-03	7.30E-03	mg/L	SW-846 8270C
4,6-Dinitro-2-methylphenol	534-52-1	Y	Groundwater	ID+Q	4.90E-02	1.67E-02	mg/L	SW-846 8270C
4-Bromophenyl phenyl ether	101-55-3	Y	Groundwater	ID+Q	6.10E-05	6.00E-04	mg/L	SW-846 8270C
4-Chloro-3-methylphenol	59-50-7	Y	Groundwater	ID+Q	1.20E-01	3.30E-03	mg/L	SW-846 8270C
4-Chloroaniline	106-47-8	Y	Groundwater	ID+Q	9.80E-02	3.30E-03	mg/L	SW-846 8270C
4-Chlorophenyl phenyl ether	7005-72-3	Y	Groundwater	ID+Q	6.10E-05	6.00E-04	mg/L	SW-846 8270C
4-Nitroaniline	100-01-6	Y	Groundwater	ID+Q	2.40E-02	1.67E-02	mg/L	SW-846 8270C
4-Nitrophenol	100-02-7	Y	Groundwater	ID+Q	4.90E-02	1.67E-02	mg/L	SW-846 8270C
Acenaphthene	83-32-9	Y	Groundwater	ID+Q	4.04E-02	3.30E-03	mg/L	SW-846 8270C
Acenaphthylene	208-96-8	Y	Groundwater	ID+Q	1.50E+00	3.30E-03	mg/L	SW-846 8270C
Acetophenone	98-86-2	Y	Groundwater	ID+Q	2.40E+00	3.30E-03	mg/L	SW-846 8270C
Aniline	62-53-3	Y	Groundwater	ID+Q	1.60E-01	3.30E-03	mg/L	SW-846 8270C
Anthracene	120-12-7	Y	Groundwater	ID+Q	1.80E-04	6.00E-04	mg/L	SW-846 8270C
Atrazine (Aatrex)	1912-24-9	Y	Groundwater	ID+Q	3.00E-03	3.00E-03	mg/L	SW-846 8270C
Benzaldehyde	100-52-7	Y	Groundwater	ID+Q	2.40E+00	6.70E-03	mg/L	SW-846 8270C
Benzidine	92-87-5	Y	Groundwater	ID+Q	4.00E-06	1.08E-02	mg/L	SW-846 8270C
Benzo(a)anthracene	56-55-3	Y	Groundwater	ID+Q	1.30E-03	1.30E-03	mg/L	SW-846 8270C
Benzo(a)pyrene	50-32-8	Y	Groundwater	ID+Q	2.00E-04	2.00E-04	mg/L	SW-846 8270C
Benzo(b)fluoranthene	205-99-2	Y	Groundwater	ID+Q	1.30E-03	1.30E-03	mg/L	SW-846 8270C
Benzo(g,h,i)perylene	191-24-2	Y	Groundwater	ID+Q	7.30E-01	3.30E-03	mg/L	SW-846 8270C
Benzo(k)fluoranthene	207-08-9	Y	Groundwater	ID+Q	1.30E-02	3.30E-03	mg/L	SW-846 8270C
Benzoic acid	65-85-0	Y	Groundwater	ID+Q	9.80E+01	1.67E-02	mg/L	SW-846 8270C
Benzyl alcohol	100-51-6	Y	Groundwater	ID+Q	7.30E+00	3.30E-03	mg/L	SW-846 8270C
Biphenyl	92-52-4	Y	Groundwater	ID+Q	1.20E+00	3.30E-03	mg/L	SW-846 8270C
Bis(2-Chloroethoxy)methane	111-91-1	Y	Groundwater	ID+Q	8.30E-04	8.00E-04	mg/L	SW-846 8270C
Bis(2-Chloroethyl)ether	111-44-4	Y	Groundwater	ID+Q	8.30E-04	8.00E-04	mg/L	SW-846 8270C
Bis(2-Chloroisopropyl)ether	108-60-1	Y	Groundwater	ID+Q	1.30E-02	3.30E-03	mg/L	SW-846 8270C

TABLE B-2 - METHOD SELECTION WORKSHEET - GROUNDWATER

Analytes		Reporting Requirement (Y or N)	Medium	Critical Parameters				Routine Available Methods
Chemicals of Interest	CAS No.			ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	
Bis(2-Ethylhexyl)phthalate	117-81-7	Y	Groundwater	ID+Q	6.00E-03	3.30E-03	mg/L	SW-846 8270C
Butyl benzyl phthalate	85-68-7	Y	Groundwater	ID+Q	1.47E-01	3.30E-03	mg/L	SW-846 8270C
Caprolactam	105-60-2	Y	Groundwater	ID+Q	1.20E+01	3.30E-03	mg/L	SW-846 8270C
Carbazole	86-74-8	Y	Groundwater	ID+Q	4.60E-02	3.30E-03	mg/L	SW-846 8270C
Chrysene	218-01-9	Y	Groundwater	ID+Q	1.30E-01	3.30E-03	mg/L	SW-846 8270C
Dibenz(a,h)anthracene	53-70-3	Y	Groundwater	ID+Q	2.00E-04	5.00E-04	mg/L	SW-846 8270C
Dibenzofuran	132-64-9	Y	Groundwater	ID+Q	6.50E-02	3.30E-03	mg/L	SW-846 8270C
Diethyl phthalate	84-66-2	Y	Groundwater	ID+Q	8.84E-01	3.30E-03	mg/L	SW-846 8270C
Dimethyl phthalate	131-11-3	Y	Groundwater	ID+Q	5.80E-01	3.30E-03	mg/L	SW-846 8270C
Di-n-butyl phthalate	84-74-2	Y	Groundwater	ID+Q	5.00E-03	1.70E-03	mg/L	SW-846 8270C
Di-n-octyl phthalate	117-84-0	Y	Groundwater	ID+Q	4.90E-01	3.30E-03	mg/L	SW-846 8270C
Fluoranthene	206-44-0	Y	Groundwater	ID+Q	2.96E-03	7.00E-04	mg/L	SW-846 8270C
Fluorene	86-73-7	Y	Groundwater	ID+Q	5.00E-02	3.30E-03	mg/L	SW-846 8270C
Hexachlorobenzene	118-74-1	Y	Groundwater	ID+Q	1.00E-03	1.00E-03	mg/L	SW-846 8270C
Hexachlorocyclopentadiene	77-47-4	Y	Groundwater	ID+Q	7.00E-05	2.80E-03	mg/L	SW-846 8270C
Hexachloroethane	67-72-1	Y	Groundwater	ID+Q	9.40E-03	2.20E-03	mg/L	SW-846 8270C
Indeno(1,2,3-cd)pyrene	193-39-5	Y	Groundwater	ID+Q	1.30E-03	1.30E-03	mg/L	SW-846 8270C
Isophorone	78-59-1	Y	Groundwater	ID+Q	9.60E-01	3.30E-03	mg/L	SW-846 8270C
Nitrobenzene	98-95-3	Y	Groundwater	ID+Q	1.20E-02	3.30E-03	mg/L	SW-846 8270C
n-Nitrosodimethylamine	62-75-9	Y	Groundwater	ID+Q	1.80E-05	1.80E-03	mg/L	SW-846 8270C
n-Nitrosodi-n-propylamine	621-64-7	Y	Groundwater	ID+Q	1.30E-04	4.00E-04	mg/L	SW-846 8270C
n-Nitrosodiphenylamine	86-30-6	Y	Groundwater	ID+Q	1.90E-01	3.30E-03	mg/L	SW-846 8270C
o-Cresol	95-48-7	Y	Groundwater	ID+Q	1.02E+00	3.30E-03	mg/L	SW-846 8270C
Pentachlorophenol	87-86-5	Y	Groundwater	ID+Q	1.00E-03	9.60E-03	mg/L	SW-846 8270C
Phenanthrene	85-01-8	Y	Groundwater	ID+Q	4.60E-03	7.00E-04	mg/L	SW-846 8270C
Phenol	108-95-2	Y	Groundwater	ID+Q	5.50E+00	3.30E-03	mg/L	SW-846 8270C
Pyrene	129-00-0	Y	Groundwater	ID+Q	2.40E-04	4.00E-04	mg/L	SW-846 8270C
Pyridine	110-86-1	Y	Groundwater	ID+Q	2.40E-02	6.70E-03	mg/L	SW-846 8270C

Notes:
NV - No value established

TABLE B-3 - METHOD SELECTION WORKSHEET - SURFACE WATER

Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	Routine Available Methods
METALS								
Aluminum	7429-90-5	Y	Surface Water	ID+Q	NV	6.70E-02	mg/L	SW-846 6010B
Antimony	7440-36-0	Y	Surface Water	ID+Q	5.00E-01	2.00E-02	mg/L	SW-846 6010B
Arsenic	7440-38-2	Y	Surface Water	ID+Q	7.80E-02	1.30E-02	mg/L	SW-846 6010B
Barium	7440-39-3	Y	Surface Water	ID+Q	NV	3.00E-03	mg/L	SW-846 6010B
Beryllium	7440-41-7	Y	Surface Water	ID+Q	NV	2.00E-03	mg/L	SW-846 6010B
Boron	7440-42-8	Y	Surface Water	ID+Q	NV	3.33E-01	mg/L	SW-846 6010B
Cadmium	7440-43-9	Y	Surface Water	ID+Q	1.00E-02	2.00E-03	mg/L	SW-846 6010B
Chromium	7440-47-3	Y	Surface Water	ID+Q	2.22E+00	3.00E-03	mg/L	SW-846 6010B
Chromium (VI)	18540-29-9	Y	Surface Water	ID+Q	4.96E-02	8.00E-03	mg/L	SW-846 6010B
Cobalt	7440-48-4	Y	Surface Water	ID+Q	NV	3.00E-03	mg/L	SW-846 6010B
Copper	7440-50-8	Y	Surface Water	ID+Q	3.60E-03	2.00E-03	mg/L	SW-846 6010B
Ferric Iron	MET-002	Y	Surface Water	ID+Q	NV	3.30E-02	mg/L	SW-846 6010B
Iron	7439-89-6	Y	Surface Water	ID+Q	NV	3.30E-02	mg/L	SW-846 6010B
Lead	7439-92-1	Y	Surface Water	ID+Q	5.30E-03	3.00E-03	mg/L	SW-846 6010B
Lithium	7439-93-2	Y	Surface Water	ID+Q	NV	1.70E-02	mg/L	SW-846 6010B
Manganese	7439-96-5	Y	Surface Water	ID+Q	1.00E-01	5.00E-03	mg/L	SW-846 6010B
Mercury	7439-97-6	Y	Surface Water	ID+Q	2.50E-05	2.00E-04	mg/L	SW-846 7470A
Molybdenum	7439-98-7	Y	Surface Water	ID+Q	NV	1.70E-02	mg/L	SW-846 6010B
Nickel	7440-02-0	Y	Surface Water	ID+Q	1.31E-02	2.00E-03	mg/L	SW-846 6010B
Selenium	7782-49-2	Y	Surface Water	ID+Q	1.36E-01	1.30E-02	mg/L	SW-846 6010B
Silver	7440-22-4	Y	Surface Water	ID+Q	3.65E+01	2.00E-03	mg/L	SW-846 6010B
Strontium	7440-24-6	Y	Surface Water	ID+Q	NV	1.70E-02	mg/L	SW-846 6010B
Thallium	7440-28-0	Y	Surface Water	ID+Q	4.70E-04	3.00E-03	mg/L	SW-846 6010B
Tin	7440-31-5	Y	Surface Water	ID+Q	NV	8.00E-03	mg/L	SW-846 6010B
Titanium	7440-32-6	Y	Surface Water	ID+Q	NV	3.30E-02	mg/L	SW-846 6010B
Vanadium	7440-62-2	Y	Surface Water	ID+Q	NV	7.00E-03	mg/L	SW-846 6010B
Zinc	7440-66-6	Y	Surface Water	ID+Q	8.42E-02	7.00E-03	mg/L	SW-846 6010B
PESTICIDES								
4,4'-DDD	72-54-8	Y	Surface Water	ID+Q	7.00E-06	7.00E-06	mg/L	SW-846 8081A
4,4'-DDE	72-55-9	Y	Surface Water	ID+Q	5.00E-06	1.70E-05	mg/L	SW-846 8081A

TABLE B-3 - METHOD SELECTION WORKSHEET - SURFACE WATER

Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	Routine Available Methods
4,4'-DDT	50-29-3	Y	Surface Water	ID+Q	1.00E-06	1.80E-05	mg/L	SW-846 8081A
Aldrin	309-00-2	Y	Surface Water	ID+Q	1.30E-04	2.00E-05	mg/L	SW-846 8081A
alpha-BHC	319-84-6	Y	Surface Water	ID+Q	2.80E-06	7.00E-06	mg/L	SW-846 8081A
alpha-Chlordane	5103-71-9	Y	Surface Water	ID+Q	2.13E-05	2.00E-05	mg/L	SW-846 8081A
beta-BHC	319-85-7	Y	Surface Water	ID+Q	NV	2.00E-05	mg/L	SW-846 8081A
delta-BHC	319-86-8	Y	Surface Water	ID+Q	NV	2.00E-05	mg/L	SW-846 8081A
Dieldrin	60-57-1	Y	Surface Water	ID+Q	2.00E-06	1.50E-05	mg/L	SW-846 8081A
Endosulfan I	959-98-8	Y	Surface Water	ID+Q	9.00E-06	9.00E-06	mg/L	SW-846 8081A
Endosulfan II	33213-65-9	Y	Surface Water	ID+Q	9.00E-06	2.40E-05	mg/L	SW-846 8081A
Endosulfan sulfate	1031-07-8	Y	Surface Water	ID+Q	9.00E-06	9.00E-06	mg/L	SW-846 8081A
Endrin	72-20-8	Y	Surface Water	ID+Q	2.00E-06	2.50E-05	mg/L	SW-846 8081A
Endrin aldehyde	7421-93-4	Y	Surface Water	ID+Q	3.00E-04	3.00E-05	mg/L	SW-846 8081A
Endrin ketone	53494-70-5	Y	Surface Water	ID+Q	NV	3.00E-05	mg/L	SW-846 8081A
gamma-BHC (Lindane)	58-89-9	Y	Surface Water	ID+Q	1.60E-05	1.60E-05	mg/L	SW-846 8081A
gamma-Chlordane	5103-74-2	Y	Surface Water	ID+Q	NV	3.00E-05	mg/L	SW-846 8081A
Heptachlor	76-44-8	Y	Surface Water	ID+Q	1.77E-06	1.40E-05	mg/L	SW-846 8081A
Heptachlor epoxide	1024-57-3	Y	Surface Water	ID+Q	3.60E-06	2.20E-05	mg/L	SW-846 8081A
Methoxychlor	72-43-5	Y	Surface Water	ID+Q	3.00E-05	3.00E-05	mg/L	SW-846 8081A
Toxaphene	8001-35-2	Y	Surface Water	ID+Q	2.00E-07	8.25E-04	mg/L	SW-846 8081A
PCBs	1336-36-3	Y	Surface Water	ID+Q	8.85E-07	6.70E-04	mg/L	SW-846 8081A
Aroclor-1016	12674-11-2	Y	Surface Water	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
Aroclor-1221	11104-28-2	Y	Surface Water	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
Aroclor-1232	11141-16-5	Y	Surface Water	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
Aroclor-1242	53469-21-9	Y	Surface Water	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
Aroclor-1248	12672-29-6	Y	Surface Water	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
Aroclor-1254	11097-69-1	Y	Surface Water	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
Aroclor-1260	11096-82-5	Y	Surface Water	ID+Q	NV	6.70E-04	mg/L	SW-846 8082
VOCs								
1,1,1,2-Tetrachloroethane	630-20-6	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
1,1,1-Trichloroethane	71-55-6	Y	Surface Water	ID+Q	3.10E+00	1.70E-03	mg/L	SW-846 8260B
1,1,2,2-Tetrachloroethane	79-34-5	Y	Surface Water	ID+Q	4.00E-02	1.70E-03	mg/L	SW-846 8260B

TABLE B-3 - METHOD SELECTION WORKSHEET - SURFACE WATER

Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	Routine Available Methods
1,1,2-Trichloroethane	79-00-5	Y	Surface Water	ID+Q	5.50E-01	1.70E-03	mg/L	SW-846 8260B
1,1-Dichloroethane	75-34-3	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
1,1-Dichloroethene	75-35-4	Y	Surface Water	ID+Q	2.50E+01	1.70E-03	mg/L	SW-846 8260B
1,1-Dichloropropene	563-58-6	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
1,2,3-Trichloropropane	96-18-4	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
1,2,4-Trichlorobenzene	120-82-1	Y	Surface Water	ID+Q	2.20E-02	1.70E-03	mg/L	SW-846 8260B
1,2,4-Trimethylbenzene	95-63-6	Y	Surface Water	ID+Q	2.17E-01	1.70E-03	mg/L	SW-846 8260B
1,2-Dibromo-3-chloropropane	96-12-8	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
1,2-Dibromoethane	106-93-4	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
1,2-Dichlorobenzene	95-50-1	Y	Surface Water	ID+Q	5.91E-01	1.70E-03	mg/L	SW-846 8260B
1,2-Dichloroethane	107-06-2	Y	Surface Water	ID+Q	4.93E-02	1.70E-03	mg/L	SW-846 8260B
1,2-Dichloroethene(Total)	540-59-0	Y	Surface Water	ID+Q	6.80E-01	3.30E-03	mg/L	SW-846 8260B
1,2-Dichloropropane	78-87-5	Y	Surface Water	ID+Q	1.50E-01	1.70E-03	mg/L	SW-846 8260B
1,3,5-Trimethylbenzene	108-67-8	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
1,3-Dichlorobenzene	541-73-1	Y	Surface Water	ID+Q	1.42E-01	1.70E-03	mg/L	SW-846 8260B
1,3-Dichloropropane	142-28-9	Y	Surface Water	ID+Q	1.50E-01	1.70E-03	mg/L	SW-846 8260B
1,4-Dichlorobenzene	106-46-7	Y	Surface Water	ID+Q	9.90E-02	1.70E-03	mg/L	SW-846 8260B
2,2-Dichloropropane	594-20-7	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
2-Butanone	78-93-3	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
2-Chloroethylvinyl ether	110-75-8	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
2-Chlorotoluene	95-49-8	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
2-Hexanone	591-78-6	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
4-Chlorotoluene	106-43-4	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
4-Isopropyltoluene	99-87-6	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
4-Methyl-2-pentanone	108-10-1	Y	Surface Water	ID+Q	1.23E+02	1.70E-03	mg/L	SW-846 8260B
Acetone	67-64-1	Y	Surface Water	ID+Q	5.64E+02	8.30E-03	mg/L	SW-846 8260B
Acrolein	107-02-8	Y	Surface Water	ID+Q	1.00E-02	8.30E-03	mg/L	SW-846 8260B
Acrylonitrile	107-13-1	Y	Surface Water	ID+Q	7.30E-03	7.30E-03	mg/L	SW-846 8260B
Benzene	71-43-2	Y	Surface Water	ID+Q	7.08E-02	1.70E-03	mg/L	SW-846 8260B
Bromobenzene	108-86-1	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Bromodichloromethane	75-27-4	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B

TABLE B-3 - METHOD SELECTION WORKSHEET - SURFACE WATER

Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	Routine Available Methods
Bromoform	75-25-2	Y	Surface Water	ID+Q	1.22E+00	1.70E-03	mg/L	SW-846 8260B
Bromomethane	74-83-9	Y	Surface Water	ID+Q	1.20E+00	1.70E-03	mg/L	SW-846 8260B
Butanol	71-36-3	Y	Surface Water	ID+Q	NV	3.80E-02	mg/L	SW-846 8260B
Carbon disulfide	75-15-0	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Carbon tetrachloride	56-23-5	Y	Surface Water	ID+Q	5.60E-03	1.70E-03	mg/L	SW-846 8260B
Chlorobenzene	108-90-7	Y	Surface Water	ID+Q	1.05E-01	1.70E-03	mg/L	SW-846 8260B
Chloroethane	75-00-3	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Chloroform	67-66-3	Y	Surface Water	ID+Q	8.61E-01	1.70E-03	mg/L	SW-846 8260B
Chloromethane	74-87-3	Y	Surface Water	ID+Q	2.70E+01	1.70E-03	mg/L	SW-846 8260B
cis-1,2-Dichloroethene	156-59-2	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
cis-1,3-Dichloropropene	10061-01-5	Y	Surface Water	ID+Q	1.07E-01	1.70E-03	mg/L	SW-846 8260B
Cyclohexane	110-82-7	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Dibromochloromethane	124-48-1	Y	Surface Water	ID+Q	4.77E-02	1.70E-03	mg/L	SW-846 8260B
Dibromomethane	74-95-3	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Dichlorodifluoromethane	75-71-8	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Ethylbenzene	100-41-4	Y	Surface Water	ID+Q	5.00E-01	1.70E-03	mg/L	SW-846 8260B
Hexachlorobutadiene	87-68-3	Y	Surface Water	ID+Q	3.20E-04	4.00E-04	mg/L	SW-846 8260B
Isopropylbenzene (Cumene)	98-82-8	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Methyl acetate	79-20-9	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Methyl iodide	74-88-4	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Methylcyclohexane	108-87-2	Y	Surface Water	ID+Q	NV	8.00E-03	mg/L	SW-846 8260B
Methylene chloride	75-09-2	Y	Surface Water	ID+Q	5.90E+00	3.30E-03	mg/L	SW-846 8260B
Naphthalene	91-20-3	Y	Surface Water	ID+Q	2.50E-01	1.70E-03	mg/L	SW-846 8260B
n-Butylbenzene	104-51-8	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
n-Propylbenzene	103-65-1	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
o-Xylene	95-47-6	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
sec-Butylbenzene	135-98-8	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Styrene	100-42-5	Y	Surface Water	ID+Q	9.10E-01	1.70E-03	mg/L	SW-846 8260B
tert-Butyl methyl ether (MTBE)	1634-04-4	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
tert-Butylbenzene	98-06-6	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Tetrachloroethene	127-18-4	Y	Surface Water	ID+Q	1.45E+00	1.70E-03	mg/L	SW-846 8260B

TABLE B-3 - METHOD SELECTION WORKSHEET - SURFACE WATER

Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	Routine Available Methods
Toluene	108-88-3	Y	Surface Water	ID+Q	9.50E-01	1.70E-03	mg/L	SW-846 8260B
trans-1,2-Dichloroethene	156-60-5	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
trans-1,3-Dichloropropene	10061-02-6	Y	Surface Water	ID+Q	1.07E-01	1.70E-03	mg/L	SW-846 8260B
trans-1,4-Dichloro-2-butene	110-57-6	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Trichloroethene	79-01-6	Y	Surface Water	ID+Q	1.94E+00	1.70E-03	mg/L	SW-846 8260B
Trichlorofluoromethane	75-69-4	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Trichlorotrifluoroethane	76-13-1	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Vinyl acetate	108-05-4	Y	Surface Water	ID+Q	NV	1.70E-03	mg/L	SW-846 8260B
Vinyl chloride	75-01-4	Y	Surface Water	ID+Q	2.77E-01	1.70E-03	mg/L	SW-846 8260B
Xylene (total)	1330-20-7	Y	Surface Water	ID+Q	8.50E-01	3.30E-03	mg/L	SW-846 8260B
SVOCs								
1,2Diphenylhydrazine/Azobenzen	122-66-7	Y	Surface Water	ID+Q	2.00E-03	2.00E-03	mg/L	SW-846 8270C
2,4,5-Trichlorophenol	95-95-4	Y	Surface Water	ID+Q	1.20E-02	3.30E-03	mg/L	SW-846 8270C
2,4,6-Trichlorophenol	88-06-2	Y	Surface Water	ID+Q	2.40E-03	2.40E-03	mg/L	SW-846 8270C
2,4-Dichlorophenol	120-83-2	Y	Surface Water	ID+Q	2.90E-01	3.30E-03	mg/L	SW-846 8270C
2,4-Dimethylphenol	105-67-9	Y	Surface Water	ID+Q	8.50E-01	1.00E-02	mg/L	SW-846 8270C
2,4-Dinitrophenol	51-28-5	Y	Surface Water	ID+Q	1.33E+00	1.67E-02	mg/L	SW-846 8270C
2,4-Dinitrotoluene	121-14-2	Y	Surface Water	ID+Q	3.40E-02	3.30E-03	mg/L	SW-846 8270C
2,6-Dinitrotoluene	606-20-2	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
2-Chloronaphthalene	91-58-7	Y	Surface Water	ID+Q	1.60E+00	3.30E-03	mg/L	SW-846 8270C
2-Chlorophenol	95-57-8	Y	Surface Water	ID+Q	1.50E-01	3.30E-03	mg/L	SW-846 8270C
2-Methylnaphthalene	91-57-6	Y	Surface Water	ID+Q	6.00E-02	3.30E-03	mg/L	SW-846 8270C
2-Nitroaniline	88-74-4	Y	Surface Water	ID+Q	NV	1.67E-02	mg/L	SW-846 8270C
2-Nitrophenol	88-75-5	Y	Surface Water	ID+Q	2.94E+00	3.30E-03	mg/L	SW-846 8270C
3,3'-Dichlorobenzidine	91-94-1	Y	Surface Water	ID+Q	2.80E-04	5.00E-04	mg/L	SW-846 8270C
3-Nitroaniline	99-09-2	Y	Surface Water	ID+Q	NV	1.67E-02	mg/L	SW-846 8270C
4,6-Dinitro-2-methylphenol	534-52-1	Y	Surface Water	ID+Q	NV	1.67E-02	mg/L	SW-846 8270C
4-Bromophenyl phenyl ether	101-55-3	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
4-Chloro-3-methylphenol	59-50-7	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
4-Chloroaniline	106-47-8	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
4-Chlorophenyl phenyl ether	7005-72-3	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C

TABLE B-3 - METHOD SELECTION WORKSHEET - SURFACE WATER

Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	Routine Available Methods
4-Nitroaniline	100-01-6	Y	Surface Water	ID+Q	NV	1.67E-02	mg/L	SW-846 8270C
4-Nitrophenol	100-02-7	Y	Surface Water	ID+Q	7.17E-01	1.67E-02	mg/L	SW-846 8270C
Acenaphthene	83-32-9	Y	Surface Water	ID+Q	4.04E-02	3.30E-03	mg/L	SW-846 8270C
Acenaphthylene	208-96-8	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Acetophenone	98-86-2	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Aniline	62-53-3	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Anthracene	120-12-7	Y	Surface Water	ID+Q	1.80E-04	6.00E-04	mg/L	SW-846 8270C
Atrazine (Aatrex)	1912-24-9	Y	Surface Water	ID+Q	NV	6.70E-03	mg/L	SW-846 8270C
Benzaldehyde	100-52-7	Y	Surface Water	ID+Q	NV	6.70E-03	mg/L	SW-846 8270C
Benzidine	92-87-5	Y	Surface Water	ID+Q	NV	1.33E-02	mg/L	SW-846 8270C
Benzo(a)anthracene	56-55-3	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Benzo(a)pyrene	50-32-8	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Benzo(b)fluoranthene	205-99-2	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Benzo(g,h,i)perylene	191-24-2	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Benzo(k)fluoranthene	207-08-9	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Benzoic acid	65-85-0	Y	Surface Water	ID+Q	NV	1.67E-02	mg/L	SW-846 8270C
Benzyl alcohol	100-51-6	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Biphenyl	92-52-4	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Bis(2-Chloroethoxy)methane	111-91-1	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Bis(2-Chloroethyl)ether	111-44-4	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Bis(2-Chloroisopropyl)ether	108-60-1	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Bis(2-Ethylhexyl)phthalate	117-81-7	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Butyl benzyl phthalate	85-68-7	Y	Surface Water	ID+Q	1.47E-01	3.30E-03	mg/L	SW-846 8270C
Caprolactam	105-60-2	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Carbazole	86-74-8	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Chrysene	218-01-9	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Dibenz(a,h)anthracene	53-70-3	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Dibenzofuran	132-64-9	Y	Surface Water	ID+Q	6.50E-02	3.30E-03	mg/L	SW-846 8270C
Diethyl phthalate	84-66-2	Y	Surface Water	ID+Q	8.84E-01	3.30E-03	mg/L	SW-846 8270C
Dimethyl phthalate	131-11-3	Y	Surface Water	ID+Q	5.80E-01	3.30E-03	mg/L	SW-846 8270C
Di-n-butyl phthalate	84-74-2	Y	Surface Water	ID+Q	5.00E-03	1.70E-03	mg/L	SW-846 8270C

TABLE B-3 - METHOD SELECTION WORKSHEET - SURFACE WATER

Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	Routine Available Methods
Di-n-octyl phthalate	117-84-0	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Fluoranthene	206-44-0	Y	Surface Water	ID+Q	2.96E-03	7.00E-04	mg/L	SW-846 8270C
Fluorene	86-73-7	Y	Surface Water	ID+Q	5.00E-02	3.30E-03	mg/L	SW-846 8270C
Hexachlorobenzene	118-74-1	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Hexachlorocyclopentadiene	77-47-4	Y	Surface Water	ID+Q	7.00E-05	2.80E-03	mg/L	SW-846 8270C
Hexachloroethane	67-72-1	Y	Surface Water	ID+Q	9.40E-03	2.20E-03	mg/L	SW-846 8270C
Indeno(1,2,3-cd)pyrene	193-39-5	Y	Surface Water	ID+Q	NV	3.30E-03	mg/L	SW-846 8270C
Isophorone	78-59-1	Y	Surface Water	ID+Q	1.29E+00	3.30E-03	mg/L	SW-846 8270C
Nitrobenzene	98-95-3	Y	Surface Water	ID+Q	6.68E-02	3.30E-03	mg/L	SW-846 8270C
n-Nitrosodimethylamine	62-75-9	Y	Surface Water	ID+Q	3.00E-02	3.30E-03	mg/L	SW-846 8270C
n-Nitrosodi-n-propylamine	621-64-7	Y	Surface Water	ID+Q	6.00E-02	3.30E-03	mg/L	SW-846 8270C
n-Nitrosodiphenylamine	86-30-6	Y	Surface Water	ID+Q	3.30E+02	3.30E-03	mg/L	SW-846 8270C
o-Cresol	95-48-7	Y	Surface Water	ID+Q	1.02E+00	3.30E-03	mg/L	SW-846 8270C
Pentachlorophenol	87-86-5	Y	Surface Water	ID+Q	9.60E-03	9.60E-03	mg/L	SW-846 8270C
Phenanthrene	85-01-8	Y	Surface Water	ID+Q	4.60E-03	7.00E-04	mg/L	SW-846 8270C
Phenol	108-95-2	Y	Surface Water	ID+Q	5.50E+00	3.30E-03	mg/L	SW-846 8270C
Pyrene	129-00-0	Y	Surface Water	ID+Q	2.40E-04	4.00E-04	mg/L	SW-846 8270C
Pyridine	110-86-1	Y	Surface Water	ID+Q	8.89E+00	6.70E-03	mg/L	SW-846 8270C

Notes:
NV - No value established

TABLE B-4 - METHOD SELECTION WORKSHEET - SEDIMENT

Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	Routine Available Methods
METALS								
Aluminum	7429-90-5	Y	Sediment	ID+Q	1.53E+05	2.70E+00	mg/Kg	SW-846 6010B
Antimony	7440-36-0	Y	Sediment	ID+Q	8.32E+01	6.70E-01	mg/Kg	SW-846 6010B
Arsenic	7440-38-2	Y	Sediment	ID+Q	8.20E+00	5.30E-01	mg/Kg	SW-846 6010B
Barium	7440-39-3	Y	Sediment	ID+Q	8.00E+03	1.30E-01	mg/Kg	SW-846 6010B
Beryllium	7440-41-7	Y	Sediment	ID+Q	2.66E+01	7.00E-02	mg/Kg	SW-846 6010B
Boron	7440-42-8	Y	Sediment	ID+Q	1.07E+05	1.10E+00	mg/Kg	SW-846 6010B
Cadmium	7440-43-9	Y	Sediment	ID+Q	1.20E+00	7.00E-02	mg/Kg	SW-846 6010B
Chromium	7440-47-3	Y	Sediment	ID+Q	8.10E+01	1.30E-01	mg/Kg	SW-846 6010B
Chromium (VI)	18540-29-9	Y	Sediment	ID+Q	1.36E+02	6.70E-01	mg/Kg	SW-846 6010B
Cobalt	7440-48-4	Y	Sediment	ID+Q	3.20E+04	1.30E-01	mg/Kg	SW-846 6010B
Copper	7440-50-8	Y	Sediment	ID+Q	3.40E+01	1.30E-01	mg/Kg	SW-846 6010B
Iron	7439-89-6	Y	Sediment	ID+Q	NV	1.30E+00	mg/Kg	SW-846 6010B
Lead	7439-92-1	Y	Sediment	ID+Q	4.67E+01	2.00E-01	mg/Kg	SW-846 6010B
Lithium	7439-93-2	Y	Sediment	ID+Q	1.07E+04	6.70E-01	mg/Kg	SW-846 6010B
Manganese	7439-96-5	Y	Sediment	ID+Q	1.40E+04	2.00E-01	mg/Kg	SW-846 6010B
Mercury	7439-97-6	Y	Sediment	ID+Q	1.50E-01	7.00E-03	mg/Kg	SW-846 7471A
Molybdenum	7439-98-7	Y	Sediment	ID+Q	1.84E+03	4.00E-01	mg/Kg	SW-846 6010B
Nickel	7440-02-0	Y	Sediment	ID+Q	2.09E+01	5.30E-01	mg/Kg	SW-846 6010B
Selenium	7782-49-2	Y	Sediment	ID+Q	2.66E+03	4.40E-01	mg/Kg	SW-846 6010B
Silver	7440-22-4	Y	Sediment	ID+Q	1.00E+00	1.30E-01	mg/Kg	SW-846 6010B
Strontium	7440-24-6	Y	Sediment	ID+Q	1.52E+05	1.30E-01	mg/Kg	SW-846 6010B
Thallium	7440-28-0	Y	Sediment	ID+Q	NV	2.70E-01	mg/Kg	SW-846 6010B
Tin	7440-31-5	Y	Sediment	ID+Q	9.19E+04	1.30E+00	mg/Kg	SW-846 6010B
Titanium	7440-32-6	Y	Sediment	ID+Q	1.00E+06	1.30E+00	mg/Kg	SW-846 6010B
Vanadium	7440-62-2	Y	Sediment	ID+Q	3.29E+02	2.70E-01	mg/Kg	SW-846 6010B
Zinc	7440-66-6	Y	Sediment	ID+Q	1.50E+02	2.70E-01	mg/Kg	SW-846 6010B
PESTICIDES								
4,4'-DDD	72-54-8	Y	Sediment	ID+Q	1.22E-03	1.20E-03	mg/Kg	SW-846 8081A
4,4'-DDE	72-55-9	Y	Sediment	ID+Q	2.07E-03	1.30E-03	mg/Kg	SW-846 8081A
4,4'-DDT	50-29-3	Y	Sediment	ID+Q	1.19E-03	1.10E-03	mg/Kg	SW-846 8081A
Aldrin	309-00-2	Y	Sediment	ID+Q	8.36E-01	7.00E-04	mg/Kg	SW-846 8081A
alpha-BHC	319-84-6	Y	Sediment	ID+Q	4.05E+00	7.00E-04	mg/Kg	SW-846 8081A
alpha-Chlordane	5103-71-9	Y	Sediment	ID+Q	4.06E+01	7.00E-04	mg/Kg	SW-846 8081A
beta-BHC	319-85-7	Y	Sediment	ID+Q	1.42E+01	1.30E-03	mg/Kg	SW-846 8081A

TABLE B-4 - METHOD SELECTION WORKSHEET - SEDIMENT

Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	Routine Available Methods
delta-BHC	319-86-8	Y	Sediment	ID+Q	1.42E+01	7.00E-04	mg/Kg	SW-846 8081A
Dieldrin	60-57-1	Y	Sediment	ID+Q	7.15E-04	7.00E-04	mg/Kg	SW-846 8081A
Endosulfan I	959-98-8	Y	Sediment	ID+Q	2.90E-03	7.00E-04	mg/Kg	SW-846 8081A
Endosulfan II	33213-65-9	Y	Sediment	ID+Q	1.40E-02	1.30E-03	mg/Kg	SW-846 8081A
Endosulfan sulfate	1031-07-8	Y	Sediment	ID+Q	9.19E+02	1.30E-03	mg/Kg	SW-846 8081A
Endrin	72-20-8	Y	Sediment	ID+Q	3.50E-03	1.30E-03	mg/Kg	SW-846 8081A
Endrin aldehyde	7421-93-4	Y	Sediment	ID+Q	4.59E+01	1.30E-03	mg/Kg	SW-846 8081A
Endrin ketone	53494-70-5	Y	Sediment	ID+Q	4.59E+01	1.30E-03	mg/Kg	SW-846 8081A
gamma-BHC (Lindane)	58-89-9	Y	Sediment	ID+Q	3.20E-04	5.00E-04	mg/Kg	SW-846 8081A
gamma-Chlordane	5103-74-2	Y	Sediment	ID+Q	NV	1.30E-03	mg/Kg	SW-846 8081A
Heptachlor	76-44-8	Y	Sediment	ID+Q	3.16E+00	7.00E-04	mg/Kg	SW-846 8081A
Heptachlor epoxide	1024-57-3	Y	Sediment	ID+Q	1.56E+00	1.30E-03	mg/Kg	SW-846 8081A
Methoxychlor	72-43-5	Y	Sediment	ID+Q	1.90E-02	6.70E-03	mg/Kg	SW-846 8081A
Toxaphene	8001-35-2	Y	Sediment	ID+Q	2.80E-02	2.80E-02	mg/Kg	SW-846 8081A
PCBs	1336-36-3	Y	Sediment	ID+Q	2.27E-02	2.27E-02	mg/Kg	SW-846 8082
Aroclor-1016	12674-11-2	Y	Sediment	ID+Q	NV	2.27E-02	mg/Kg	SW-846 8082
Aroclor-1221	11104-28-2	Y	Sediment	ID+Q	NV	2.27E-02	mg/Kg	SW-846 8082
Aroclor-1232	11141-16-5	Y	Sediment	ID+Q	NV	2.27E-02	mg/Kg	SW-846 8082
Aroclor-1242	53469-21-9	Y	Sediment	ID+Q	NV	2.27E-02	mg/Kg	SW-846 8082
Aroclor-1248	12672-29-6	Y	Sediment	ID+Q	NV	2.27E-02	mg/Kg	SW-846 8082
Aroclor-1254	11097-69-1	Y	Sediment	ID+Q	NV	2.27E-02	mg/Kg	SW-846 8082
Aroclor-1260	11096-82-5	Y	Sediment	ID+Q	NV	2.27E-02	mg/Kg	SW-846 8082
VOCs								
1,1,1,2-Tetrachloroethane	630-20-6	Y	Sediment	ID+Q	2.10E+03	1.70E-03	mg/Kg	SW-846 8260B
1,1,1-Trichloroethane	71-55-6	Y	Sediment	ID+Q	1.70E-01	1.70E-03	mg/Kg	SW-846 8260B
1,1,2,2-Tetrachloroethane	79-34-5	Y	Sediment	ID+Q	9.40E-01	1.70E-03	mg/Kg	SW-846 8260B
1,1,2-Trichloroethane	79-00-5	Y	Sediment	ID+Q	9.56E+02	1.70E-03	mg/Kg	SW-846 8260B
1,1-Dichloroethane	75-34-3	Y	Sediment	ID+Q	7.35E+04	1.70E-03	mg/Kg	SW-846 8260B
1,1-Dichloroethene	75-35-4	Y	Sediment	ID+Q	3.67E+04	1.70E-03	mg/Kg	SW-846 8260B
1,1-Dichloropropene	563-58-6	Y	Sediment	ID+Q	5.45E+02	1.70E-03	mg/Kg	SW-846 8260B
1,2,3-Trichloropropane	96-18-4	Y	Sediment	ID+Q	7.79E+00	7.00E-04	mg/Kg	SW-846 8260B
1,2,4-Trichlorobenzene	120-82-1	Y	Sediment	ID+Q	9.20E+00	1.70E-03	mg/Kg	SW-846 8260B
1,2,4-Trimethylbenzene	95-63-6	Y	Sediment	ID+Q	3.67E+04	1.70E-03	mg/Kg	SW-846 8260B
1,2-Dibromo-3-chloropropane	96-12-8	Y	Sediment	ID+Q	1.01E+01	1.70E-03	mg/Kg	SW-846 8260B
1,2-Dibromoethane	106-93-4	Y	Sediment	ID+Q	2.72E+01	1.70E-03	mg/Kg	SW-846 8260B

TABLE B-4 - METHOD SELECTION WORKSHEET - SEDIMENT

Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	Routine Available Methods
1,2-Dichlorobenzene	95-50-1	Y	Sediment	ID+Q	3.40E-01	1.70E-03	mg/Kg	SW-846 8260B
1,2-Dichloroethane	107-06-2	Y	Sediment	ID+Q	5.99E+02	1.70E-03	mg/Kg	SW-846 8260B
1,2-Dichloroethene(Total)	540-59-0	Y	Sediment	ID+Q	NV	3.30E-03	mg/Kg	SW-846 8260B
1,2-Dichloropropane	78-87-5	Y	Sediment	ID+Q	8.01E+02	1.70E-03	mg/Kg	SW-846 8260B
1,3,5-Trimethylbenzene	108-67-8	Y	Sediment	ID+Q	3.67E+04	1.70E-03	mg/Kg	SW-846 8260B
1,3-Dichlorobenzene	541-73-1	Y	Sediment	ID+Q	1.70E+00	1.70E-03	mg/Kg	SW-846 8260B
1,3-Dichloropropane	142-28-9	Y	Sediment	ID+Q	5.45E+02	1.70E-03	mg/Kg	SW-846 8260B
1,4-Dichlorobenzene	106-46-7	Y	Sediment	ID+Q	3.50E-01	1.70E-03	mg/Kg	SW-846 8260B
2,2-Dichloropropane	594-20-7	Y	Sediment	ID+Q	8.01E+02	1.70E-03	mg/Kg	SW-846 8260B
2-Butanone	78-93-3	Y	Sediment	ID+Q	4.41E+05	1.70E-03	mg/Kg	SW-846 8260B
2-Chloroethylvinyl ether	110-75-8	Y	Sediment	ID+Q	4.95E+01	3.30E-03	mg/Kg	SW-846 8260B
2-Chlorotoluene	95-49-8	Y	Sediment	ID+Q	3.06E+03	1.70E-03	mg/Kg	SW-846 8260B
2-Hexanone	591-78-6	Y	Sediment	ID+Q	4.41E+04	1.70E-03	mg/Kg	SW-846 8260B
4-Chlorotoluene	106-43-4	Y	Sediment	ID+Q	1.47E+04	1.70E-03	mg/Kg	SW-846 8260B
4-Isopropyltoluene	99-87-6	Y	Sediment	ID+Q	7.35E+04	1.70E-03	mg/Kg	SW-846 8260B
4-Methyl-2-pentanone	108-10-1	Y	Sediment	ID+Q	5.88E+04	1.70E-03	mg/Kg	SW-846 8260B
Acetone	67-64-1	Y	Sediment	ID+Q	6.61E+05	8.30E-03	mg/Kg	SW-846 8260B
Acrolein	107-02-8	Y	Sediment	ID+Q	3.67E+02	8.30E-03	mg/Kg	SW-846 8260B
Acrylonitrile	107-13-1	Y	Sediment	ID+Q	1.01E+02	8.30E-03	mg/Kg	SW-846 8260B
Benzene	71-43-2	Y	Sediment	ID+Q	5.70E-02	1.70E-03	mg/Kg	SW-846 8260B
Bromobenzene	108-86-1	Y	Sediment	ID+Q	1.47E+04	1.70E-03	mg/Kg	SW-846 8260B
Bromodichloromethane	75-27-4	Y	Sediment	ID+Q	8.79E+02	1.70E-03	mg/Kg	SW-846 8260B
Bromoform	75-25-2	Y	Sediment	ID+Q	6.50E-01	1.70E-03	mg/Kg	SW-846 8260B
Bromomethane	74-83-9	Y	Sediment	ID+Q	1.03E+03	3.30E-03	mg/Kg	SW-846 8260B
Butanol	71-36-3	Y	Sediment	ID+Q	7.35E+04	8.30E-03	mg/Kg	SW-846 8260B
Carbon disulfide	75-15-0	Y	Sediment	ID+Q	7.35E+04	1.70E-03	mg/Kg	SW-846 8260B
Carbon tetrachloride	56-23-5	Y	Sediment	ID+Q	1.20E+00	1.70E-03	mg/Kg	SW-846 8260B
Chlorobenzene	108-90-7	Y	Sediment	ID+Q	8.20E-01	1.70E-03	mg/Kg	SW-846 8260B
Chloroethane	75-00-3	Y	Sediment	ID+Q	2.94E+05	1.70E-03	mg/Kg	SW-846 8260B
Chloroform	67-66-3	Y	Sediment	ID+Q	7.35E+03	1.70E-03	mg/Kg	SW-846 8260B
Chloromethane	74-87-3	Y	Sediment	ID+Q	4.19E+03	1.70E-03	mg/Kg	SW-846 8260B
cis-1,2-Dichloroethene	156-59-2	Y	Sediment	ID+Q	7.35E+03	1.70E-03	mg/Kg	SW-846 8260B
cis-1,3-Dichloropropene	10061-01-5	Y	Sediment	ID+Q	7.35E+01	1.70E-03	mg/Kg	SW-846 8260B
Dibromochloromethane	124-48-1	Y	Sediment	ID+Q	6.49E+02	1.70E-03	mg/Kg	SW-846 8260B
Dibromomethane	74-95-3	Y	Sediment	ID+Q	7.27E+03	1.70E-03	mg/Kg	SW-846 8260B

TABLE B-4 - METHOD SELECTION WORKSHEET - SEDIMENT

Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	Routine Available Methods
Dichlorodifluoromethane	75-71-8	Y	Sediment	ID+Q	1.47E+05	1.70E-03	mg/Kg	SW-846 8260B
Ethylbenzene	100-41-4	Y	Sediment	ID+Q	3.60E+00	1.70E-03	mg/Kg	SW-846 8260B
Hexachlorobutadiene	87-68-3	Y	Sediment	ID+Q	3.06E+01	3.30E-03	mg/Kg	SW-846 8260B
Isopropylbenzene (Cumene)	98-82-8	Y	Sediment	ID+Q	7.35E+04	1.70E-03	mg/Kg	SW-846 8260B
Methyl acetate	79-20-9	Y	Sediment	ID+Q	7.35E+05	3.30E-03	mg/Kg	SW-846 8260B
Methyl iodide	74-88-4	Y	Sediment	ID+Q	1.03E+03	1.70E-03	mg/Kg	SW-846 8260B
Methylcyclohexane	108-87-2	Y	Sediment	ID+Q	1.00E+06	1.70E-03	mg/Kg	SW-846 8260B
Methylene chloride	75-09-2	Y	Sediment	ID+Q	7.27E+03	3.30E-03	mg/Kg	SW-846 8260B
Naphthalene	91-20-3	Y	Sediment	ID+Q	1.60E-01	1.70E-03	mg/Kg	SW-846 8260B
n-Butylbenzene	104-51-8	Y	Sediment	ID+Q	6.12E+03	1.70E-03	mg/Kg	SW-846 8260B
n-Propylbenzene	103-65-1	Y	Sediment	ID+Q	2.94E+04	1.70E-03	mg/Kg	SW-846 8260B
o-Xylene	95-47-6	Y	Sediment	ID+Q	1.00E+06	1.70E-03	mg/Kg	SW-846 8260B
sec-Butylbenzene	135-98-8	Y	Sediment	ID+Q	2.94E+04	1.70E-03	mg/Kg	SW-846 8260B
Styrene	100-42-5	Y	Sediment	ID+Q	1.47E+05	1.70E-03	mg/Kg	SW-846 8260B
tert-Butyl methyl ether (MTBE)	1634-04-4	Y	Sediment	ID+Q	7.35E+03	1.70E-03	mg/Kg	SW-846 8260B
tert-Butylbenzene	98-06-6	Y	Sediment	ID+Q	2.94E+04	1.70E-03	mg/Kg	SW-846 8260B
Tetrachloroethene	127-18-4	Y	Sediment	ID+Q	5.30E-01	1.70E-03	mg/Kg	SW-846 8260B
Toluene	108-88-3	Y	Sediment	ID+Q	6.70E-01	1.70E-03	mg/Kg	SW-846 8260B
trans-1,2-Dichloroethene	156-60-5	Y	Sediment	ID+Q	1.47E+04	1.70E-03	mg/Kg	SW-846 8260B
trans-1,3-Dichloropropene	10061-02-6	Y	Sediment	ID+Q	5.45E+02	1.70E-03	mg/Kg	SW-846 8260B
trans-1,4-Dichloro-2-butene	110-57-6	Y	Sediment	ID+Q	NV	1.70E-03	mg/Kg	SW-846 8260B
Trichloroethene	79-01-6	Y	Sediment	ID+Q	1.60E+00	1.70E-03	mg/Kg	SW-846 8260B
Trichlorofluoromethane	75-69-4	Y	Sediment	ID+Q	2.20E+05	1.70E-03	mg/Kg	SW-846 8260B
Trichlorotrifluoroethane	76-13-1	Y	Sediment	ID+Q	1.00E+06	1.70E-03	mg/Kg	SW-846 8260B
Vinyl acetate	108-05-4	Y	Sediment	ID+Q	7.35E+05	1.70E-03	mg/Kg	SW-846 8260B
Vinyl chloride	75-01-4	Y	Sediment	ID+Q	3.63E+01	1.70E-03	mg/Kg	SW-846 8260B
Xylene (total)	1330-20-7	Y	Sediment	ID+Q	1.47E+05	3.30E-03	mg/Kg	SW-846 8260B
SVOCs								
1,2Diphenylhydrazine/Azobenzen	122-66-7	Y	Sediment	ID+Q	1.78E+01	1.10E-01	mg/Kg	SW-846 8270C
2,4,5-Trichlorophenol	95-95-4	Y	Sediment	ID+Q	1.53E+04	1.10E-01	mg/Kg	SW-846 8270C
2,4,6-Trichlorophenol	88-06-2	Y	Sediment	ID+Q	1.29E+03	1.10E-01	mg/Kg	SW-846 8270C
2,4-Dichlorophenol	120-83-2	Y	Sediment	ID+Q	4.59E+02	1.10E-01	mg/Kg	SW-846 8270C
2,4-Dimethylphenol	105-67-9	Y	Sediment	ID+Q	3.06E+03	1.10E-01	mg/Kg	SW-846 8270C
2,4-Dinitrophenol	51-28-5	Y	Sediment	ID+Q	3.06E+02	5.50E-01	mg/Kg	SW-846 8270C
2,4-Dinitrotoluene	121-14-2	Y	Sediment	ID+Q	2.09E+01	1.10E-01	mg/Kg	SW-846 8270C

TABLE B-4 - METHOD SELECTION WORKSHEET - SEDIMENT

Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	Routine Available Methods
2,6-Dinitrotoluene	606-20-2	Y	Sediment	ID+Q	2.09E+01	1.10E-01	mg/Kg	SW-846 8270C
2-Chloronaphthalene	91-58-7	Y	Sediment	ID+Q	9.90E+03	1.10E-01	mg/Kg	SW-846 8270C
2-Chlorophenol	95-57-8	Y	Sediment	ID+Q	3.67E+03	1.10E-01	mg/Kg	SW-846 8270C
2-Methylnaphthalene	91-57-6	Y	Sediment	ID+Q	7.00E-02	2.20E-02	mg/Kg	SW-846 8270C
2-Nitroaniline	88-74-4	Y	Sediment	ID+Q	4.59E+01	5.50E-01	mg/Kg	SW-846 8270C
2-Nitrophenol	88-75-5	Y	Sediment	ID+Q	3.06E+02	1.10E-01	mg/Kg	SW-846 8270C
3,3'-Dichlorobenzidine	91-94-1	Y	Sediment	ID+Q	3.16E+01	2.20E-01	mg/Kg	SW-846 8270C
3-Nitroaniline	99-09-2	Y	Sediment	ID+Q	4.59E+01	5.50E-01	mg/Kg	SW-846 8270C
4,6-Dinitro-2-methylphenol	534-52-1	Y	Sediment	ID+Q	3.06E+02	5.50E-01	mg/Kg	SW-846 8270C
4-Bromophenyl phenyl ether	101-55-3	Y	Sediment	ID+Q	9.47E-01	1.10E-01	mg/Kg	SW-846 8270C
4-Chloro-3-methylphenol	59-50-7	Y	Sediment	ID+Q	7.65E+02	1.10E-01	mg/Kg	SW-846 8270C
4-Chloroaniline	106-47-8	Y	Sediment	ID+Q	6.12E+02	1.10E-01	mg/Kg	SW-846 8270C
4-Chlorophenyl phenyl ether	7005-72-3	Y	Sediment	ID+Q	9.47E-01	1.10E-01	mg/Kg	SW-846 8270C
4-Nitroaniline	100-01-6	Y	Sediment	ID+Q	3.74E+02	5.50E-01	mg/Kg	SW-846 8270C
4-Nitrophenol	100-02-7	Y	Sediment	ID+Q	3.06E+02	5.50E-01	mg/Kg	SW-846 8270C
Acenaphthene	83-32-9	Y	Sediment	ID+Q	1.60E-02	1.60E-02	mg/Kg	SW-846 8270C
Acenaphthylene	208-96-8	Y	Sediment	ID+Q	4.40E-02	2.20E-02	mg/Kg	SW-846 8270C
Acetophenone	98-86-2	Y	Sediment	ID+Q	1.53E+04	1.10E-01	mg/Kg	SW-846 8270C
Aniline	62-53-3	Y	Sediment	ID+Q	1.07E+03	1.10E-01	mg/Kg	SW-846 8270C
Anthracene	120-12-7	Y	Sediment	ID+Q	8.53E-02	2.20E-02	mg/Kg	SW-846 8270C
Atrazine (Aatrex)	1912-24-9	Y	Sediment	ID+Q	6.40E+01	2.20E-01	mg/Kg	SW-846 8270C
Benzaldehyde	100-52-7	Y	Sediment	ID+Q	7.35E+04	2.20E-01	mg/Kg	SW-846 8270C
Benzidine	92-87-5	Y	Sediment	ID+Q	6.18E-02	6.70E-02	mg/Kg	SW-846 8270C
Benzo(a)anthracene	56-55-3	Y	Sediment	ID+Q	2.61E-01	2.20E-02	mg/Kg	SW-846 8270C
Benzo(a)pyrene	50-32-8	Y	Sediment	ID+Q	4.30E-01	2.20E-02	mg/Kg	SW-846 8270C
Benzo(b)fluoranthene	205-99-2	Y	Sediment	ID+Q	1.59E+01	1.10E-01	mg/Kg	SW-846 8270C
Benzo(g,h,i)perylene	191-24-2	Y	Sediment	ID+Q	3.71E+03	1.10E-01	mg/Kg	SW-846 8270C
Benzo(k)fluoranthene	207-08-9	Y	Sediment	ID+Q	1.59E+02	1.10E-01	mg/Kg	SW-846 8270C
Benzoic acid	65-85-0	Y	Sediment	ID+Q	6.12E+05	5.50E-01	mg/Kg	SW-846 8270C
Benzyl alcohol	100-51-6	Y	Sediment	ID+Q	4.59E+04	1.10E-01	mg/Kg	SW-846 8270C
Biphenyl	92-52-4	Y	Sediment	ID+Q	1.10E+00	1.10E-01	mg/Kg	SW-846 8270C
Bis(2-Chloroethoxy)methane	111-91-1	Y	Sediment	ID+Q	1.29E+01	1.10E-01	mg/Kg	SW-846 8270C
Bis(2-Chloroethyl)ether	111-44-4	Y	Sediment	ID+Q	4.95E+01	1.10E-01	mg/Kg	SW-846 8270C
Bis(2-Chloroisopropyl)ether	108-60-1	Y	Sediment	ID+Q	2.03E+02	1.10E-01	mg/Kg	SW-846 8270C
Bis(2-Ethylhexyl)phthalate	117-81-7	Y	Sediment	ID+Q	1.82E-01	2.20E-02	mg/Kg	SW-846 8270C

TABLE B-4 - METHOD SELECTION WORKSHEET - SEDIMENT

Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit	Units	Routine Available Methods
Butyl benzyl phthalate	85-68-7	Y	Sediment	ID+Q	1.10E+01	1.10E-01	mg/Kg	SW-846 8270C
Caprolactam	105-60-2	Y	Sediment	ID+Q	7.65E+04	2.20E-01	mg/Kg	SW-846 8270C
Carbazole	86-74-8	Y	Sediment	ID+Q	7.10E+02	1.10E-01	mg/Kg	SW-846 8270C
Chrysene	218-01-9	Y	Sediment	ID+Q	3.84E-01	1.10E-01	mg/Kg	SW-846 8270C
Dibenz(a,h)anthracene	53-70-3	Y	Sediment	ID+Q	6.34E-02	2.20E-02	mg/Kg	SW-846 8270C
Dibenzofuran	132-64-9	Y	Sediment	ID+Q	2.00E+00	1.10E-01	mg/Kg	SW-846 8270C
Diethyl phthalate	84-66-2	Y	Sediment	ID+Q	6.30E-01	1.10E-01	mg/Kg	SW-846 8270C
Dimethyl phthalate	131-11-3	Y	Sediment	ID+Q	1.22E+05	1.10E-01	mg/Kg	SW-846 8270C
Di-n-butyl phthalate	84-74-2	Y	Sediment	ID+Q	1.10E+01	1.10E-01	mg/Kg	SW-846 8270C
Di-n-octyl phthalate	117-84-0	Y	Sediment	ID+Q	3.06E+03	1.10E-01	mg/Kg	SW-846 8270C
Fluoranthene	206-44-0	Y	Sediment	ID+Q	6.00E-01	1.10E-01	mg/Kg	SW-846 8270C
Fluorene	86-73-7	Y	Sediment	ID+Q	1.90E-02	1.90E-02	mg/Kg	SW-846 8270C
Hexachlorobenzene	118-74-1	Y	Sediment	ID+Q	8.88E+00	1.10E-01	mg/Kg	SW-846 8270C
Hexachlorocyclopentadiene	77-47-4	Y	Sediment	ID+Q	9.19E+02	1.10E-01	mg/Kg	SW-846 8270C
Hexachloroethane	67-72-1	Y	Sediment	ID+Q	1.00E+00	1.10E-01	mg/Kg	SW-846 8270C
Indeno(1,2,3-cd)pyrene	193-39-5	Y	Sediment	ID+Q	1.59E+01	1.10E-01	mg/Kg	SW-846 8270C
Isophorone	78-59-1	Y	Sediment	ID+Q	1.50E+04	1.10E-01	mg/Kg	SW-846 8270C
Nitrobenzene	98-95-3	Y	Sediment	ID+Q	7.65E+01	1.10E-01	mg/Kg	SW-846 8270C
n-Nitrosodimethylamine	62-75-9	Y	Sediment	ID+Q	1.07E+00	1.10E-01	mg/Kg	SW-846 8270C
n-Nitrosodi-n-propylamine	621-64-7	Y	Sediment	ID+Q	6.31E-01	2.20E-02	mg/Kg	SW-846 8270C
n-Nitrosodiphenylamine	86-30-6	Y	Sediment	ID+Q	9.01E+02	1.10E-01	mg/Kg	SW-846 8270C
o-Cresol	95-48-7	Y	Sediment	ID+Q	7.65E+03	1.10E-01	mg/Kg	SW-846 8270C
Pentachlorophenol	87-86-5	Y	Sediment	ID+Q	5.61E+01	5.50E-01	mg/Kg	SW-846 8270C
Phenanthrene	85-01-8	Y	Sediment	ID+Q	2.40E-01	2.20E-02	mg/Kg	SW-846 8270C
Phenol	108-95-2	Y	Sediment	ID+Q	4.59E+04	1.10E-01	mg/Kg	SW-846 8270C
Pyrene	129-00-0	Y	Sediment	ID+Q	6.65E-01	1.10E-01	mg/Kg	SW-846 8270C
Pyridine	110-86-1	Y	Sediment	ID+Q	7.35E+02	1.10E-01	mg/Kg	SW-846 8270C

Notes:
NV - No value established

TABLE B-5 - METHOD SELECTION WORKSHEET - FISH TISSUE

Analytes				Critical Parameters				
Chemicals of Interest	CAS No.	Reporting Requirement (Y or N)	Medium	ID Only (ID) or ID Plus Quantitation (ID+Q)	Preliminary Screening Value (PSV)	Target Method Detection Limit[1]	Units	Routine Available Methods
METALS								
Lead	7439-92-1	Y	Fish Tissue	ID+Q	NA	0.187	mg/Kg	SW-846 6010B
Silver	7440-22-4	Y	Fish Tissue	ID+Q	NA	0.053	mg/Kg	SW-846 6010B
PESTICIDES								
4,4'-DDE	72-55-9	Y	Fish Tissue	ID+Q	NA	0.00745	mg/Kg	SW-846 8081A
4,4'-DDT	50-29-3	Y	Fish Tissue	ID+Q	NA	0.00595	mg/Kg	SW-846 8081A
SVOCs								
Benzo(a)anthracene	56-55-3	Y	Fish Tissue	ID+Q	NA	0.0881	mg/Kg	SW-846 8270C
Benzo(a)pyrene	50-32-8	Y	Fish Tissue	ID+Q	NA	0.0584	mg/Kg	SW-846 8270C
Benzo(b)fluoranthene	205-99-2	Y	Fish Tissue	ID+Q	NA	0.0467	mg/Kg	SW-846 8270C
Benzo(k)fluoranthene	207-08-9	Y	Fish Tissue	ID+Q	NA	0.0392	mg/Kg	SW-846 8270C
Chrysene	218-01-9	Y	Fish Tissue	ID+Q	NA	0.0298	mg/Kg	SW-846 8270C
Dibenz(a,h)anthracene	53-70-3	Y	Fish Tissue	ID+Q	NA	0.0494	mg/Kg	SW-846 8270C
Hexachlorobenzene	118-74-1	Y	Fish Tissue	ID+Q	NA	0.029	mg/Kg	SW-846 8270C
Indeno(1,2,3-cd)pyrene	193-39-5	Y	Fish Tissue	ID+Q	NA	0.0235	mg/Kg	SW-846 8270C

SAMPLING AND ANALYSIS PLAN - VOLUME II
QUALITY ASSURANCE PROJECT PLAN

FOR THE
GULFCO MARINE MAINTENANCE
SUPERFUND SITE
FREEPORT, TEXAS

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1.0 INTRODUCTION

The United States Environmental Protection Agency (EPA) named the former site of Gulfco Marine Maintenance, Inc. in Freeport, Brazoria County, Texas (the Site) to the National Priorities List (NPL) in May 2003. The EPA issued a modified Unilateral Administrative Order (UAO), effective July 29, 2005, requiring Respondents to conduct a Remedial Investigation and Feasibility Study (RI/FS) for the Site. This Quality Assurance Project Plan (QAPP) was prepared as Volume II of a Sampling and Analysis Plan (SAP) in accordance with Paragraph 27.b of the Statement of Work (SOW) for the RI/FS included as an Attachment to the UAO. The QAPP was prepared by Pastor, Behling & Wheeler, LLC (PBW), on behalf of LDL Coastal Limited LP (LDL), Chromalloy American Corporation (Chromalloy) and The Dow Chemical Company (Dow) (collectively referred to as Respondents in the UAO).

The QAPP format and elements have been developed in accordance with guidance developed by the United States Environmental Protection Agency (EPA, 2001; EPA, 2002). The plan presents the policies, organization, objectives, functional activities, and other specific Quality Assurance/Quality Control (QA/QC) activities designed to achieve the precision, accuracy, completeness, comparability, and representativeness required to make the data quality acceptable for the RI/FS. A general description of RI/FS activities is provided in the RI/FS Work Plan (PBW, 2006a). Specific sampling locations and procedures are described in Volume I of the SAP, the Field Sampling Plan (FSP) (PBW, 2006b).

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2.0 PROJECT MANAGEMENT

2.1 PROJECT ORGANIZATION

The general project organization is presented in Figure 1. This chart shows the primary members of the project management team, and lists the current site contractors. Roles and responsibilities for the Project Coordinator and other team members are described in the RI/FS WP. The responsibilities of the persons assigned to QA/QC activities are listed below.

2.1.1 Respondents' Project Coordinator

The Respondents' Project Coordinator will provide the principal point of contact and control for matters concerning the project and field investigation implementation. In consultation with the Respondents, the Project Coordinator will:

- Coordinate field investigation activities and develop a detailed schedule;
- Establish project policies and procedures to meet the specific objectives of the project;
- Orient all field staff concerning the project;
- Develop and meet ongoing project staffing requirements, including mechanisms to review and evaluate each work product;
- Review the work performed on each project to help ensure its quality, responsiveness and timeliness; and
- Represent the project team at meetings and public hearings, if necessary.

The Project Coordinator is responsible for implementation of the QA program in conformance with this QAPP. Final responsibility for project quality rests with the Project Coordinator.

2.1.2 Remedial Investigation Manager

The RI Manager will direct and supervise all RI work. The RI Manager's responsibilities will be to review all RI project work to ensure that it meets the specific project goals, meets technical standards, and is in accordance with the objectives and procedures discussed herein.

2.1.3 Quality Assurance Manager

The Quality Assurance Manager (QA Manager) will remain independent of direct involvement in day-to-day operations, but will have direct access to staff, as necessary, to resolve any QA issues. The QA Manager has sufficient authority to stop work on the investigation as deemed necessary in the event of serious QA/QC issues. Specific functions and duties include:

- Performing QA audits on various phases of the project's operations, as necessary;
- Reviewing and approving this QAPP and other QA plans and procedures;
- Performing validation of data collected relative to RI/FS activities and this QAPP; and
- Providing QA technical assistance to project staff.

The QA Manager will notify the Project Coordinator of particular circumstances that may adversely affect the quality of data and ensure implementation of corrective actions needed to resolve nonconformances noted during assessments.

2.1.4 Field Supervisor

The Field Supervisor will be responsible for all aspects of field work performed as part of a specific RI/FS activity. Different project subtasks or activities may have different Field Supervisors. Duties of the Field Supervisor will include:

- Maintaining field records;
- Continually surveying the Site for potential work hazards and relate any new information to site personnel at the Tailgate Safety Meeting held each day prior to beginning field activities.

- Ensuring that field personnel are properly trained, equipped, and familiar with Standard Operating Procedures and the Health and Safety Plan;
- Overseeing sample collection, handling and shipping; ensuring proper functioning of field equipment; and
- Informing the laboratory when samples are shipped to the lab and verifying samples arrived at the lab.

The primary duty of the Field Supervisor is to ensure that the field sampling is performed in accordance with the project sampling plans and this QAPP. The Field Supervisor will also require that appropriate personal protective equipment will be worn and disposed of according to the Health and Safety Plan (PBW, 2005). In addition, the Field Supervisor may be responsible for preparing monitoring reports for review by the Project Manager.

2.1.5 Analytical Lab Project Manager

The Analytical Laboratory Project Manager will work directly with the Field Supervisor and QA Manager and will be responsible for the following:

- Ensuring all necessary laboratory resources are available to meet project schedules;
- Shipping sample containers and preservatives to the field samplers;
- Overseeing production and final review of analytical reports;
- Coordinating laboratory analyses;
- Supervising in-house chain of custody (COC);
- Scheduling sample analyses;
- Overseeing laboratory data review;
- Approving final analytical reports prior to submission;
- Overseeing laboratory QA;
- Overseeing QA/QC documentation;
- Defining appropriate laboratory QA procedures; and

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- Determining whether to implement laboratory corrective actions, as required.

2.2 PROBLEM DEFINITION/BACKGROUND

As described in the RI/FS WP, the overall problem to be addressed by the RI/FS is to evaluate the nature and extent of contamination at and from the Site, assess the risk from this contamination to human health and the environment, and evaluate potential remedial alternatives. Consistent with this overall problem, the specific objectives of this 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) select the appropriate alternative for site remediation.

The technical approach for meeting these objectives is described in detail in the RI/FS WP, and includes the following overarching components:

- Use of existing data from previous site investigations;
- Incorporation of TRIAD Approach elements, including systematic project planning, dynamic work strategies; and real-time measurement technologies;
- Focus on potential receptors and an evaluation of the risks associated with the potential exposure pathways identified in the Conceptual Site Model (CSM) through a receptor-based investigation program;
- Consideration of Site end use objectives in terms of land use/zoning, and potential site development issues, particularly to the extent that the Site remedy supports and may even augment Site development plans; and
- Recognition of potential contributions from natural processes to Site remediation.

2.3 PROJECT/TASK DESCRIPTION

This QAPP has been developed to address the activities described in the RI/FS WP and in the FSP. Protocols that will be followed for sample handling and storage, chain of custody, laboratory analyses, reporting, data validation, and corrective actions are described in this QAPP, or will be added to the QAPP as they become necessary. The information contained in this QAPP is intended for use in conjunction with the sampling methods and procedures described in detail in the FSP.

The goal of the QAPP is to assure that the data collected meet the project objectives established in Section 2.4. All QA/QC procedures will be in accordance with applicable professional standards, government regulations and guidelines, and specific project goals and requirements.

Samples will be submitted to the analytical laboratory for analysis. Sample data will first be verified by reviewing field documentation and chain-of-custody records. The laboratory will internally verify the data by reviewing documentation of sample receipt, sample preparation, sample analysis, laboratory QC samples, data reduction and data reporting. Data verification and validation will then be conducted in accordance with the procedures presented in Section 5.0 of this QAPP.

Consistent with the TRIAD approach, should any field analytical methods, including field screening methods for evaluating the presence of non-aqueous phase liquids (NAPL), be employed, a Demonstration of Method Applicability (DMA) will be prepared and submitted to EPA for review and approval.

2.4 PROJECT OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

Data quality objectives (DQOs) are qualitative and quantitative statements derived from the outputs of each step of the DQO process. The DQO process is a series of planning steps based on the scientific method that is designed to ensure that the type, quantity and quality of environmental data used in decision-making are appropriate for the intended application (EPA, 2000a).

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There are seven steps in the DQO process which are:

1) Stating the problem;
2) Identifying the decision;
3) Identifying inputs to the decision;
4) Defining the boundaries of the study;
5) Developing a decision rule;
6) Specifying limits on decision errors; and
7) Optimizing the design for obtaining data.

The problem, as stated in Section 2.2 of this QAPP, is to: a) evaluate the nature and extent of contamination at and from the Site and also assess the risk from this contamination to human health and the environment; b) provide sufficient site data necessary to evaluate remedial technologies; and c) evaluate alternatives for addressing the risk to human health and the environment from the contamination at and from the Site. This problem statement is consistent across all types of data needs.

In accordance with the above seven step process, DQOs were developed by media for the CSM exposure routes and associated data needs identified in Table 13 of the RI/FS WP as follows:

- Table 1 – Soils/Sediment;
- Table 2 – Groundwater;
- Table 3 – Surface Water; and
- Table 4 – Fish Tissue.

In addition, geotechnical investigation DQOs are provided in Table 5.

Based on the DQOs, the project analytical objectives for each media can be summarized as presented in Table 6. All measurements must be made so that results are of sufficient quality (i.e., technical validity and legal defensibility) to support the project objectives. As such, all data collected should meet the following criteria:

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- Sampling – Samples will be collected using approved standard operating procedures.
- Documentation – Sample custody will be documented to maintain security and show control during transfer of samples from collection through disposal.
- Laboratory – The analytical laboratory will have a documented quality system which complies with ANSI/ASQC E-4 1994, "Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs," (American National Standard, January 5, 1995) and "EPA Requirements for Quality Management Plans (QA/R-2)" (EPA/240/B-01/002, March 2001). This requirement is considered met by laboratories accredited under the National Environmental Laboratory Accreditations Program (NELAP).
- Analysis – Data must be definitive (i.e., generated using rigorous analytical methods such as an EPA-approved method, ASTM standard method, or laboratory method that is formally documented and demonstrated to be applicable).
- Quality Control (QC) – Measurement performance criteria for both field and laboratory QC must be based on the intended use and should be a function of sampling design, requirements in the analytical methods, and standard accepted practice.
- Sensitivity – For data that will be used in quantitative risk assessment, the Method Detection Limit (MDL) should be less than the Preliminary Screening Values (PSV) as defined in the RI/FS WP. If it is not possible to achieve an MDL below the PSV, then the standard available method with the lowest possible MDL shall be used for that analyte. The laboratory should routinely check the MDLs for reasonableness and update them as necessary.

2.4.1 Analytical Methodologies

Appropriate analytical methodologies have been selected based on the criteria presented in Section 2.4 and presented for each media in Appendices A through E. Additionally, Appendices A through E summarize the method requirements for sample preservation and holding time.

2.4.2 Data Quality Indicators/Performance Criteria

Performance goals have been established based on the criteria presented in Section 2.4 for each of the Data Quality Indicators (Precision, Accuracy, Completeness, Representativeness, and Comparability) as defined below.

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2.4.2.1 Precision

Precision is a measure of the reproducibility between two or more measurements of the same characteristic (i.e., analyte, parameter) under the same or similar conditions. Determining the agreement among replicate measurements of the same sample assesses the precision of the analytical procedure; combined precision of sampling and analysis procedures is assessed from the agreement between measurements of field duplicate samples. The relative percent difference (RPD) in the results will be computed for each duplicate pair using the equation provided in Section 3.6.

Field Precision Objectives

Precision of sampling and analysis procedures will be assessed through the collection of field duplicate samples at the frequencies listed in Appendices A through E for the specific media. The goals for precision of field duplicate results are also listed in the appendices. Data for duplicate analyses will be evaluated only if both of the samples in the duplicate pair have a concentration greater than the method quantitation limit (MQL). It is noted here that natural variation in some of the matrices will affect how closely these goals are met; that is, if variation is high, then these goals are unrealistic. Consequently, RPD results from field duplicates will not be used as a basis for invalidating any analytical data.

Laboratory Precision Objectives

Precision of the analytical procedure will be assessed through duplicate analyses of laboratory QC and field samples. Data for duplicate analyses will be evaluated only if both of the samples in the duplicate pair have a concentration greater than the method quantitation limit (MQL). The precision goals for laboratory duplicates for each media/analyte are listed in Appendices A though E.

2.4.2.2 Accuracy

Accuracy is a measure of the bias in terms of the degree of agreement between an observed value (i.e., sample result) and the accepted reference or true value. Accuracy is expressed as the

percent recovery of spiked analytes. The equations used to calculate percent recovery are included in Section 3.6.

Laboratory blank samples and field blanks will also be used to quantify the effect of sample contamination on overall data accuracy.

Field Accuracy Objectives

The potential for field contamination will be assessed through collection of equipment blanks (when non-dedicated sampling equipment is used) and trip blanks (for VOC samples) and adherence to all sample handling, preservation and holding time requirements. The objectives for minimizing the effect of field contamination on sample accuracy are listed for each media in Appendices A through E.

Laboratory Accuracy Objectives

Laboratory accuracy will be evaluated by the analysis of laboratory control samples (LCS), matrix spike (MS) samples and surrogate spikes (SU), with results expressed as a percentage recovery measured relative to the true (known) concentration. Laboratory LCS, MS/MSD, and SU recovery goals are provided in Appendices A through E for each media. In addition, laboratory preparation blank results will be used to measure any contamination introduced during the analytical process. The objectives for minimizing the effect of laboratory contamination on sample accuracy are concentrations less than the MQL in all blank samples.

2.4.2.3 Completeness

Completeness is the percentage of valid measurements or data points obtained, as a proportion of the number of measurements or data points planned for the project. Completeness is affected by such factors as sample bottle breakage and acceptance/rejection of analytical results. Completeness will be re-calculated and presented in each validation checklist. If completeness approaches the established goal (within 2-3%), corrective action will be instituted as described in Section 4.0. The completeness goal on a sample level is 90% and the goal on an analyte level is 80%.

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2.4.2.4 Representativeness

Representativeness is a qualitative objective, defined as the degree to which data accurately and precisely represent the characteristic of a population, the parameter variations at a sampling point, the process condition, or an environmental condition within a defined spatial and/or temporal boundary.

Field Representativeness Objectives

Field representativeness is achieved by collecting a sufficient number of unbiased (representative) samples and implementing a QC program for sample collection and handling prior to analyses. The sampling approaches developed for this project will provide for samples that are representative of site conditions. Any equipment blank and field blank results will also be evaluated to ensure that analytical results are representative of sample concentrations.

Laboratory Representativeness Objectives

Representativeness in the laboratory is ensured by using the proper analytical procedures, appropriate sample handling and preparation methods, meeting sample holding times and analyzing and assessing duplicate samples.

2.4.2.5 Comparability

Comparability is the confidence with which one data set can be compared to another.

Measures to Ensure Comparability of Field Data

Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the standard field protocols in the FSP are consistently followed and that the sampling techniques specified in the sampling plan are consistently used.

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Measures to Ensure Comparability of Laboratory Data

Planned analytical data will be comparable when the sampling and analytical methods described in the FSP and in this QAPP are used for sample collection and laboratory analysis. This goal is achieved through the consistent use of standard techniques to collect and analyze representative samples. Results of sample analyses will be consistently reported in appropriate units. Comparability is also dependent upon the laboratory obtaining the QA objectives for accuracy and precision. All data that meet the QA objectives described in this document and are considered usable will be considered comparable data.

2.5 QUALITY OBJECTIVES AND CRITERIA FOR HISTORICAL DATA

For secondary data (data that were previously collected for a different intended use), acceptance criteria are used in place of measurement performance criteria. Historical data that have been obtained using standard sampling techniques, custody documentation, and definitive analytical procedures and that have been previously validated and not rejected for serious QC deficiencies are considered acceptable for nature and extent and quantitative risk assessment purposes. These previously validated existing data will be reviewed prior to use to ensure consistency (particularly in terms of data flag usage and reporting format such as units, reporting limits, etc.), with data validation procedures for data obtained during the RI/FS.

Historical data that have not been previously validated and that will be used for nature and extent or risk assessment purposes will be validated in accordance with the procedures described in Section 5.0. Historical data that have not been obtained using standard sampling techniques, custody documentation, and definitive analytical procedures may only be used qualitatively.

2.6 SPECIAL TRAINING/CERTIFICATION

All field personnel who will collect samples addressed by this QAPP will have received 40 hour OSHA Hazardous Waste Site Operations training with annual 8-hour refreshers and medical monitoring. All personnel shall also have received 24 hours of supervised field training. The Field Project Supervisor shall have completed an additional 8-Hour OSHA Supervisor training

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course. The Site Safety Officer shall hold a current certificate for first aid/CPR training. Other training may be instituted as required. The RI Manager will be responsible for assuring that all required training is obtained and for maintaining all records documenting the required training.

2.7 DOCUMENTS AND RECORDS

The Respondents' Project Coordinator will distribute the QAPP to the persons listed on the distribution list on page vii of the QAPP. The Project Coordinator will be responsible for ensuring that all addenda are provided to the persons on this list, such that they will have the most current approved version of the QAPP. Updates to the QAPP will be controlled through use of a revision header on each page. This header will note the date of the revision and the revision letter (D for draft and F for final) followed by a revision number.

The FSP will also be distributed as indicated on this list. All QA audit reports, progress reports, corrective action reports and validation checklists will be maintained by the Project Coordinator with a copy retained by the QA Manager. Other project documents will be managed as described below.

2.7.1 Field Operation Records

Field operation records include sample collection records, chains of custody (COCs), custody seals, QC sample records, field procedures, and corrective action reports. Field sampling activities are documented on field data sheets. At each site, station IDs, location, sampling time, date, and sample collector's name/signature are recorded. The type of sample collected from each location will be recorded and serve as a check to assure that all intended samples are collected. If a field or lab QA/QC sample is to be collected at a site for a specific sample, this information will be documented on the field data sheets.

Values for all measured field parameters will be recorded. Observational data will be recorded, for instance water appearance, weather, biological activity in the sample, unusual odors, and other sample specific information.

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COCs will be filled out for all samples collected and include the information documented in Section 3.3 below.

Any problems or comments related to a specific sample will also be documented on the field data sheet. Such information would include moving a station location, if analytical samples require composites to be generated from more than one sample or if there were any circumstances at a site that prevented a sample from being collected.

Any corrective actions necessary to insure that sample integrity is maintained will be documented. If field standard operating procedures (SOPs) are violated or deviations are made, a corrective action report will be documented indicating what occurred, actions taken to correct the failure, as well as the effect of the action on the sample in question.

2.7.2 Laboratory Records

Laboratory records will include all of the data in the data reporting package (described in a later section. In addition to the items in the data reporting package, at a minimum, the following records will be maintained by the laboratory:

- Sample preparation log books;
- Standard solutions preparation log books;
- Temperature records for storage units (standards, samples);
- Equipment calibration and maintenance records; and
- Certification records for standards.

2.7.3 Data Handling Records

Data generated as part of this project will be handled according to the data management steps outlined in Section 3.10, as well as the verification and validation procedures identified in Section 5.0 of this document.

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2.7.4 Laboratory Data Reporting Package Format/Documentation Control

The analytical laboratory will prepare Level IV data packages for all analyses. The data package will include the following reportable data:

- A signed narrative which includes a detailed discussion of non-conformity events, corrective measures, data deficiencies, sample dilutions required, any evidence of matrix interference, etc.
- Complete Chain-of-Custody Documentation;
- Laboratory Sample Receipt Forms;
- Sample Identification and QC Batch Cross-Reference Table;
- Test Reports for Samples;
- Surrogate Recovery Data;
- Test Reports for Laboratory Blank Samples;
- Summary Forms for Laboratory Control Samples (LCS);
- Summary Forms for Matrix Spike/Matrix Spike Duplicate (MS/MSD);
- Summary Forms for Laboratory Duplicates;
- Summary Forms for Internal Standards;
- Summary Forms for GC/MS Tuning;
- Summary Forms for Metals Interference Check Samples, Serial Dilutions and MSA;
- Summary Forms for GC Dual Column/Detector Confirmation;
- Summary Forms for Pesticide Breakdown;
- Instrument run logs, extraction logs, and digestion logs;
- Initial calibration data with summary report;
- Initial calibration verification (ICV) data with summary report;
- Continuing calibration verification (CCV) data with summary report;

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- Initial calibration blank (ICB) data with summary report;
- Continuing calibration blank (CCB) data with summary report;
- Method detection limit documentation;
- DCS Documentation for reasonableness check of MDL; and
- Raw data (instrument printouts, chromatograms, mass spectra) for all samples, QC samples, and standards.

Test Reports shall include both the Method Detection Limit (MDL) and Method Quantitation Limit (MQL) adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and which take into account sample characteristics, sample preparation, and analytical adjustments. The MDL shall be determined by the laboratory using the procedures in 40 CFR Part 136, Appendix B and should be routinely checked for reasonableness using the procedures for the Detectability Check Sample (DCS) as established by the Texas Commission on Environmental Quality (TCEQ). The Method Quantitation Limit shall correspond to the lowest non-zero concentration standard in the laboratory's initial calibration curve and is based on the final volume of extract (or sample) used by the laboratory. Non-detected results shall be reported as less than the value of the sample-specific MDL. Concentrations between the MDL and MQL shall be reported with a J-flag flag (or B-flag for inorganics) to indicate the concentration is an estimate. Aqueous results shall be reported in mg/L for inorganics and μg/L for organics. Soil and sediment data shall be reported in mg/kg for inorganics and μg/kg for organics and shall be corrected for dry-weight. For GC analyses requiring secondary confirmation (i.e., Pesticides by SW-846 Method 8081 and PCB-Congeners by SW-846 Method 8082), the lower result shall be reported unless the relative percent difference (RPD) between the results exceeds the method criteria (40%) and there is no clear interference. The narrative should include a discussion of any disparity between results.

Summary Forms shall include the applicable QC parameter (i.e., RSD, recovery, RPD, etc.) for each analyte along with the true or reference amount, the measured amount, and the laboratory control limits. The Laboratory Control Samples shall contain all target analytes for the analytical method as listed in Appendices A-E, which are routinely spiked by the laboratory. The Matrix Spike and Matrix Spike Duplicates (MS/MSDs) must be prepared using a sample from the Site

(as indicated on the Chain-of-Custody) and shall contain the same target analytes as the LCS at an appropriate level compared to the unspiked sample result.

Data reporting packages will be organized according to the analytical laboratory's sample data groups (SDGs). Data reporting packages will be prepared by the Analytical Lab Project Manager in both paper and electronic form. One paper copy and one electronic copy (on CD) of each data package will be submitted to the RI Manager. The electronic copy will be in portable document format (pdf) with all pages numbered sequentially. Data in Microsoft Excel or Microsoft Access will also be required in order to enter the data into a database. The pdf files will be read-only such that data items cannot be edited. Electronic copies will be provided on CD and by electronic mail.

2.7.5 Data Archiving and Retrieval

The documents that describe, specify, report, or certify activities, requirements, procedures, or results for the various activities and the items and materials that furnish objective evidence of the quality of items or activities are listed in Table 7. All field-collected data will be housed in its original format. Table 7 shows documents and record types, locations where these records will be housed, retention time and the form of the record. Laboratory data that are stored electronically will be archived electronically, and where printed as part of the paper data report package, will also be archived in paper form. In general, all records must be retained for a period of 10 years following commencement of construction of any remedial action which is selected following completion of the RI/FS, per Section XX, Paragraph 79 of the UAO.

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3.0 DATA GENERATION AND ACQUISITION ELEMENTS

3.1 SAMPLING PROCESS DESIGN

Project sampling processes were designed to obtain information necessary to address those data needs associated with potentially complete or indeterminant exposure routes as described in the CSM, and identified during the RI/FS scoping process as described in the RI/FS WP. The DQOs in Tables 1-5 were developed for those identified potential exposure routes on a media-specific basis. As shown on Figure 10 of the RI/FS WP and detailed in the FSP, the sampling processes are iterative based on the data obtained and comparisons to Preliminary Screening Values (PSVs).

3.1.1 Scheduled Project Activities

Schedules for each sampling activity are shown on Figure 11 of the RI/FS WP.

3.1.2 Rationale for the Design

The overall rationale for the design of the RI/FS program is discussed in Section 4.0 of the RI/FS WP. Design rationale and objectives for specific tasks, including data generation subtasks, are provided by task in Section 5.0 of the RI/FS WP and are also evaluated by media in the DQOs. The rationale for the selection of specific sampling locations is included in the FSP. The proposed analytical suite for each sample is related to the Potential Source Area (PSA) associated with that sample, described in the RI/FS WP.

3.1.3 Design Assumptions

The design of the sampling program is based on the CSM, and the data needs resulting from an analysis of the CSM and the DQOs for the media to be sampled. Specific assumptions with regard to individual samples locations are provided in the FSP.

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3.1.4 Sample Locations and Frequencies

Sample locations and sampling frequencies, including the type and total number of sample types/matrices and how samples sites will be identified, are specified in Section 3.0 of the FSP.

3.1.5 Critical and Non-Critical Samples

All chemical and physical samples collected are designated as critical samples. Sample integrity is of utmost concern for the activities covered by this QAPP, such that data gaps are not created in the record, and the end user requirements of the data are met.

3.1.6 Validation of Non-Standard Methods

All methods for sample collection are based on standard methods and accepted practices. Should any non-standard field analytical methods be proposed, a DMA will be prepared and submitted to EPA for review and approval prior to use.

3.2 SAMPLING METHODS

All sample methods are described in the FSP. SOPs for these methods are provided in Appendix A of the FSP.

3.2.1 Sample Volume, Containers, and Preservation

The sample volume, container and preservation requirements will be in accordance with requirements for the specific analytical methods. This information is provided in Appendices A through E for the specific activities covered by this QAPP.

3.2.2 Sampling/Measurement System Failure Response and Corrective Action Process

Failure of a sampling or measurement system shall be reported to the Field Supervisor and then to the RI Manager. The RI Manager is responsible for corrective actions, as described in Section 4.

3.3 FIELD SAMPLE HANDLING AND CUSTODY

3.3.1 Chain-of-Custody (COC)

Proper sample handling and custody procedures ensure the custody and integrity of samples beginning at the time of sampling and continuing through transport, sample receipt, preparation, analysis, and disposal.

A sample is in custody if it is in actual physical possession or in a secured area that is restricted to authorized personnel. The COC form is used to document sample handling during transfer from the field to the laboratory and among contractors. The list of items below should be included on the COC form.

- Site identification
- Sample identification
- Date and time of collection
- Sample matrix
- Container type
- Number of containers
- Preservative used
- Notation if the sample was filtered
- Analyses required
- Name and signature of collector(s)
- Custody transfer signatures and dates and time of transfer
- Name of laboratory admitting the samples
- Bill of lading (if applicable)

3.3.2 Sample Labeling

Sample labels are completed with an indelible, waterproof marker. Label information includes the sample identification number, the date and time of sampling and sample type. The sample identification numbering system for the project has been designed to uniquely identify each sampling station and sample according to the Site grid. This numbering system consists of grid column and row identification, sample media, a sequential sample location identifier, depth (if applicable), and QA/QC identifier (if applicable), as detailed in Section 4.0 of the FSP.

3.3.3 Sample Handling

Sample handling procedures for each activity and type of sample are described in the FSP.

3.3.4 Failures in Chain of Custody and Corrective Action

All failures associated with COC procedures are immediately reported to the person who originally signed the COC, typically the Field Supervisor. These include such items as delays in transfer, resulting in holding time violations; violations of sample preservation requirements; incomplete documentation, including signatures; possible tampering of samples; broken or spilled samples, etc. The RI Manager or Field Supervisor, in consultation with the QA Manager will determine if the procedural violation may have compromised the validity of the resulting data. Any failures that have reasonable potential to compromise data quality will invalidate data, and the sampling event should be repeated. The resolution of the situation will be reported to the Project Coordinator. Corrective action reports will be maintained by the QA Manager.

3.4 LABORATORY SAMPLE HANDLING AND CUSTODY

3.4.1 Sample Receipt

Upon receipt by the laboratory, sample integrity will be inspected and documented on the COC or associated document (i.e., a sample receipt report or similar document). Information to be noted on the COC includes: name of person inspecting cooler, integrity of custody seals, sample cooler temperature, evidence of preservation, physical condition of sample container, and airbill number.

The COCs will be reviewed for completeness. If any sample integrity or sample ID problems or discrepancies are found, the Field Supervisor or RI Manager will be notified immediately. A COC addendum or sample receipt report may be used to document the corrective actions used to address any COC discrepancies. If an addendum is not used, corrective actions used to correct COC discrepancies must be recorded directly on the COC. Samples will be stored in a specially designated area that is clean, dry, and refrigerated (if needed). After sample analysis, the unused portion of the sample and sample extracts/digestates, together with all identifying labels will be stored until written permission to destroy the samples is given by the RI Manager. Samples will be disposed of at treatment storage and disposal facilities (TSDFs) that are approved by Respondents. All sample labels will be rendered illegible prior to sample disposal.

3.4.2 Sample Labeling

The field sample number will be recorded on the sample inventory, the COC, and on the sample label. All samples will be assigned discrete sample identification numbers (sample control numbers) upon receipt by the laboratory. The laboratory sample control number will remain the same throughout the analysis and data entry procedures. Final results will be reported with both the field sample ID and the laboratory sample control number.

3.4.3 Sample Custody

The laboratory will be responsible for maintaining an accurate custody record for each sample in the lab. Records will be maintained to document the date and time the sample is checked out of sample storage for analysis and the date and time at which the sample is returned. The Laboratory Project Manager or laboratory contact will be responsible for supplying the Field Supervisor (or their designee) with a sample acknowledgment form within 24 hours of sample receipt. This form will provide sample receipt information, sample log-in information, and the laboratory project number for the samples. A completed, signed COC will be sent by the laboratory to the RI Manager with the final data report.

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3.5 ANALYTICAL METHODS

Analytical methods are shown for each activity in Appendices A through E. Laboratory SOPs are provided in Appendix G. Performance-based measurement system (PBMS) methods may also be used as specified in Section 3.5.1.

The SW-846 methods contain inherent flexibility as described in Section 2.1 of Chapter 2 of SW-846. Where this flexibility is employed in this project, documentation shall be provided as described in Section 3.5.2. Consistent with the application of the TRIAD approach during the RI/FS, a DMA will be prepared and submitted to EPA for review and approval prior to use of any field analytical methods.

3.5.1 Performance-Based Measurement System Methods

Performance-based measurement system (PBMS) methods are sample preparation and analytical methods that differ in some part of the procedures of the methods that are specified for this project in Appendices A through E. A PBM system is "a set of processes wherein the data quality needs, mandates or limitations of a program or project are specified, and serve as criteria for selecting appropriate methods to meet those needs in a cost-effective manner."[1] Examples of where PBMS methods may be used in this project are in overcoming matrix interference problems, lowering detection limits, and otherwise improving data quality to meet project DQOs.

If a laboratory uses PBMS methods, it should meet the QA/QC criteria recommended in the SW-846 manual. At a minimum, method performance should be supported by the QC components in Chapter 1 (Quality Control) of SW-846, including the QC information that should be documented. Specifically, Section 4.3.4 (Test Methods) of Chapter 1 describes the minimum written documentation requirements for laboratory procedures. Section 4.4 (Laboratory QA and QC Procedures) of Chapter 1 describes the minimum QA/QC requirements for analytical procedures including proficiency (precision, bias and method detection limit), control procedures

[1] OSWER PBMS Implementation Plan, A Cooperative Effort Among OSW, OERR, OUST, TIO, FFRRO, and CEPPO, October 9, 1998 (revision 1), page 3.

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and control limits (laboratory control samples, method blank, and matrix spikes), corrective action, and data handling.

Where PBMS methods are used in this project, documentation shall be provided as described in Section 3.5.2.

3.5.2 Documentation for Alternative Analytical Procedures

Where alternative analytical procedures, such as real-time field analytical methods, are used in this project, demonstration is required that they provide performance equivalent to the methods listed for this project in Appendices A through E. Alternative analytical procedures include those involving the inherent flexibility as allowed in SW-846 methods in Section 2.1 of Chapter 2 of SW-846 as well as those based on PBMS. Documentation of this demonstration will be in a DMA, which will include performance data as well as a detailed description of the procedures such as in an SOP.

3.5.3 Standards Traceability

All standards used in the laboratory are traceable to certified reference materials. Standards preparation is fully documented and maintained in a standards log book. Each document includes information concerning the standard identification, starting materials, including concentration, amount used and lot number, date prepared, expiration date and preparer's initials or signature. The reagent bottle is labeled in a way that traces the reagent back to the preparation.

3.5.4 Failures in Measurement Systems and Corrective Actions

In many cases, the field technician or lab analyst will be able to correct problems. If the problem is resolved by the field technician or lab analyst, he/she will document the problem on the field data sheet or laboratory record and complete the analysis. If the problem is not resolvable, then it is conveyed to the Laboratory Project Manager, who will make the determination and notify the QA Manager. If the analytical system failures may compromise the sample results, the resulting

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data will not be reported. The nature and disposition of the problem is reported on the data report, which is sent to the RI Manager.

3.6 QUALITY CONTROL

3.6.1 Sampling Quality Control Requirements and Acceptability Criteria

The minimum field QC requirements are outlined for each activity in Appendices A through E. Specific requirements are outlined below.

3.6.1.1 Field Duplicate

Field duplicates will be collected at the frequency given in Appendices A through E for each sampling activity covered by this QAPP, typically at the frequency of one per 20 field samples collected or at least one per sampling day. A field duplicate is defined as a second sample (or measurement) from the same location, collected in immediate succession, using identical techniques. The duplicate sample will be collected from the same homogenized composite material as the sample it is duplicating and will be submitted "blind" (i.e., without identifying it as a duplicate). Duplicate samples are sealed, handled, stored, shipped, and analyzed in the same manner as the primary sample. Precision of duplicate results is expressed as is calculated by the relative percent difference (RPD) calculated as defined by 100 times the absolute value of the difference (range) of each duplicate set, divided by the average value (mean) of the set:

$$\text{RPD} = \frac{\text{ABS (primary sample result} - \text{duplicate sample result)}}{\text{average of primary and duplicate sample result}} \times 100$$

3.6.1.2 Field Splits

Field splits are not required for any of the activities, but may be requested by the EPA. A field split is collected in the same manner as a field duplicate.

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3.6.1.3 Equipment Blanks

Equipment blanks (rinsate) blanks will be collected at the frequency given in Appendices A through E for each sampling activity covered by this QAPP. When possible, rinsate blanks will be collected from the final rinse water of non-dedicated decontaminated equipment to assess the effectiveness of the cleaning and decontamination procedure.

3.6.1.4 Trip Blanks

Trip blanks will be collected at the frequency given in Appendices A through E for each sampling activity covered by this QAPP. Since trip blanks are used only when samples are collected for volatile organic compounds analyses, not all activities will require trip blanks.

3.6.2 Laboratory Measurement Quality Control Requirements and Acceptability Criteria

Detailed laboratory QC requirements are contained within each individual method SOP in Appendix G. The minimum requirements for the QC samples are outlined below. Laboratory QC sample results are reported with the data report.

3.6.2.1 Laboratory Duplicates, Matrix Spikes, and Matrix Spike Duplicates

Duplicate analysis is performed as a measurement of precision on the analytical process. Laboratory duplicates are independently repeated measurements of the same sample, which are performed by the same analyst and under the same conditions. The sample is split in the laboratory and each fraction is carried through all stages of preparation and analysis. The calculation for relative percent difference (RPD) is performed from the two sample results. The equation for calculating RPD was provided in Section 3.6.1.1.

The duplicate procedure is performed at least once per 20 samples (5%). Control limit criteria are found in Appendices A through E for each media.

Matrix spike samples are prepared by adding a known amount of each target analyte (or a subset thereof) to a known amount of sample. The matrix spike is added at the beginning of the

procedure and is carried through the entire measurement process. The sample itself (without a matrix spike) is also carried through the analytical process. In order to produce reliable recovery results, the spike level must be similar to the sample concentration. Because the matrix spike samples are prepared and analyzed at the same time as the sample, only a reasonable estimate of the spike level can be made. Where samples are collected in field areas that are expected to have high concentrations, they will be identified for the laboratory, and corresponding spike levels can be used. The amount of the spike should be at least four times the amount in the unspiked sample.

The spike recovery measures the effects of interferences caused by the sample matrix in the analytical process. The matrix spike recovery is calculated as follows:

$$\% \text{ Recovery} = \frac{\text{spiked sample result} - \text{sample result}}{\text{theoretical spike concentration}} \times 100$$

The matrix spike procedure is performed once per batch of 20 samples. The matrix spike is performed twice and the second spike is called the matrix spike duplicate. This procedure evaluates the precision associated with the procedure and the analyst performing the procedure and is calculated as a RPD as described above.

The sample to be used for the MS/MSD shall be designated on the COC. The MS/MSD is used to document the bias of a method due to sample matrix, not to control the analytical process and thus laboratory corrective action is not instituted based on MS/MSD results. If completeness goals are not being met as described in Section 2.4.4, alternative methodologies will be pursued. Control limit criteria for the MS/MSD are found in Appendices A through E for each media.

3.6.2.2 Laboratory Control Standard (LCS) and Laboratory Control Standard Duplicates (LCSDs)

The laboratory control sample (LCS) is an aliquot of a solid or aqueous certified reference material containing a known amount of each target analyte being measured. The LCS is treated like a field sample from the beginning of the procedure and is carried through the entire measurement process. The amount of the spike should be at a level less than or equal to the

midpoint of the calibration curve for each analyte. The LCS is analyzed once per batch of 20 analytical samples.

The percent recovery of the target analytes in the LCS assists in determining whether the procedure is in control. It is further used to evaluate the accuracy and bias of all or a portion of the measurement process. The LCS recovery is calculated as follows:

$$\% \text{ Recovery} = \frac{\text{measured amount}}{\text{known amount}} \times 100$$

If insufficient quantity of sample is provided to perform a matrix spike and matrix spike duplicate, a duplicate LCS (LCSD) is prepared and analyzed and the RPD is calculated as described in Section 3.6.1.1.

Control limit criteria for the LCS are found in Appendices A through E for each media. If the LCS recovery is lower than the control limit or if the LCS recovery is higher than the control limit and the analyte is present in the samples, laboratory corrective action should be taken. If the LCS recovery is higher than the control limit and the samples are ND for the analyte, the data may be accepted.

3.6.2.3 Detectability Check Sample

The laboratory should routinely check the instrument MDL to verify the laboratory's ability to reliably detect the parameter at the MDL that is used for reporting detected results and calculation of non-detected results. The detectability check standard will be checked on a quarterly basis and the results maintained on file with the MDL data.

3.6.2.4 Method Blank

The method blank is analyte-free water or solid material that is processed simultaneously with and under the same conditions as the samples. The method blank is analyzed to demonstrate that the analytical system itself is not contaminated with the analyte(s) being measured. The method blank results should be below the Method Quantitation Limit or corrective action must be taken.

No qualification is warranted if a sample result from the sample group is greater than or equal to five times the associated blank concentration. Analytical results less than five times the associated blank concentration are qualified as non-detected.

3.6.2.5 Additional Method Specific QC Requirements

Additional QC samples may be run (e.g., continuing calibration samples), as specified in the method SOPs. The requirements for these samples, their acceptance criteria, and corrective action are method-specific.

3.6.3 Failures in Quality Control and Corrective Action

All qualified data are evaluated by the RI Manager, in consultation with the QA Manager. In that differences in field duplicate sample results are used to assess the entire sampling process, including environmental variability, the arbitrary rejection of results based on pre-determined limits is not practical. Therefore, the professional judgment of the RI Manager and QA Manager will be relied upon in evaluating results. Rejecting sample results based on wide variability is a possibility. Field blank values exceeding the acceptability criteria may automatically invalidate the sample, especially in cases where high blanks may be indicative of contamination that causes a result to exceed the standard. Field duplicate excursions will be noted. Equipment blank results are also scrutinized very closely. Corrective action will involve identification of the cause of the failure where possible. Response actions may include re-analysis of questionable samples. In some cases, a site may have to be resampled to achieve project goals.

Laboratory measurement quality control failures are evaluated by the Laboratory Project Manager and findings reported to the RI Manager. Specific instances requiring laboratory corrective action are listed in Section 4.1.3.

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3.7 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

All sampling equipment testing and maintenance requirements are detailed in the manufacturer's specifications for a particular piece of equipment. Sampling equipment is inspected and tested upon receipt and is verified to be appropriate for use. Field instruments and equipment will be maintained in accordance with the manufacturer's instructions. Field instruments that fail two consecutive calibration requirements will be tagged as "nonfunctional" and returned to the manufacturer for repair or replacement. Acceptance criteria are detailed in the manufacturer's documentation for each instrument.

The equipment testing and maintenance procedures for all laboratory tools, gauges and instruments are documented in the laboratory's QA Manual (Appendix G). Testing and maintenance records are maintained and are available for inspection. Instruments requiring daily or in-use testing may include, but are not limited to: water baths, ovens, autoclaves, incubators, refrigerators, and laboratory pure water. Critical spare parts for essential equipment are maintained or are available through a preferred vendor status to prevent downtime. Maintenance records are available for inspection.

3.8 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

3.8.1 Field Equipment Calibration

Field equipment calibration requirements are contained in the manufacturer's documentation. All field equipment requiring calibration will be conducted according to the manufacturer's specifications, including tolerance limits and frequencies. Calibration will be conducted daily prior to use. Pre- and post-calibration logs will be kept (or the information provided on standard field records) to insure that equipment has maintained calibration during its use.

3.8.2 Laboratory Equipment Calibration

Detailed laboratory calibration procedures are contained within the specifications and SOPs for each analysis in Appendix G. The laboratory QA Manager identifies all tools, gauges,

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instruments, and other sampling, measuring, and testing equipment used for data collection activities affecting quality that must be controlled and, at specified periods must be calibrated to maintain performance within specified limits. Calibration records are maintained and are available for inspection. Equipment requiring periodic calibrations include, but are not limited to, thermometers, pH meters, balances and analytical instruments.

3.9 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

All new batches of field and laboratory supplies are inspected and tested before use to ensure that they are adequate and free of contaminants. Acceptance criteria are detailed in the manufacturer's documentation for the product. The Laboratory Project Manager provides additional details on acceptance requirements for laboratory supplies and consumables. The procurement of purchased items and services that directly affect the quality of environmental projects, shall be planned and controlled to ensure that the quality of the items and services is known, documented, and meets the QAPP requirements and acceptance criteria.

3.10 DATA MANAGEMENT

Data management provides a process for tracing the path of the data from their generation in the field or laboratory to their final use or storage. The following elements are included in this process: recording, validation, transformation, transmittal, reduction, analysis, tracking, and storage and retrieval.

3.10.1 Data Recording

Sample collection will be documented and tracked using field log forms, field logbook entries, and Chain-of-Custody Records. Field personnel will complete these forms, which then will be reviewed for correctness and completeness by the Field Supervisor. Copies of these forms will be maintained in the project files.

3.10.2 Data Validation

Data validation is addressed in Section 5.0 of this QAPP.

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3.10.3 Data Transformation

Since data will be collected and/or reported using proper units according to this QAPP, no data transformation is expected. If data transformation is necessary, the transformation procedures will be added to this QAPP.

3.10.4 Data Transmittal

The Field Supervisor will be responsible for assuring that field data are entered onto the appropriate field data forms, and will report any problems to the RI Manager. Field Supervisors will submit the complete field data forms to the RI Manager for review and error checking.

Field Supervisors will also ensure that all samples collected in the field are submitted to the laboratory according to the methods outlined in this QAPP or the FSP. The laboratory will submit to the RI Manager or Field Supervisor the analytical data results in their standard hard-copy format (including raw data format) and in an electronic data deliverable (EDD) format prior to sending the final data report in PDF to the RI Manager. The EDD shall be in space or comma-delimitated ASCII format or in Excel spreadsheet format that will allow for easy integration into a digital database.

Once reviewed by the RI Manager or Field Supervisor for obvious transcription or reporting errors, the final data report in both hard-copy and EDD formats will be transmitted and ready for validation by the QA Manager. Following data validation, any data qualifiers added to data during the validation process will be imported into the project database. Entry or upload of EDDs and data qualifiers into the project database will be completed by a designee of the RI Manager. The data and qualifiers will be initially verified by the individual entering the data. Upon completion of the initial verification step, a report will be generated of the data and verified by the RI Manager against the original data. Only final versions of electronic data will be entered into the database. All electronic data will be verified before and after incorporation into the database against the hard copy reports that accompany the data.

All qualified data will be included with the data packages during all subsequent data transmittal processes. The final hard copy data validation checklists will be included with the data in the

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Nature and Extent Data Report (NEDR) and the Preliminary Site Characterization Report (PSCR).

All field forms and lab data will be organized and stored by sample location allowing for easy access if needed. Data can be transferred electronically either on disc, CD, tape or as an email attachment.

3.10.5 Data Analysis

Data analysis will be conducted as described in the RI/FS WP. Applications that may be utilized to analyze the data include Microsoft Excel and Microsoft Access. The results of data analysis for each activity will be presented in the Remedial Investigation Report.

3.10.6 Data Storage and Retrieval

PBW's RI Manager is responsible for project data storage and retrieval. Laboratory data that are stored electronically will be archived electronically, and where printed as part of the paper data report package, will also be archived in paper form. Both the electronic data and hard copies will be maintained in PBW's Round Rock, TX office. In general, all records and data must be retained for a period of 10 years following commencement of construction of any remedial action which is selected following completion of the RI/FS, per Section XX, Paragraph 79 of the UAO. Table 7 shows documents and record types, locations where these records will be housed, retention time and the form of the record.

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4.0 ASSESSMENT AND OVERSIGHT ELEMENTS

4.1 ASSESSMENTS AND REPONSE ACTIONS

Table 8 presents types of assessments and response action for data collection activities governed by this QAPP.

4.1.1 Corrective Action

Corrective action is the process of identifying, recommending, approving and implementing measures to counter unacceptable procedures or poor QC performance which can affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation and data assessment. All proposed corrective actions should be documented as well as the steps taken to implement the corrective action. Corrective action should only be implemented after approval by the RI Manager or his designee. If immediate corrective action is required, approvals secured by telephone from the RI Manager should be documented.

For noncompliance problems, a formal corrective action program will be developed and implemented at the time the problem is identified. The person who identifies the problem is responsible for notifying the RI Manager. If the problem is related to an analytical procedure affecting the quality of data produced, this information will be promptly communicated to the Analytical Lab Project Manager, the RI Manager and the QA Manager. Implementation of corrective action will be confirmed in writing through the same channels.

Any nonconformance with the established QC procedures will be identified and corrected in accordance with this QAPP. The RI Manager, or his designee, will issue a nonconformance report for each nonconformance condition and include a copy of this report in the project's files.

4.1.2 Field Corrective Action

Corrective action in the field may be needed when the sample program is changed (i.e., more/less samples, sampling locations or frequencies other than those specified in the RI/FS WP or FSP) or

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when sampling procedures and/or field procedures require modification due to unexpected conditions. In general, the field team may identify the need for corrective action. The field staff, in conjunction with the field team leader, will recommend a corrective action. The RI Manager will approve the corrective measure, which will be implemented by the field team. It will be the responsibility of the RI Manager to ensure the corrective action has been implemented.

If the corrective action will supplement the RI/FS WP or FSP, using existing and approved procedures in the QAPP, corrective action approved by the RI Manager will be documented. If corrective actions result in less samples, alternate sampling locations, etc., which may cause project QA objectives not to be achieved, it will be necessary that all levels of project management concur with the proposed action.

Corrective action resulting from internal field audits will be implemented immediately if data quality would be adversely affected due to unapproved or improper use of approved methods. The QA Manager will identify deficiencies and recommend corrective action to the RI Manager. Implementation of corrective actions will be performed by the field team under the direction of the RI Manager.

Corrective actions will be documented in the field book. No staff member will initiate corrective action without prior communication of findings through the proper channels. If the actions taken are insufficient to correct the problem identified, work may be stopped by the RI Manager. If at any time a corrective action issue is identified which directly impacts the project objectives, the Project Coordinator will be notified immediately.

4.1.3 Laboratory Corrective Action

Corrective actions in the laboratory may occur prior to, during or after initial analyses. As such, the initial analyses must be performed quickly enough to allow time for reanalysis within the required holding time. A number of conditions, such as broken sample containers, may be identified during sample login or just prior to analysis. The Analytical Laboratory Project Manager will notify the QA Manager of such conditions prior to analysis. Following consultation with lab analysts and section leaders, it may be necessary for the Analytical Laboratory Project

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Manager to approve the implementation of corrective action. Some conditions that may trigger corrective action or optional procedures during or after analysis include dilution of samples, sample reanalysis when certain quality control criteria are not met, etc.

Laboratory personnel are alerted that corrective actions may be necessary if:

- QC data are outside the control limits for precision or accuracy;
- Sample results are outside the instrument calibration range;
- Laboratory method blanks contain target analytes above acceptable levels;
- Deficiencies are detected during internal or external audits or from the results of performance evaluation samples; or
- Inquiries concerning data quality are received.

The following specific instances require laboratory corrective action:

- The laboratory method blanks contain target analytes above the MQL and any associated sample contains the analyte at a concentration less than five times that in the blank.
- The LCS recovery is less than 10% for any organic target analyte or 30% for any inorganic analyte.
- The LCS recovery is outside the control limit for more than 1/2 of the target analytes for multi-analyte analyses such as VOC and SVOC.
- The surrogate recovery is less than 10% for any single surrogate.
- The MS recovery is less than 30% for any inorganic analyte.
- The internal standard area is less than 25% (i.e., -75%) of that in the midpoint standard for any single internal standard.

The corrective action shall include reanalyzing (and extracting or digesting, as applicable) the affected samples and/or immediate notification of the QA Manager.

Corrective action procedures are often handled at the bench level by the analyst, who reviews the analytical procedures for possible errors, checks the instrument calibrations and performance, etc.

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If the problem persists or cannot be identified, the matter is referred to the laboratory supervisor or Analytical Laboratory Project Manager for further investigation. Once resolved, full documentation of the corrective action procedure is filed. These corrective actions are performed prior to release of the data from the laboratory. All corrective actions associated with sample analyses for this project will be documented and reported in the sample package narrative.

4.1.4 Corrective Action During Data Validation and Data Assessment

The need for corrective action may be identified during either data validation or data assessment. Potential types of corrective action may include resampling, reanalysis of samples, or reprocessing of the sample data. These actions are dependent upon the ability to mobilize the field team and whether the data to be collected are necessary to meet the required QA objectives. If the QA Manager identifies a corrective action situation, it is the RI Manager who will be responsible for approving the implementation of corrective action. All corrective actions of this type will be documented by the QA Manager.

4.2 REPORTS TO MANAGEMENT

4.2.1 Laboratory Data Report

Laboratory data reports contain the results of all specified QC measures listed in Section 2.5.4, including but not limited to equipment blank, filter and reagent blanks, field blanks, laboratory duplicates, laboratory control standards, calibration, and matrix spikes. This information is reviewed by the QA Manager and compared to the pre-specified acceptance criteria to determine acceptability of the data before forwarding to the RI Manager.

4.2.2 Reports to Project Management

The Field Supervisor will report to the RI Manager daily following each field monitoring event. A brief written report will be sent via e-mail to the RI Manager that documents any problems, delays, or corrective actions that may be required or that may affect the subsequent sampling

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efforts. The report will also include a brief synopsis of the work conducted during the field monitoring event.

5.0 DATA VALIDATION AND USABILITY

5.1 INTRODUCTION

Data are conventionally placed into one of five different levels (EPA, 1988), depending on the intended use of the data. These five analytical levels, the applicable data uses, and examples of the type of data are shown in the following table:

ANALYTICAL LEVEL	DATA USES	EXAMPLES
Level 1	Site Characterization Monitoring during implementation	Portable instruments Field test kits
Level 2	Site Characterization Evaluation of Alternatives Engineering Design Monitoring during Implementation	Organics by gas chromatography (GC) Inorganics by atomic adsorption (AA) Inorganics by X-ray diffraction
Level 3	Risk Assessment PRP Determination Site Characterization Evaluation of Alternatives Engineering Design Monitoring during Implementation	Analysis using analyte-specific EPA procedures, other than CLP
Level 4	Risk Assessment PRP Determination Evaluation of Alternatives Engineering Design	Organics/Inorganics by GC/MS, AA, ICP CLP analyses
Level 5	Risk Assessment PRP Determination	Non-conventional parameters Modified methods Appendix 8 Parameters

Standard data review levels, which have originated from the analytical levels, are defined as follows:

DATA REVIEW LEVEL	DATA USES	ITEMS VALIDATED	OBJECTIVE
Level 2	Site Characterization Evaluation of Alternatives Engineering Design Monitoring during Implementation	General Performance Data such as Sample Preservation and Holding Time; Field and Laboratory Blanks; and Laboratory and Matrix Spikes	Assess technical validity
Level 3	Risk Assessment PRP Determination Site Characterization Evaluation of Alternatives Engineering Design Monitoring during Implementation	General Performance Data plus Instrument Performance Data such as Initial Calibration, Continuing Calibration Verification, and Interference Checks	Assess technical validity Provide legal defensibility

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Level 4	Risk Assessment PRP Determination Evaluation of Alternatives Engineering Design	General Performance Data, Instrument Performance Data, and Analyte Identification and Quantitation (raw data review)	Assess technical validity Provide legal defensibility Address data integrity

5.2 DATA REVIEW: VERIFICATION, VALIDATION, AND INTEGRITY

For the purpose of this document, verification means the processes taken to determine compliance of data with project requirements, including documentation and technical criteria. Validation means those processes taken independently of the data-generation processes to determine the usability of data for its intended use(s). Integrity means the processes taken to assure that no falsified data will be reported.

All data obtained from field and laboratory measurements will be reviewed and verified for conformance to project requirements, and then validated against the project objectives that are listed in Section 2.4. Data supported by appropriate quality control results that meet the project objectives defined for this project will be considered acceptable without qualification. Data associated with quality control results that do not meet the project objectives defined for this project will be assigned appropriate qualifiers reflecting the potential impact on data usability. Analytical data will be considered usable unless rejected during the validation process.

The procedures for verification and validation of data are described in Section 5.3, below. The Field Supervisor is responsible for ensuring that field data are properly reviewed and verified for integrity by reviewing field equipment calibration records and verifying proper field procedures. The Analytical Lab Project Manager is responsible for ensuring that laboratory data are scientifically valid, defensible, of acceptable precision and accuracy, and reviewed for integrity and indicates this by signing the data package Narrative. The QA Manager will be responsible for ensuring that all laboratory data are properly reviewed and verified, and submitted in the required format to the project database. The QA Manager is responsible for validating the laboratory data and documenting the review. Finally, the RI Manager, with the concurrence of the QA Manager, is responsible for verifying that all data to be reported meet the objectives of the project and are suitable for reporting.

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5.3 VERIFICATION AND VALIDATION METHODS

All data will be verified to ensure they are representative of the samples analyzed and locations where measurements were made, and that the sample results and associated quality control data conform to project specifications. The staff and management of the respective field, laboratory, and data management tasks are responsible for the integrity, validation and verification of the data each task generates or handles throughout each process. The field and laboratory tasks ensure the verification of raw data, electronically generated data, and information on COC forms and hard copy output from instruments. The Analytical Lab Project Manager will document the review of the reported data per the laboratory's QA Plan.

Verification, validation and integrity review of all laboratory data will be performed or supervised by the QA Manager. The data to be verified are evaluated against project specifications (Section 2.4) and are checked for errors, especially errors in transcription, calculations, and data input. The QA Manager will validate all reported laboratory data in accordance with the project Data Validation Standard Operating Procedure (SOP No. 16) (Appendix F).. All laboratory data will be validated using a Level III data review. For critical samples, such as tissue analysis for human health risk assessment, a Level IV review may be instituted. The level of data review established for each media/activity is included in Appendices A-E. The validation will be documented on the Validation Checklist included in the SOP and data qualifiers will be added to the database as appropriate. The SOP includes guidelines for applying data qualifiers. Generally, data will be rejected for use if the holding time is grossly exceeded or the QC data indicates an extremely low bias (<10% true value) in the measurement.

Potential outliers are identified by the QA Manager and RI Manager by examining results for unreasonable data, or identified using computer-based statistical software. If a question arises or an error or potential outlier is identified, the Field Supervisor or the Analytical Lab Project Manager responsible for generating the data is contacted to resolve the issue. Issues that can be corrected are corrected and documented electronically or by initialing and dating the associated paperwork. If an issue cannot be corrected, the QA Manager and/or the RI Manager will determine the appropriate course of action, or the data associated with the issue are rejected.

The RI Manager and QA Manager are each responsible for validating that the verified data are scientifically valid, defensible, of known precision, accuracy, integrity, meet the project objectives of the project, and are reportable. One element of the validation process involves evaluating the data again for anomalies. The QA Manager or RI Manager may designate other experts familiar with the project to perform this evaluation. Any suspected errors or anomalous data must be addressed by the manager of the task associated with the data before data validation can be completed.

5.4 RECONCILIATION WITH USER REQUIREMENTS

The data collected pursuant to this QAPP will be evaluated to see whether it supports the project objectives (Table 6). Statistical evaluations may be performed on some data sets, as outlined in the RI/FS WP. The results of data evaluation, including limitations of the use of the data, will be presented in the RI Report.

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6.0 REFERENCES

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TABLES

TABLE 1 - SOILS/SEDIMENT DATA QUALITY OBJECTIVES

Conceptual Site Model Exposure Route[1]	**Inhalation of particulates in ambient air resulting from fugitive dust generation and/or contact with/ingestion of particles deposited on surface soil.**	**Ingestion of and dermal contact with sediments as a result of surface runoff of Chemicals of Interest (COIs) from Potential Source Areas (PSAs). Exposure to soil via ingestion and dermal contact.**	**Ingestion of fish potentially containing COIs as a result of surface runoff of COIs from PSAs to surface water/sediments from PSAs and uptake by fish.**
1. State the problem	*Conduct a site investigation and assess the potential risks posed by releases of chemicals associated with the Site, and develop remedial alternatives to address any unacceptable risks.*		
2. Identify the Decision	Do COIs in surface soil pose an unacceptable risk through fugitive dust emissions and/or airborne transport to off-site areas?	Do COIs in soil and/or sediments pose an unacceptable risk to human health or ecological receptors through ingestion or dermal contact with the surface soil?	Do COIs in soil pose an unacceptable risk via runoff to surface water/sediments and uptake by fish?
3. Identify inputs to the decision	• Evaluate existing Site soil data. • Evaluate background COI concentrations in soil. • Collect soil samples as described in the RI/FS Work Plan and Field Sampling Plan. • Measure COI in surface soil samples collected. • Validate analytical data. • QA/QC samples: Collect 1 field duplicate and 1 MS/MSD sample per 20 samples for COI analyses. • Analytical method detection limit targets are provided in Appendix A for soil.	• Evaluate existing Site soil and sediment data. • Evaluate background COI concentrations. • Collect soil and sediment samples as described in the RI/FS Work Plan and Field Sampling Plan. • Measure COIs in soil and sediment samples collected. • Validate analytical data. • QA/QC samples: Collect 1 field duplicate and 1 MS/MSD sample per 20 samples for COI analyses. • Analytical method detection limit targets are provided in Appendix A for soil and Appendix D for sediment.	• Evaluate existing Site soil and sediment data. • Evaluate background concentrations. • Collect soil and sediment samples as described in the RI/FS Work Plan and Field Sampling Plan. • Measure COIs in soil and sediment samples collected. • Validate analytical data. • QA/QC samples: Collect 1 field duplicate and 1 MS/MSD sample per 20 samples for COI analyses. • Analytical method detection limit targets are provided in Appendix A for soil and Appendix D for sediment.

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TABLE 1 - SOILS/SEDIMENT DATA QUALITY OBJECTIVES

Conceptual Site Model Exposure Route[1]	**Inhalation of particulates in ambient air resulting from fugitive dust generation and/or contact with/ingestion of particles deposited on surface soil.**	**Ingestion of and dermal contact with sediments as a result of surface runoff of Chemicals of Interest (COIs) from Potential Source Areas (PSAs). Exposure to soil via ingestion and dermal contact.**	**Ingestion of fish potentially containing COIs as a result of surface runoff of COIs from PSAs to surface water/sediments from PSAs and uptake by fish.**
4. Define boundaries of the study	• The horizontal boundaries are the lateral extents of contamination as determined by the Preliminary Screening Value (PSV) comparisons described in the RI/FS Work Plan (PBW, 2006a). In addition background soil samples may be collected from a designated area approximately 2,000 feet northeast of the Site. • The vertical boundaries are the vertical extents of contamination as determined by the PSV comparisons described in the RI/FS Work Plan. • The temporal boundary is the initial RI sampling to occur in 2006 and 2007.	• The horizontal boundaries are the lateral extents of contamination as determined by the PSV comparisons described in the RI/FS Work Plan. In addition background soil samples may be collected from a designated area approximately 2,000 feet northeast of the Site. Background sediment samples will be collected from a designated location approximately 1.5 miles east of the Site. • The vertical boundaries are the vertical extents of contamination as determined by the PSV comparisons described in the RI/FS Work Plan. • The temporal boundary is the initial RI sampling to occur in 2006 and 2007.	• The horizontal boundaries are the lateral extents of contamination as determined by the PSV comparisons described in the RI/FS Work Plan. In addition background soil samples may be collected from a designated area approximately 2,000 feet northeast of the Site. Background sediment samples will be collected from a designated location approximately 1.5 miles east of the Site. • The vertical boundaries are the vertical extents of contamination as determined by the PSV comparisons described in the RI/FS Work Plan. • The temporal boundary is the initial RI sampling to occur in 2006 and 2007.
5. Develop a decision rule	If COIs exceed the PSVs for soil, then those COI soil data will be quantitatively evaluated in the BHHRA. Additional delineation may be necessary.	If COIs exceed the PSVs for soil or sediment, then those COI soil/sediment data will be quantitatively evaluated in the BHHRA. Additional off-site delineation may be necessary.	If COIs exceed the PSVs for soil or sediment, then those COI soil/sediment data will be quantitatively evaluated in the BHHRA. Additional off-site delineation may be necessary.
6. Specify limits on decision errors	Precision criteria for use of measurement data are defined in Section 2.4.2 and Appendix A for soil (QAPP).	Precision criteria for use of measurement data are defined in Section 2.4.2 and Appendix A for soil and Appendix D for sediment (QAPP).	Precision criteria for use of measurement data are defined in Section 2.4.2 and Appendix A for soil and Appendix D for sediment (QAPP).

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TABLE 1 - SOILS/SEDIMENT DATA QUALITY OBJECTIVES

Conceptual Site Model Exposure Route[1]	**Inhalation of particulates in ambient air resulting from fugitive dust generation and/or contact with/ingestion of particles deposited on surface soil.**	**Ingestion of and dermal contact with sediments as a result of surface runoff of Chemicals of Interest (COIs) from Potential Source Areas (PSAs). Exposure to soil via ingestion and dermal contact.**	**Ingestion of fish potentially containing COIs as a result of surface runoff of COIs from PSAs to surface water/sediments from PSAs and uptake by fish.**
7. Optimize design for obtaining data	The number of samples (random and judgmental) for the RI/FS investigation has been selected to provide a dataset size that is adequate for meaningful analysis. The sampling design is expected to provide adequate characterization of the media. However, additional sampling may be needed based on the results of the initial RI sampling event.	The number of samples (random and judgmental) for the RI/FS investigation has been selected to provide a dataset size that is adequate for meaningful analysis. The sampling design is expected to provide adequate characterization of the media. However, additional sampling may be needed based on the results of the initial RI sampling event.	The number of samples (random and judgmental) for the RI/FS investigation has been selected to provide a dataset size that is adequate for meaningful analysis. The sampling design is expected to provide adequate characterization of the media. However, additional sampling may be needed based on the results of the initial RI sampling event.

Notes:
1. See Figures 7 – 10 of RI/FS Work Plan for more detailed descriptions of exposure routes.

TABLE 2 – GROUNDWATER DATA QUALITY OBJECTIVES

Conceptual Site Model Exposure Route[1]	**Inhalation of vapors that have migrated from groundwater through the soil pore space and into ambient air.**	**Exposure to potable water through ingestion, dermal contact, ingestion of crops that were irrigated with water, and inhalation of vapors emitted from water as a result of COI leaching to groundwater.**
1. State the problem	*Conduct a site investigation to evaluate the lateral and vertical extent of potential NAPL and the potential risks from ingestion of groundwater downgradient of the Site; develop remedial alternatives to address any unacceptable risks.*	
2. Identify the Decision	Do COIs in groundwater or NAPL at the Site pose an unacceptable risk through inhalation of vapors from groundwater?	Have COIs in groundwater NAPL migrated downgradient of the Site to pose an acceptable risk through ingestion of groundwater?
3. Identify inputs to the decision	• Evaluate existing Site groundwater data. • Collect groundwater samples from and evaluate presence of NAPL in temporary well points and permanent wells on Site. • Develop estimates of hydraulic conductivity and saturated thickness measurements at well locations. • Use water level data from the existing monitoring well locations and RI monitoring wells to prepare a potentiometric map (groundwater flow direction and hydraulic gradient). • Evaluate stratigraphic data for NAPL migration. • Measure COIs in groundwater samples collected. • Validate analytical data. • QA/QC samples: Collect 1 field duplicate and 1 MS/MSD sample per 20 samples for COI analyses. • Analytical method detection limit targets for groundwater are provided in Appendix B.	<u>Physical completeness of exposure pathway</u> • Evaluate status of domestic/residential/public supply wells entered into governmental water well databases and perform field survey in Site vicinity. • Review area zoning restrictions for private wells (i.e., water provided by city). <u>Presence of COIs in groundwater at concentrations that pose potential risk</u> • Collect groundwater samples from and evaluate presence of NAPL in temporary well points and permanent wells on Site. • Develop estimates of hydraulic conductivity and saturated thickness measurements at well locations. • Use water level data from the existing monitoring well locations and RI monitoring wells to prepare a potentiometric map (groundwater flow direction and hydraulic gradient). • Evaluate stratigraphic data for NAPL migration. • Evaluate classification of groundwater beneath and downgradient of the Site • Measure COIs in groundwater samples collected. • Validate analytical data. • QA/QC samples: Collect 1 field duplicate and 1 MS/MSD sample per 20 samples for COI analyses. • Analytical method detection limit targets for groundwater are provided in Appendix B.

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TABLE 2 – GROUNDWATER DATA QUALITY OBJECTIVES

Conceptual Site Model Exposure Route[1]	Inhalation of vapors that have migrated from groundwater through the soil pore space and into ambient air.	Exposure to potable water through ingestion, dermal contact, ingestion of crops that were irrigated with water, and inhalation of vapors emitted from water as a result of COI leaching to groundwater.
4. Define boundaries of the study	• The horizontal boundaries are the lateral extents of contamination as determined by the PSV comparisons described in the RI/FS Work Plan. • The vertical boundary for groundwater is the base of the uppermost water-bearing unit in which COI concentrations are reported above PSVs. • The temporal boundary is the initial RI sampling to occur in 2006 and 2007.	• The horizontal boundaries are the lateral extents of contamination as determined by the PSV comparisons described in the RI/FS Work Plan. • The vertical boundary for groundwater is the base of the uppermost water-bearing unit in which COI concentrations are reported above PSVs. • The temporal boundary is the initial RI sampling to occur in 2006 and 2007.
5. Develop a decision rule	If COIs exceed the PSVs for inhalation from groundwater through soil, then those COI groundwater data will be quantitatively evaluated in the BHHRA.	If COIs exceed the PSVs for groundwater at the property boundary, or if NAPL is present, then additional off-site delineation will be necessary.
6. Specify limits on decision errors	Precision criteria for use of measurement data are defined in Section 2.4.2 and Appendix B for groundwater.	Precision criteria for use of measurement data are defined in Section 2.4.2 and Appendix B for groundwater.
7. Optimize design for obtaining data	The number of samples for the RI/FS investigation has been selected to provide a dataset size that is adequate for meaningful analysis. The sampling design is expected to provide adequate characterization of the media. However, additional sampling may be needed based on the results of the initial RI sampling event.	The number of samples for the RI/FS investigation has been selected to provide a dataset size that is adequate for meaningful analysis. The sampling design is expected to provide adequate characterization of the media. However, additional sampling may be needed based on the results of the initial RI sampling event.

Notes:
1. See Figures 7 – 10 of RI/FS Work Plan for more detailed descriptions of exposure routes.

TABLE 3 - SURFACE WATER DATA QUALITY OBJECTIVES

Conceptual Site Model Exposure Route[1]	**Exposure via contact with surface water, and inhalation of vapors emitted from surface water as a result of surface runoff of COIs from PSAs.**	**Exposure via contact with surface water, and inhalation of vapors emitted from surface water as a result of COI leaching to groundwater, groundwater discharge to surface water.**
1. State the problem	*Conduct a site investigation to evaluate the lateral extent of COIs in surface water in the wetlands in the North Area, in ponds on the Site, and in the Intracoastal Waterway to evaluate potential risks posed by releases of chemicals associated with the Site, and develop remedial alternatives to address any unacceptable risks.*	
2. Identify the Decision	• Do COIs in wetland, pond, and Intracoastal Waterway surface water pose an unacceptable risk to potential receptors?	• Do COIs in wetland, pond, and Intracoastal Waterway surface water pose an unacceptable risk to potential receptors?
3. Identify inputs to the decision	• Evaluate existing Site surface water data. • Collect surface water samples as described in the RI/FS Work Plan and Field Sampling Plan. • Measure COIs in surface water samples collected. • Validate analytical data. • QA/QC samples: Collect 1 field duplicate and 1 MS/MSD sample per 20 samples for COI analyses. • Analytical method detection limit targets for surface water are provided in Appendix C.	• Evaluate existing Site surface water data. • Collect surface water samples as described in the RI/FS Work Plan and Field Sampling Plan. • Measure COIs in surface water samples collected. • Validate analytical data. • QA/QC samples: Collect 1 field duplicate and 1 MS/MSD sample per 20 samples for COI analyses. • Analytical method detection limit targets for surface water are provided in Appendix C.
4. Define boundaries of the study	• The horizontal boundaries are the lateral extents of contamination as determined by the PSV comparisons described in the RI/FS Work Plan. • The vertical boundary for surface water samples is the bottom depth of the water body. • The temporal boundary is the initial RI sampling to occur in 2006 and 2007.	• The horizontal boundaries are the lateral extents of contamination as determined by the PSV comparisons described in the RI/FS Work Plan. • The vertical boundary for surface water samples is the bottom depth of the water body. • The temporal boundary is the initial RI sampling to occur in 2006 and 2007.

TABLE 3 - SURFACE WATER DATA QUALITY OBJECTIVES

Conceptual Site Model Exposure Route[1]	**Exposure via contact with surface water, and inhalation of vapors emitted from surface water as a result of surface runoff of COIs from PSAs.**	**Exposure via contact with surface water, and inhalation of vapors emitted from surface water as a result of COI leaching to groundwater, groundwater discharge to surface water.**
5. Develop a decision rule	• If COIs exceed the PSVs for surface water, then those COI surface water data will be quantitatively evaluated in the BHHRA. Additional delineation may be necessary.	• If COIs exceed the PSVs for surface water, then those COI surface water data will quantitatively evaluated in the BHHRA. Additional delineation may be necessary.
6. Specify limits on decision errors	Precision criteria for use of measurement data are defined in Section 2.4.2 and Appendix C for surface water.	Precision criteria for use of measurement data are defined in Section 2.4.2 and Appendix C for surface water.
7. Optimize design for obtaining data	The number of surface water samples has been selected to provide a dataset that is adequate for meaningful analysis. The sampling design is expected to provide adequate characterization of the media. However, additional sampling may be needed based on the results of the initial RI sampling event.	The number of surface water samples has been selected to provide a dataset that is adequate for meaningful analysis. The sampling design is expected to provide adequate characterization of the media. However, additional sampling may be needed based on the results of the initial RI sampling event.

Notes:
1. See Figures 7 - 10 of RI/FS Work Plan for more detailed descriptions of exposure routes.

TABLE 4 - FISH TISSUE DATA QUALITY OBJECTIVES

Conceptual Site Model Exposure Route[1]	**Ingestion of finfish and crabs from the Intracoastal Waterway near the Site.**
1. State the problem	*Conduct a site investigation to evaluate if commonly consumed species of finfish and crabs in the vicinity of the Site have been impacted by COIs at the Site such that they pose an unacceptable risk to potential receptors through consumption.*
2. Identify the Decision	Do COIs present in sediments as a result of Site operations pose an unacceptable risk to potential receptors?
3. Identify inputs to the decision	• Collect nine samples from three finfish species (legal size limit) commonly caught in the area and consumed; and nine samples from blue crabs caught in the vicinity of the Site. • Measure COIs in fish tissue samples collected (COIs, excluding essential nutrients, detected above sample quantitation limits (SQLs) and background in the sediment samples will determine the list of COIs to be analyzed in fish tissue samples). • Validate the analytical data. • If warranted, analyze background fish tissue samples for selected COIs reported in Site fish tissue samples. • QA/QC samples: Collect 1 field duplicate and 1 MS/MSD sample per species for COI analyses. • Analytical method detection limit targets will be identified following Intracoastal Waterway sediment sampling.
4. Define boundaries of the study	• The horizontal boundaries are the Site property boundaries (east and west) as extended to the adjacent Intracoastal Waterway. Background samples will be collected from a designated area approximately 1.5 miles east of the Site. • No vertical boundaries – fish may be sampled from any depth. . • The temporal boundary is the initial RI sampling to occur in 2007.
5. Develop a decision rule	If COIs are detected in fish tissue, then those data will be quantitatively evaluated in the BHHRA.
6. Specify limits on decision errors	Precision criteria for use of measurement data are defined in Section 2.4.2. Specific limits will be established following the Intracoastal Waterway sediment sampling results.
7. Optimize design for obtaining data	A single species of red drum, spotted seatrout, and southern flounder (within the legal size limits) will provide a sufficient quantity for analyses. Edible tissue from five adult blue crabs will need to be collected for sufficient sample quantity.

Notes:
1. See Figures 7 – 10 of RI/FS Work Plan for more detailed descriptions of exposure routes.

TABLE 5 - GEOTECHNICAL DATA QUALITY OBJECTIVES

Conceptual Site Model Exposure Route[1]	**Inhalation of volatile organic compounds (VOCs) volatilized to air from residual wastes in former surface impoundments.**
1. State the problem	*Assess the construction and current condition of the cap/cover at the former surface impoundments.*
2. Identify the Decision	• Is the cap/cover construction and current condition adequate to sufficiently restrict the movement of volatile organic compounds (VOCs) from travel through the cap/cover to outdoor air?
3. Identify inputs to the decision	• Collect samples of the cap material (four soil borings) to 5 feet below ground surface or until the base of the cap material is encountered in the borings. • Perform geotechnical tests (percent passing No. 200 sieve, Atterburg Limits, vertical hydraulic conductivity) on the samples collected. • Collect and document field observations of desiccation cracks, erosion features, and overall surface conditions.
4. Define boundaries of the study	• The horizontal boundaries are the extents of the former impoundment cap/cover • The vertical boundary for surface soil is 5 feet below ground surface, or to the base of the cap/cover material. • The temporal boundary is the initial RI sampling to be conducted in 2006 and 2007.
5. Develop a decision rule	If the existing cap/cover construction and/or condition is judged to be insufficient based on geotechnical data and field inspection, then a more detailed evaluation of potential volatilization of VOCs through the cap may be necessary.
6. Specify limits on decision errors	Precision criteria for use of measurement data are defined in Section 2.4.2 and Appendix A for soil.
7. Optimize design for obtaining data	Four soil borings, in addition to a field inspection of the cap/cover, will provide sufficient data to characterize the former impoundment cap/cover.

Notes:
1. See Figures 7 - 10 of RI/FS Work Plan for more detailed descriptions of exposure routes.

TABLE 6 – PROJECT OBJECTIVES SUMMARY

Media	Chemicals of Interest (COI)	Location	Objective
Soil	VOC, SVOC, Pesticides, PCB, Metals	• Potential Source Areas (PSA) – Former AST Tank Farm, Pipelines, Former Surface Impoundment Area, Former Wash Water Storage Tank Area, Sand Blasting Areas, Welding Area, Dry Dock Area, Surface Drainage Areas, Former Septic Tank Areas, Former Product Storage Tank Area, Former Gasoline Storage Tank Area	• Nature and extent of contamination • Quantitative risk assessment - human health and ecological
Soil	PCB	• PSA - Former Electrical Shed	• Nature and extent of contamination • Quantitative risk assessment - human health and ecological
Soil	Metals	• PSA - Lot 21 Area (top 1-inch) • Lots 19 and 20 west of Site (top 1-inch) • Residential Properties west of Snapper Lane (top 1-inch)	• Nature and extent of contamination • Quantitative risk assessment - human health
Soil	VOC, SVOC, Pesticides, PCB, Metals	• Site-wide grid sampling[1]	• Nature and extent of contamination • Quantitative risk assessment - human health and ecological
Sediment	VOC, SVOC, Pesticides, PCB, Metals	• Wetlands Area • On-site Ponds • Intracoastal Waterway	• Nature and extent of contamination • Quantitative risk assessment - human health and ecological
Sediment	VOC, SVOC, Pesticides, PCB, Metals	• Site-wide grid sampling	• Investigate possibility of additional Potential Source Areas • Nature and extent of contamination • Quantitative risk assessment - human health and ecological
Ground-water	VOC, SVOC, Pesticides, PCB, Metals	• PSAs - Former AST Tank Farm, Pipelines, Former Surface Impoundment Area, Former Wash Water Storage Tank Area, Sand Blasting Areas, Dry Dock Area, Surface Drainage Areas, Former Septic Tank Areas, Former Product Storage Tank Area, Lot 21 Area • Site Perimeter • Wetlands Area	• Nature and extent of contamination • Quantitative risk assessment - human health

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TABLE 6 – PROJECT OBJECTIVES SUMMARY

Media	Chemicals of Interest (COI)	Location	Objective
Surface Water	VOC, SVOC, Pesticides, PCB, Metals	• On-Site Ponds • Wetlands Area • Intracoastal Waterway	• Quantitative risk assessment - human health and ecological
Fish Tissue	To be determined based on Sediment data.	• Intracoastal Waterway	• Quantitative risk assessment - human health
NAPL	VOC, SVOC, Pesticides	Locations where NAPL is found (if any)	• Quantitative risk assessment - human health and ecological

Notes:

1. Sediment samples will be collected from areas that are considered wetlands and soil samples from other areas.

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TABLE 7 - DOCUMENT AND RECORD RETENTION

Record	Type	Retention Period	Archival Location	Disposition
Field Records – field data sheets, field notebooks, Chains-of -Custody, etc.	Paper	Until 10 years following commencement of construction of any remedial action which is selected following completion of the RI/FS.	In Pastor, Behling & Wheeler, LLC (PBW) files.	After retention period, Respondents will notify EPA at least 90 days before documents are scheduled to be destroyed. If EPA requests that documents be saved, Respondents will give documents or copies of documents to EPA per Section XX, Paragraph 79 of the modified Unilateral Administrative Order (UAO).
Laboratory records – sample receipt and storage logs, COCs, sample preparation records, instrument performance records, raw data files, etc.	Paper, Electronic	Until 10 years following commencement of construction of any remedial action which is selected following completion of the RI/FS.	In laboratory files during duration of project; to PBW files for remainder of retention period	After retention period, Respondents will notify EPA at least 90 days before documents are scheduled to be destroyed. If EPA requests that documents be saved, Respondents will give documents or copies of documents to EPA per the modified UAO.

TABLE 8 - ASSESSMENTS AND RESPONSE ACTIONS

Assessment Activity	Approximate Schedule	Responsible Party	Scope	Response Requirements
Status Monitoring, Oversight, etc.	Continuous	Respondents' Project Coordinator	Monitoring of the project status and records to ensure requirements are being fulfilled.	Report to Respondents. Ensure project requirements are being fulfilled.
Monitoring Systems Audits	Daily during field sampling activities	Field Supervisor	Field sampling, handling and measurement; and data management as they relate to this project.	Immediate response to RI Manager to address corrective actions.
Laboratory Monitoring	Following data reporting	Quality Assurance Manager	Record keeping, sample handling and data reporting	Response in writing to Respondents' Project Coordinator to address corrective actions.

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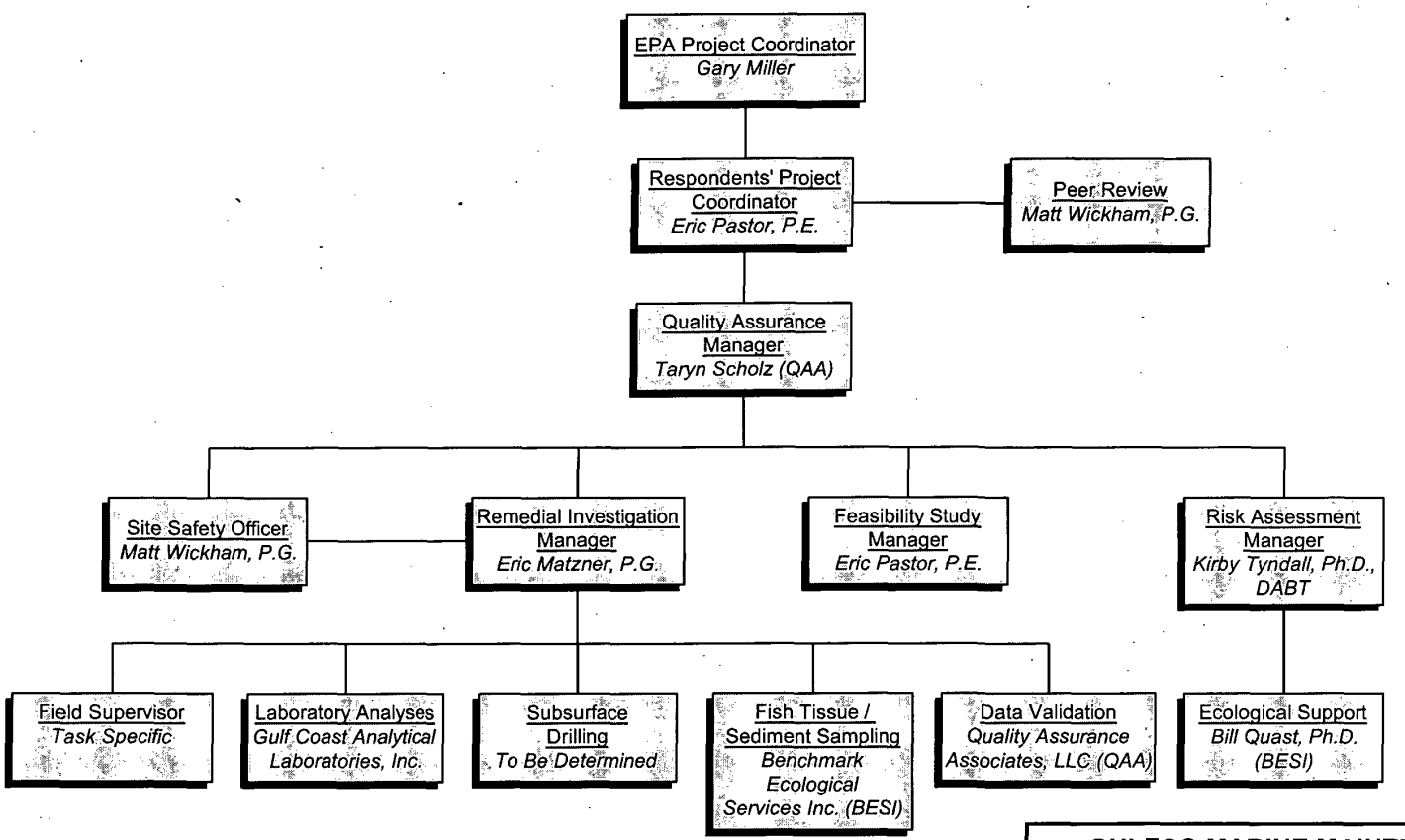
FIGURES



GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 1

PROJECT ORGANIZATION

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

APPENDIX A

QA/QC INFORMATION – SOIL

TABLE A-1 - PARAMETERS AND METHOD SPECIFICATIONS

MEDIA: SOIL

Intended Use: Investigate possibility of additional Potential Source Areas
Nature and extent of contamination
Quantitative risk assessment - human health and ecological

QC Level: Level III with Level IV for 10% of the sample sets (selected by RI Manager with consideration given to sample results, location and matrix)

Laboratory Parameters	Sampling SOP	Measurement Technique	Preparation Method	Analysis Method
Chemical Analyses				
Metals	PBW-SOP-5	ICP-AES	SW846 3050B	SW846 6010B
Chromium VI	PBW-SOP-5	Colorimetric	SW846 3060A	SW846 7196A
Mercury	PBW-SOP-5	Cold Vapor AA	SW846 7471A	SW846 7471A
Organochlorine Pesticides	PBW-SOP-5	GC	SW846 3550B cleanup (e.g., 3620B) as needed	SW846 8081A
PCBs	PBW-SOP-5	GC	SW846 3550B cleanup (e.g., 3665A) as needed	SW846 8082
VOCs	PBW-SOP-5	GC/MS	SW846 5035	SW846 8260B
SVOCs	PBW-SOP-5	GC/MS	SW846 3550B cleanup (e.g., 3640A) as needed	SW846 8270C
Moisture Content	PBW-SOP-5	Gravimetric	NA	SM 2540G
Total Organic Carbon	PBW-SOP-5	NA	NA	SW846 415.1/9060
Soil Bulk Density	PBW-SOP-5	NA	NA	ASTM D2937
pH	PBW-SOP-5	NA	NA	SW-846 9045
Geotechnical Analyses[1]				
Percent Passing No. 200 Sieve Analysis	PBW-SOP-5	NA	NA	ASTM D1140
Atterburg Limits	PBW-SOP-5	NA	NA	ASTM 4318
Vertical Hydraulic Conductivity	PBW-SOP-5	NA	NA	COE EM-1110-2-1906

NOTES:
1. Analyses only performed on Former Impoundment Cap samples.

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TABLE A-2 - SAMPLE CONTAINER, PRESERVATION AND HOLDING TIME REQUIREMENTS

MEDIA: SOIL

Laboratory Parameters	Container	Preservation	Holding Time
Chemical Analyses			
Metals	P, G	Cool to 4 C	6 months
Chromium VI	P, G	Cool to 4 C	30 days (preparation) 4 days (analysis)
Mercury	P, G	Cool to 4 C	28 days
Organochlorine Pesticides	G-TLC	Cool to 4 C	14 days (preparation) 40 days (analysis)
PCBs	G-TLC	Cool to 4 C	14 days (preparation) 40 days (analysis)
VOCs[1]	G-TLS or G-TLC	Cool to 4 C	14 days
SVOCs	G-TLC	Cool to 4 C	14 days (preparation) 40 days (analysis)
Moisture Content	P, G	Cool to 4 C	NA
Total Organic Carbon	G-TLC	Cool to 4 C	28 days
Soil Bulk Density	P, G	Cool to 4 C	NA
pH	P, G	Cool to 4 C	Immediately upon receipt

P – Polyethylene G – Glass TLC – Teflon®-lined cap TLS – Teflon®-lined septum

Notes:
1. Samples shall not contain headspace. Solid samples collected in EnCore samplers must be transferred to a soil sample vial within 48 hours.

TABLE A-3 - FIELD QUALITY CONTROL SAMPLE REQUIREMENTS

MEDIA: SOIL

Laboratory Parameters	Trip Blanks	Equipment/ Field Blanks	Field Duplicates[1]	Matrix Spikes/ Matrix Spike Duplicates[1]
Metals	NA	1 per day	1 per 20 samples	1 per 20 samples[2]
Chromium VI	NA	1 per day	1 per 20 samples	1 per 20 samples[2]
Mercury	NA	1 per day	1 per 20 samples	1 per 20 samples[2]
Organochlorine Pesticides	NA	1 per day	1 per 20 samples	1 per 20 samples
PCBs	NA	1 per day	1 per 20 samples	1 per 20 samples
VOCs	1 per cooler	1 per day	1 per 20 samples	1 per 20 samples
SVOCs	NA	1 per day	1 per 20 samples	1 per 20 samples

Notes:
1. Frequency is one per twenty samples or one per day, whichever is greater.
2. An analytical duplicate (i.e., unspiked) may be substituted for the matrix spike duplicate.

TABLE A-4 - QUALITY CONTROL OBJECTIVES
MEDIA: SOIL

Analyte	Method[1]	Target MDL[2] (mg/Kg)	Target MQL[3] (mg/Kg)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Total Moisture	Std Methods 2540 G	0.01	0.01	NA	NA	NA	NA	NA	30	NA	NA	NA
Chloride	9251	3.3	10	NA	NA	70-130	<MQL	70-130	30	NA	NA	NA
Sulfate	9038	17	50	NA	NA	70-130	<MQL	70-130	30	NA	NA	NA
Chromium (VI)	7196A	0.67	2	NA	NA	70-130	<MQL	70-130	30	50	NA	NA
ICP metals												
Aluminum	6010B	2.7	8	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Antimony	6010B	0.33	2.4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Arsenic	6010B	0.53	1.6	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Barium	6010B	0.33	1	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Beryllium	6010B	0.07	0.2	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Boron	6010B	1.1	4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Cadmium	6010B	0.07	0.2	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Cobalt	6010B	0.13	0.4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Copper	6010B	0.13	0.4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Iron	6010B	1.3	4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Lead	6010B	0.2	0.6	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Lithium	6010B	0.67	2	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Manganese	6010B	0.2	0.6	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Nickel	6010B	0.53	1.6	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Selenium	6010B	0.44	1.6	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Silver	6010B	0.13	0.4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Thallium	6010B	0.27	0.8	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Titanium	6010B	1.3	4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Zinc	6010B	0.27	0.8	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Mercury	7471A	0.007	0.02	NA	0.995	80-120	<MQL	70-130	30	50	NA	NA
Organochlorine Pesticides												
4,4'-DDD	8081A	0.0008	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
4,4'-DDE	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
4,4'-DDT	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aldrin	8081A	0.0007	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
alpha-BHC	8081A	0.0007	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
alpha-Chlordane	8081A	0.0007	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
beta-BHC	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA

TABLE A-4 - QUALITY CONTROL OBJECTIVES
MEDIA: SOIL

Analyte	Method[1]	Target MDL[2] (mg/Kg)	Target MQL[3] (mg/Kg)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
delta-BHC	8081A	0.0007	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Dieldrin	8081A	0.0005	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Endosulfan I	8081A	0.0007	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Endosulfan II	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Endosulfan sulfate	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Endrin	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Endrin aldehyde	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Endrin ketone	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
gamma-BHC (Lindane)	8081A	0.001	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
gamma-Chlordane	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Heptachlor	8081A	0.0007	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Heptachlor epoxide	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Methoxychlor	8081A	0.0067	0.02	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Toxaphene	8081A	0.0667	0.2	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Polychlorinated Biphenyls												
Aroclor-1016	8082	0.0233	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aroclor-1221	8082	0.0233	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aroclor-1232	8082	0.0233	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aroclor-1242	8082	0.0233	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aroclor-1248	8082	0.0233	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aroclor-1254	8082	0.0233	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aroclor-1260	8082	0.0233	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Individual Congeners	8082	0.0066	0.0066	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Volatile Organics												
1,1,1,2-Tetrachloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,1,1-Trichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,1,2,2-Tetrachloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,1,2-Trichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,1-Dichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,1-Dichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,1-Dichloropropene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2,3-Trichloropropane	8260B	0.0007	0.002	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2,4-Trichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

TABLE A-4 - QUALITY CONTROL OBJECTIVES
MEDIA: SOIL

Analyte	Method[1]	Target MDL[2] (mg/Kg)	Target MQL[3] (mg/Kg)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
1,2,4-Trimethylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2-Dibromo-3-chloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2-Dibromoethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2-Dichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2-Dichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2-Dichloroethene (Total)	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2-Dichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,3,5-Trimethylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,3-Dichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,3-Dichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,4-Dichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,2-Dichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Butanone	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Chloroethylvinyl ether	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Chlorotoluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Hexanone	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Chlorotoluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Isopropyltoluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Methyl-2-pentanone	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Acetone	8260B	0.0083	0.025	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Acrolein	8260B	0.0083	0.025	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Acrylonitrile	8260B	0.0083	0.025	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bromobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bromodichloromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bromoform	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bromomethane	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Butanol	8260B	0.0083	0.025	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Carbon disulfide	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Carbon tetrachloride	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Chlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Chloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Chloroform	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Chloromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

TABLE A-4 - QUALITY CONTROL OBJECTIVES
MEDIA: SOIL

Analyte	Method[1]	Target MDL[2] (mg/Kg)	Target MQL[3] (mg/Kg)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
cis-1,2-Dichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
cis-1,3-Dichloropropene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Dibromochloromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Dibromomethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Dichlorodifluoro-methane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Ethylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Hexachlorobutadiene	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Isopropylbenzene (Cumene)	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Methyl Acetate	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Methyl iodide	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Methylcyclohexane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Methylene chloride	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
n-Butylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
n-Propylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
o-Xylene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
sec-Butylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Styrene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
tert-Butyl methyl ether (MTBE)	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
tert-Butylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Tetrachloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Toluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
trans-1,2-Dichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
trans-1,3-Dichloropropene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
trans-1,4-Dichloro-2-butene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Trichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Trichlorofluoromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Trichlorotrifluoroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Vinyl acetate	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Vinyl chloride	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Xylene (total)	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

TABLE A-4 - QUALITY CONTROL OBJECTIVES
MEDIA: SOIL

Analyte	Method[1]	Target MDL[2] (mg/Kg)	Target MQL[3] (mg/Kg)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
SEMIVOLATILE ORGANICS												
1,2Diphenylhydrazine/ Azobenzene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,4,5-Trichlorophenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,4,6-Trichlorophenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,4-Dichlorophenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,4-Dimethylphenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,4-Dinitrophenol	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,4-Dinitrotoluene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,6-Dinitrotoluene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Chloronaphthalene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Chlorophenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Methylnaphthalene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Nitroaniline	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Nitrophenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
3,3'-Dichlorobenzidine	8270C	0.22	0.66	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
3-Nitroaniline	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4,6-Dinitro-2-methylphenol	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Bromophenyl phenyl ether	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Chloro-3-methylphenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Chloroaniline	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Chlorophenyl phenyl ether	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Nitroaniline	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Nitrophenol	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Acenaphthene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Acenaphthylene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Acetophenone	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Aniline	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Anthracene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Atrazine (Aatrex)	8270C	0.22	0.66	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzaldehyde	8270C	0.22	0.66	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

TABLE A-4 - QUALITY CONTROL OBJECTIVES
MEDIA: SOIL

Analyte	Method[1]	Target MDL[2] (mg/Kg)	Target MQL[3] (mg/Kg)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Benzidine	8270C	0.067	1.32	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzo(a)anthracene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzo(a)pyrene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzo(b)fluoranthene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzo(g,h,i)perylene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzo(k)fluoranthene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzoic acid	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzyl alcohol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Biphenyl	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bis(2-Chloroethoxy)methane	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bis(2-Chloroethyl)ether	8270C	0.105	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bis(2-Chloroisopropyl)ether	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bis(2-Ethylhexyl)phthalate	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Butyl benzyl phthalate	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Caprolactam	8270C	0.22	0.66	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Carbazole	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Chrysene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Dibenz(a,h)anthracene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Dibenzofuran	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Diethyl phthalate	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Dimethyl phthalate	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Di-n-butyl phthalate	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Di-n-octyl phthalate	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Fluoranthene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Fluorene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Hexachlorobenzene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Hexachlorocyclo-pentadiene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Hexachloroethane	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Indeno(1,2,3-cd)pyrene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Isophorone	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Nitrobenzene	8270C	0.019	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
n-Nitrosodimethylamine	8270C	0.065	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

TABLE A-4 - QUALITY CONTROL OBJECTIVES
MEDIA: SOIL

Analyte	Method[1]	Target MDL[2] (mg/Kg)	Target MQL[3] (mg/Kg)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
n-Nitrosodi-n-propylamine	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
n-Nitrosodiphenylamine	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
o-Cresol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Phenanthrene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Phenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Pyrene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Pyridine	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

Notes:

1. Unless otherwise indicated, analytical methods are from EPA SW-846 "Test Methods for Evaluating Solid Waste."
2. Method Detection Limits are determined by the laboratory using the procedures in 40 CFR Part 136, Appendix B. The MDL listed here is the maximum method detection limit that will support the project performance objectives. Sample Detection Limits (which are adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and take into account sample characteristics, sample preparation, sample cleanup, and analytical adjustments including dry-weight adjustments) will be higher.
3. Method Quantitation Limits correspond to the lowest non-zero concentration standard in the laboratory's initial calibration curve calculated using the normal aliquot sizes and final volumes prescribed in the analytical method. The MQL listed here is based on typical laboratory performance. Sample Quantitation Limits (which are adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and take into account sample characteristics, sample preparation, sample cleanup, and analytical adjustments including dry-weight adjustments) will be higher.
4. Per the analytical methods for organics, the %RSD for an individual analyte may exceed the criteria as long as the mean %RSD for all calibrated analytes is within the criteria. For data qualification purposes, the %RSD criteria will be applied to each individual analyte and the data flagged accordingly. For GC/MS analyses, the analytical method also includes criteria for the Relative Response Factor (RRF) for a subset of the calibrated analytes. For data qualification purposes, a minimum RRF criteria of 0.05 will be applied to each individual analyte and the data flagged accordingly.
5. Per the analytical methods for organics, the CCV response for an individual analyte may be outside the criteria as long as the mean CCV response for all calibrated analytes is within the criteria. For data qualification purposes, the CCV criteria will be applied to each individual analyte and the data flagged accordingly. For inorganics, the same limits apply for the ICV.
6. Criteria apply for all blank types including method blanks, calibration blanks, equipment blanks, and trip blanks. For data qualification purposes, blank concentrations for all positively identified analytes (i.e., above the detection limit) will be assessed and the data flagged accordingly. However, laboratory corrective action is instituted only for concentrations above the quantitation limit.
7. Criteria are for data qualification purposes. The laboratory shall monitor performance and institute routine corrective action using the laboratory-established limits but the lower limit shall not be below 10% for organics and 30% for inorganics.
8. Expressed as percent of area for internal standard in midpoint calibration standard.

APPENDIX B

QA/QC INFORMATION – GROUNDWATER

TABLE B-1 - PARAMETERS AND METHOD SPECIFICATIONS

MEDIA: GROUNDWATER

Intended Use: Nature and extent of contamination
Quantitative risk assessment - human health and ecological

QC Level: 100% Level III

Laboratory Parameters	Sampling SOP	Measurement Technique	Preparation Method	Analysis Method
Chemical Analyses				
Hardness	PBW-SOP-10	By Calculation	NA	SM 2340B
Total Dissolved Solids	PBW-SOP-10	Gravimetric	NA	EPA 160.1
Total Suspended Solids	PBW-SOP-10	Gravimetric	NA	EPA 160.2
Total Organic Carbon	PBW-SOP-10	Carbonaceous Analyzer	NA	SW-846 9060
Chloride	PBW-SOP-10	Colorimetric	NA	SW-846 9251
Sulfate	PBW-SOP-10	Turbidimetric	NA	SW-846 9038
Major Anions (Ca, Mg, K, Na)	PBW-SOP-10	ICP-AES	SW846 3010A	SW846 6010B
Chromium VI	PBW-SOP-10	Colorimetric	NA	SW846 7196A
Metals	PBW-SOP-10	ICP-AES	SW846 3010A	SW846 6010B
Mercury	PBW-SOP-10	Cold Vapor AA	SW846 7470A	SW846 7470A
Organochlorine Pesticides	PBW-SOP-10	GC	SW846 3510C	SW846 8081A
PCBs	PBW-SOP-10	GC	SW846 3510C	SW846 8082
VOCs	PBW-SOP-10	GC/MS	SW846 5030B	SW846 8260B
SVOCs	PBW-SOP-10	GC/MS	SW846 3510C	SW846 8270C
NAPL Analyses				
Specific Gravity	PBW-SOP-10	gravimetric	NA	SM 2710F
Organochlorine Pesticides	PBW-SOP-10	GC	NA	SW846 8081A
VOCs	PBW-SOP-10	GC/MS	NA	SW846 8260B
SVOCs	PBW-SOP-10	GC/MS	NA	SW846 8270C

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TABLE B-2 - SAMPLE CONTAINER, PRESERVATION AND HOLDING TIME REQUIREMENTS

MEDIA: GROUNDWATER

Laboratory Parameters	Container	Preservation	Holding Time
Hardness	P, G	HNO3 to pH < 2	6 months
Total Dissolved Solids	P, G	Cool to 4 C	7 days
Total Suspended SolidS	P, G	Cool to 4 C	7 days
Total Organic Carbon	P, G	HCl to pH < 2[1] Cool to 4 C	28 days
Chloride	P, G	Cool to 4 C	28 days
Sulfate	P, G	Cool to 4 C	28 days
Major Anions (Ca, Mg, K, Na)	P, G	HNO3 to pH < 2	6 months
Chromium VI	P, G	Cool to 4 C	24 hours
Metals	P, G	HNO3 to pH < 2	6 months
Mercury	P, G	HNO3 to pH < 2	28 days
Organochlorine Pesticides	G-TLC (Amber)	Cool to 4 C	7 days (preparation) 40 days (analysis)
PCBs	G-TLC (Amber)	Cool to 4 C	7 days (preparation) 40 days (analysis)
VOCs[2]	G-TLS	HCl to pH < 2[1] Cool to 4 C	14 days
SVOCs	G-TLC (Amber)	Cool to 4 C	7 days (preparation) 40 days (analysis)

P – Polyethylene G – Glass TLC – Teflon®-lined cap TLS – Teflon®-lined septum

Notes:
1. H_2SO_4 or solid $NaHSO_4$ are also acceptable preservatives.
2. Samples shall not contain headspace or air bubbles.

TABLE B-3 - FIELD QUALITY CONTROL SAMPLE REQUIREMENTS

MEDIA: GROUNDWATER

Laboratory Parameters	Trip Blanks	Equipment/ Field Blanks	Field Duplicates(1)	Matrix Spikes/ Matrix Spike Duplicates(1)
Chromium VI	NA	1 per day	1 per 20 samples	1 per 20 samples(2)
Metals	NA	1 per day	1 per 20 samples	1 per 20 samples(2)
Mercury	NA	1 per day	1 per 20 samples	1 per 20 samples(2)
Organochlorine Pesticides	NA	1 per day	1 per 20 samples	1 per 20 samples
PCBs	NA	1 per day	1 per 20 samples	1 per 20 samples
VOCs	1 per cooler	1 per day	1 per 20 samples	1 per 20 samples
SVOCs	NA	1 per day	1 per 20 samples	1 per 20 samples

Notes:
1. Frequency is one per twenty samples or one per day, whichever is greater.
2. An analytical duplicate (i.e., unspiked) may be substituted for the matrix spike duplicate.

TABLE B-4 - QUALITY CONTROL OBJECTIVES

MEDIA: GROUNDWATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Hardness	Std Methods 2340B	0.23	0.66	NA	NA	70-130	<MQL	70-130	30	NA	NA	NA
Total Dissolved Solids (TDS)	EPA 160.1	10	10	NA	NA	NA	<MQL	NA	30	NA	NA	NA
Total Suspended Solids	EPA 160.2	1	1	NA	NA	NA	<MQL	NA	30	NA	NA	NA
Total Organic Carbon	9060	1	1	NA	NA	70-130	<MQL	70-130	30	NA	NA	NA
Chloride	9251	0.333	1	NA	NA	70-130	<MQL	70-130	30	NA	NA	NA
Sulfate	9038	1.67	5	NA	NA	70-130	<MQL	70-130	30	NA	NA	NA
Chromium (VI)	7196A	0.008	0.02	NA	NA	70-130	<MQL	70-130	30	40	NA	NA
ICP Metals												
Aluminum	6010B	0.067	0.2	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Antimony	6010B	0.006	0.06	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Arsenic	6010B	0.01	0.04	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Barium	6010B	0.003	0.01	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Beryllium	6010B	0.002	0.005	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Boron	6010B	0.333	1	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Cadmium	6010B	0.002	0.005	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Cobalt	6010B	0.003	0.01	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Copper	6010B	0.002	0.01	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Iron	6010B	0.033	0.1	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Lead	6010B	0.003	0.015	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Lithium	6010B	0.017	0.05	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Manganese	6010B	0.005	0.015	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Nickel	6010B	0.002	0.04	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Selenium	6010B	0.013	0.04	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Silver	6010B	0.002	0.01	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Thallium	6010B	0.0029	0.02	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Titanium	6010B	0.033	0.1	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Zinc	6010B	0.007	0.02	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
MERCURY	7470A	0.0002	0.0004	NA	0.995	80-120	<MQL	70-130	30	40	NA	NA
Organochlorine Pesticides												
4,4'-DDD	8081A	0.000025	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
4,4'-DDE	8081A	0.00003	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
4,4'-DDT	8081A	0.000018	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aldrin	8081A	0.00002	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA

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MEDIA: GROUNDWATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
alpha-BHC	8081A	0.00002	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
alpha-Chlordane	8081A	0.00002	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
beta-BHC	8081A	0.00002	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
delta-BHC	8081A	0.00002	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Dieldrin	8081A	0.000015	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Endosulfan I	8081A	0.000009	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Endosulfan II	8081A	0.000024	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Endosulfan sulfate	8081A	0.000009	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Endrin	8081A	0.000025	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Endrin aldehyde	8081A	0.00003	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Endrin ketone	8081A	0.00003	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
gamma-BHC (Lindane)	8081A	0.000016	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
gamma-Chlordane	8081A	0.00003	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Heptachlor	8081A	0.000014	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Heptachlor epoxide	8081A	0.000022	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Methoxychlor	8081A	0.00003	0.0005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Toxaphene	8081A	0.000825	0.005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Polychlorinated Biphenyls												
Aroclor-1016	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aroclor-1221	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aroclor-1232	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aroclor-1242	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aroclor-1248	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aroclor-1254	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aroclor-1260	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Individual Congeners	8082	0.00002	0.00002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Volatile Organics												
1,1,1,2-Tetrachloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,1,1-Trichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,1,2,2-Tetrachloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,1,2-Trichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,1-Dichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,1-Dichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,1-Dichloropropene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%

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MEDIA: GROUNDWATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
1,2,3-Trichloropropane	8260B	0.0007	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2,4-Trichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2,4-Trimethylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2-Dibromo-3-chloropropane	8260B	0.0003	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2-Dibromoethane	8260B	0.0004	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2-Dichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2-Dichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2-Dichloroethene (Total)	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2-Dichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,3,5-Trimethylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,3-Dichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,3-Dichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,4-Dichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,2-Dichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Butanone	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Chloroethylvinyl ether	8260B	0.0008	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Chlorotoluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Hexanone	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Chlorotoluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Isopropyltoluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Methyl-2-pentanone	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Acetone	8260B	0.0083	0.025	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Acrolein	8260B	0.0083	0.025	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Acrylonitrile	8260B	0.0017	0.025	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bromobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bromodichloromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bromoform	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bromomethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Butanol	8260B	0.038	0.1	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Carbon disulfide	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Carbon tetrachloride	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Chlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Chloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%

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MEDIA: GROUNDWATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Chloroform	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Chloromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
cis-1,2-Dichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
cis-1,3-Dichloropropene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Dibromochloromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Dibromomethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Dichlorodifluoro methane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Ethylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Hexachlorobutadiene	8260B	0.0004	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Isopropylbenzene (Cumene)	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Methyl Acetate	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Methyl iodide	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Methylcyclohexane	8260B	0.008	0.02	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Methylene chloride	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
n-Butylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
n-Propylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
o-Xylene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
sec-Butylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Styrene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
tert-Butyl methyl ether (MTBE)	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
tert-Butylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Tetrachloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Toluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
trans-1,2-Dichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
trans-1,3-Dichloropropene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
trans-1,4-Dichloro-2-butene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Trichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Trichlorofluoromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Trichlorotrifluoroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Vinyl acetate	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Vinyl chloride	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%

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Xylene (total)	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Semivolatile Organics												
1,2Diphenylhydrazine/ Azobenzene	8270C	0.0011	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,4,5-Trichlorophenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,4,6-Trichlorophenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,4-Dichlorophenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,4-Dimethylphenol	8270C	0.01	0.02	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,4-Dinitrophenol	8270C	0.0167	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,4-Dinitrotoluene	8270C	0.0013	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,6-Dinitrotoluene	8270C	0.0013	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Chloronaphthalene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Chlorophenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Methylnaphthalene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Nitroaniline	8270C	0.0073	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Nitrophenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
3,3'-Dichlorobenzidine	8270C	0.002	0.02	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
3-Nitroaniline	8270C	0.0073	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4,6-Dinitro-2-methylphenol	8270C	0.0167	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Bromophenyl phenyl ether	8270C	0.0006	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Chloro-3-methylphenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Chloroaniline	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Chlorophenyl phenyl ether	8270C	0.0006	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Nitroaniline	8270C	0.0167	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Nitrophenol	8270C	0.0167	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Acenaphthene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Acenaphthylene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Acetophenone	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Aniline	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Anthracene	8270C	0.0006	0.002	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Atrazine (Aatrex)	8270C	0.003	0.02	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzaldehyde	8270C	0.0067	0.02	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzidine	8270C	0.0108	0.04	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%

TABLE B-4 - QUALITY CONTROL OBJECTIVES

MEDIA: GROUNDWATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Benzo(a)anthracene	8270C	0.0013	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzo(a)pyrene	8270C	0.0002	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzo(b)fluoranthene	8270C	0.0013	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzo(g,h,i)perylene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzo(k)fluoranthene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzoic acid	8270C	0.0167	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzyl alcohol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Biphenyl	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bis(2-Chloroethoxy)methane	8270C	0.0008	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bis(2-Chloroethyl)ether	8270C	0.0008	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bis(2-Chloroisopropyl)ether	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bis(2-Ethylhexyl)phthalate	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Butyl benzyl phthalate	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Caprolactam	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Carbazole	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Chrysene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Dibenz(a,h)anthracene	8270C	0.0005	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Dibenzofuran	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Diethyl phthalate	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Dimethyl phthalate	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Di-n-butyl phthalate	8270C	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Di-n-octyl phthalate	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Fluoranthene	8270C	0.0007	0.002	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Fluorene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Hexachlorobenzene	8270C	0.001	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Hexachlorocyclo-pentadiene	8270C	0.0028	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Hexachloroethane	8270C	0.0022	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Indeno(1,2,3-cd)pyrene	8270C	0.0013	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Isophorone	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Nitrobenzene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
n-Nitrosodimethylamine	8270C	0.0018	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
n-Nitrosodi-n-propylamine	8270C	0.0004	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%

TABLE B-4 - QUALITY CONTROL OBJECTIVES

MEDIA: GROUNDWATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
n-Nitrosodiphenylamine	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
o-Cresol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Phenanthrene	8270C	0.0007	0.002	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Phenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Pyrene	8270C	0.0004	0.002	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Pyridine	8270C	0.0067	0.02	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%

Notes:

1. Unless otherwise indicated, analytical methods are from EPA SW-846 "Test Methods for Evaluating Solid Waste."
2. Method Detection Limits are determined by the laboratory using the procedures in 40 CFR Part 136, Appendix B. The MDL listed here is the maximum method detection limit that will support the project performance objectives. Sample Detection Limits (which are adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and take into account sample characteristics, sample preparation, sample cleanup, and analytical adjustments including dry-weight adjustments) will be higher.
3. Method Quantitation Limits correspond to the lowest non-zero concentration standard in the laboratory's initial calibration curve calculated using the normal aliquot sizes and final volumes prescribed in the analytical method. The MQL listed here is based on typical laboratory performance. Sample Quantitation Limits (which are adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and take into account sample characteristics, sample preparation, sample cleanup, and analytical adjustments including dry-weight adjustments) will be higher.
4. Per the analytical methods for organics, the %RSD for an individual analyte may exceed the criteria as long as the mean %RSD for all calibrated analytes is within the criteria. For data qualification purposes, the %RSD criteria will be applied to each individual analyte and the data flagged accordingly. For GC/MS analyses, the analytical method also includes criteria for the Relative Response Factor (RRF) for a subset of the calibrated analytes. For data qualification purposes, a minimum RRF criteria of 0.05 will be applied to each individual analyte and the data flagged accordingly.
5. Per the analytical methods for organics, the CCV response for an individual analyte may be outside the criteria as long as the mean CCV response for all calibrated analytes is within the criteria. For data qualification purposes, the CCV criteria will be applied to each individual analyte and the data flagged accordingly. For inorganics, the same limits apply for the ICV.
6. Criteria apply for all blank types including method blanks, calibration blanks, equipment blanks, and trip blanks. For data qualification purposes, blank concentrations for all positively identified analytes (i.e., above the detection limit) will be assessed and the data flagged accordingly. However, laboratory corrective action is instituted only for concentrations above the quantitation limit.
7. Criteria are for data qualification purposes. The laboratory shall monitor performance and institute routine corrective action using the laboratory-established limits but the lower limit shall not be below 10% for organics and 30% for inorganics.
8. Expressed as percent of area for internal standard in midpoint calibration standard.

APPENDIX C

QA/QC INFORMATION – SURFACE WATER

TABLE C-1 - PARAMETERS AND METHOD SPECIFICATIONS

MEDIA: SURFACE WATER

Intended Use: Quantitative risk assessment - human health and ecological

QC Level: Level III with Level IV for 10% of the sample sets (selected by RI Manager with consideration given to sample results, location and matrix)

Laboratory Parameters	Sampling SOP	Measurement Technique	Preparation Method	Analysis Method
Chemical Analyses				
Hardness	PBW-SOP-10 BESI-SOP-600	By Calculation	NA	SM 2340B
Total Dissolved Solids	PBW-SOP-10 BESI-SOP-600	Gravimetric	NA	EPA 160.1
Total Suspended Solids	PBW-SOP-10 BESI-SOP-600	Gravimetric	NA	EPA 160.2
Total Organic Carbon	PBW-SOP-10 BESI-SOP-600	Carbonaceous Analyzer	NA	SW-846 9060
Chloride	PBW-SOP-10 BESI-SOP-600	Colorimetric	NA	SW-846 9251
Sulfate	PBW-SOP-10 BESI-SOP-600	Turbidimetric	NA	SW-846 9038
Major Anions (Ca, Mg, K, Na)	PBW-SOP-10 BESI-SOP-600	ICP-AES	SW846 3010A	SW846 6010B
Chromium VI	PBW-SOP-10 BESI-SOP-600	Colorimetric	NA	SW846 7196A
Metals (total)	PBW-SOP-10 BESI-SOP-600	ICP-AES	SW846 3010A	SW846 6010B
Metals (dissolved)	PBW-SOP-10 BESI-SOP-600	ICP-AES	SW846 3010A	SW846 6010B
Mercury	PBW-SOP-10 BESI-SOP-600	Cold Vapor AA	SW846 7470A	SW846 7470A
Organochlorine Pesticides	PBW-SOP-10 BESI-SOP-600	GC	SW846 3510C	SW846 8081A
PCBs	PBW-SOP-10 BESI-SOP-600	GC	SW846 3510C	SW846 8082
VOCs	PBW-SOP-10 BESI-SOP-600	GC/MS	SW846 5030B	SW846 8260B
SVOCs	PBW-SOP-10 BESI-SOP-600	GC/MS	SW846 3510C	SW846 8270C

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TABLE C-2 - SAMPLE CONTAINER, PRESERVATION AND HOLDING TIME REQUIREMENTS

MEDIA: SURFACE WATER

Laboratory Parameters	Container	Preservation	Holding Time
Hardness	P, G	HNO3 to pH < 2	6 months
Total Dissolved Solids	P, G	Cool to 4 C	7 days
Total Suspended Solids	P, G	Cool to 4 C	7 days
Total Organic Carbon	P, G	HCl to pH < 2[1] Cool to 4 C	28 days
Chloride	P, G	Cool to 4 C	28 days
Sulfate	P, G	Cool to 4 C	28 days
Major Anions (Ca, Mg, K, Na)	P, G	HNO3 to pH < 2	6 months
Chromium VI	P, G	Cool to 4 C	24 hours
Metals (total)	P, G	HNO3 to pH < 2	6 months
Metals (dissolved)	P, G	Filter onsite HNO3 to pH < 2	6 months
Mercury	P, G	HNO3 to pH < 2	28 days
Organochlorine Pesticides	G-TLC (Amber)	Cool to 4 C	7 days (preparation) 40 days (analysis)
PCBs	G-TLC (Amber)	Cool to 4 C	7 days (preparation) 40 days (analysis)
VOCs[2]	G-TLS	HCl to pH < 2[1] Cool to 4 C	14 days
SVOCs	G-TLC (Amber)	Cool to 4 C	7 days (preparation) 40 days (analysis)

P – Polyethylene G – Glass TLC – Teflon®-lined cap TLS – Teflon®-lined septum

Notes:
1. H_2SO_4 or solid $NaHSO_4$ are also acceptable preservatives.
2. Samples shall not contain headspace or air bubbles.

TABLE C-3 - FIELD QUALITY CONTROL SAMPLE REQUIREMENTS

MEDIA: SURFACE WATER

Laboratory Parameters	Trip Blanks	Equipment/ Field Blanks	Field Duplicates[1]	Matrix Spikes/ Matrix Spike Duplicates[1]
Chromium VI	NA	1 per day	1 per 20 samples	1 per 20 samples[2]
Metals (total)	NA	1 per day	1 per 20 samples	1 per 20 samples[2]
Metals (dissolved)	NA	1 per day	1 per 20 samples	1 per 20 samples[2]
Mercury	NA	1 per day	1 per 20 samples	1 per 20 samples[2]
Organochlorine Pesticides	NA	1 per day	1 per 20 samples	1 per 20 samples
PCBs	NA	1 per day	1 per 20 samples	1 per 20 samples
VOCs	1 per cooler	1 per day	1 per 20 samples	1 per 20 samples
SVOCs	NA	1 per day	1 per 20 samples	1 per 20 samples

Notes:
1. Frequency is one per twenty samples or one per day, whichever is greater.
2. An analytical duplicate (i.e., unspiked) may be substituted for the matrix spike duplicate.

TABLE C-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SURFACE WATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Hardness	Std Methods 2340B	0.23	0.66	NA	NA	70-130	<MQL	70-130	30	NA	NA	NA
Total Dissolved Solids (TDS)	EPA 160.1	10	10	NA	NA	NA	<MQL	NA	30	NA	NA	NA
Total Suspended Solids	EPA 160.2	1	1	NA	NA	NA	<MQL	NA	30	NA	NA	NA
Total Organic Carbon	9060	1	1	NA	NA	70-130	<MQL	70-130	30	NA	NA	NA
Chloride	9251	0.333	1	NA	NA	70-130	<MQL	70-130	30	NA	NA	NA
Sulfate	9038	1.67	5	NA	NA	70-130	<MQL	70-130	30	NA	NA	NA
Chromium (VI)	7196A	0.008	0.02	NA	NA	70-130	<MQL	70-130	30	40	NA	NA
ICP Metals												
Aluminum	6010B	0.067	0.2	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Antimony	6010B	0.02	0.06	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Arsenic	6010B	0.013	0.04	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Barium	6010B	0.003	0.01	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Beryllium	6010B	0.002	0.005	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Boron	6010B	0.333	1	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Cadmium	6010B	0.002	0.005	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Cobalt	6010B	0.003	0.01	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Copper	6010B	0.002	0.01	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Iron	6010B	0.033	0.1	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Lead	6010B	0.003	0.015	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Lithium	6010B	0.017	0.05	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Manganese	6010B	0.005	0.015	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Nickel	6010B	0.002	0.04	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Selenium	6010B	0.013	0.04	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Silver	6010B	0.002	0.01	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Thallium	6010B	0.003	0.02	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Titanium	6010B	0.033	0.1	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Zinc	6010B	0.007	0.02	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Mercury	7470A	0.0002	0.0004	NA	0.995	80-120	<MQL	70-130	30	40	NA	NA
Organochlorine Pesticides												
4,4'-DDD	8081A	0.000007	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
4,4'-DDE	8081A	0.000017	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
4,4'-DDT	8081A	0.000018	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA

TABLE C-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SURFACE WATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Aldrin	8081A	0.00002	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
alpha-BHC	8081A	0.000007	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
alpha-Chlordane	8081A	0.00002	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
beta-BHC	8081A	0.00002	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
delta-BHC	8081A	0.00002	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Dieldrin	8081A	0.000015	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Endosulfan I	8081A	0.000009	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Endosulfan II	8081A	0.000024	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Endosulfan sulfate	8081A	0.000009	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Endrin	8081A	0.000025	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Endrin aldehyde	8081A	0.00003	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Endrin ketone	8081A	0.00003	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
gamma-BHC (Lindane)	8081A	0.000016	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
gamma-Chlordane	8081A	0.00003	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Heptachlor	8081A	0.000014	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Heptachlor epoxide	8081A	0.000022	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Methoxychlor	8081A	0.00003	0.0005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Toxaphene	8081A	0.000825	0.005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Polychlorinated Biphenyls												
Aroclor-1016	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aroclor-1221	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aroclor-1232	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aroclor-1242	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aroclor-1248	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aroclor-1254	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aroclor-1260	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Individual Congeners	8082	0.00002	0.00002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Volatile Organics												
1,1,1,2-Tetrachloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,1,1-Trichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,1,2,2-Tetrachloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,1,2-Trichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,1-Dichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%

TABLE C-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SURFACE WATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
1,1-Dichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,1-Dichloropropene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2,3-Trichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2,4-Trichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2,4-Trimethylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2-Dibromo-3-chloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2-Dibromoethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2-Dichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2-Dichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2-Dichloroethene (Total)	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2-Dichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,3,5-Trimethylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,3-Dichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,3-Dichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,4-Dichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,2-Dichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Butanone	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Chloroethylvinyl ether	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Chlorotoluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Hexanone	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Chlorotoluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Isopropyltoluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Methyl-2-pentanone	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Acetone	8260B	0.0083	0.025	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Acrolein	8260B	0.0083	0.025	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Acrylonitrile	8260B	0.0073	0.025	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bromobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bromodichloromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bromoform	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bromomethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Butanol	8260B	0.038	0.1	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Carbon disulfide	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Carbon tetrachloride	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%

TABLE C-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SURFACE WATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Chlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Chloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Chloroform	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Chloromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
cis-1,2-Dichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
cis-1,3-Dichloropropene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Cyclohexane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Dibromochloromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Dibromomethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Dichlorodifluoro-methane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Ethylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Hexachlorobutadiene	8260B	0.0004	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Isopropylbenzene (Cumene)	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Methyl Acetate	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Methyl iodide	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Methylcyclohexane	8260B	0.008	0.02	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Methylene chloride	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
n-Butylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
n-Propylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
o-Xylene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
sec-Butylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Styrene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
tert-Butyl methyl ether (MTBE)	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
tert-Butylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Tetrachloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Toluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
trans-1,2-Dichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
trans-1,3-Dichloropropene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
trans-1,4-Dichloro-2-butene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Trichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%

TABLE C-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SURFACE WATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Trichlorofluoromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Trichlorotrifluoroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Vinyl acetate	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Vinyl chloride	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Xylene (total)	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Semivolatile Organics												
1,2Diphenylhydrazine/ Azobenzene	8270C	0.002	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,4,5-Trichlorophenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,4,6-Trichlorophenol	8270C	0.0024	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,4-Dichlorophenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,4-Dimethylphenol	8270C	0.01	0.02	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,4-Dinitrophenol	8270C	0.0167	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,4-Dinitrotoluene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,6-Dinitrotoluene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Chloronaphthalene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Chlorophenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Methylnaphthalene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Nitroaniline	8270C	0.0167	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Nitrophenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
3,3'-Dichlorobenzidine	8270C	0.0005	0.02	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
3-Nitroaniline	8270C	0.0167	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4,6-Dinitro-2-methylphenol	8270C	0.0167	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Bromophenyl phenyl ether	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Chloro-3-methylphenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Chloroaniline	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Chlorophenyl phenyl ether	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Nitroaniline	8270C	0.0167	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Nitrophenol	8270C	0.0167	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Acenaphthene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Acenaphthylene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Acetophenone	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%

TABLE C-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SURFACE WATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Aniline	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Anthracene	8270C	0.0006	0.002	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Atrazine (Aatrex)	8270C	0.0067	0.02	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzaldehyde	8270C	0.0067	0.02	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzidine	8270C	0.0133	0.04	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzo(a)anthracene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzo(a)pyrene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzo(b)fluoranthene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzo(g,h,i)perylene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzo(k)fluoranthene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzoic acid	8270C	0.0167	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzyl alcohol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Biphenyl	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bis(2-Chloroethoxy)methane	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bis(2-Chloroethyl)ether	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bis(2-Chloroisopropyl)ether	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bis(2-Ethylhexyl)phthalate	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Butyl benzyl phthalate	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Caprolactam	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Carbazole	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Chrysene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Dibenz(a,h)anthracene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Dibenzofuran	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Diethyl phthalate	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Dimethyl phthalate	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Di-n-butyl phthalate	8270C	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Di-n-octyl phthalate	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Fluoranthene	8270C	0.0007	0.002	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Fluorene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Hexachlorobenzene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Hexachlorocyclo-pentadiene	8270C	0.0028	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Hexachloroethane	8270C	0.0022	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%

TABLE C-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SURFACE WATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Indeno(1,2,3-cd)pyrene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Isophorone	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Nitrobenzene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
n-Nitrosodimethylamine	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
n-Nitrosodi-n-propylamine	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
n-Nitrosodiphenylamine	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
o-Cresol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Phenanthrene	8270C	0.0007	0.002	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Phenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Pyrene	8270C	0.0004	0.002	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Pyridine	8270C	0.0067	0.02	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%

Notes:

1. Unless otherwise indicated, analytical methods are from EPA SW-846 "Test Methods for Evaluating Solid Waste."
2. Method Detection Limits are determined by the laboratory using the procedures in 40 CFR Part 136, Appendix B. The MDL listed here is the maximum method detection limit that will support the project performance objectives. Sample Detection Limits (which are adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and take into account sample characteristics, sample preparation, sample cleanup, and analytical adjustments including dry-weight adjustments) will be higher.
3. Method Quantitation Limits correspond to the lowest non-zero concentration standard in the laboratory's initial calibration curve calculated using the normal aliquot sizes and final volumes prescribed in the analytical method. The MQL listed here is based on typical laboratory performance. Sample Quantitation Limits (which are adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and take into account sample characteristics, sample preparation, sample cleanup, and analytical adjustments including dry-weight adjustments) will be higher.
4. Per the analytical methods for organics, the %RSD for an individual analyte may exceed the criteria as long as the mean %RSD for all calibrated analytes is within the criteria. For data qualification purposes, the %RSD criteria will be applied to each individual analyte and the data flagged accordingly. For GC/MS analyses, the analytical method also includes criteria for the Relative Response Factor (RRF) for a subset of the calibrated analytes. For data qualification purposes, a minimum RRF criteria of 0.05 will be applied to each individual analyte and the data flagged accordingly.
5. Per the analytical methods for organics, the CCV response for an individual analyte may be outside the criteria as long as the mean CCV response for all calibrated analytes is within the criteria. For data qualification purposes, the CCV criteria will be applied to each individual analyte and the data flagged accordingly. For inorganics, the same limits apply for the ICV.
6. Criteria apply for all blank types including method blanks, calibration blanks, equipment blanks, and trip blanks. For data qualification purposes, blank concentrations for all positively identified analytes (i.e., above the detection limit) will be assessed and the data flagged accordingly. However, laboratory corrective action is instituted only for concentrations above the quantitation limit.
7. Criteria are for data qualification purposes. The laboratory shall monitor performance and institute routine corrective action using the laboratory-established limits but the lower limit shall not be below 10% for organics and 30% for inorganics.
8. Expressed as percent of area for internal standard in midpoint calibration standard.

APPENDIX D

QA/QC INFORMATION – SEDIMENT

TABLE D-1 - PARAMETERS AND METHOD SPECIFICATIONS

MEDIA: SEDIMENT

Intended Use: Investigate possibility of additional Potential Source Areas
Nature and extent of contamination
Quantitative risk assessment - human health and ecological

QC Level: Level III with Level IV for 10% of the sample sets (selected by RI Manager with consideration given to sample results, location and matrix)

Laboratory Parameters	Sampling SOP	Measurement Technique	Preparation Method	Analysis Method
Chemical Analyses				
Total Moisture	BESI-SOP-101; BESI-SOP-102	Gravimetric	NA	SM 2540G
Chloride	BESI-SOP-101; BESI-SOP-102	Colorimetric	NA	SW846 9251
Sulfate	BESI-SOP-101; BESI-SOP-102	Turbidimetric	NA	SW846 9038
Chromium VI	BESI-SOP-101; BESI-SOP-102	Colorimetric	SW846 3060A	SW846 7196A
Metals	BESI-SOP-101; BESI-SOP-102	ICP-AES	SW846 3050B	SW846 6010B
Mercury	BESI-SOP-101; BESI-SOP-102	Cold Vapor AA	SW846 7471A	SW846 7471A
Organochlorine Pesticides	BESI-SOP-101; BESI-SOP-102	GC	SW846 3550B cleanup (e.g., 3620B) as needed	SW846 8081A
PCBs	BESI-SOP-101; BESI-SOP-102	GC	SW846 3550B cleanup (e.g., 3665A) as needed	SW846 8082
VOCs	BESI-SOP-101; BESI-SOP-102	GC/MS	SW846 5035	SW846 8260B
SVOCs	BESI-SOP-101; BESI-SOP-102	GC/MS	SW846 3550B cleanup (e.g., 3640A) as needed	SW846 8270C
Grain-Size	BESI-SOP-101; BESI-SOP-102	NA	NA	ASTM C-136
Total Organic Carbon	BESI-SOP-101; BESI-SOP-102	NA	NA	SW846 415.1/9060

TABLE D-2 - SAMPLE CONTAINER, PRESERVATION AND HOLDING TIME REQUIREMENTS

MEDIA: SEDIMENT

Laboratory Parameters	Container	Preservation	Holding Time
Chemical Analyses			
Chloride	P, G	Cool to 4 C	28 days
Sulfate	P, G	Cool to 4 C	28 days
Chromium VI	P, G	Cool to 4 C	30 days (preparation) 4 days (analysis)
Metals	P, G	Cool to 4 C	6 months
Mercury	P, G	Cool to 4 C	28 days
Organochlorine Pesticides	G-TLC	Cool to 4 C	14 days (preparation) 40 days (analysis)
PCBs	G-TLC	Cool to 4 C	14 days (preparation) 40 days (analysis)
VOCs[1]	G-TLS or G-TLC	Cool to 4 C	14 days
SVOCs	G-TLC	Cool to 4 C	14 days (preparation) 40 days (analysis)
Grain-Size	P, G	none	none
Total Organic Carbon	P, G	Cool to 4 C	28 days

P – Polyethylene G – Glass TLC – Teflon®-lined cap TLS – Teflon®-lined septum

TABLE D-3 - FIELD QUALITY CONTROL SAMPLE REQUIREMENTS

MEDIA: SEDIMENT

Laboratory Parameters	Trip Blanks	Equipment/ Field Blanks	Field Duplicates[1]	Matrix Spikes/ Matrix Spike Duplicates[1]
Chromium VI	NA	1 per day	1 per 20 samples	1 per 20 samples[2]
Metals	NA	1 per day	1 per 20 samples	1 per 20 samples[2]
Mercury	NA	1 per day	1 per 20 samples	1 per 20 samples[2]
Organochlorine Pesticides	NA	1 per day	1 per 20 samples	1 per 20 samples
PCBs	NA	1 per day	1 per 20 samples	1 per 20 samples
VOCs	1 per cooler	1 per day	1 per 20 samples	1 per 20 samples
SVOCs	NA	1 per day	1 per 20 samples	1 per 20 samples

Notes:
1. Frequency is one per twenty samples or one per day, whichever is greater.
2. An analytical duplicate (i.e., unspiked) may be substituted for the matrix spike duplicate.

TABLE D-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SEDIMENT

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Total Moisture	Std Methods 2540 G	0.01	0.01	NA	NA	NA	NA	NA	30	NA	NA	NA
Chloride	9251	3.3	10	NA	NA	70-130	<MQL	70-130	30	NA	NA	NA
Sulfate	9038	17	50	NA	NA	70-130	<MQL	70-130	30	NA	NA	NA
Chromium (VI)	7196A	0.67	2	NA	NA	70-130	<MQL	70-130	30	50	NA	NA
ICP Metals												
Aluminum	6010B	2.7	8	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Antimony	6010B	0.67	2.4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Arsenic	6010B	0.53	1.6	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Barium	6010B	0.13	0.4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Beryllium	6010B	0.07	0.2	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Boron	6010B	1.1	4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Cadmium	6010B	0.07	0.2	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Cobalt	6010B	0.13	0.4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Copper	6010B	0.13	0.4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Iron	6010B	1.3	4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Lead	6010B	0.2	0.6	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Lithium	6010B	0.67	2	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Manganese	6010B	0.2	0.6	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Nickel	6010B	0.53	1.6	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Selenium	6010B	0.44	1.6	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Silver	6010B	0.13	0.4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Thallium	6010B	0.27	0.8	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Titanium	6010B	1.3	4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Zinc	6010B	0.27	0.8	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
MERCURY	7471A	0.007	0.02	NA	0.995	80-120	<MQL	70-130	30	50	NA	NA
Organochlorine Pesticides												
4,4'-DDD	8081A	0.0012	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
4,4'-DDE	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
4,4'-DDT	8081A	0.0011	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aldrin	8081A	0.0007	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
alpha-BHC	8081A	0.0007	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
alpha-Chlordane	8081A	0.0007	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
beta-BHC	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
delta-BHC	8081A	0.0007	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA

TABLE D-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SEDIMENT

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Dieldrin	8081A	0.0007	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Endosulfan I	8081A	0.0007	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Endosulfan II	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Endosulfan sulfate	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Endrin	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Endrin aldehyde	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Endrin ketone	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
gamma-BHC (Lindane)	8081A	0.0005	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
gamma-Chlordane	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Heptachlor	8081A	0.0007	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Heptachlor epoxide	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Methoxychlor	8081A	0.0067	0.02	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Toxaphene	8081A	0.028	0.2	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Polychlorinated Biphenyls												
Aroclor-1016	8082	0.0227	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aroclor-1221	8082	0.0227	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aroclor-1232	8082	0.0227	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aroclor-1242	8082	0.0227	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aroclor-1248	8082	0.0227	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aroclor-1254	8082	0.0227	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aroclor-1260	8082	0.0227	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Individual Congeners	8082	0.0066	0.0066	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Volatile Organics												
1,1,1,2-Tetrachloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,1,1-Trichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,1,2,2-Tetrachloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,1,2-Trichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,1-Dichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,1-Dichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,1-Dichloropropene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2,3-Trichloropropane	8260B	0.0007	0.002	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2,4-Trichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2,4-Trimethylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2-Dibromo-3-	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

TABLE D-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SEDIMENT

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
chloropropane												
1,2-Dibromoethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2-Dichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2-Dichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2-Dichloroethene (Total)	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2-Dichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,3,5-Trimethylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,3-Dichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,3-Dichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,4-Dichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,2-Dichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Butanone	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Chloroethylvinyl ether	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Chlorotoluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Hexanone	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Chlorotoluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Isopropyltoluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Methyl-2-pentanone	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Acetone	8260B	0.0083	0.025	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Acrolein	8260B	0.0083	0.025	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Acrylonitrile	8260B	0.0083	0.025	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bromobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bromodichloromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bromoform	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bromomethane	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Butanol	8260B	0.0083	0.025	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Carbon disulfide	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Carbon tetrachloride	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Chlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Chloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Chloroform	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Chloromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
cis-1,2-Dichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
cis-1,3-Dichloropropene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

TABLE D-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SEDIMENT

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Dibromochloromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Dibromomethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Dichlorodifluoro-methane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Ethylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Hexachlorobutadiene	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Isopropylbenzene (Cumene)	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Methyl Acetate	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Methyl iodide	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Methylcyclohexane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Methylene chloride	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
n-Butylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
n-Propylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
o-Xylene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
sec-Butylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Styrene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
tert-Butyl methyl ether (MTBE)	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
tert-Butylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Tetrachloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Toluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
trans-1,2-Dichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
trans-1,3-Dichloropropene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
trans-1,4-Dichloro-2-butene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Trichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Trichlorofluoromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Trichlorotrifluoroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Vinyl acetate	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Vinyl chloride	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Xylene (total)	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Semivolatile Organics												
1,2Diphenylhydrazine/ Azobenzene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

TABLE D-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SEDIMENT

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
2,4,5-Trichlorophenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,4,6-Trichlorophenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,4-Dichlorophenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,4-Dimethylphenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,4-Dinitrophenol	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,4-Dinitrotoluene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,6-Dinitrotoluene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Chloronaphthalene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Chlorophenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Methylnaphthalene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Nitroaniline	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Nitrophenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
3,3'-Dichlorobenzidine	8270C	0.22	0.66	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
3-Nitroaniline	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4,6-Dinitro-2-methylphenol	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Bromophenyl phenyl ether	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Chloro-3-methylphenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Chloroaniline	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Chlorophenyl phenyl ether	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Nitroaniline	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Nitrophenol	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Acenaphthene	8270C	0.016	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Acenaphthylene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Acetophenone	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Aniline	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Anthracene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Atrazine (Aatrex)	8270C	0.22	0.66	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzaldehyde	8270C	0.22	0.66	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzidine	8270C	0.067	1.32	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzo(a)anthracene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzo(a)pyrene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzo(b)fluoranthene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzo(g,h,i)perylene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

TABLE D-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SEDIMENT

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Benzo(k)fluoranthene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzoic acid	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzyl alcohol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Biphenyl	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bis(2-Chloroethoxy)methane	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bis(2-Chloroethyl)ether	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bis(2-Chloroisopropyl)ether	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bis(2-Ethylhexyl)phthalate	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Butyl benzyl phthalate	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Caprolactam	8270C	0.22	0.66	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Carbazole	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Chrysene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Dibenz(a,h)anthracene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Dibenzofuran	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Diethyl phthalate	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Dimethyl phthalate	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Di-n-butyl phthalate	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Di-n-octyl phthalate	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Fluoranthene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Fluorene	8270C	0.019	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Hexachlorobenzene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Hexachlorocyclo-pentadiene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Hexachloroethane	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Indeno(1,2,3-cd)pyrene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Isophorone	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Nitrobenzene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
n-Nitrosodimethylamine	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
n-Nitrosodi-n-propylamine	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
n-Nitrosodiphenylamine	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
o-Cresol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Phenanthrene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Phenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

TABLE D-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SEDIMENT

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Pyrene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Pyridine	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

Notes:

1. Unless otherwise indicated, analytical methods are from EPA SW-846 "Test Methods for Evaluating Solid Waste."
2. Method Detection Limits are determined by the laboratory using the procedures in 40 CFR Part 136, Appendix B. The MDL listed here is the maximum method detection limit that will support the project performance objectives. Sample Detection Limits (which are adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and take into account sample characteristics, sample preparation, sample cleanup, and analytical adjustments including dry-weight adjustments) will be higher.
3. Method Quantitation Limits correspond to the lowest non-zero concentration standard in the laboratory's initial calibration curve calculated using the normal aliquot sizes and final volumes prescribed in the analytical method. The MQL listed here is based on typical laboratory performance. Sample Quantitation Limits (which are adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and take into account sample characteristics, sample preparation, sample cleanup, and analytical adjustments including dry-weight adjustments) will be higher.
4. Per the analytical methods for organics, the %RSD for an individual analyte may exceed the criteria as long as the mean %RSD for all calibrated analytes is within the criteria. For data qualification purposes, the %RSD criteria will be applied to each individual analyte and the data flagged accordingly. For GC/MS analyses, the analytical method also includes criteria for the Relative Response Factor (RRF) for a subset of the calibrated analytes. For data qualification purposes, a minimum RRF criteria of 0.05 will be applied to each individual analyte and the data flagged accordingly.
5. Per the analytical methods for organics, the CCV response for an individual analyte may be outside the criteria as long as the mean CCV response for all calibrated analytes is within the criteria. For data qualification purposes, the CCV criteria will be applied to each individual analyte and the data flagged accordingly. For inorganics, the same limits apply for the ICV.
6. Criteria apply for all blank types including method blanks, calibration blanks, equipment blanks, and trip blanks. For data qualification purposes, blank concentrations for all positively identified analytes (i.e., above the detection limit) will be assessed and the data flagged accordingly. However, laboratory corrective action is instituted only for concentrations above the quantitation limit.
7. Criteria are for data qualification purposes. The laboratory shall monitor performance and institute routine corrective action using the laboratory-established limits but the lower limit shall not be below 10% for organics and 30% for inorganics.
8. Expressed as percent of area for internal standard in midpoint calibration standard.

APPENDIX E

QA/QC INFORMATION – FISH TISSUE

TABLE E-1 - ANALYTES AND METHOD SPECIFICATIONS

MEDIA: FISH TISSUE

Intended Use: Quantitative risk assessment - human health

QC Level: Level IV for all sample sets

Laboratory Parameters	Sampling Method	Measurement Technique	Preparation Method SOP	Analysis Method SOP
Chemical Analyses				
Total Moisture	BESI-SOP-303; BESI-SOP-304	Gravimetric	NA	SM 2540G
Percent Lipids	BESI-SOP-303; BESI-SOP-304	Extraction	NA	Batelle 6.11
Lead, Silver	BESI-SOP-303; BESI-SOP-304	ICP-AES	3050B	SW846 6010B
4,4'-DDE, 4,4'-DDT	BESI-SOP-303; BESI-SOP-304	GC	GCAL EXT-073	SW846 8081A
benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, hexachlorobenzene, and indeno(1,2,3-cd)pyrene	BESI-SOP-303; BESI-SOP-304	GC/MS	GCAL EXT-073	SW846 8270C-SIM

TABLE E-2 - SAMPLE CONTAINER, PRESERVATION AND HOLDING TIME REQUIREMENTS

MEDIA: FISH TISSUE

Laboratory Parameters	Container	Preservation	Holding Time[1]
Percent Lipids	PTFE, G	Cool to 4° C or Freeze at -20° C +/- 10° C (archive samples)	1 year
Lead, Silver	PTFE, G	Cool to 4° C or Freeze at -20° C +/- 10° C (archive samples)	6 months
4,4'-DDE, 4,4'-DDT	PTFE, G	Cool to 4° C or Freeze at -20° C +/- 10° C (archive samples)	14 days (preparation) 40 days (analysis)
benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, hexachlorobenzene, and indeno(1,2,3-cd)pyrene	PTFE, G	Cool to 4° C or Freeze at -20° C +/- 10° C (archive samples)	14 days (preparation) 40 days (analysis)

PTFE – Polytetrafluoroethylene (Teflon) G – Glass

Note:
1. Fish tissue samples (finfish and crab) may be archived for up to 6 months prior to analysis (EPA, 2000b. *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 1.* OW/EPA 823-B-00-007, November).

TABLE E-3 - FIELD QUALITY CONTROL SAMPLE REQUIREMENTS

MEDIA: FISH TISSUE

Laboratory Parameters	Trip Blanks	Equipment/Field Blanks	Field Duplicates	Matrix Spikes/ Matrix Spike Duplicates
Total Moisture	NA(1)	NA	1 per species	NA
Percent Lipids	NA	NA	1 per species	NA
Lead, Silver	NA	4(2)	1 per species	1 per fish species(3)
4,4'-DDE, 4,4'-DDT	NA	4(2)	1 per species	1 per fish species(3)
benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, hexachlorobenzene, and indeno(1,2,3-cd)pyrene	NA	4(2)	1 per species	1 per fish species(3)

Notes:
1. NA = Not applicable for the analyte and sampling techniques.
2. One equipment blank sample collected for each of the first four tissue processing events.
3. One Matrix Spike/Matrix Spike Duplicate (MS/MSD) sample collected for each of the three fish species. A MS/MSD sample will not be collected for the crab samples.

TABLE E-4 - QUALITY CONTROL OBJECTIVES

MEDIA: FISH TISSUE

Analyte	Method[1]	Target MDL[2] (mg/Kg)	Target MQL[3] (mg/Kg)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Total Moisture	SM 2540G	0.01	0.01	NA	NA	NA	NA	NA	30	50	NA	NA
Percent Lipids	Batelle 6.11	0.01	0.01	NA	NA	NA	<MQL	70-130	30	50	NA	NA
Lead	6010B	0.187	0.6	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Silver	6010B	0.053	0.4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
4,4'-DDE	8081A	0.00745	0.025	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
4,4'-DDT	8081A	0.00595	0.025	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Benzo(a)pyrene	8270C-SIM	0.0881	0.167	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzo(a)anthracene	8270C-SIM	0.0584	0.167	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzo(b)fluoranthene	8270C-SIM	0.0467	0.167	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzo(k)fluoranthene	8270C-SIM	0.0392	0.167	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Chrysene	8270C-SIM	0.0298	0.167	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Dibenz(a,h)anthracene	8270C-SIM	0.0494	0.167	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Hexachlorobenzene	8270C-SIM	0.0290	0.167	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Indeno(1,2,3-cd)pyrene	8270C-SIM	0.0235	0.167	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

Notes:

1. Unless otherwise indicated, analytical methods are from EPA SW-846 "Test Methods for Evaluating Solid Waste."

2. Method Detection Limits are determined by the laboratory using the procedures in 40 CFR Part 136, Appendix B. MDLs for tissue analysis are on a wet weight basis. (Sample results will also be on a wet weight basis.) The MDL listed here is Gulf Coast Analytical Laboratories, Inc. (GCAL) current MDL and applies for the November 2006 sampling event. MDLs for future events may vary. Additionally, Sample Detection Limits (which are adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and take into account sample characteristics, sample preparation, sample cleanup, and analytical adjustments) may be higher.
3. Method Quantitation Limits correspond to the lowest non-zero concentration standard in the laboratory's initial calibration curve calculated using the normal aliquot sizes and final volumes prescribed in the analytical method. The MQL listed here is based on typical laboratory performance. Sample Quantitation Limits (which are adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and take into account sample characteristics, sample preparation, sample cleanup, and analytical adjustments) may be higher.
4. Per the analytical methods for organics, the %RSD for an individual analyte may exceed the criteria as long as the mean %RSD for all calibrated analytes is within the criteria. For data qualification purposes, the %RSD criteria will be applied to each individual analyte and the data flagged accordingly. For GC/MS analyses, the analytical method also includes criteria for the Relative Response Factor (RRF) for a subset of the calibrated analytes. For data qualification purposes, a minimum RRF criteria of 0.05 will be applied to each individual analyte and the data flagged accordingly.
5. Per the analytical methods for organics, the CCV response for an individual analyte may be outside the criteria as long as the mean CCV response for all calibrated analytes is within the criteria. For data qualification purposes, the CCV criteria will be applied to each individual analyte and the data flagged accordingly. For inorganics, the same limits apply for the ICV.
6. Criteria apply for all blank types including method blanks, calibration blanks, equipment blanks, and trip blanks. For data qualification purposes, blank concentrations for all positively identified analytes (i.e., above the detection limit) will be assessed and the data flagged accordingly. However, laboratory corrective action is instituted only for concentrations above the quantitation limit.
7. Criteria are for data qualification purposes. The laboratory shall monitor performance and institute routine corrective action using the laboratory-established limits but the lower limit shall not be below 10%.
8. Expressed as percent of area for the internal standard in the sample as compared to that in the daily midpoint calibration standard.

APPENDIX F

DATA VALIDATION STANDARD OPERATING PROCEDURE

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 16

FOR DATA VALIDATION

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes a protocol for the validation of analytical laboratory data collected during activities required by the modified Unilateral Administrative Order (UAO) for the Gulfco Marine Maintenance Superfund Site. Included in this protocol are Level III and Level IV procedures to evaluate and validate the completeness, accuracy and precision with respect to the project-specific data quality objectives.

The Quality Assurance Project Plan (QAPP) and applicable SOPs must be reviewed before this SOP is used to assess laboratory data. The individual performing the data reviews shall be familiar with the analytical method and other procedures used for the project. Familiarity with project and laboratory quality control requirements is critical to appropriate use of this procedure.

The individual performing the data reviews must also be familiar with the USEPA National Functional Guidelines (NFG) referenced herein. The SOP provides guidance for application of the data qualifier flags; however, analytical circumstances surrounding sample analyses are variable and the reviewer may need to refer to the National Functional Guidelines for further information.

2.0 DEFINITIONS

Definitions of accuracy, precision and completeness and methods for computing their measures are provided below.

2.1 Accuracy

Accuracy is the degree of difference between the measured or calculated value and the true value. Data accuracy and analytical bias are often assessed by the analysis of laboratory control samples (LCS), matrix spike (MS) samples, and/or surrogate spikes with results expressed as a percentage recovery measured relative to the true (known) concentration.

The percentage recovery for LCS or surrogate spikes is calculated as:

$$\text{Recovery (\%)} = \frac{A}{T} \times 100$$

where: A = measured concentration of the LCS or surrogate; and
T = known concentration.

The percentage recovery for MS samples is calculated as:

$$\text{Recovery (\%)} = \frac{A - B}{T} \times 100$$

where: A = measured concentration of the spiked sample;
B = measured concentration of unspiked sample; and
T = amount of spike added.

Method blanks and equipment blanks are analyzed to quantify artifacts introduced during sampling, transport, or analysis that may affect the accuracy of the data.

2.2 Precision

Precision is the level of agreement between duplicate measurements of the same analyte. Laboratory precision is assessed by determining the agreement of results for replicate measurements of the same sample. Field precision is assessed by determining the agreement for results for two independent samples collected from the same site at the same time. Precision may be evaluated using LCS/LCSD samples, MS/MSD samples, laboratory duplicate samples and/or field duplicate samples.

The relative percent difference (RPD) used to assess precision is calculated as:

$$RPD\ (\%) = \frac{|2\ (S_1 - S_2)|}{S_1 + S_2} \times 100$$

where: S_1 = measured sample concentration; and

S_2 = measured duplicate concentration.

2.3 Completeness

Analytical completeness is the percentage of usable (non-rejected) data measurements obtained, as a proportion of the number of planned measurements for the sample set. Analytical completeness is affected by such factors as sample bottle breakage and acceptance/non-acceptance of analytical results. Percentage completeness (C) is calculated as:

$$C\ (\%) = \frac{V}{P} \times 100$$

where: V = number of valid (usable) measurements obtained (all data other than rejected data; and

P = number of measurements planned.

Definitions for the different types of reporting limits are provided below.

2.4 Method Detection Limit (MDL)

The minimum concentration of an analyte that the laboratory can measure and report with 99% confidence that the analyte concentration is greater than zero. The MDL is determined by the laboratory for each analyte in a given reagent matrix (water or soil) generally using the procedures specified in 40 CFR Part 136, Appendix B. It is a measure of the concentration an instrument can detect or 'see' in a given reagent matrix. Project quality objectives include a requirement that the laboratory routinely check the MDL for reasonableness.

2.5 Sample Detection Limit (SDL)

The MDL adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and taking into account sample characteristics, sample preparation, and analytical adjustments including dry-weight adjustments. It is a measure of the concentration an instrument can detect or 'see' in a given sample. For this project, non-detects are reported using the SDL.

2.6 Method Quantitation Limit (MQL)

The lowest non-zero concentration standard in the laboratory's initial calibration curve calculated using the normal aliquot sizes and final volumes prescribed in the analytical method. The MQL is a measure of the concentration an instrument can accurately measure in a typical sample.

2.7 Sample Quantitation Limit (SQL)

The MQL adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and taking into account sample characteristics, sample preparation, and analytical adjustments including dry-weight adjustments. It is a measure of the concentration an instrument can accurately measure in a given sample. Analytes with concentrations above the SDL but below the SQL, though present in the sample, may not be accurately measured and are thus flagged as estimated (J).

2.8 Data Qualifier Flags

As a result of data validation, data qualifier flags may be applied to individual analytical results. Definitions of the flags applied for data qualification are as follows:

Flag	Definition
J	Analyte confirmed present, but the reported value is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
J+	The reported value is an estimated quantity, and the result may be biased high.
J-	The reported value is an estimated quantity, and the result may be biased low.

R The data are not usable due to serious deficiencies in meeting quality control criteria. The analyte may or may not be present in the sample.

U Analyte not detected at or above the sample detection limit.

UJ Analyte not detected at or above the sample detection limit, but the reported limit is an estimated quantity. The associated numerical value is an approximate concentration that may be inaccurate or imprecise.

NJ Analyte tentatively identified. Presence of the analyte is not confirmed and the reported value is an estimated quantity.

Note: The J data qualifier may be assigned to laboratory data that was qualified by the lab as an estimated concentration between the laboratory's detection limit and the limit of quantitation.

When an option exists to assign two different flags, the flag higher in the data quality hierarchy will be assigned. The hierarchy is:

R > UJ > U > NJ > J > J+ or J-

Additional explanation regarding assignment of qualifiers, in accordance with the review procedures detailed below, is provided in Table 1.

3.0 PROCEDURES

3.1 Level III Data Validation

A Data Validation Checklist is attached to this SOP. The checklist will be completed to document the data validation process. For Level III validation, the first part of the Data Validation Checklist will be completed according to the following procedure:

(1) Review the Tables in Appendices A through E of the QAPP and note the analytical methods, intended use, target method detection limits, target method quantitation limits, quality control samples and associated control limits specified for each analyte/media.

(2) Review the Chain-of-Custody records (COC). Verify that all necessary information was provided on each COC and that all required signatures are present. Verify that analytical laboratory results were reported for all samples listed on the COCs. Note any problems documented on the COCs by either the sampler or the laboratory.

(3) Verify that field quality control samples were submitted at the project-specified frequency (one equipment blank and one field duplicate per 20 field samples or one per day and one VOC trip blank per shipping container).

(4) Review laboratory records of sample temperature upon receipt and preservation information to verify that samples were properly preserved and VOA vials were completely filled. Verify that samples were received within 2 days of collection. Document any field sample results requiring qualification based on inadequate sample preservation on the Qualified Data Table section of the Validation Checklist.

(5) Briefly summarize the laboratory's case narrative, or note if not present. Summarize any notes or comments documented throughout the laboratory report.

(6) Verify that each sample was prepared and analyzed within the recommended holding time. Document any field sample results requiring qualification based on exceedances of holding time on the Qualified Data Table section of the Validation Checklist.

(7) Review the laboratory method detection limits and method quantitation limits reported by the laboratory against the project evaluation criteria (see the tables in Appendices A through E for each analyte/matrix). Note elevated detection and quantitation limits and assess if the elevated limits are justified by analytical limitations or anomalies. Apply the J data qualifier to all results between the SDL and SQL, as indicated by laboratory J-flag.

(8) Verify the correct field IDs, analytical method references, sample matrix, and proper reporting units were included in the laboratory report. Verify that soil and sediment results are corrected for dry-weight.

(9) Verify that method detection limit studies have been conducted according to the method SOP and have been routinely checked for reasonableness using Detectability Check Samples.

(10) Review the calibration data to ensure proper instrument operating conditions for analysis and quantification of field sample results. Verify the appropriate number of standards was used and the %RSD or correlation coefficient is in compliance with project requirements. Apply data qualifiers to the associated field sample results (those quantitated with the calibration curve) according to the guidelines in Table 1 of this SOP. Refer to the NFG for application of data qualifier flags in the event the situation is not adequately defined in Table 1. Document any field sample results requiring qualification based on calibration data not meeting requirements on the Qualified Data Table section of the Validation Checklist.

(11) For inorganics, verify the initial calibration verification (ICV) was analyzed after the calibration curve and the continuing calibration verification (CCV) samples were analyzed after every ten samples and the recoveries are in compliance with project control limits. Apply data qualifiers to the associated field sample results (those analyzed after the ICV or near the CCV) according to the guidelines in Table 1 of this SOP. Document any field sample results requiring qualification based on ICV or CCV recovery outside control limits on the Qualified Data Table section of the Validation Checklist.

(12) For organics, verify the continuing calibration verification (CCV) samples were analyzed every twelve-hour analytical shift and the recoveries are in compliance with the project control limits. Apply data qualifiers to the associated field sample results (those analyzed on the same shift) according to the guidelines in Table 1 of this SOP. Document any

field sample results requiring qualification based on CCV recovery outside control limits on the Qualified Data Table section of the Validation Checklist.

(13) For inorganics, verify that the initial calibration blank (ICB) was analyzed immediately after the ICV and the continuing calibration blanks (CCB) were analyzed immediately after the CCVs and the concentrations do not exceed the reporting limit. Analysis should be terminated if an ICB or CCB result is greater than the MQL. Apply data qualifiers to the associated field sample results (those analyzed after the ICB or near the CCB) according to the guidelines in Table 1 of this SOP. Document any field sample results requiring qualification based on ICB results on the Qualified Data Table section of the Validation Checklist.

(14) Verify that one method blank was analyzed per analytical batch (maximum 20 samples). Review the results of all method, equipment, and trip blanks and verify that the concentrations do not exceed the reporting limit. Analysis should be terminated if a method blank result is greater than the MQL. If an analyte was detected in a method blank or field blank, check to see if any field sample analyte concentrations associated with that blank were less than five times (ten times for common laboratory contaminants) the blank concentration. If an associated sample result is less than five (or ten) times the blank concentration, the result is potentially biased high and will be qualified as non-detected (less than reporting limit). If an analyte is detected in the method blank and also in an equipment blank, first apply the five times rule using the method blank concentration. The equipment blank results may be considered non-detect due to method blank contamination. Apply data qualifiers to the associated field sample results (those analyzed in the same analytical batch or collected at the same time) according to the guidelines in Table 1 of this SOP. Refer to the NFG for application of data qualifier flags in the event the situation is not defined in Table 1. Document any field sample results requiring qualification based on method blank and/or field blank results on the Qualified Data Table section of the Validation Checklist.

(15) Verify that one LCS was analyzed per analytical batch (maximum 20 samples) and recoveries are in compliance with project control limits. For analytical batches with an LCS and LCSD, compare the mean recovery to the control limits. Deficient LCS recoveries for more than ½ the target analytes for a multi-analyte parameter (VOC, SVOC, etc.) or single recoveries below 30% for inorganics or 10% for organics may indicate serious instrument or calibration problems. The samples should be discarded and the preparation and analysis repeated; however, professional judgment should be used to evaluate whether sample results associated with low-biased LCS recoveries should be rejected or qualified as estimated concentrations with potential low bias. Apply data qualifiers to the associated field sample results (those analyzed in the same analytical batch) according to the guidelines in Table 1 of this SOP. Document any field sample results requiring qualification based on LCS recoveries outside control limits on the Qualified Data Table section of the Validation Checklist.

(16) Verify one MS was analyzed for every twenty field samples and recoveries are in compliance with project control limits. For analytical batches with an MS and MSD, compare the mean recovery to the control limits. MS recoveries outside control limits may indicate possible sample matrix interferences, resulting in qualification of the associated sample results as estimated concentrations with a potential low or high bias. MS recoveries below 30% for inorganics may also indicate serious analytical problems; *however, professional judgment* (and Post Digestion Spike results, if available) should be used to evaluate whether sample results associated with low-biased MS recoveries should be rejected or qualified as estimated concentrations with potential low bias. Apply data

qualifiers to the associated field sample results (those analyzed in the same analytical batch and with the same sample matrix) according to the guidelines in Table 1 of this SOP. The check is inconclusive and qualifiers are not applied if the amount of the spike is not at least four times the amount in the unspiked sample. Document any field sample results requiring qualification based on MS recoveries outside control limits on the Qualified Data Table section of the Validation Checklist.

(17) Verify one laboratory duplicate, MSD, or LCSD was analyzed for every twenty field samples and the RPDs are in compliance with project control limits; however, if one or both of the results are less than five times the MQL, use the difference in the results with ± 1 times the MQL as the control limit. If an RPD or difference is outside of the control limits, the associated data should be considered estimated values due to poor analytical precision. Apply data qualifiers to the associated field sample results (those analyzed in the same analytical batch and with the same sample matrix) according to the guidelines in Table 1 of this SOP. Document any field sample results requiring qualification based on analytical duplicate RPDs outside control limits on the Qualified Data Table section of the Validation Checklist.

(18) Calculate RPDs for field duplicates and verify they are in compliance with project control limits; however, if one or both of the results are less than five times the MQL, use the difference in the results with ± 2 times the MQL as the control limit for waters and ± 3 times the MQL for soils. Field duplicates measure both field and laboratory precision; therefore the results may have more variability than laboratory duplicates that only measure laboratory precision. If an RPD or difference is outside of the control limits, the associated data should be considered estimated due to poor field and/or laboratory precision. The assessment of field precision will alert the data user to the possible heterogeneity of the sample matrix. Apply data qualifiers to the associated field sample results (those collected at the same time, analyzed in the same analytical batch and with the same sample matrix) according to the guidelines in Table 1 of this SOP. Document any field sample results requiring qualification based on field duplicate RPDs outside control limits on the Qualified Data Table section of the Validation Checklist.

(19) Verify the appropriate surrogates were used for each analysis and recoveries are in compliance with project control limits. Surrogate recoveries below 10% may indicate serious analytical problems. The samples should be discarded and the preparation and analysis repeated; however, professional judgment should be used to evaluate whether sample results associated with low-biased surrogate recoveries should be rejected or qualified as estimated concentrations with potential low bias. Apply data qualifiers to the associated field sample results (those for target analytes of the same type as the surrogate) according to the guidelines in Table 1 of this SOP. The check is inconclusive and qualifiers should not be applied if the surrogates were diluted out of the sample. Note these cases and use the LCS and MS to assess accuracy for the affected samples. Refer to the NFG for application of data qualifier flags in the event the situation is not adequately defined in Table 1. Document any field sample results requiring qualification based on surrogate recoveries outside control limits on the Qualified Data Table section of the Validation Checklist.

(20) Verify the appropriate internal standards were used for each analysis and responses are in compliance with project requirements (within a factor of two of the midpoint calibration standard). Internal standard areas below 25% of those in the calibration standard may indicate serious analytical problems. The sample analysis should be repeated; however, professional judgment should be used to evaluate whether sample results associated with low internal standard areas should be rejected or qualified as estimated concentrations

with potential low bias. Apply data qualifiers to the associated field sample results (those for target analytes quantitated with the internal standard) according to the guidelines in Table 1 of this SOP. Refer to the NFG for application of data qualifier flags in the event the situation is not adequately defined in Table 1. Document any field sample results requiring qualification based on internal standard areas not meeting requirements on the Qualified Data Table section of the Validation Checklist.

(21) Calculate the completeness as defined in Section 2.0 of this SOP. Report the calculated completeness percentage on the checklist. The project completeness goal is 90% on a sample basis and 80% on an analyte basis.

3.2 Level IV Data Validation

For Level IV validation, the first part of the Data Validation Checklist will be completed as above and the second part of the Data Validation Checklist will be completed according to the following procedures:

(1) Verify that the sample results were calculated correctly and transcribed properly from the raw data by checking the values against the instrument printout (taking into account any preparation or dilution factors noted in the laboratory preparation and/or run logs) for 10% of the samples. Check the sample results for reasonableness, i.e. chromatographic profile should be consistent with order of magnitude of results, total metals should not be less than dissolved metals, total metal should not be less than speciated metal, etc.)

(2) Verify that the QC parameters (including ICAL %RSD, RRF, ICV/CCV %R, LCS %R, MS/MSD %R, Duplicate RPD, Surrogate %R, Internal Standard Relative Area, and ICS %R) are calculated correctly by re-calculating the values using data on the instrument printout for one analyte in 10% of the samples.

(3) For pesticides, verify that the pesticide breakdown mixture was analyzed every twelve-hour analytical shift and the recoveries are within the analytical method requirements (less than or equal to 15%). Apply data qualifiers to the associated field sample results (those analyzed on the same shift) according to the guidelines in Table 1 of this SOP. Refer to the NFG for application of data qualifier flags in the event the situation is not defined in Table 1. Document any field sample results requiring qualification based on percent breakdown outside requirements on the Qualified Data Table section of the Validation Checklist.

(4) For GC/MS, verify that the tuning performance solution was analyzed every twelve-hour analytical shift and the ion abundance criteria are within the analytical method requirements. Apply data qualifiers to the associated field sample results (those analyzed on the same shift) according to the guidelines in Table 1 of this SOP. Refer to the NFG for application of data qualifier flags in the event the situation is not defined in Table 1. Document any field sample results requiring qualification based on tuning performance criteria on the Qualified Data Table section of the Validation Checklist.

(5) For GC/MS, verify that the relative response factors (RRF) for the target analytes in each calibration standard are above the minimum project requirements. Low response factors may indicate serious instrument sensitivity problems; however, professional judgment should be used to evaluate whether sample results associated with low calibration RRFs

should be rejected or if it may be possible to elevate the reporting limits to a concentration where an acceptable RRF was obtained. Apply data qualifiers to the associated field sample results (those quantitated with the calibration curve) according to the guidelines in Table 1 of this SOP. Document any field sample results requiring qualification based on low response factors on the Qualified Data Table section of the Validation Checklist.

(6) For ICP metals, verify that the interference check sample (ICS) was analyzed every analytical run and the recoveries are within the analytical method requirements (80-120%). ICS recoveries outside the criteria may indicate a potential bias in sample results due to improper instrument set up. Recoveries below 30% may indicate serious instrument or calibration problems; however, professional judgment should be used to evaluate whether sample results associated with low-biased ICS recoveries should be rejected or qualified as estimated concentrations with potential low bias. Apply data qualifiers to the associated field sample results (those analyzed in the same analytical run) according to the guidelines in Table 1 of this SOP. Refer to the NFG for application of data qualifier flags in the event the situation is not defined in Table 1. Document any field sample results requiring qualification based on ICS recoveries outside criteria on the Qualified Data Table section of the Validation Checklist.

(7) For ICP metals, verify that the initial calibration blanks (ICB), continuing calibration blanks (CCB), and method blanks do not have negative concentrations whose absolute value exceeds the MQL. Negative concentrations above the MQL may indicate a potential low bias in sample results due to improper instrument set up. Apply data qualifiers to the associated field sample results (those analyzed after the ICB, near the CCB, or in the same analytical batch as the method blank) with non-detects or concentrations less than or equal to ten times that in the ICB or CCB according to the guidelines in Table 1 of this SOP. Refer to the NFG for application of data qualifier flags in the event the situation is not defined in Table 1. Document any field sample results requiring qualification based on negative ICP blank results on the Qualified Data Table section of the Validation Checklist.

(8) For GC and GC/MS, verify that the qualitative identification criteria in the analytical method are met for the analytes identified in 10% of the samples. (For GC single-component target analytes, the analyte retention time must be within the daily retention time window and either the identification must be confirmed or the analyte must be known to be present at the site. For GC multi-component target analytes, the retention times of the major peaks must be within the daily retention time window and there must be a clearly identifiable pattern. For GC/MS, the internal standard retention times must be within $\pm$30 seconds of that for the daily standard, the analyte relative retention time must be within $\pm$0.06 units of that for the daily standard, and the intensities of the characteristic ions must be within $\pm$30% of that for the daily standard.) Examine the sample chromatogram for evidence of poor chromatographic performance (abrupt baseline shifts, excessive baseline rise, poor resolution, peak tailing, or peak splitting), evidence of sample carryover, short run times, or undocumented manual integrations. Refer to the NFG for application of data qualifier flags. Document any field sample results requiring qualification based on qualitative identification on the Qualified Data Table section of the Validation Checklist.

(9) For GC with second column/detector confirmation, verify the RPD between the two quantitated results is within the analytical method requirements (less than or equal to 40%). The higher value should be reported unless coelution is suspected. Apply the J data qualifier to all sample results with a high second quantitation RPD. Document any field

sample results requiring qualification based on second quantitation RPD outside criteria on the Qualified Data Table section of the Validation Checklist.

Table 1 provides guidance for application of the data qualifier flags. The table is not intended to include all situations in which a data qualifier flag could be assigned. Analytical circumstances surrounding sample analyses are variable and may result in application of data qualifier flags due to circumstances not detailed on Table 1. Refer to the National Functional Guidelines for further information on application of data qualifiers.

3.4 Documentation of Validation

A Data Validation Checklist will be completed to document the verification of processes and the validation qualifiers assigned to individual results. The checklists will be included in the project file containing the associated laboratory analytical reports.

4.0 DATA USE

Validation qualifier flags are assigned to describe the degree to which individual values provide accurate and precise results. Table 2 lists each of the data qualifier flags and the QC outcomes that may result in the application of that flag. The meaning of the qualifier flags in terms of future data uses are as follows:

Values that are assigned J flags (J, J+, or J-) are considered estimated results. Data assigned these flags indicate that they may not be accurate or precise within the limits specified in the QAPP but that the magnitude of the potential imprecision or inaccuracy is not great enough to reject the value for project data uses.

Values assigned an R flag do not meet the accuracy or precision project requirements specified to provide quantitative data for the project data uses. The R flag indicates that serious deficiencies were encountered preventing the generation of usable data for the project objectives.

Values are assigned U flags when the value is less than the sample reporting limit or to indicate that a low concentration of the analyte cannot be confirmed due to the presence of interference or the presence of the analyte in associated blanks. UJ flags may be applied to indicate values less than the reported limit may not be accurate or precise. Values flagged with U or UJ are fully

usable and should be considered non-detected. The reported numerical result may be used for project objectives.

Values without flags assigned have met all of the project data quality objectives and are suitable for all project data uses.

5.0 QUALITY ASSURANCE

The QA Manager and Project Coordinator will review the completed Data Validation Checklists for conformance with the procedures described herein. Any questions or comments resulting from that review will be resolved before the checklists are considered final. The database manager will modify the project electronic database to include any data qualifiers detailed on a finalized Checklist.

6.0 REFERENCES

USEPA *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, OSWER9240.1-35, EPA 540-R-01-008, October 2004.

USEPA *Contract Laboratory Program National Functional Guidelines for Organic Data Review*, OSWER9240.1-05A, EPA-540/R-99-008 (PB99-963506), October 1999.

Table 1 Guidance for Assignment of Data Qualifier Flags

QC Check	Outcome	Data Qualifier for Results > RL	Data Qualifier for Non-Detects
Hold Time	Exceeds hold time	J	UJ
	Improper preservation	J	UJ
	Grossly exceeds hold time	J	R
Pesticide Breakdown	Excessive DDT or Endrin breakdown	J (parent analyte) NJ (products)	R (parent analyte)
GC/MS Tune	Outside ion abundance criteria	J	UJ
ICAL	%RSD or r exceeds criteria	J	UJ
	RRF below limit	J	R (or elevate RL)
ICV/CCV	%R outside criteria	J	UJ
ICB/CCB	Sample result ≤ 1x blank value	U	none
	Absolute value of negative ICP blank result > MQL	J- (if result < 2x MQL)	UJ
Method or Field Blank	Sample result ≤ 5x (10x for common laboratory contaminants) blank value	U	none
	Absolute value of negative ICP blank result > MQL	J- (if result < 2x MQL)	UJ
LCS	Recovery <30% (inorganics) or <10% (organics)	J-	R
	Recovery below limit	J-	UJ
	Recovery above limit	J+	none
Matrix Spike(1)(2)	Recovery <30% (inorganics only)	J-	R
	Recovery below limit	J-	UJ
	Recovery above limit	J+	none
Analytical Duplicate(1)	Result ≥ 5x MQL and RPD exceeds criteria	J	none
	Result < 5x MQL and Difference exceeds criteria	J	UJ

Field Duplicate[1]	Result ≥ 5x MQL and RPD exceeds criteria	J	none
	Result < 5x MQL and Difference exceeds criteria	J	UJ
Surrogate[3]	Recovery <10%	J-	R
	Recoveries below limit[4]	J-	UJ
	Recoveries above limit[4]	J+	none
	Recoveries above and below limit[4]	J	UJ
Internal Standard[5]	Area response <25%	J	R
	Area response below limit	J	UJ
	Area response above limit	J	none
ICP ICS	Recovery <30%	J-	R
	Recovery below limit	J-	UJ
	Recovery above limit	J+	none
GC Second Quantitation	RPD > 40%	J	none

(1) Flagging applies to samples with the same matrix.

(2) Check waived if the amount of the spike is not at least four times the amount in the unspiked sample.

(3) Flagging applies to target analytes of the same type as the surrogate (e.g., acid or B/N for SVOC). Check waived if surrogates diluted out of sample.

(4) For methods with multiple surrogates, flagging applies only if more than one surrogate of a particular type is deficient.

(5) Flagging applies to target analytes quantitated with the internal standard.

Table 2 Guidance for Interpretation of Data Qualifier Flags

Data Qualifier Flag Assigned	PBW Standard Procedure No. 20 Guidance for Interpretation of Data Qualifier Flags
U	Sample result <RL Sample result >RL and less than 5-10x highest associated blank concentration
J	Sample result >RL and holding time exceeded or improper preservation Sample result >RL and instrument calibration or performance does not meet requirements Sample result ≥5x MQL and analytical duplicate RPD outside control limits Sample result between RL and 5x MQL and difference for analytical duplicates greater than ± 1x MQL Sample result ≥5x MQL and field duplicate RPD >50% Sample result between RL and 5x MQL and difference for field duplicates greater than ± 2x MQL (waters) or ± 3x MQL (soils)Sample result>RL and internal standard area outside control limits Sample result between RL and MQL and assigned a "J" qualifier by the laboratory indicating an estimated concentration
R	Holding time grossly exceeded Serious quality deficiency resulting in unusable data such as very low instrument response or spike recovery
UJ	Sample result <RL and holding time exceeded or improper preservation (option to assign R for gross exceedance of holding time) Sample result <RL and instrument calibration or performance does not meet requirements (option to assign R for very low instrument response) Sample result <RL and LCS, MS, surrogate, or ICS recovery below control limits (option to assign R for very low recovery) Sample result<RL and internal standard area below control limits (option to assign R for very low response)
J-	Sample result >RL and LCS, MS, surrogate, or ICS recovery below control limits
J+	Sample result >RL and LCS, MS, surrogate, or ICS recovery above control limits
NJ	Sample result > RL and identification criteria not met or identification not confirmed.

FIGURE SOP 16-1. DATA VALIDATION CHECKLIST

DATA VALIDATION CHECKLIST (Level III and Level IV)				
Client Name:	Project Number:			
Property Location:	Project Manager:			
Laboratory:	Laboratory Job No.:			
Reviewer:	Date Checked:			
ITEM	**Yes**	**No**	**NA**	**Comment Number**
Chain of Custody (COC) and Sample Receipt at Lab				
1. Signed COCs included and seals used?				
2. Date and time of sample collection included?				
3. All samples listed on the COC analyzed for in accordance with the RI/FS Work Plan?				
4. Field QC sample frequency met project requirements?				
5. Sample receipt temperature 2-6°C?				
6. Samples preserved appropriately?				
7. Samples received within 2 days of collection?				
8. Any problems noted?				
Laboratory Report and Data Package				
9. Signed Case Narrative included?				
10. Analytical discrepancies noted in case narrative?				
11. Field sample IDs included?				
12. Laboratory sample IDs included?				
13. Date of analysis included?				
14. Date of sample preparation included?				
15. Samples prepared within holding time?				
16. Samples analyzed within holding time?				
17. Detection limit and quantitation limit included?				
18. Project target limits achieved?				
19. Elevated reporting limits justified?				
20. Method references included?				
21. Sample matrix included?				
22. Sample result units reported correctly?				
23. Soil/ sediment results corrected for dry-weight?				
24. MDLs reasonable per DCS?				
25. Calibration data acceptable?				
26. ICV and CCV recoveries within project control limits?				
27. ICB and CCB results <RL?				
28. Method blank results <RL?				
29. Equipment and Trip blank results <RL?				
30. All COIs included in LCS?				
31. LCS recovery within project control limits?				
32. MS/MSD recoveries within project control limits?				
33. LCS/LCSD RPDs within project control limits?				
34. MS/MSD RPDs within project control limits?				
35. Laboratory duplicate RPDs within project control limits?				
36. Field duplicate RPDs within project control limits?				
37. Surrogate recoveries within project control limits?				
38. Internal standard areas within project control limits?				

FIGURE SOP 16-1. DATA VALIDATION CHECKLIST

39. Completeness percentage within project limits?				
Definitions: **CCB** – Continuing Calibration Blank; **CCV** – Continuing Calibration Verification; **COI** – Compounds of Interest; **DCS** – Detectability Check Sample; **ICB** – Initial Calibration Blank; **ICV** – Initial Calibration Verification; **LCS** – Laboratory Control Sample; **LCSD** – Laboratory Control Sample Duplicate; **MDL** – Method Detection Limit; **MS/MSD** – Matrix Spike/Matrix Spike Duplicate; **RL** – Reporting Limit; **RPD** – Relative Percent Difference				
COMMENTS				

FIGURE SOP 16-1. DATA VALIDATION CHECKLIST

DATA VALIDATION CHECKLIST (Level IV only)				
Client Name:	Project Number:			
Property Location:	Project Manager:			
Laboratory:	Laboratory Job No.:			
Reviewer:	Date Checked:			
ITEM	**Yes**	**No**	**NA**	**Comment Number**
Laboratory Report and Raw Data Package				
1. Sample results calculated and transcribed correctly?				
2. QC parameters calculated and reported correctly?				
3. Pesticide breakdown ≤ 15%?				
4. GC/MS tuning performance within criteria?				
5. GC/MS RRF above minimum project requirements?				
6. ICP ICS recoveries within criteria?				
7. ICP ICB/CCB absolute value of results <MQL?				
8. GC qualitative identification criteria met?				
9. GC/MS qualitative identification criteria met?				
10. GC second confirmation %D criteria met?				
COMMENTS				

FIGURE SOP 16-1. DATA VALIDATION CHECKLIST

QUALIFIED DATA TABLE

Field Sample Identification	Assigned Data Qualifier	Reason for Qualification

APPENDIX G

ANALYTICAL LABORATORY
QUALITY ASSURANCE PROJECT PLAN

GCAL
GULF COAST ANALYTICAL LABORATORIES, INC

QUALITY ASSURANCE PROGRAM PLAN

FOR

GCAL Inc.
7979 GSRI Avenue
Baton Rouge, Louisiana 70820

Revision 24
August 26, 2004

Approval Signatures:

10/6/04
Date
President

10/06/04
Date
Operations Manager

10/6/04
Date
QA/QC Director

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1.0 QUALITY ASSURANCE POLICY STATEMENT

Quality Assurance consists of a planned system of activities necessary to provide confidence in the results of laboratory analytical determinations. The principal objective of GCAL is the production of high quality analytical data through the use of measurements that are accurate and reliable for the intended purpose. We are dedicated to providing analytical data and services that conform to all of the requirements specified and expected by our clients. This Quality Assurance Program Plan details facilities, personnel and equipment necessary for accomplishing this objective along with general procedures and practices that will be followed to maintain adherence to the objective. All policies and procedures have been structured in accordance with the NELAC standards adopted in July 1999 and in accordance with applicable state, EPA, and other regulatory agency requirements, regulations, methods, and guidance.

There is a commitment and dedication by all laboratory staff to produce data of known and documented quality. This commitment and dedication to quality is fully supported from the bench level to upper management in order to meet the objectives of our laboratory and best serve our clients.

GCAL's approach to Quality Assurance starts with the General Manager who delineates policy and sets goals in conjunction with senior management personnel. Policies are implemented by management staff and laboratory personnel. All departments are involved in the process by providing assessment of operating procedures along with recommendations for improvements or corrections. The QAPP and the appropriate Standard Operating Procedures are distributed to all laboratory personnel as controlled documents according to SOP QA-001 (Document Control). All personnel are required to read and comply with this program.

The Quality Assurance/Quality Control Director, who reports directly to the General Manager, oversees prevention, assessment, and correction procedures for the analytical laboratory and various associated departments within the organization. These three functions; prevention, assessment, and correction, comprise the foundation of the laboratory's approach to Quality Assurance.

Prevention covers positive actions taken before or during analyses to insure that the analytical systems are functioning properly. Prevention includes such things as instrument calibration and maintenance, frequent standardization, personnel training and quality control planning.

Assessment is a component of quality control that includes monitoring of performance to determine precision and accuracy. Examples include duplicate and spike analyses, check samples, peer review of calculations and validation of methodology.

Correction is action taken to determine the causes of quality defects and to restore proper functioning of the analytical system. This may involve trouble shooting to correct instrument

malfunctions, or retraining of personnel.

All quality assurance activity requires constant monitoring and documentation to provide evidence of consistent, valid analytical data. GCAL keeps records of such activities in order to have available for its clients documented assurance that the data they receive quantitatively reflect the parameters requested.

The policies and practices of quality assurance/quality control presented in this plan are set forth as minimums. Additional quality assurance/quality control measures may be required for a specific project.

2.0 ETHICS POLICY

GCAL utilizes a clearly stated ethics policy in the form of the following Ethics and Data Integrity Statement. This agreement is discussed with all new employees during orientation and is then signed and retained with the employee's training file. Violation of the agreement is basis for termination of employment.

GCAL

ETHICS AND DATA INTEGRITY AGREEMENT

I, _____, state that I understand the high standards of integrity required of me with regard to the duties I perform and the data I report in connection with my employment at GCAL. Our core values are honesty, success, service and integrity, I understand that it is critical for our long-term success that each and every employee align with all company core values.

I agree that in the performance of my duties for GCAL and its clients, I shall conform to the following ethics standards and will report immediately to the Quality Assurance Manager and the appropriate supervisor any information concerning misrepresentation of analytical data that includes, but is not limited to:

1) Altering an instrument computer or clock for any inappropriate purpose;

2) Altering the contents of logbooks and/or data sheets to misrepresent data;

3) Misrepresenting an analyst's identity;

4) Changing raw data documents with correction fluid;

5) Preparation and submittal of "fake" data packages;

6) Inappropriate calibration techniques such as peak shaving, setting fraudulent integrator parameters, or use of computer macros that alter QC results.

7) Changing reported results without proper documentation and approval;

8) Altering injection volumes for calibration and misrepresenting the true values;

9) Failure to comply with standard operating procedures or methods without proper documentation and approval;

10) Any attempt to misrepresent data or events as they actually occur in the course of data production, review or reporting;

11) Disposing of or deleting electronic data files or hardcopy of raw data;

12) Engaging in any practice that ultimately misrepresents data or narratives in any way.

I will not knowingly participate in any such activity and will not tolerate unethical practices by others. I understand that confidentiality will be strictly enforced by GCAL when dealing with these matters. As a further extension of my commitment to this program, I am responsible for seeking approval to report data resulting from techniques or procedures that may deviate from standard operating procedures, methods, or industry standard practices. Any such reporting of data will include a laboratory narrative that must be approved by the appropriate supervisor and the QA Manager.

If I am unsure of how to properly handle data generated by me, I am responsible for seeking advice and approval from the Quality Assurance Manager and the appropriate supervisor. I agree to inform the Quality Assurance Manager and the appropriate supervisor of any accidental reporting of non-authentic data by myself or others within 24 hours of discovery.

I understand that if I knowingly participate in any such prohibited activity, I will be subject to serious disciplinary action that may include termination by GCAL. I also understand that I face individual suspension and debarment from all Federal programs should I be convicted of such practices. I understand that suspension and debarment from all Federal programs affects my ability to work in the environmental field, as well as, any other professions where government funding or loans may be involved. I understand the most serious consequence of unethical conduct can be imprisonment if convicted.

However, it is not the company's intent to punish anyone for an accidental mistake or oversight. Employees will not face disciplinary actions in this case. Repeated careless or neglectful behavior will be subject to corrective action. Covering up a mistake or oversight is not acceptable behavior and will result in termination. Mistakes or oversights should be immediately reported to the Quality Assurance Manager and the appropriate supervisor.

My signature affirms my understanding of the consequences of violating this "ETHICS AND DATA INTEGRITY AGREEMENT" and my commitment to its intent. My signature further affirms that I have received formal training on this topic.

_____
(Signature)

_____
(Date)

3.0 QUALITY ASSURANCE MANAGEMENT

3.1 Quality Assurance Responsibilities

The direct and ultimate responsibility for assuring data quality at GCAL rests with the General Manager. The General manager develops policies and general quality assurance strategies in collaboration with the Operations Manager, QA/QC Director, and Department Supervisors (GCMS-SVOA, GCMS-VOA, GC, Metals, Sample Preparation/Extractions, General Chemistry, Sample Management).

GCAL has clearly defined staff Quality Assurance (QA) responsibilities. The first level of QA lies with the laboratory analyst, who is responsible for performing the work properly, documenting it, and obtaining peer review to assure that it meets scientific standards. To accomplish this, the analyst must have a clear understanding of the analytical techniques and procedures used and the factors which affect the quality of the results. Analysts' capabilities are verified prior to conducting analyses and reviewed periodically thereafter.

Analysts must have a working knowledge of the QA policies, including data quality objectives for laboratory control standards, duplicates, and spikes; an understanding of detection limits and standard calibration requirements; and a knowledge of preventive maintenance techniques.

The second level of quality assurance lies with the management staff which includes Department Supervisors. Management is responsible for the proper training of analysts and stresses the importance of accuracy and reliability of results. Management is responsible for the quality of all analytical data produced. This responsibility includes routine review and approval or disapproval of all data and inspection of the QC records associated with the data. If the data are not adequately substantiated, corrective action is taken.

The QA/QC Director supports the entire process of the QA/QC program. This includes administration of the program as outlined in this manual, maintenance of QA records including this QAPP and preparation of reports to management covering QA activities. The QA/QC Director performs periodic audits of the QA procedures and staff, and coordinates all performance audits (e.g. check sample programs). The QA/QC Director will also assist in the preparation of QA programs to fit specific needs of clients, or for bid proposals.

3.2 Quality Assurance System

3.2.1 Personnel Training

It is the policy of GCAL to hire employees with an educational background and/or experience in an analytical field. On-the-job training takes place for all new employees based on needs identified by the job description and tasks of the position.

The training program begins with an orientation program designed to familiarize the new employee with safety and chemical hygiene issues, the importance of QA/QC in the analytical laboratory, general laboratory procedures, and company policies. All employees undergo training in ethical and legal responsibilities including the potential penalties for improper, unethical, or illegal actions. Each employee must read and sign an Ethics and Data Integrity Agreement. All technical personnel undergo a training process involving twelve lecture tapes covering basic laboratory functions. A written test follows each lecture tape.

New employees are under the supervision of experienced analysts and/or the department supervisors who are responsible for showing them the analytical procedures including the applicable QA/QC. This training includes review of the Standard Operating Procedure (SOP) and applicable instrumentation or equipment. Manuals for various methods are readily available to supplement the SOP for each analysis. Among the manuals are current copies of the EPA Test Methods for Evaluating Solid Waste (SW846), Chemical Analysis for Water and Wastes, Standard Methods and applicable ASTM methods. The analyst will perform an acceptable initial demonstration of capability before the institution of a test method. This is accomplished by analyzing four laboratory control samples (LCS) and verifying that the precision and accuracy requirements of the laboratory or method have been met. This demonstration will be repeated whenever there is a significant change to the instrument or test method.

GCAL also recognizes development training as a means to increase the effectiveness of the employee and the organization. Therefore, GCAL utilizes other applicable training methods along with on-the-job training. Examples of this are seminars, specialized training by instrument manufacturers, internal training courses, and encouraging the employees to take related college courses. On-going proficiency is documented by performance evaluation samples, an annual demonstration of capability, and /or analysis of blind samples.

Training is also necessary for an employee whose performance does not meet standard requirements. This deficiency may be identified in a performance appraisal or through the occurrence of problems.

New employees are hired for a probationary period of three months. At the end of three months the employee's records are reviewed and evaluated for performance and productivity and a decision is made whether to continue employment.

Periodic reviews are given to all personnel. The purpose of these reviews is to give recognition for good work and outline personnel and departmental objectives, suggestions for improvement and clarification of responsibilities. Other topics which concern either employee or employer are also discussed at this time.

Training files are maintained for each employee. The records include the demonstration of capability, performance evaluation and blind study results, training course certificates, in-house or external training seminar documentation, and ethics and manual integration agreements.

A demonstration of continued proficiency is performed annually by each analyst. Documentation is included in the analyst's training file. This is performed in one of the following:

- acceptable performance of a blind sample
- another demonstration of capability (analysis of four LCSs with acceptable levels of precision and accuracy
- succesful analysis of a blind performance sample on a the method or similar test method (e.g., GCMS Volatiles 8260B/624)

3.2.2 Procurement and Inventory Control

Chemical reagents, solvents, gases, glassware and general chromatographic supplies are ordered as needed to maintain sufficient quantities on hand for use. Purchase orders are maintained as an inventory control of materials ordered by the laboratory. All orders are processed through central receiving and routed to the appropriate departments. Routine supplies are maintained on site in an inventory control stock room.

The grade or purity ordered varies depending on the analytical requirements. Standards and reagents are purchased from laboratory approved vendors. All reagents must meet A.C.S. (American Chemical Society) Reagent Grade specifications or better and all purchased standards are NIST traceable (if available). Chemical reagents and standards are dated when received and/or prepared in the laboratory and stored according to manufacturers suggestions. Flammable cabinets are available for hazardous reagents. Several refrigerators and freezers are in use to prevent contamination or deterioration. Incompatible reagents are stored separately. Prepared reagents and standards must include the name, concentration, and expiration date (if applicable).

For all analyses, an independent standard (ICV-second source or lot#) is analyzed after each initial calibration. This standard must meet the criteria established for each analytical method.

It is the responsibility of the analyst to maintain the integrity of all chemicals used and notify the head of purchasing when standards or reagents do not meet specification so that corrective action can be taken. It is also the responsibility of the analyst to contact purchasing ahead of time before supplies are actually needed.

The purchase of analytical instrumentation is based on anticipated sample volume and the need to maintain superior quality data. Specifications are carefully examined to be sure new in-

strumentation meets current and anticipated needs. Warranty and service contract information is gathered at the time bids are reviewed and this information is considered in making the final selection. An extensive performance check-out before the instrument is accepted is mandatory. New equipment must undergo a rigorous method validation before being put into production. Operators of new instruments are sent to training courses if necessary.

Inventory records are maintained for all major capital equipment. Major suppliers of consumable items are:

Allometrics	Templet & Templet	Dionex
Fisher Scientific Company	Supelco	CPI
Environmental Express	Perkin-Elmer	Shimadzu

3.2.3 Standards for Analysis

Preparation of standards for calibration must be made from pure materials (of known purity, 98% or better preferred) or from purchased concentrates certified by NIST, EPA, or other acceptable agencies.

All solvents used for preparation of standards for GC, GCMS, and HPLC are of pesticide grade. All standards, reagents, and solvents used for trace metal analysis must be trace-metal grade.

Stock standards can be kept up to one year if no expiration date is indicated by the manufacturer. All standards must be stored under conditions which provide the best protection against contamination and deterioration. Upon preparation of the standard, the following items must be recorded on the bottle containing the standard: laboratory assigned ID, standard name, concentration, initials of the analyst preparing the standard, date prepared, and expiration date. All other information regarding the standard including solvent used, lot number(s) of solvent used, the analyte source, purity and lot number, expiration date, concentration, dilution procedure, analyst's initials, and date prepared must be entered in the log book (see Miscellaneous Forms at the end of this manual).

Preparation of intermediate standard solutions is necessary for many tests. These working standards include calibration standards, spiking solutions, surrogate solutions, internal standard solutions, etc., and must be stored as required when not in use. Working standards for the analysis of volatile organic constituents must be prepared at least once in two weeks. Working standards for the analysis of semi-volatile organic constituents and pesticides must be prepared as needed or every six months.

Working standards for trace metal analysis should be prepared at least once a month for concentrations of 1 mg/L and less. Calibration standards for mercury are digested as needed and calibration standards for graphite furnace are prepared daily.

The identification of each standard prepared must be unique and all documents related to sample analysis in which the standard was used must contain this unique identification. The document should be such that all of the standard information could be traced from the raw data for the sample.

Freezers and refrigerators are designated for storage of standards. Samples are not stored with standards.

3.2.4 Equipment Operation, Calibration and Maintenance

Equipment is defined as any non-disposable mechanical and/or electronic device used in the generation or measurement of data.

The calibration of instruments and support equipment is required to ensure that the analytical system is operating correctly and functioning within acceptable precision, accuracy and sensitivity limits. Calibration is defined as the systematic determination of the relationship of the response of the measurement system to a known standard. The calibrations or calibration checks are performed with reference standards traceable to primary standards (e.g. NIST or other certified standards). If traceable chemical standards are not available, standards may be prepared according to the laboratory quality control procedures or the project's requirements. The calibration requirements for each type of equipment or instrument are defined in the standard operating procedures. Additionally, specific requirements may be defined in a project plan.

1. Equipment for the generation, measurement or determination of data shall be adequately calibrated.

2. Equipment shall have adequate procedures for operation, calibration, maintenance and quality control which shall:
   -Be prepared in written form as an SOP
   -Be congruent with the manufacturer's recommendations
   -Reflect actual use patterns for the equipment
   -Establish frequency intervals particular to the equipment

3. Equipment shall be calibrated and maintained in accordance with the procedures and schedules detailed in the equipment SOP.

4 Calibration and maintenance intervals begin from the date of last calibration or service.

5. Equipment maintenance shall be documented and the records retained in accordance with the logging requirements of the SOP, in the respective equipment file.

The Operations Manager and/or the Department Supervisor shall:
- Identify, compile and write the SOP
- Make pertinent SOP's available to the appropriate staff (This is to be coordinated with the QA Manager)
- Maintain instrument SOP's with the equipment or instruments. Operation manuals shall also be available in the immediate work area. The Department Supervisor is responsible for verifying that the manufacturer's manuals are kept up-to-date by replacing obsolete information with updates provided by the manufacturer.
- Ensure that the logbooks are initiated and maintained in accordance with the SOP's
- Review records for completeness and accuracy, which indicates the equipment, is in proper working order.
- Monitor and assure compliance with the SOP.

The Quality Assurance Department shall:
-Coordinate SOP preparation.
-Coordinate review/revision of SOP's.
-Reproduce and issue SOP's.
-Retain current and historical copies of the SOP's.
-Maintain distribution list of issued SOP's. Recall superseded copies.
-Verify compliance (via inspections).

The calibration of analytical balances is verified daily before use at a mass or masses that bracket the measurements performed on the balance. NIST traceable weights are used for the verification. The balance verifications are documented in a logbook assigned to each balance. The acceptance criteria for the verification is based on the balance sensitivity requirement and the particular weight and is documented in the front cover of each log book.

All refrigerators and freezers are monitored for proper temperature by measuring and recording internal temperatures on a daily basis. The temperatures are documented in a logbook assigned to each refrigerator or freezer. The acceptance criteria for the temperatures is identified in the logbooks. Thermometers are checked at least annually against a NIST traceable thermometer.

The calibration of variable volume mechanical pipets is performed at one to three volumes that bracket the range of use on the day of use. Fixed volume mechanical pipets are verified monthly. The accuracy of non-standard labware is verified gravimetrically unless the manufacturer supplies the accuracy tolerances. All gravimetric verifications are documented in a logbook.

Other support equipment such as ovens, waterbaths, and digestion blocks are monitored for compliance with the specified temperature ranges. All checks are documented in the appropriate logbook.

Calibration of an instrument is accomplished by relating a response to a concentration of an analyte. Each SOP defines the requirements for the initial calibration curve such as the number of standards, the acceptance criteria and the frequency for calibration. On a daily basis, the calibration of the instrument must be verified at the concentration and frequency

defined in the SOP.

Maintenance is defined as cleaning and/or replacing equipment components to assure that the equipment has been properly and periodically serviced and is in satisfactory condition.

It is the responsibility of the analyst to verify that the instrument configuration and operating conditions used satisfy the analytical requirements and to maintain quality control data confirming instrument performance and analytical results.

If equipment outside the permanent control of the laboratory is utilized, it must meet the same criteria above. The laboratory shall ensure that the function and calibration status of the equipment is checked and shown to be satisfactory before it is put into service. The equipment must meet all requirements of LADEQ regulations/NELAC standards.

3.2.5 Reporting and Recording Data

All raw data is recorded in bound books and/or by instrument printout. This includes such information as standard curves, matrix spikes, duplicates, reagent blanks, calculations and any notations concerning a given analysis. All preventive maintenance information is recorded in a logbook assigned to each instrument.

When analyses are complete, the information is downloaded or manually entered into the LIMS. The data is then reviewed and authorized by the Department Supervisor. The final report is then printed. GCAL has the capabilities to produce several levels of reports. These include a LIMS report with batch QC, a CLP like forms package, and a full CLP like deliverable package. The level of reporting should be specified when the samples are submitted. After the complete package is assembled, the data validation manager or his designee will review the data. Only after the reports have been authorized and signed by the Operations Manager or his designee are they released to the client. After final approval of the reported data, various electronic deliverable formats can be produced to submit data by electronic means.

The laboratory will retain all records related to sample analysis including raw test data, calculations, derived data, calibrations and copies of test reports. These records will be stored in systematic manner for a minimum of five years. Longer periods of storage may be arranged at the time of a project initiation. If the laboratory is going out of business, clients will be notified at least 60 days (if time permits) prior to closure of the laboratory and will receive a final report for all submitted samples. The client notification will request instructions on the retention or distribution of laboratory records and will provide contact information for after the closure.

Additional information is kept in-house for documentation of control. This includes performance evaluation reports, equipment and supplies inventory, control charts for laboratory control samples, matrix spikes and duplicates, quality assurance audits, standards as knowns, standards as blinds and method validations. This information is used by management to track the progress and needs of the corporation.

3.3 Quality Assessment

Quality assessment is accomplished by monitoring the accuracy, completeness, and precision of the quality control data, such as blanks, calibration curves, duplicates, spikes, internal standards or surrogates. Additionally, system audits, standards as knowns and standards as blinds may be used to validate the correctness of numerical computations. Other tools are preventive maintenance, performance evaluations and chain-of-custody procedures. By proper maintenance of these tools, the entire system of data production is verified.

3.3.1 Processing of Quality Control Data

This section describes the analytical treatment of the data resulting from the quality control samples through specific routine procedures used to assess data precision and accuracy.

A reagent and/or method blank is prepared and analyzed with each set of samples. Field blanks (if provided by the client) are analyzed to determine possible sample contamination during collection and shipment to the laboratory. Trip blanks are applicable to volatile organics analysis (VOA) where volatile contaminants can be introduced from ambient air on site, during shipment, and in the laboratory.

A Laboratory Control Standard (LCS) consisting of an interference free matrix spiked with the analytes of interest or a representative list of the analytes of interest is prepared and analyzed with each batch of twenty or fewer samples. Analyte-free reagent water is used for water samples. A purified solid matrix such as Ottawa sand or sodium sulfate is used for soil or solid samples. For those tests that it is difficult to obtain a suitable solid matrix for spiking, analyte free reagent water is taken through the preparation and analysis procedure. The LCS may also be a standard reference material. A matrix spike (a sample to which known concentrations of target analytes have been added before sample manipulation) is performed on one sample in each batch of twenty or fewer samples for those tests that spiking is applicable. A duplicate for each matrix type is included in each batch of twenty or fewer samples. Routinely, the laboratory includes a matrix duplicate (a sample the laboratory divides into two aliquots) in inorganic test batches and a matrix spike duplicate (a duplicate of the matrix spike) in organic test batches. The type of duplicate to include in a batch may be modified based on specific project requirements. Additionally, a matrix duplicate may be performed instead of matrix spike duplicate if it is known that the target analytes are present in the sample and a matrix spike duplicate may be performed instead of a matrix duplicate if it is known that target analytes are not present in the sample. A Laboratory Control Standard Duplicate (LCSD) is included if insufficient sample is available to perform a duplicate on a sample.

If required by the method, each sample is spiked with the appropriate surrogate standards prior to extraction and analysis for all organic compounds analysis. Internal standards are added to all samples for GC Volatiles, GC/MS Volatiles and GC/MS Semi-volatiles testing prior to analysis. A continuous flow internal standard is used for ICP analysis.

When the analysis of a sample set is completed, the results will be reviewed and evaluated to

assess the validity of the data set. Review is based on the following criteria:

Reagent Blank Evaluation - The reagent and/or method blank results are evaluated for high readings characteristic of background contamination. If high blank values are observed, laboratory glassware and reagents should be checked for contamination and the analysis halted until the system can be brought under control before further sample analysis proceeds. The concentration of an analyte in a reagent blank must be less than ½ the reporting limit or less than 5% of the analyte detected in the associated samples.

Field Blank Evaluation - Field blank results are evaluated for high readings similar to the reagent and/or method blanks described above. If high field blank readings are encountered, the procedure for sample collection, shipment, and laboratory analysis should be reviewed. If both the reagent and/or method blanks and the field blanks exhibit significant background contamination, the source of contamination is probably within the laboratory. In the case of VOAs, ambient air in the laboratory and reagents should be checked as possible sources of contamination.

Calibration Standard Evaluation - The calibration curve is evaluated to determine linearity through its full range, and that sample values are within the range defined by the low and high standards. If the curve is not linear, sample values must be corrected for nonlinearity by deriving sample concentrations from a graph or by using an appropriate algorithm to fit a nonlinear curve to the standards.

Duplicate Sample Evaluation - Duplicate sample analysis for the sample set is used to determine the precision of the analytical method for the sample matrix. The duplicate results are used to calculate the precision as defined by the relative percent difference (RPD). If the RPD is above the control limit, the sample set may be re-analyzed for the parameter in question or the failure is documented in the case narrative.

Matrix Spike Evaluation - The observed recovery of the spike versus the theoretical spike recovery is used to calculate accuracy as defined by the percent recovery. If the accuracy value exceeds the control limits for the given parameter, the LCS is reviewed to verify the analytical system is in control. The failure may be a result of an error or the matrix. If the accuracy value exceeds the control limit, the sample set may be reanalyzed for the parameter in question.

Reference Standard Evaluation - Standard Reference Materials analyses are compared with true values and acceptable ranges. Values outside the acceptable ranges require corrective action to determine the source of error. All sample analyses should be halted pending this evaluation. Following correction of the problem, the SRM should be reanalyzed.

Laboratory Control Standard Evaluation - The results of check standard analyses are compared with the true values and the percent recovery of the check standard is calculated. If correction is required, the check standard should be reanalyzed to demonstrate that the corrective action has been successful. Control chart data is reviewed periodically to verify the laboratory is

performing within the established control limits.

Surrogate Standard Evaluation - The results of surrogate standard determinations are compared with the true values spiked into the sample matrix prior to extraction and analysis. The percent recoveries of the surrogate standards are calculated and reported with the sample results. If recoveries are outside the control limits, re-preparation and analysis may be required. The specific corrective action required is documented in each applicable SOP.

Additional data validation is accomplished by participation in performance evaluations such as those sponsored by EPA approved suppliers which provide further review for in-house QA/QC procedures.

3.3.2 Statistical Quality Control

As part of the analytical quality control program, the precision and accuracy for each analytical method is established by the use of control charts. This may include only a subset of the target analytes. The charts are used to assess the method performance over a period of time. A minimum of twenty measurements of precision and accuracy are used to establish a chart. In general, control limits of ±three standard deviations are utilized.

Control charts are developed to predict trends (positive or negative) in the analytical processes and to determine when an analysis is out of control.

Examples of situations which may show up in control charts are:

- Shift in mean - this may be caused by incorrectly prepared standards or reagents, contamination of sample, problems in instrument calibration, or analyst error.
- Trend of mean upward - this may be caused by deterioration of standards or reagents.
- Trend of mean downward - this may be caused by concentration of standard due to evaporation of solvent or deterioration of reagents.
- Increase in variability - this may be caused by poor technique by the analyst or deviation from procedure.

3.3.2.1 Precision

Precision is the measure of how closely multiple analyses of a particular sample agree with each other. To determine the precision of the method and/or laboratory analyst, a routine program of duplicate analyses is performed. The results of the duplicate analyses are used to calculate the relative percent difference (RPD), which is the governing quality control parameter for precision.

The relative percent deviation (RPD) for duplicate analyses is defined as 100 times the difference (range) of each replicate set, divided by the average value (mean) of the duplicate set.

3.3.2.2 Accuracy

In addition to the evaluation of analytical precision, GCAL evaluates accuracy. Accuracy is the measure of the closeness of an observed value to the "true" value (theoretical or reference value or population mean). The accuracy of an analytical method and/or the laboratory analyst, is based on the analysis of laboratory control standards. The results laboratory control standards are used to calculate the quality control parameter for accuracy evaluation, the Percent Recovery (%R).

The %R is defined as 100 times the observed concentration divided by the true concentration of the spike.

3.3.3 Data Validation

Data validation is performed to check data integrity and to verify that the data is correct and of an acceptable quality. Data integrity involves reviewing all documentation for errors and mistakes. It includes review for correct documentation of sample ID's, verification that holding times were met, transcription errors, correct calculations, complete records, and for acceptable chain of custody documentation. A review of the data is performed to verify the results and to assure that all QC is within acceptable criteria. The data is reviewed according to the criteria that applies to the particular analysis and according to the client specific project requirements. The reviewer will identify unacceptable data and initiate the appropriate corrective actions.

Data validation begins with the processing of data. Data processing can be performed by the analyst who obtained the data or by another analyst. Validation continues with checking that the data processing has been done correctly. This step can be performed by an independent analyst or the Department Supervisor. At this time a member of the QA/QC Department may review the data processing. All those who review data processing shall indicate this by signature and date on the documents validated or reviewed.

In general, data will be processed by an analyst in one of the following ways:

- Manual computation of results directly on the data sheet or on calculation pages attached to the data sheets
- Input of raw data for computer processing
- Direct acquisition and processing of raw data by a computer.

If data is manually processed by an analyst, all steps in the computation shall be provided

including equations used and the source of input parameters such as response factors, dilution factors, and calibration constants. The analyst shall sign and date in ink each page of calculations. For data that are input by an analyst and processed using a computer, a copy of the input shall be kept and uniquely identified with the sample numbers and other information as needed. The samples analyzed shall be evident and the input initialed and dated by the analyst. If data are directly acquired from instrumentation and processed, the analyst shall verify that the following are correct: sample numbers, calibration constants and response factors, output parameters such as units, and numerical values used for detection limits. The analyst shall initial and date the resulting output.

The Department Supervisor or his representative will validate the data entered into the LIMS. The data is then released to the Report Generation department for generation and preparation of a final report. Data reports must be reviewed to verify that information reported by GCAL corresponds with processed analytical results. The final report is reviewed by the Data Validation department prior to transmission of the report from the laboratory. The laboratory Data Validation Manager or his designee signs the final report. The client will be notified in writing if there were any difficulties encountered while performing the analysis.

4.0 ADMINISTRATIVE ORGANIZATION

GCAL is organized along clear lines of authority to provide our clients with service that is efficient and reliable. The organizational structure of the laboratory is shown in Appendix A. To assure communication between the departments, key personnel meet weekly, or more frequently as needed to discuss and coordinate the activities in the laboratory. The laboratory personnel also meet daily with project management to discuss key issues for that day. Resumes of key personnel are attached in Appendix A.

It is the policy of the laboratory that at each management and operational level a designated deputy or deputies will maintain continuity of service and other functions in the event of absence of key staff.

Each department within the laboratory has specific roles and responsibilities in terms of producing a product of known quality. All laboratory personnel are expected to have a working knowledge of the Quality Assurance Program Plan.

The General Manager bears the primary responsibility for data quality at the laboratory. The General Manager directs the functional areas of marketing, finance and administration for the laboratory.

The Operations Manager is responsible for coordinating the activities of analysts and technicians. The Operations Manager assures the commitment of sufficient resources for the timely generation of data of a known quality. The technical operation of the laboratory is the responsibility of the Operations Manager.

The Technical Services Manager is responsible for coordinating the activities of the sample administration department, client services, and administrative support personnel.

The Information Technology Director manages the implementation and development of information technology tools. He is also responsible for the automated data collection systems used by the laboratory. He performs strategic planning for IT projects based on projected needs of the Laboratory. Interacts with clients to determine IT requirements such as electronic deliverables.

The QA/QC Director is responsible for the preparation and maintenance of the laboratory Quality Assurance Program Plan. The QA/QC Director acts as the official laboratory contact for audits, performance evaluation studies, and project-specific quality control issues. The QA/QC Director approves and confirms the implementation of corrective actions. The QA/QC Director is responsible for the approval and distribution of controlled documents. The QA/QC Director has the authority to intercede in all areas where quality related problems exist. No work will be released until the related quality deficiency has been corrected and approval has been given to proceed forward.

Department Supervisors are responsible for the overall flow of work and data through the laboratory. They are responsible for the maintenance of accurate SOP's. Further responsibilities include general management of all activities within their department, ensuring that all instrumentation and equipment meet performance criteria and calibration requirements, and training of laboratory staff. The Supervisor is responsible for validating data released from the department. Department Supervisors inform the Operations Manager or Technical Services Manager of project status and capacity issues.

Project Managers act as liaisons between the laboratory and the client. Responsibilities include sample scheduling, communicating project-specific requirements to laboratory personnel, review of log-in summaries, notifying the client of any sample receipt or analytical problems, monitoring the progress of analytical work, and providing data to clients in a timely manner. Project Managers document client complaints.

At the bench level, analysts/chemists are responsible for the generation of data by analyzing samples according to written SOP's. They are also responsible for ensuring that all documentation related to the analysis is accurate and complete. The analyst/chemist should inform the Department Supervisor of quality problems immediately. The analysts/chemists have the authority to accept or reject data based on compliance with QC acceptance criteria. Analysts/Chemists are responsible for initial review of all data.

The Data Validation Manager is responsible for review of final reports. Any discrepancies found in the data is reported to the appropriate Department Supervisor for review and correction if necessary.

5.0 FACILITY DESCRIPTION AND CAPITAL EQUIPMENT

5.1 LABORATORY FACILITIES

GCAL is a full service environmental laboratory. The laboratory was established in 1979 with a staff of two and has grown to its present size of over 55 employees operating in a modern laboratory space of 20,000 square feet.

The laboratory's working areas are subdivided into areas for instrumental analysis, wet chemistry and sample preparation . These areas are designed to allow for a safe and comfortable working environment with special attention having been given to ventilation, air flow patterns and environmental controls. Administrative and Marketing areas are located for optimization of supervision and to allow for efficient handling of paperwork and results. The laboratory is protected by an electronic security system. A floor plan of the facility is included in this document.

5.2 CAPITAL EQUIPMENT

Laboratory equipment and instrumentation are maintained in compliance with instrumentation manuals. All equipment is kept in working condition to allow for conformity to each approved method. The key instrumentation such as Gas Chromatography, Mass Spectrometers/Gas Chromatographs, ICP and Atomic Absorption Spectrometers have maintenance contracts with their respective suppliers. A list of instrumentation and equipment is included in Appendix B.

6.0 PREVENTIVE MAINTENANCE

In order to prevent system down time, minimize corrective maintenance cost and to help insure data validity, GCAL uses a system of preventive maintenance.

Specific operator manuals are used to pinpoint steps in the preventive maintenance scheme for individual instruments. All routine maintenance is performed as recommended by the manufacturer. These manuals also assist in identification of commonly needed replacement parts so that an inventory of these parts can be properly maintained. Maintenance contracts are purchased for most instruments. This insures periodic preventive maintenance visits by factory authorized service representatives and immediate service for corrective actions if required.

An instrument log, is associated with each instrument. Notation of the date and preventive maintenance activity is recorded when performed. This includes routine service checks by laboratory personnel as well as factory service calls. Instrumentation logs are periodically reviewed by the QA manager and the information contained in them is used to help identify long and short term equipment needs of the laboratory. This log also provides a written source for future use in preventive maintenance. A preventive maintenance SOP details the frequency and type of routine maintenance required for laboratory instrumentation. Maintenance logs are also used for ovens, refrigerators, incubators, etc. The log is to ensure that every facet in the operation of this lab is correctly documented.

Calibration curves, verification standards and internal standards insure that an instrument produces acceptable results. If calibration values do not conform to the expected results, calibration is repeated. An operator may perform routine maintenance at this point if problems persist. Some examples of these tasks would be the replacement of a nebulizer, adjusting an uptake level, cleaning a mixing chamber or replacing a column. Intensive maintenance is performed by authorized representatives of the instrument manufacturer.

All balances are serviced by an external certified service engineer semi-annually. Analytical balances are calibrated daily, using Class S weights. The Class S weights are re-certified annually. Daily temperature logs are also kept for other instrumentation to insure reliable analytical data. All liquid-in-glass thermometers used for recording temperatures are calibrated against a NIST-traceable thermometer yearly. The calibration of dial-type thermometers and temperature probes are checked quarterly against a NIST-traceable

thermometer.

When a piece of equipment is deemed defective, it is taken out of service and identified with an orange "OUT OF SERVICE" label. For support equipment such as balances, ovens, coolers, and pipettors, the QA/QC Department is notified so that proper servicing and repair can be scheduled. Routine and preventive maintenance for major instrumentation is performed by the analysts. If outside service is necessary, it is scheduled by the Department Supervisor, with approval from the Operations Manager. Satisfactory instrument performance must be verified prior to returning to service any repaired equipment.

7.0 CORRECTIVE ACTION

Corrective actions are a continual part of GCAL's plan for quality assurance in sample analysis. When errors, deficiencies, or out-of-control situations develop, corrective action is taken.

Every attempt is made by the laboratory staff to comply with the requirements set forth in the methodology, Standard Operating Procedures, and the Quality Assurance Program Plan. If departures are needed due to client requests they will be reviewed by the Operations Manager and the QA/QC Director. If departures from specified requirements occur due to unforeseen circumstances , the occurrence will be documented. If samples are affected by the departure the client will be notified and a case narrative will be included with the report. Corrective action will be initiated if necessary

On-the-spot or immediate action usually applies to spontaneous, or generally non-recurring problems, such as an instrument malfunction. Long-term corrective action is used to eliminate unsatisfactory conditions in order to improve overall data quality.

On-the-spot Corrective Action Procedure: Any staff member who detects/suspects nonconformance to previously established criteria or procedure in equipment, instruments, data, methods, etc. shall immediately notify the appropriate department supervisor and/or Operations Manager. In many cases, the staff member will be able to correct the problem.

When a situation results in a change in data reported, a corrected report shall be prepared and submitted to the client. The corrected report file copy shall then be attached to the top of the original report file copy so that sample analytical data is complete and accurate.

If a large quantity of data is affected, or if any of the analyses conducted during the suspect period were of a critical nature, or if the program involved is one which requires documented corrective action, the long-term corrective action procedure is to be followed.

Long-term Corrective Action Procedure: Any staff member who detects a recurring or unresolved quality assurance problem shall advise the Operations Manager and the QA/QC Director. The QA/QC Director shall notify the Operations Manager and the Department Supervisor if applicable, and prepare and route a Corrective Action Form (CAF), and advise

GCAL management by copy of the CAF (See Miscellaneous Forms).

As determined appropriate, the staff member, Department Supervisor, Operations Manager, QA/QC Director, and GCAL management shall consult to determine a suitable corrective action plan and report same on the CAF. The corrective action shall be initiated, documented and results forwarded to QA/QC Director. The QA/QC Director shall investigate to verify resolution. The QA/QC Director shall close the CAF or plan for follow up if determined necessary before CAF may be considered closed. If the corrective action was unsuccessful, the above procedure is to be repeated.

In the event that data reported to clients has been affected/corrected, they will be contacted in writing by the QA/QC Director, informing them of the circumstances and that a corrected report will be issued to them.

Corrective action forms will also be used to document and investigate customer inquiries and complaints.

8.0 LABORATORY EVALUATION AND AUDIT

8.1 Performance Audits

As a check on the laboratory's accuracy and precision, as well as to demonstrate performance for certification, GCAL participates in several inter- and intra-laboratory check sample programs. The intra-laboratory check sample program includes the submission of blind samples (duplicates and spikes) by the QA/QC Director. These samples are analyzed as routine samples by normal procedures with no additional priority or care by the analyst. In this way, a normal laboratory analysis is completed and reviewed by the QA/QC Director to monitor the control of test procedures and analysts.

We participate in the following programs to demonstrate analytical proficiency or to provide proof of acceptable performance for certification by outside agencies.

- Water Pollution Performance Evaluation Studies
- Soil Studies

8.2 System Audits

System audits are performed to determine if all aspects of the QA program are operational.

The following elements of the program are reviewed by the QA/QC Director:

Sample handling, including custody and storage procedures
Sample analysis
Records
Preventive maintenance
Check sample programs (proficiency testing)
Training

Through use of a check list, the QA/QC Director reviews all information pertaining to QA at this time, summarizes the situation and notes any deficiencies. A report is prepared based on the audit and is distributed to management in a timely manner. The report is also discussed with laboratory personnel so that a concerted effort can be made to correct any deficiencies as well as provide positive feedback.

The QA/QC department conducts a review of 5% of all final reports. The review includes a complete audit of the raw data and the report.

8.3 Annual Management Review

The laboratory quality system will be reviewed annually by the management. The review will ensure the suitability and effectiveness of the quality system and introduce any necessary changes and improvements. The review will include at least the following:

- Matters arising from the previous review
- Review of audit reports – external and internal
- Proficiency study results and corrective actions
- Results of in-house quality checks
- Client complaints
- Staff training
- Adequacy of staff, equipment, and facility resources
- Future plans and estimates for new work and new staff

9.0 SUBCONTRACTING OF ANALYSIS

Sub-contracting laboratories will be reviewed with an emphasis on their overall quality control practices and compliance to GCAL quality assurance requirements. Any laboratory used for subcontracting must be certified or accredited if required for the project. The QA/QC Department will submit a request to lab to provide verification of certification or will notify the appropriate accrediting authority to verify certification. If testing is subcontracted to another laboratory, the client will be notified in writing.

10.0 ANALYTICAL METHODOLOGY

GCAL utilizes methods of analysis that provide evidence of analyte identification, separation from interfering substances, limits of measurement appropriate to that of analyte concentration and reasonable measures of precision and accuracy of the data obtained. Depending upon the analysis requested and the sample matrix, the methods used may be official, standard or reference, screening, or modified. Analyses will be performed in accordance with the methods cited herein unless specific project requirements or needs dictate adoption of an alternate method or modification of the cited methods.

If analysis is performed in an alternate manner, the method shall be documented. Documentation is dependent upon the specific instrumentation and data collection and reduction methods used within the lab. Methods used directly from official or standard procedures are referenced as such. Routinely used procedures are available in each department and are also available on the internet. Official protocols are used when required or requested.

The methods indicated in the following tables are typical and for information purposes only. Additional methods are available, including industrial hygiene methods.

10.1 Arrangements Ensuring Laboratory Review of New Work

For the laboratory to perform additional work within its scope or to expand its scope of testing a thorough review must be undertaken. Laboratory management considers available resources and current and pending workload prior to accepting new work.

It is the responsibility of the Laboratory Operations Manager, with input from the department supervisors and General Manager, to assess the ability of the laboratory to accept new work.

ORGANICS

PARAMETERS	METHOD	REFERENCE
Aromatic Volatile Organics	8021B	2
Benzidine	605	6
Explosives	8330	2
Phenols	604 8041	6 2
Organochlorine Pesticides	608 8081A	6 2
PCB's	8082	2
TPHG	8015BM	2
TPHD	8015BM	2
GRO	8015BM	2
DRO	8015BM	2
ORO	8015BM	2
Petroleum Range Organics	FL-PRO	10
Total Petroleum Hydrocarbons	TX1005/1006	13,14
EPH	MASS	15
VPH	MASS	16
Organophosphorus	8141A	2

Pesticides		
Chlorinated Herbicides	8151A	2

ORGANICS

PARAMETERS	METHOD	REFERENCE
Dissolved Gases	RSK175	9
GC/MS Volatile Organics	624 8260B	6 2
GC/MS Semivolatile Organics	625 8270C	6 2
GC/MS SIM	8270C	2
HPLC-PAHs	8310	2
Solvents	8000	2
Alcohols	8000	2
Methanol	94.03/99.01	11
Extractions and Preparations		
TCLP	1311	2
SPLP	1312	2
Liquid-Liquid	3510C 3520C	2 2
Ultrasonic	3550B	2

ORGANICS

PARAMETERS	METHOD	REFERENCE
Extractions and Preparations		
Waste Dilution	3580A	2
Soxhlet	3540C	2
Purge & Trap	5030B	2
Closed System Purge & Trap & Extraction for VOA in Solids and Wastes	5035	2

METALS

PARAMETERS	METHOD	REFERENCE
Aluminum		
-ICP	200.7	7
	6010B	2
Antimony		
-GFAA	204.2	1
	7041	2
-ICP	200.7	7
	6010B	2
Arsenic		
-GFAA	206.2	1
	7060A	2
-ICP	200.7	7
	6010B	2
Barium		
-ICP	200.7	7
	6010B	2
Beryllium		
-ICP	200.7	7
	6010B	2
Boron		
-ICP	200.7	7
	6010B	2
Cadmium		
-ICP	200.7	7
	6010B	2
Calcium		
-ICP	200.7	7
	6010B	2

METALS

PARAMETERS	METHOD	REFERENCE
Chromium		
-ICP	200.7	7
	6010B	2
Chromium (Hexavalent)		
-colorimetric	7196A	2
Cobalt		
-ICP	200.7	7
	6010B	2
Copper		
-ICP	200.7	7
	6010B	2
Iron		
-ICP	200.7	7
	6010B	2
Lead		
-GFAA	239.2	1
	7421	2
-ICP	200.7	7
	6010B	2
Magnesium		
-ICP	200.7	7
	6010B	2
Manganese		
-ICP	200.7	7
	6010B	2
Mercury		
-Cold vapor	245.1	1
	7470A	2
	7471A	2
Molybdenum		
-ICP	200.7	7
	6010B	2
Nickel		
-ICP	200.7	7
	6010B	2

METALS

PARAMETERS	METHOD	REFERENCE
Phosphorus	200.7	7
Potassium		
-ICP	200.7	7
	6010B	2
Selenium		
-GFAA	270.2	1
	7740	2
-ICP	200.7	7
	6010B	2
Silver		
-ICP	200.7	7
	6010B	2
Sodium		
-ICP	200.7	7
	6010B	2
Strontium	200.7	7
-ICP	6010B	2
Thallium		
-GFAA	279.2	1
	7841	2
-ICP	200.7	7
	6010B	2
Tin		
-ICP	200.7	7
	6010B	2
Titanium		
-ICP	200.7	7
	6010B	2
Vanadium		
-ICP	200.7	7
	6010B	2
Zinc		

-ICP	200.7	7
	6010B	2

METALS

PARAMETERS	METHOD	REFERENCE
Zirconium		
-ICP	200.7	7
	6010B	2
Sample Preparation Methods		
- Acid Digestion – Aqueous FLAA & ICP	200.7	7
	3010A	2
- Acid Digestion – Aqueous GFAA	200.0, 2XX.X	1
	3020A	2
- Acid Digestion – Solids	3050B	2
- Microwave Assisted Acid Digestion – Solids & Organic Matrices	3051	2
	3052	2
- TCLP	1311	2
- SPLP	1312	2

INORGANICS

PARAMETERS	METHOD	REFERENCE
Acidity	305.1/305.2	1
	2310 B	3
Alkalinity	310.1	1
	310.2	1
	2320 B	3
Ash	D482	4
BOD/BODC	405.1	1
	5210 B	3
Bromide	320.1	1
	300.0	1
	9056	2
BTU – Heat of Combustion	D240-92	4
Cation Exchange Capacity	9080	2
COD	Hach 8000/8328	5
Corrosivity	1110	2
	9040	2
	9045	2
Chloride	325.3	1
	300.0	1
	9056	2
	9251	2
Residual Chlorine	330.3	1
	4500-Cl G	3

INORGANICS

PARAMETERS	METHOD	REFERENCE
Coliform		
-Fecal	9222 D	3
Color	110.2	1
	2120 C	3
Conductivity	120.1	1
	2510 B	3
	9050A	2
Corrosivity Toward Steel	1110	2
Cyanide		
-Free	335.3	1
-Total	335.2/335.3	1
	9012A	2
-Amenable to Chlorination	335.1/335.3	1
	9012A	2
Density	2520C	3
Fluoride	340.1	1
	300.0	1
	9056	2
Hardness		
-Calculation	2340B	3
Ignitability	1010	2
	1030	2.
% Moisture	SW846	2
Nitrogen		
-Ammonia	350.2	1
	350.3	1
	4500-NH_3BF	3
	4500-NH_3BF	3

INORGANICS

PARAMETERS	METHOD	REFERENCE
Nitrogen		
-Kjeldahl	351.3	1
	4500-NH_3BE	3
	4500-NH_3BF	3
-Nitrate	353.2	1
-Nitrite	353.2	1
-Total Nitrate-Nitrite	353.2	1
Oil & Grease	1664A	8
	9070	2
	9071A	2
Oxygen, Dissolved	360.1	1
	4500-OC	3
Paint Filters Liquids Test	9095A	2
Phenolics	420.1/420.2	1
	9066	2
pH	150.1	1
	4500-H^+B	3
	9040A	2
	9045A	2
Phosphorus		
-Orthophosphate	365.2	1
	4500PBE	3
-Total Phosphorus	365.1	1
Reactivity		
-Cyanide	7.3.3.2	2
-Sulfide	7.3.4.2	2
Silica, Dissolved	370.1	1
	4500-SiD	3

INORGANICS

PARAMETERS	METHOD	REFERENCE
Solids		
-Total Dissolved	160.1	1
	2540 C	3
-Total Suspended	160.2	1
	2540 D	3
-Total Solids	160.3	1
	2540 B	3
-Total Volatile Solids	160.4	1
	2540 E	3
-Volatile Suspended Solids	2540 E	3
-Settleable	2540 F	3
Specific Gravity	2710 F	3
Sulfate	375.4	1
	300.0	1
	9038	2
	9056	2
Sulfide	376.1	1
	376.2	1
	4500-S^{-2}D	3
	9034	2
Sulfite	377.1	1
	4500-SO_3^{-2}B	3
Surfactants		
-Ionic (MBAS)	5540 C	3
-Non-Ionic (CTAS)	5540 D	3
Total Organic Carbon (TOC)	415.1	1
	5310B	3
	9060	2
Total Organic Halides (TOX)	450.1	1
	9020B	2
	5050/9056	2

INORGANICS

PARAMETERS	METHOD	REFERENCE
Turbidity	180.1 2130 B	1 3
Viscosity	D2196	4
Perchlorate	314.0	12
Sample Preparation Procedures		
- Alkaline Digestion – Cr^{+6}	3060A	2
- Bomb Prep Method for Solid Waste	5050	2
- Distillation – Sulfides	9030B	2
- SPLP	1312	2

METHOD REFERENCES

1) EPA 600 4-79-020, Methods For Chemical Analysis of Water and Wastes, 1983, second printing.

2) EPA SW-846, Test Methods for Evaluation Solid Waste, 3rd Edition, Update I dated 7/92, Update II dated 9/94, Update IIA dated 8/93, Update IIB dated 1/95, Update III dated 12/96.

3) APHA/AWWA/WPCF, Standard Methods for the Examination of Water and Wastewater, 18th Edition, 1992.

4) ASTM, American Society for Testing & Materials.

5) Hach Company, EPA Approved Procedures for Water and Wastewater, 1986.

6) 40 CFR Part 136 Appendix A, Test Procedures for Analysis of Organic Pollutants

7) Method 200.7, Determination of Metals and Trace Elements in Water and Wastes By Inductively Coupled Plasma-Atomic Emission Spectrometry, Revision 4.4, EMMC Version, May 1994.

8) EPA-821-R-98-002, USEPA Office of Water Analytical Methods; Method 1664, Revision A: N-Hexane Extractable Material (HEM; Oil and Grease) and Silica Gel Treated N-Hexane Extractable Material (SGT-HEM; Non-polar Material) by Extraction and Gravimetry, February 1999.

9) EPA Standard Operating Procedure

10) Florida Department of Environmental Protection, Method For Determination of Petroleum Range Organics, FL-PRO, Revision 1, November 1995.

11) NCASI Method DI/MEOH-94.03, Methanol in Process Liquids by GC/FID, May 2000 and NCASI Method DI/HAPS-99.01, Selected Haps in Condensates by GC/FID, February 2000.

12) NERL, Office of Research and Development, EPA; Method 314.0, Determination of Perchlorate in Drinking Water Using Ion Chromatography, Revision 1.0, November 1999.

13) TNRCC; Method 1005, Total Petroleum Hydrocarbons, Revision 03, June1,2001.

14) TNRCC, Method 1006, Characterization of Nc_6 to Nc_{35} Petroleum Hydrocarbons in Environmental Samples , Draft

15) Massachusetts Department of Environmental Protection, Method for the Determination of Extractable Hydrocarbons (EPH), Revision1

16) Massachusetts Department of Environmental Protection, Method for the Determination of Volatile Hydrocarbons (VPH)

11.0 STANDARD OPERATING PROCEDURES

GCAL employs standard procedures for all work performed. These standard procedures insure that work is completed in a professional and timely manner and that all contractual obligations are met.

The standard operating procedures cover (1) sample receipt and handling, (2) data generation, reduction and validation, and (3) sample and waste disposal.

Standard safety procedures are also part of GCAL Standard Operating Procedures. Confidentiality and security agreements on all work performed are strictly enforced.

The following procedures are used at GCAL in order to obtain dependable analytical results and to ensure compliance with regulations.

1) To protect yourself and others, the Laboratory Safety Manual must be followed completely. Each provision is to be read and understood thoroughly prior to working in the laboratory.

2) Sample integrity is a vital part of Quality Assurance. Samples being submitted should be logged in immediately. If there must be a delay, log-in should be aware of those samples requiring refrigeration, and store them accordingly until they can be logged in. Any sample that is suspected of being contaminated, improperly stored or preserved, or improperly prepared, should be reported to the group leader immediately. No sample is to be analyzed if there is a question as to its integrity.

3) Always return a sample to its place of origin after use. This not only aids in the preservation of sample integrity, but also in better sample tracking.

4) No sample, reagent or standard is to be left open unattended. If a samples preparation must be interrupted, the contents of the containers will be properly covered to prevent contamination and evaporation.

5) Sample homogeneity is very important in the analysis of all parameters. Liquid samples are to be shaken sufficiently. Soil samples are to be combined efficiently prior to analysis.

6) New standards and reagents are to be maintained according to procedural guidelines for each parameter. These standards are to be labeled with the date of preparation and properly stored. Pre-prepared standards and reagents are labeled with the date of receipt and properly stored. Before an analysis is performed the standards and reagents used should be checked for quality.

7) Only primary standard reagents are to be used in the preparation of laboratory

standards. The standard is to be prepared according to the method specifications including appropriate drying times.

8) Calibration requirements are to be followed for all methods. If the standard does not authenticate the initial calibration curve, a new calibration curve is necessary.

9) Each group of samples being analyzed will be accompanied by a reagent or method blank (MB). These blanks are only valid if carried through the exact chemical processes involved in analyzing the samples and quality control data. Failure to include blanks will cause data from that particular set of samples to be invalid. If a set of data is determined invalid, it must be re-analyzed.

10) Each analyst is responsible for his/her own tests. This means that they must first read and understand the official procedures. The analyst must also prove that he is able to perform the test with the precision and accuracy required. It is the duty of the group leader to work with each analyst to improve their understanding of the analysis and their ability to produce precise and accurate data. All methods used must be approved and accepted by this laboratory. Modifications on any method must be reported to the QA/QC Department to determine the reliability and accuracy of the modification.

11) All quality control data is to be calculated at the time of analysis. The appropriate corrective action must be taken for failures.

12) Quality Control data for inorganic parameters is maintained on a 5% minimum basis for all parameters analyzed in a given day.

13) Quality Control data for organic analysis is maintained daily to give a 5% minimum daily average.

14) A record of all analyses is maintained. Preparation log sheets are stored in binders in sequential order. All raw data is filed for future reference.

15) All logbook entries are labeled, dated and signed.

16) It is the responsibility of the analyst who operates a particular instrument to perform all required maintenance according to the schedule defined in the instrument manual. A record of the date and activity performed during preventive maintenance, daily services and service representative visits must be maintained.

17) Temperature and calibration checks are to be performed daily. All refrigerators, water baths and ovens are to be checked by the analyst using them. If there are any changes made to regulate the temperature it is to be noted on the temperature

record.

18) At the completion of a project, the Department Supervisor reviews the data obtained. If it is determined that the results meet the previously described criteria for acceptance of the data, the Department Supervisor validates the data in the LIMS.This is documented electronically by the initials of the validtor and the date.

11.1 Sample Custody and Integrity

GCAL utilizes a Laboratory Information Management System (LIMS) that was specifically developed for the needs of environmental laboratories. Horizon, developed by Chemware, Inc. tracks samples and data throughout the laboratory. Results are available from the LIMS in a variety of hard copy formats. Furthermore, web access can be provided to clients who wish to view their data via the world wide web. A password security system prevents a client from viewing any data other than their own.

The following is an example of some of the information that is entered into the system:

1. Sample number (unique to this sample)
2. Job number (unique to this job or set of samples)
3. Date received
4. Time received
5. Date analytical results due
6. Sample description
7. Customer's name
8. Customer's address
9. Group number
10. Storage location
11. Notation of any special handling instructions or priority assignments
12. Billing information - purchase orders
13. Analyses requested

The Sample Administration Department also maintains an electronic log of all samples received. The log includes basic information concerning the samples including; date of receipt, client, matrix and tests assigned. The information is stored with the final report.

GCAL understands that sample integrity is a vital part of Quality Assurance. Samples submitted to the laboratory should be logged in immediately. If there must be a delay in this process, log-in should be aware of those samples requiring refrigeration and store them accordingly. Any sample that is suspected of being contaminated, improperly stored or preserved, or improperly prepared, should be reported to the client immediately. Storage blanks located in the volatiles refrigerators are analyzed every two weeks. Records of these analyses are maintained in the GC and GC/MS Volatiles laboratories. No sample is analyzed if there is a question concerning its integrity.

After the sample analyses are complete and the final report is issued to the client, samples are held for 60 days from receipt before disposal. Samples may be held longer per the customer request. All customers are encouraged to take possession of their remaining sample after analysis.

11.2 Chain of Custody

A complete chain of custody is maintained by GCAL. Each sample when submitted to our laboratory is accompanied by a Chain of Custody form (Figure 3). These forms contain pertinent information about the sample including specific analytical requests, sampling notes, sample condition, customer name and address.

Additionally, information concerning the site name, field identification marks, date and time of collection, sampler signature, and preservation data is recorded.

Samples are tagged, preserved if necessary and stored appropriately (i.e. refrigerator, freezer or shelf). Samples to be analyzed for volatile organic compounds are stored in refrigerators located in the volatiles analytical laboratories.

11.3 Custody Transfer

If a sample requires additional work to be performed by a qualified outside laboratory, a chain of custody form is completed and submitted with a representative portion of the sample. A copy of this form is maintained on file along with similar information located in a logbook. The chosen laboratory must sign and date the form upon receipt and return it, along with any unused sample, upon completion of analysis.

11.4 Sample Kits

Occasionally, a customer will request a sampling kit (bottles, vials, etc.) with which to collect samples. Chain of Custody forms are always sent along with the kit to insure proper sample

custody. This form is completed at the time of sample collection and is returned with the samples.

11.5 Shipping Requirements

The Department of Transportation (DOT) regulations shall be used for packaging and quantities of shipment. Shipping containers shall be secured using impact strapping material. Copies of the signed Chain of Custody (COC) forms must be delivered with the containers. Any samples being split with another party must be properly labeled, contain a COC, and be packed and shipped according to DOT regulations.

A laboratory file is maintained listing sample kits prepared for clients. It contains the client name, address, form of delivery, preservative (if requested), sample bottle distribution, and analyses to be performed. Additionally, the date the kit is requested, sent and expected arrival date is included, along with any pertinent miscellaneous information.

11.6 Cleaning Procedures

The method of cleaning is determined by the substances to be cleaned and the analysis to be performed. All bottles are purchased pre-cleaned. Accepted disposable glassware is also utilized to prevent contamination.

Water soluble substances can be washed with hot water and the vessel finally rinsed with small amounts of deionized water. Other substances may require the use of a detergent, organic solvent, chromic acid cleaning solution, nitric acid or aqua regia.

For trace metal analysis, the glassware shall be soaked in a 1:1 nitric acid bath. Rinse thoroughly with successive portions of deionized water. Chromic acid should not be used for cleaning of glassware for trace metal analysis or BOD bottles.

Glassware used for phosphate determinations should be thoroughly rinsed with tap water and then deionized water. Detergents containing phosphates should not be used for cleaning this glassware.

For ammonia and Kjeldahl nitrogen determinations, the glassware must be rinsed with ammonia-free water.

Glassware should be cleaned in the following manner:

- Wash with detergent and water
- Rinse three times with warm tap water
- Rinse three times with deionized water

- Rinse three times with acetone (reagent grade or better). (For organic glassware)
- The preceding procedure is programmed into the laboratory dishwasher which is used for most glassware. The acetone rinse step is replaced with a high heat drying step.
- Glassware used for metals analysis is soaked in an acid bath a minimum of 4 hours and then rinsed with deionized water.
- Periodically glassware may be soaked in a chromic acid cleaning solution. (Except for metals glassware and BOD bottles)
- Prior to sample preparation or analysis, the glassware is rinsed one time with the solvent to be used in the method.

11.7 Data Generation and Reduction

Initial data reduction is the responsibility of the analyst who performs the analysis and/or operates an instrument.

Each analyst records all manually generated data in a logbook associated with the analysis or type of analysis being performed. The spike recoveries and precision for duplicates are calculated and recorded in the logbook. The analyst verifies that all sample identifications are accurate.

Data reduction includes all activities that convert instrument/computer responses into reportable results. This may involve calculations, compound identification, and QC sample calculations. Final results are obtained by direct reading from the instrument or calculations based on instrument readings, output, or responses. Manual data reduction is performed by calculating results with the appropriate formula. Manually entered information such as the sample ID is reviewed for accuracy on the hard copy. Computer data reduction requires that the analyst verify information used in final calculations is entered accurately. The analyst must also review the raw data for properly identified components, possible interferences, confirmation requirements, and acceptable readings for multiple integrations.

Instrumentation run logs generated by the Target software for organic analysis are placed in a three ring binder that serves as the logbook for the applicable instruments. The run log identifies the file number for retrieving hard copy or electronic data. Bench sheets and/or hard copy printouts of run sequences are maintained for Inorganic data. The hard copy is retrievable based on the analytical date and time. All raw data is maintained in files by the individual departments.

All associated quality control samples are documented or referenced on the run log or sequence along with the sample analytical data or a file number which represents the appropriate hard copy or electronic data. The recoveries are documented on the raw data or in the logbook as appropriate.

Data verification is performed to check data integrity and to verify that the data is correct and of an acceptable quality. Data integrity involves reviewing all documentation for errors and mistakes. It includes review for correct documentation of sample ID's, verification that holding times were met, transcription errors, correct calculations, complete records and for acceptable chain of custody documentation. A review of the data is performed to verify the results and to assure that all QC is within acceptable criteria. The Data is reviewed according to the criteria which applies to the particular analysis and according to the client specific project requirements. The reviewer will identify unacceptable data and initiate the appropriate corrective actions. The Department Supervisor or his representative will review the data entered into the LIMS. Validated data is released to the Report Generation Department. Hard copies of the final reports are reviewed by the Data Validation Department.

12.0 SAMPLE HANDLING GUIDELINES

Inorganic and Conventional Parameters

Parameters	Method*	Container	Recommended Quantity (mL)	Preservative	Holding Time
Acidity	305.1, 2310B	P,G	100	4^0C	14 days
Alkalinity	310.1, 310.2, 2320B	P,G	100	4^0C	14 days
Ammonia-N	4500NH3BE, 350.3	P,G	500	4^0C, H_2SO_4 to pH <2	28 days
Biochemical Oxygen Demand (BOD)	405.1, 5210B	P,G	1000	4^0C	48 hours
Bromide	300.0, 9056	P,G	200	None	28 days
Chemical Oxygen Demand (COD)	HACH 8000	P,G	100	4^0C H_2SO_4 to pH <2	28 days
Chloride	325.3, 9251, 9056	P,G	200	None	28 days
Chlorine, Residual	330.3, 4500 CLG	P,G	200	None	Immediately
Coliform, Fecal	9222D	P,G (sterile)	100	4^0C, $Na_2S_2O_3$	6 hours
Color	2120C, 110.3	P,G	100	4^0C	48 hours
Cyanide	335.1, 335.2, 335.3 9012A	P,G	1000	4^0C, ascorbic acid, NaOH to pH > 12	14 days
Ferrous Iron	3500FED	P,G	100	2mHCl/100mL	Immediately
Flashpoint	1010	P,G	100	None	Not specified
Fluoride	300.0, 9056, 340.2	P	500	None	28 days
Hardness	130.2 2340B	P,G	100	HNO_3 to pH < 2	6 months
Nitrogen, Kjeldahl (TKN)	4500NH, 351.4	P,G	500	4^0C, H_2SO_4 to pH < 2	28 days
Nitrate-N	353.2	P,G	100	4^0C	48 hours
Nitrite-N	353.2	P,G	100	4^0C	48 hours
Nitrate-Nitrite as N	353.2	P,G	200	4^0C, H_2SO_4 to pH < 2	28 days
Oil and Grease	1664A	G	1000	4^0C, H_2SO_4 or HCl to pH < 2	28 days
Phenols	420.1, 420.2, 9066	P,G	1000	4^0C, H_2SO_4 to pH < 2	28 days
Phosphorus, Total	365.1	P,G	200	4^0C, H_2SO_4 to pH < 2	28 days
Phosphorus, Ortho	365.2, 4500PE	P,G	200	4^0C	48 hours
pH	150.1, 9040B, 9045C	P,G	100	None	Immediately
Radiochemisrty					
Alpha, Beta, Radium	900 & 9000 series	P,G	2000	HNO_3 to pH < 2	6 months
Tritium		P,G	100	None	6 months
Radon, I-131		P,G	1000	HNO_3 to pH < 2	14 days
Reactivity	SW846 7.3.3.2, 7.3.4.2	G	100g	4^0C	Not Specified
Silica	370.1, 4500Si D	P, PFTE, Quartz	100	4^0C	28 days
Solids, Dissolved (TDS)	160.1, 2540C	P,G	100	4^0C	7 days
Solids, Suspended (TSS)	160.2, 2540D	P,G	500	4^0C	7 days
Solids, Volatile (TVS)	160.4, 2540E	P,G	100	4^0C	7 days
Solids, Total (TS)	160.3, 2.540B	P,G	100	4^0C	7 days

Inorganic and Conventional Parameters

Parameters	Method*	Container	Recommended Quantity (mL)#	Preservative#	Holding Time**
Specific Conductance	120.1, 9050	P,G	100	4^0C	28 days
Specific Gravity	2710F	P,G	100	4^0C	28 days
Sulfate	375.4, 9056, 9038	P,G	200	4^0C	28 days
Sulfide	376.1, 376.2, 9034	P,G	500	4^0C, Zn acetate, NaOH to pH > 9	7 days
Sulfite	4500S03B	P,G	200	None	Immediately
Surfactants (MBAS)	425.1, 5540C	P,G	250	4^0C	48 hours
Total Organic Carbon (TOC)	415.1, 9060	P,G	100	4^0C, HCl to pH < 2	28 days
Total Organic Halogens (TOX)	9020B	G-TLC (amber)	100	4^0C, H_2SO_4 to pH <2	28 days
Total Petroleum Hydrocarbon (TPH)	418.1	G-TLC	1000	4^0C, H_2SO_4 or HCl to pH < 2	28 days
Turbidity	180.1, 2130B	P,G	100	4^0C	48 hours
Viscosity	D2196	P,G	500	None	Not Specified

*The methods listed are from typical EPA references.
#Solid and waste samples: Quantity 1-100g, preservative 4°C.
**Holding time for solids and samples is not defined
Organic Nitrogen = TKN – Ammonia-N

Metals

Parameters	Method*	Container	Recommended Quantity (mL)	Preservative	Holding Time
Metals (except Hexavalent Chromium and Mercury):					
Aqueous					
Total	6010B, 200.0, 7000 series	P,G	500	HNO_3 to pH < 2	6 months
Dissolved	6010B, 200.0, 7000 series	P,G	500	Filter on site HNO_3 to pH < 2	6 months
Solid					
Total	6010B, 200.0, 7000 series	P,G	100g	4^0C	6 months
Hexavalent Chromium:					
Aqueous	7196A	P,G	500	4^0C	24 hours
Solid	3060A/7196A	P,G	100g	4^0C	30/7 days
Mercury:					
Aqueous					
Total	245.2/7470	P,G	500	HNO_3 to pH < 2	28 days
Dissolved	245.2/7470	P,G	500	Filter on site HNO_3 to pH < 2	28 days
Solid					
Total	7471	P,G	100g	4^0C	28 days

Metals – Boron must be collected in a polyethylene container.
*The methods listed are from typical EPA references.
CrIII=Total Cr-Hexavalent Cr

Organic Parameters

Volatile Organics

Sample Matrix	Method*	Container	Minimum Quantity	Preservative	Holding Time
Concentrated Waste Samples	8021B, 8260B, 8015M	G-TLC or G-TLS	2 x 40mL vials or 2-oz wide mouth	4^0C	14 days
Aqueous Samples	8021B, 8260B, 8015M, 624, VPH	G-TLS	2 x 40mL vials	4^0C, HCl to pH < 2, $Na_2S_2O_3$ if residual chlorine present	14 days, 7 days if not acid preserved
Solid Samples	8021B,8260B, 8015M, VPH	G-TLS or G-TLC	2-oz wide mouth and/or 3 Encores	4^0C	14 days **

*The methods listed are from typical EPA references.

**Solid samples collected in EnCore™ samplers must be transferred to a soil sample vial within 48 hours.

Semivolatile Organics, Pesticides/PCBs, Herbicides, PAHs, Petroleum Hydrocarbons

Sample Matrix	Method*	Container	Minimum Quantity	Preservative	Holding Time
Concentrated Waste Sample	8270C, 8081, 8082, 8015M, 8151A, 8141A, FL-PRO	G-TLC (Amber)	1 Liter	None	14 days until extraction, 40 days after extraction
Aqueous Samples	8270C, 8081, 8082, 8015M, 8151A, 8141A, 8310,608, 625, FL-PRO,EPH ***	G-TLC (Amber)	2 x 1 Liter	4^0C	7 days until extraction, 40 days after extraction
Solid Samples	8270C, 8081, 8082, 8015M, 8151A, 8141A, 8310,EPH FL-PRO ***	G-TLC	8 oz.	4^0C	14 days until extraction, 40 days after extraction

Parameter	Method*	Container	Recommended Quantity	Preservative	Holding Time
Dioxins and Furans**	613, 8280A, 8290, 1613	G-TLC(Amber)	2 x 1 Liter	4^0C	30 days until extraction, 45 days after extraction

*The methods listed are from typical EPA references.

**Concentrated wastes and soil samples are collected in 2 oz. to 1 Liter amber glass jars with TLC.

***1005/1006, Petroleum Hydrocarbons –14 days after extraction

TCLP/SPLP Parameters

Parameters	Holding Time from Collection to TCLP Extraction (days)	Holding Time from TCLP Extraction to Preparative Extraction (days)	Holding Time from TCLP/Preparative Extraction to Analysis (days)	Total Time
Volatiles	14	NA	14	28
Semivolatiles	14	7	40	61
Mercury	28	NA	28	56
Metals	180	NA	180	360

Reference: 40CFR Part 136 Tables 1A, 1B, 1C, 1D & 1E and Table II., SW846 Table 4-1 and Table 3-1, SW846 Method 1311 8.5.

*The methods listed are from typical EPA references

Acronymn Definitions: (Teflon is a registered trademark of E.I. DuPont)

CLP: EPA Contract Laboratory Program G-TLC: Glass with Teflon®-lined cap NA: Not Applicable G: Glass G-TLS: Glass with Teflon®-lined septrum P: Polyethylene

13.0 WASTE MANAGEMENT

13.1 Waste Collection and Storage

Samples are stored in the appropriate cooler for 60 days after receipt. After 60 days, samples are moved to a waste area. The samples are scanned out for disposal on the LIMS. The samples are then stored in the waste staging area until disposal into appropriate drums. Hazardous samples are returned to the client whenever possible to be disposed of with larger quantities of the sample material. Laboratory waste is segregated by laboratory personnel into waste streams which have been established by the Regulatory Compliance Officer. The waste streams are determined by analysis of the waste and through process knowledge. All laboratory wastes are disposed of in the proper container. No waste is placed in regular trash containers or poured down the drain. Waste is stored in drums in satellite accumulation areas and then in the central accumulation facility. Waste disposal service is provided by approved vendors who will incinerate, landfill, treat, or reclaim the waste based on the characteristics.

13.2 Pollution Prevention

Environmental concerns, risks to employees and the public, and high disposal costs have increased the need and effort of the laboratory to minimize or prevent waste generation. The quantity of chemicals and standards purchased is based on expected usage during its shelf-life and the disposal cost of the unused material. The volume of standards and reagents prepared in the laboratory reflect stability and anticipated usage. If possible, methods requiring the use of hazardous chemicals or that produce hazardous waste are replaced with an alternative method. Sample containers are selected based on the minimum volume that is necessary to perform a test, therefore reducing sample waste. Sample sizes are reduced in some cases, therefore reducing the quantities of extraction solvents and reagents.

14.0 SAFETY PROCEDURES

GCAL has a comprehensive safety program outlined for all employees. A safety manual is distributed to each employee followed by a training seminar to familiarize the employee with the safety procedures at GCAL.

14.1 Basic Safety Rules

1. All injuries are promptly reported to a supervisor.
2. All hazards are promptly reported to a supervisor.
3. Running and horseplay are not permitted in the laboratory.
4. Smoking is not permitted in the laboratory.
5. Laboratory glassware is not to be used for eating or drinking.
6. Laboratory reagents such as sucrose or sodium chloride should not be used for food.
7. Eating on the premises is confined to designated areas.

14.2 Arrangement of Furniture And Equipment

Furniture is arranged for maximum use of available space while providing working conditions that are efficient and safe.

Aisles are kept at least 4 feet wide to provide for safe passage of personnel and equipment, and are kept free of obstructions.

Stepladders or footstools are supplied for reaching high objects and are kept out of the way when not in use.

Eyewash stations, safety showers and fire extinguishers are located centrally and care is taken to avoid blocking access to them.

14.3 Hoods And Ventilation

Adequate hood facilities are installed and used where toxic or flammable materials are used. Hood windows provide physical protection and greater control of fumes.

14.4 Spills

Spilled materials are cleaned up promptly. All spills should be handled as if corrosive or dangerous unless definitely known to be harmless. Spill Kits are located in the laboratory.

Corrosive or toxic materials are not placed in waste cans in the laboratory. When in doubt a supervisor is consulted.

Broken glass is swept up immediately and discarded so as to avoid any injury or cuts.

14.5 Emergency Equipment

Fire extinguishers are located in each room of the laboratory. The paths to these are kept free and clear at all times.

An extinguisher which has been used shall not be returned to its holder until it has been recharged and checked.

Any fire that appears to be too large to extinguish immediately is reported to the fire department at once. All fires, regardless of size are to be reported to a supervisor. Causes shall be determined and necessary steps to prevent a similar accident shall be taken.

Eye washes are located in the laboratories for irrigation of the eyes if corrosive liquids should be splashed into them. Tubing attached to faucets in the sink may also be used to wash the eyes if necessary.

A safety shower is centrally located in the laboratories and is be used whenever corrosive materials are spilled on an analysts' skin or clothing.

All safety equipment is periodically checked to be sure everything is in working order and is easily accessible.

General first aid kits are located throughout the laboratory. These kits contain first aid products for the treatment of minor cuts and bruises, burns or abrasions,and personal discomfort.

14.6 Protective Equipment

Lab coats and aprons are supplied for all employees of GCAL. Protective clothing is always available to prevent damage to clothing and persons.

Shoes must be worn at all times and must be closed-toe, high heels or sandals are not acceptable.

Eye Protection is mandatory for all personnel working in the laboratory. Safety glasses or goggles should be worn by analysts to protect the full eye area.

Various types of gloves are provided for employees: Insulated gloves are provided for use when handling hot or cold items; Heavy rubber gloves are to be used when handling corrosive liquids or unknown substances; Lightweight disposable gloves are provided for use with toxic or irritating substances.

Air purifying respirators are available for use when working with organic vapors and/or acid fumes. These respirators should be worn whenever contact with irritating concentrations of these fumes are encountered.

Coverall suits made of chemically resistant material are provided for wear whenever sampling at a hazardous waste site or in potentially dangerous or unknown situations. These suits are disposable and provide protection for clothing and personnel.

14.7 Storage of Laboratory Materials

All chemicals, reagents and glassware are stored in such a manner that they are easily located and do not present a danger. Heavy items are kept near the floor.

Flammable solvents are stored in special cabinets or in solvent bunker. Only quantities required for immediate use are stored in analytical areas.

Reagents are grouped to prevent danger from hazardous combinations. Acids and bases are stored separately.

Compressed gases are stored away from heat and open flames. They are always contained by chains or belts to prevent rolling or toppling. A special cart is used to transport replacement cylinders and empties.

14.8 Chemical And Sample Handling

If there are questions about proper chemical handling the MSDS (Material Safety Data Sheet) is used as reference.

Samples are always treated as if they were hazardous chemicals.
Rubber pipet bulbs are used.
Procedures which produce flames or toxic vapors are performed under a hood.
Chemicals are returned to their proper storage area after use.
All prepared solutions are properly labeled.
Acids are always poured into water when diluting.
Large amounts of alkali are never added to water at one time.
Glass-stoppered containers are not used for storing alkaline solutions.
Labels for Acid and Caustic solutions will note the concentrations.

14.9 Labeling

All sample and chemical solutions are clearly labeled with chemical name and concentration or sample number. Label should note any danger associated with the solution, date of preparation, laboratory assigned ID, initials of analyst, and expiration date.

15.0 CONFIDENTIALITY

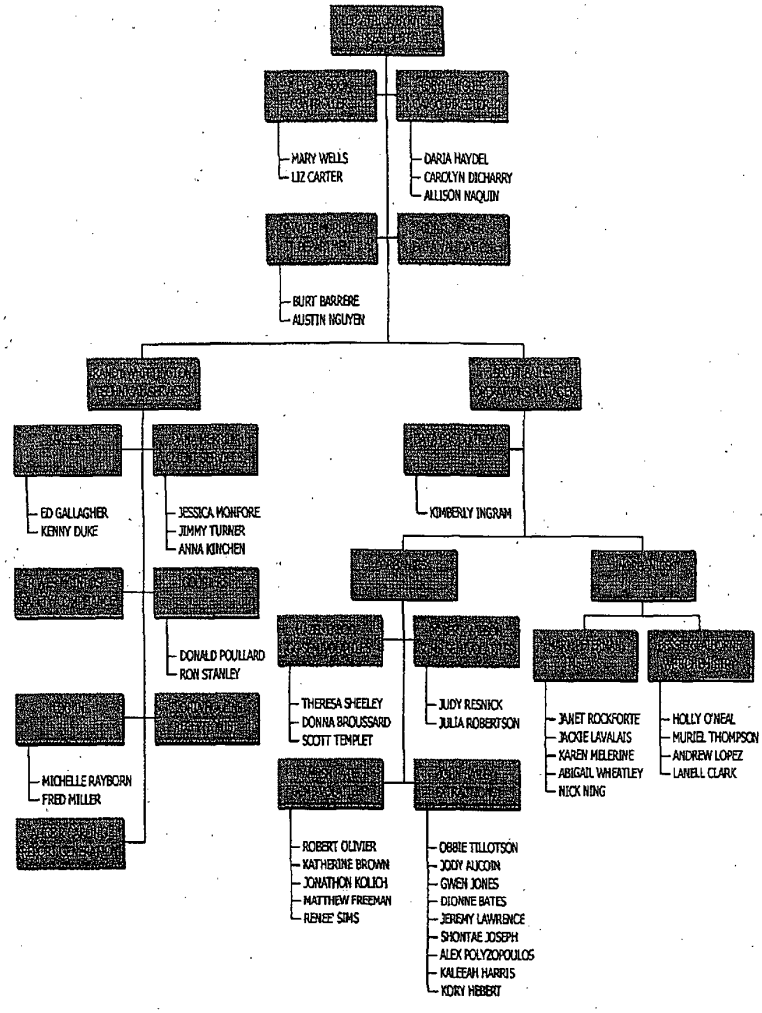
GCAL understands that it must retain in confidence all information obtained through the analysis of samples or the information disclosed to GCAL in order to adequately perform and interpret analyses.

GCAL will maintain the secrecy and confidentiality of any proprietary information it receives or generates.

Only the party who requested the analytical work or consultation, and who will receive the final report (and invoice) will be informed of any findings.

Results of analyses will not be disclosed to anyone other than the contracting party without unequivocal authorization by the contracting party.

APPENDIX A


MARY WELLS
LIZ CARTER
DARIA HAYDEL
CAROLYN DICHARRY
ALLISON NAQUIN
BURT BARRERE
AUSTIN NGUYEN
ED GALLAGHER
KENNY DUKE
JESSICA MONFORE
JIMMY TURNER
ANNA KINCHEN
KIMBERLY INGRAM
DONALD POULLARD
RON STANLEY
MICHELLE RAYBORN
FRED MILLER
THERESA SHEELEY
DONNA BROUSSARD
SCOTT TEMPLET
JUDY RESNICK
JULIA ROBERTSON
JANET ROCKFORTE
JACKIE LAVALAIS
KAREN MELERINE
ABIGAIL WHEATLEY
NICK NING
HOLLY O'NEAL
MURIEL THOMPSON
ANDREW LOPEZ
LANELL CLARK
ROBERT OLIVIER
KATHERINE BROWN
JONATHON KOLICH
MATTHEW FREEMAN
RENEE SIMS
OBBIE TILLOTSON
JODY AUCOIN
GWEN JONES
DIONNE BATES
JEREMY LAWRENCE
SHONTAE JOSEPH
ALEX POLYZOPOULOS
KALEEAH HARRIS
KORY HEBERT

CHARLES P. BYRNE

President and General Manager, GCAL, Inc., Baton Rouge, LA, January 1997 - present.

Responsible for all operations within the facility including laboratory, administrative, financial and marketing functions. Responsible for long range planning and structuring of future business operations.

Previous Experience:

Vice-President and General Manager, ITS-Environmental Laboratories, Baton Rouge, LA, September 1993 - January 1997.

Corporate officer in charge of all operations within the facility including laboratory, administrative, financial and marketing functions. Responsible for long range planning and structuring of future business operations.

Laboratory Manager, West-Paine Laboratories, Inc. Baton Rouge, LA, June 1992 - September 1993.

Responsible for the profit and loss of the Baton Rouge facility. Directly supervise all operations of the laboratory including staffing, budgeting and production.

Organic Manager, West-Paine Laboratories, Inc., Baton Rouge, LA., August 1991 - June 1992.

Responsible for supervision of analysts functioning in the areas of Sample Extraction, Residue Analysis via GC, Purgeables and Extractables via GC-MS. Troubleshoots and interfaces with GC-MS System Management, consisting of five HP GC-MS with RTE-6-VM and RTE-A Operating Systems. Performs method development and reviews data. Previous positions included GC/MS manager and GC manager.

Previous Experience:

GC/MS Analyst, ETC/Toxicon, Baton Rouge, LA., August 1989 - June 1991.

Operator of two Finnigan MAT 4510B Gas Chromatography/Mass Spectrometry Systems conducting the analysis of volatile organic compounds using USEPA Contract Laboratory Program (CLP)

methodology, including data reduction and report production using QA

Formaster software. Operation of HP 5890 Gas Chromatograph (ECD, FID), performing the analysis of chlorinated pesticides and PCB's using CLP methodology. The analysis of raw data and the production of data packages using QA Formaster software.

Education: BS Microbiology, Louisiana State University, Baton Rouge, LA, 1990.

Member ACS

ITS Managerial Training Skills Workshop - 1993, 1994

Cornell ITS Executive Development Program - 1994, 1995

Government Institutes Inc., RCRA Regulations, Air Toxics - 1993, 1994

Introduction to Mass Spectrometry, Basic Mass Spectrometry Interpretation - 1991

ITS - Environmental Laboratories, Baton Rouge, Manager and Supervisor Training Retreat - June 1996

Louisiana State University Fire and Emergency Training Institute- HazMat Technician Refresher - 8 Hr. - June 17, 1998

Bank One Managing and Financing Independent Business - 16 Hours - October 1998

SCOTT A. BAILEY

Current Position:

Operations Manager, GCAL Inc., Baton Rouge, LA January 1997 - Present

Responsible for coordinating the overall activities of the analytical laboratories on a daily basis and providing long-term direction. Responsibilities include monitoring the scheduling of analytical testing and releasing testing data and results.

Previous Experience:

Operations Manager, ITS-Environmental Laboratories, Baton Rouge, LA September 1995 - January 1997

Responsible for coordinating the overall activities of the analytical laboratories on a daily basis and providing long-term direction. Responsibilities include monitoring the scheduling of analytical testing and releasing testing data and results.

Organics Manager, ITS – Environmental Laboratories, Baton Rouge, LA, October1993 - September 1995

Responsible for the management of the GC, GCMS, and the extraction departments of the laboratory. Duties also included supervision of the report generation department.

Division Manager, National Environmental Testing, Baton Rouge,LA March 1992 - October 1993

Directed the functional areas of marketing, finance, chemistry, and administration for the Baton Rouge facility. Additional duties included contract administration, scheduling, and client consultation.

Operation Manager, Environmental Testing & Certification Corporation, Baton Rouge, LA , December 1989 - January 1992

Directed the functional areas of marketing, finance, chemistry, and administration for the Baton Rouge facility. Additional duties included contract administration, scheduling, and client consultation.

Scott A. Bailey
Page 2

Previous Experience: **Analyst, ETC, Baton Rouge, LA, December 1983 - December 1989**

Education: BS, Environmental Health, Louisiana State University, Baton Rouge, LA, December 1991

ITS Managerial Training Skills Workshop, 1994

ITS - Environmental Laboratories, Baton Rouge, Manager and Supervisor Training Retreat - June 1996

UCLA ITS Executive Development Program - August

ROBYN B. MIGUES

Current Position:

QA/QC Manager, GCAL Inc., Baton Rouge, LA, January 1997 - Present

Responsible for implementing and monitoring the laboratory Quality Assurance Program Plan, conducting internal audits, reviewing reports, investigating problem areas, control-chart generation, establishing data-quality criteria, verifying corrective actions are being taken when necessary, and monitoring performance evaluation studies. Additional duties include providing reports concerning QA matters to management.

Previous Experience:

QA/QC Manager, ITS- Environmental Laboratories, Baton Rouge, LA October 1994 - January 1997

Responsible for implementing and monitoring the laboratory Quality Assurance Program Plan, conducting internal audits, reviewing reports, investigating problem areas, control-chart generation, establishing data-quality criteria, verifying corrective actions are being taken when necessary, and monitoring performance evaluation studies. Additional duties include providing reports concerning QA matters to management.

General Chemistry Supervisor, ITS- Environmental Laboratories, Baton Rouge, LA, June 1994 - October 1994

Responsibility includes the management and training of personnel conducting inorganic analysis using EPA methodologies. Duties include data validation, QC review, instrument maintenance and method set up.

Metals Supervisor, ITS –Environmental Laboratories, Baton Rouge, LA, October 1993 - June 1994

Responsible for the management and supervision of the Metals section which includes supervision of metals sample preparation, supervision and training of analysts, scheduling sample workload, analysis of samples by various analytical instrumentation and reviewing and validating all data.

Research Associate, Louisiana State University, Agronomy Department, Baton Rouge, LA, September 1990 - March 1993

Prepared and analyzed samples by ICP, maintained ICP and other laboratory

equipment, assisted associate Professor of soil and environmental chemistry with laboratory courses and research projects and supervised student workers. Computer experience includes Quattro

Previous Experience:

Spectroscopy and Water Departments Supervisor, James Laboratories,Lafayette, LA, February 1987 - September 1990
Laboratory Technician

Prepared and analyzed samples by ICP, Flame Atomic Absorption & Emission, Mercury Hydride System and Graphite Furnace. Performed quality control coordination, trained laboratory technicians, maintained equipment . Prepared and analyzed various sample types.

Education:

BS Geology, University of Southwestern Louisiana, Lafayette, LA, May 1985.

Member - American Society for Quality Control

Perkin Elmer Spectroscopy training course - 1987

Basic Statistics - Pittsburgh Conference Continuing Education Program - March 1995

Quality Management/Quality Assurance in Industry and in the Laboratory - ACS Short Course - March 1995

ITS Managerial Training Skills Workshop - 1994

ITS- Environmental Laboratories, Baton Rouge, Manager and Supervisor Training Retreat - June 1996

Executrain Microsoft Excel 5.0 Beginning For Windows - July, 1996

ERTCO - Thermometer Calibration per ISO - October 1997

Assuring Ethical Practices in The Environmental Laboratory, A Training Short Course – Analytical Excellence – October 27, 2000

Member - LADEQ Laboratory Accreditation Task Force

RANDY K. WHITTINGTON

Current Position:

Technical Services Manager, GCAL Inc., Baton Rouge, LA, January 1997 - Present

Responsible for the management and supervision of Sample Management, Project Management, and Report Generation. Duties include implementing systems for increased productivity in all three sections. Also coordinates communication among these departments and other areas of the laboratory and marketing.

Previous Experience:

Technical Services Manager, ITS-Environmental Laboratories, Baton Rouge, LA, October 1996 - January 1997

Responsible for the management and supervision of Sample Management, Client Services, and Report Generation. Duties include implementing systems for increased productivity in all three sections. Also coordinates communication among these departments and other areas of the laboratory and marketing.

Project Manager and Data Validation Manager, Terra Consulting Group, Baton Rouge, LA, 1993 - 1996

Performed organic data validation for CLP and RCRA data packages for pesticides, PCBs, volatile and semi-volatile analytical fractions. Responsible for the design and implementation of the analytical aspects needed to generate legally defensible data for a Remedial Feasibility Investigation (RFI) at various large chemical plants. Ensured data validation issues were addressed in the day-to-day operations of the investigation.

Gas Chromatography Supervisor, West-Paine Laboratories, Baton Rouge, LA, 1991-1993

Directly responsible for the supervision of the organics laboratory in environmental and hazardous waste matrices following current SW-846, 500 and 600 series methodologies. Responsibilities include coordinating and managing of QA/QC for all Gas Chromatography data from sample login, extraction, analysis, review and preparation of computerized reports.

Randy K. Whittington
Page 2

Previous Experience:

Gas Chromatography Laboratory Manager, ETC/Toxicon, Baton Rouge, LA, 1987-1991

Supervised the Gas Chromatography laboratory in the analysis of Organochlorine and Organophosphorus Pesticides, PCBs, Herbicides, PNAs, VOA and Semi-VOAs; supervised all aspects of the GC laboratory including analysis, data interpretation, report preparation, instrument maintenance, method development, and problem solving. In 1990 temporarily relocated to Edison, New Jersey to restructure the Gas Chromatography division while also implementing USEPA CLP and Finnigan QA Formaster; maintained efficiency of twenty-two various Gas Chromatographs.

Education:

BS, Environmental Engineering , Columbia Southern University

ITS Managerial Training Skills Workshop - 1993

Finnigan QA Formaster Training

Restek Chromatography Class

Bank One Managing and Financing Independent Business - 16 Hours - October 1998

CURTIS A. EKKER

Current Position:

Data Validation Manager, GCAL Inc., Baton Rouge, LA, January 1997 - Present

Responsible for validation of final reports. This includes correlation of data between departments, review of chain of custody, review of reported QC, verification of correct reporting level, and review of narratives.

Previous Experience:

Data Validation Manager, ITS-Environmental Laboratories, Baton Rouge, LA, September 1993 - January 1997

Responsible for validation of final reports.

General Chemistry Supervisor, ITS – Environmental Laboratories, Baton Rouge, LA, June1989 - September 1993

Responsible for supervising the work of 11 analysts. This includes training all new employees to follow EPA Protocol in work and to bring their proficiency up to an acceptable level of productivity. Ensure all analytical work is performed and reported with customer time requirement. Ensure that new and infrequently analyzed parameters are properly analyzed. Involved in setting up new analytical methods for Wet Lab. Responsible for generation, implementation, and maintenance of Standard Operating Procedures.

General Chemistry Laboratory Technician, West-Paine Laboratories, Baton Rouge, LA., June 1988 - June 1989

Responsible for preparation and analysis of samples by wet chemistry methods. Instrumentation included flashpoint tester and HACH spectrophotometer. Additional responsibilities included initial review of data and associated QC and entry into the LIMS.

Education:

BS Chemistry, Southeastern Louisiana University, Hammond, LA, 1988.

ITS Managerial Training Skills Workshop - 1993, 1994

Curtis A. Ekker
Page 2

Education:

Dionex Ion Chromatography Training Course - 1991

Data Validation - ACS Short Course - March, 1995

ITS - Environmental Laboratories, Baton Rouge, Manager and Supervisor Retreat - June 1996

ExecuTrain Microsoft Excel 5.0 Beginning For Windows - July 1996

Member - ACS

DANA MERRILL

Current Position: **Senior Project Manager, GCAL Inc., November 2000 - Present**

Act as the main point of contact for the client in the laboratory. Provide technical information to clients and keep them informed of project progress. Coordinate and schedule projects with various departments within the laboratory according to the customers analytical and turnaround requirements. Review chains of custody, login reports and final reports.

Previous Experience: **Project Manager, GCAL Inc., August 1994 - March 1999**

Act as the main point of contact for the client in the laboratory. Provide technical information to clients and assist with analytical needs. Review client C-O-C's and reports. Generate client invoices. Create project and site codes to allow for better handling of client samples. Disseminate information internally regarding projects and specific client needs. Document all communications with client.

GC/MS Analyst, American Analytical & Technical Services, March 1992 - July 1994

Responsibilities included analysis of environmental samples for volatile and semi-volatile constituents utilizing GC/MS systems (HP Series 5970, 5971, and 5972, with RTE-A and Chem Station Data Systems). Responsibilities also involved the creation of CLP and SW846 data packages using EPA approved methodologies and protocols including but not limited to: Methods 500, 600, 8000 series. Daily duties involved sample management, routine maintenance of analytical equipment and the preparation of calibration and quality control standards.

GC/MS Group Leader, ITS- Environmental Laboratories, January 1989 - February 1992

Coordination and scheduling of projects according to priority, hold times and work load. Review and validate data and generate quantitative analysis reports for release to clients. Responsibilities included analysis of environmental samples for volatile and semi-volatile constituents utilizing GC/MS systems (HP Series 5970, RTE-E and RTE-A Data Systems). Responsibilities also involved the creation of CLP and SW846 data packages using EPA approved methodologies and protocols

including but not limited to: Methods 500, 600, 8000 series. Daily duties involved sample management, routine maintenance of analytical equipment and the preparation of calibration and quality control standards. Also responsible for training of department personnel. Supervision of 4 employees.

Organic Extraction/GC Group Leader, West Paine Laboratories, August 1987 - January 1989

Responsible for scheduling and inter-laboratory coordination of projects. Review and validate GC data and generate quantitative analysis reports for release to clients. Daily duties involved sample management, routine maintenance of analytical equipment and the preparation of calibration and quality control standards. Also responsible for training of department personnel. Supervision of 6 employees.

GC Operator, West Paine Laboratories, November 1986 -August 1987

GC operations for the purpose of analyzing extractable constituents. Review GC data and generate quantitative analysis reports for review prior to release to clients.

Lab Technician, West Paine Laboratories, May 1986 -November 1986

Prepared environmental samples for GC and GC/MS according to SW846 methodology.

Education: Mary Carroll High School
Corpus Christi, TX 1966 Graduate
Mathematics and Science Curriculum

Hewlett Packard Short Course, Introduction to MS Interpretation, May 1991

CAROLYN A. DICHARRY

Current Position:

Project Manager, GCAL Inc., Baton Rouge, LA, November 1999 - Present

Responsible for management of client projects and project management activities within the laboratory. Serves as the interface between client and laboratory management to achieve client satisfaction with delivery of analytical results on schedule and to the requested level of quality.

Previous Experience:

QA/QC Assistant, GCAL Inc., Baton Rouge, LA, July 1998 – November 1999

Responsible for assisting in implementing and monitoring the laboratory Quality Assurance Program Plan, conducting monthly internal audits, calibrating thermometers and mechanical pipets, and updating employee training files.

Supervisor, Asbestos Laboratory and Industrial Hygiene Laboratory Director, GCAL Inc., Baton Rouge, LA, January 1997 – July 1998

Responsibilities include management, supervision, staffing, and training all asbestos personnel. Client relations, writing contracts and bids, court consultants, and business development. Formulating all QA/QC manuals, operations, analyses and procedures which adhere to EPA protocol for PLM and PCM. Ordering, designing, and maintaining analytical equipment and laboratory facilities. Organization of intra and inter laboratory proficiency. Additional responsibilities include the administration of the industrial hygiene laboratory.

Supervisor, Asbestos Laboratory, ITS - Environmental Laboratories, Baton Rouge, LA, December 1991 - January 1997.

Responsibilities include management, supervision, staffing, and training all asbestos personnel. Client relations, writing contracts and bids, court consultants, and business development. Formulating all QA/QC manuals, operations, analyses and procedures which adhere to EPA protocol for PLM and PCM. Ordering, designing, and maintaining analytical equipment and laboratory facilities. Organization of intra and inter laboratory proficiency.

Geologist/Microscopist, West-Paine Laboratories, Inc., Baton Rouge, LA., January 1991 - December 1991.

Responsibilities include Phase Contrast Microscopy Analysis (PCM), Polarized Light Microscopy Analysis (PLM), Scanning Electron Microscopy Analysis (SEM) and Inter-Laboratory Quality Control Program for PCM and PLM analysis.

Lab Technician, Kemron Environmental Services,, Baton Rouge, LA., May 1989 - December 1989.

Responsibilities included Polarized Light Microscopy Analysis and Phase Contrast Analysis.

Education:

Secondary Education Degree, Nicholls State University, Thibodaux, LA., 1987

BS, Geology, Nicholls State University, Thibodaux, LA., 1984

Sampling and Evaluating Airborne Asbestos Dust - NIOSH 585 - May, 1989

ITS- Environmental Laboratories, Laboratory Skills Training Program, August -1995

ITS Managerial Training Skills Workshop - 1993,1994

ITS - Environmental Laboratories , Baton Rouge, Manager and Supervisor Training Retreat - June 1996

Executrain Microsoft Excel 5.0 Beginning For Windows - July, 1996

JAMES D. TURNER

Current Position:

Project Manager, Gulf Coast Analytical Laboratories, Baton Rouge, LA, October, 2004 - Present

Responsible for management of client projects and project management activities within the laboratory. Served as the interface between client and laboratory management to achieve client satisfaction with delivery of analytical results on schedule and to the requested level of quality.

Previous Experience:

QC Lab Manager, The Wright Group, Inc., Crowley, LA March 2004 – October 2004

Responsible for the management of a neutraceutical laboratory for a food fortification company.

Organics Manager, Gulf Coast Analytical Laboratories, Baton Rouge, LA, June 2001- February 2004

Responsible for the management of the GC, GCMS, and the extraction departments of the laboratory.

Training Officer, Gulf Coast Analytical Laboratories, Baton Rouge, LA , January 2000 - 2001

Responsibilities include development of a company training program that will efficiently train employees to ensure compliance with the internal SOP's and the analytical methods. The officer will be responsible for initial training of new employees as well as ongoing training for all employees. The officer will also maintain the training records and the analyst certification program.

General Chemistry Supervisor, Gulf Coast Analytical Laboratories, Baton Rouge, LA, January 1997 - Present

Responsible for the supervision and training of personnel, conducting inorganic analysis using EPA methodologies, correlation and validation of data, maintenance of Standard Operating Procedures (SOPs) and instrumentation, method set up and day-to-day management of the general chemistry laboratory.

General Chemistry Department Group Leader, ITS -Environmental Laboratories, Baton Rouge, LA, August 1996 - January 1997

Responsible for analyst training, instrument maintenance, and scheduling daily work loads.

General Chemistry Laboratory Technician, ITS -Environmental Laboratories, Baton Rouge, LA, November 1992 - August 1996

Responsible for preparation and analysis of standards and samples for most wet chemistry tests. Experience on instrumentation includes Lachat Quick Chem Analyzer, TOC, TOX, HACH Spectrophotometer, IC, HPLC, GCMS, and GPC. Additional responsibilities included initial review of data and associated QC and entry into the LIMS.

Chemist, La-Mar-Ka Chemical, Baton Rouge, LA, November 1991 - November 1992

Responsible for preparation and standardization of chemical solutions. Instrumentation experience included D.L. 40 Auto Titrator and Moisture Analyzer.

General Chemistry Laboratory Technician, Enviromed Laboratories, Baton Rouge, LA, June 1988 - November 1991

Experience includes preparation and analysis of samples by wet chemistry methods and preparation of samples by organic extraction procedures. Introduced to GC/MS. Assisted with sample collection and waste disposal.

Education:

BS, Microbiology, Louisiana State University, Baton Rouge, LA, May 1999
Minor-Chemistry

OSHA 40 hour Hazardous Waste Training Course - August 1991

ITS - Environmental Laboratories, Laboratory Skills Training Program - August 1995

ITS - Environmental Laboratories, Basic Gas Chromatography Theory - May 1996

ALPHA LYDIA COOK

Current Position:

Controller and Human Resources Director, GCAL Inc., Baton Rouge, LA, January 1997 - present

Responsible for supervision of the Accounts Receivable, Purchasing and Accounts Payable Departments. Included are responsibilities for payroll, collections, and cash management. Additional responsibilities include preparation of capital expenditure requests and reconciliation of the requests with the budget. Shares the budget preparation duty with the General Manager. Maintains the General Ledger and Accounts Payable on AccPac Accounting System on a Novell Network. Human Resources responsibilities include advertising for positions, interviewing applicants, and employee benefits.

Previous Experience:

Controller, ITS - Environmental Laboratories, Baton Rouge, LA, June 1990 -January 1997
Human Resources Director, ITS Testing - Environmental Laboratories, Baton Rouge, LA, 1993 - January 1997

Responsible for supervision of the Accounts Receivable, Purchasing and Accounts Payable Departments. Included are responsibilities for payroll, collections, and cash management. Prepares monthly reports for corporate office and prepares Capital Expenditure requests and reconciles requests to the budget. Budget preparation is a joint duty of the Controller and the Chief Operations Officer. Maintained the General Ledger and Accounts Payable on an automated function run on the HP3000 and on AccPac Accounting System on the Novell Network. Human Resources responsibilities include advertising for positions, interviewing applicants, and employee benefits.

Director of Business & Operations Services, University Relations and Development, Louisiana State University, Baton Rouge, LA., May 1985 - June 1990

Department handles all phases of accounting and computer work in the division. Operate an IBM System 36 computer, which was upgraded in 1986 to accommodate the new programs and database being maintained. Installed a general ledger system, which is now in use by all areas of this division.

Previous Experience:

Corporate Controller, B. Olinde and Sons, Inc., Baton Rouge, LA., October 1980 - May 1985

Responsible for all phases of the accounting for the multifaceted business. Responsible for installation of a general ledger package, which would integrate with the packages in place and began automating the general ledger.

Education:

BS, Microbiology, Louisiana State University, 1986

MS, Food Science/Experimental Statistics, Louisiana State University, 1974.

CPA Preparatory Program, Louisiana State University, 1978

CPA Certificate, October 1979

Cornell - ITS Executive Development Program - August 1991

ITS Managerial Training Skills Workshop - 1993, 1994

ITS Environmental Laboratories - Baton Rouge, Manager and Supervisor Training Retreat, June 1996

Member - Society of Louisiana Public Accountants

Member – Louisiana Notary Association, Notary Certificate – November 1993

APPENIDX B

EQUIPMENT	MAKE/MODEL	SERIAL NUMBER
GCMSSV 1	AGILENT 5973	US10441235

EQUIPMENT	MAKE/MODEL	SERIAL NUMBER
	AGILENT 6890N	US10134037
GCMSSV 3	AGILENT 5973	US3220204
	AGILENT 6890N	CN10407013
GCMSV 0	HP 5890 SERIES II	3336A58851
	HP 5972	3501A02325
GCMSV 2	HP 5890 SERIES II	3029A29908
	HP 5972	3449A02093
GCMSV 3	HP 5890 SERIES II	3033A31455
	HP 5970	3034A12865
GCMSV 4	HP 5890 SERIES II	3336A54720
	HP 5971 A	3050A01785
GCMSV5	HP 5890 SERIES II	3310A48460
	HP 5972	3307A00395
GCMSV6	AGILENT 5973N/G2579A	US44621145
	AGILENT 6890N	CN10452003
PURGE/TRAP(GCMSV-0)	TEKMAR-LSC 2000	88161013
PURGE/TRAP(GCMSV-1)	TEKMAR-LSC 2000	92114001
PURGE/TRAP(GCMSV-2)	TEKMAR-LSC 2000	91162010
PURGE/TRAP(GCMSV-3)	TEKMAR-LSC 2000	90163023
PURGE/TRAP(GCMSV-4)	TEKMAR-LSC 3100	99076013
AUTOSAMPLER(GCMSV-0)	TEKMAR DOHRMANN SOLATEK 72	USO2294002
AUTOSAMPLER(GCMSV-1)	TEKMAR DOHRMANN SOLATEK 72	US02184009
AUTOSAMPLER(GCMSV-2)	TEKMAR ALS 2032/2016	94056005/91113002
AUTOSAMPLER(GCMSV-3)	TEKMAR ALS 2032/2016	92268005/95084019
AUTOSAMPLER(GCMSV-4)	TEKMAR DOHRMANN SOLATEK 72	US02098018
AUTOSAMPLER(GCMSV-5)	TEKMAR DOHRMANN SOLATEK 72	US02205002
FUME HOOD	LABCONCO (#20) GCMSV	
FUME HOOD	LABCONCO(#19)	
COOLER	TRUE(#22)	1330620
REFRIG/FREEZER	SEARS (V0A 2)	983108619
FREEZER	FRIGIDAIRE, MODEL #MFU17F3GW6 (#12) GCMSV	WB02927861
REFRIGERATOR	WPAINE 0570(C6) GCMSV	
GCSV 1	HP 5890 SERIES I	2843A19501
GCSV 2	HP 5890 SERIES II	3133A37433
GCSV 3	HP 5890 SERIES II	3108A34124
GCSV 4	HP 5890 SERIES II	3029A29801
GCSV 5	HP 5890 SERIES II	3033A30601
GCSV 6	HP 5890 SERIES II	3140A38274
GCSV 8	HP 5890 SERIES II	3336A53945
GCSV 11	HP 5890 SERIES II	3033A30303
GCSV 12	AGILENT TECH 6980N	US10338067
GCSV 14	AGILENT TECH 6890N	US10342128

EQUIPMENT	MAKE/MODEL	SERIAL NUMBER
GCSV 15	AGILENT TECH 6890N	CN10413018
EASY FLASH	TDX(GCSV#11)	997776
EASY FLASH	TDX(GCSV#7)	983302
FUME HOOD	LABCONCO(#33)	
GCV1	HP 5890 SERIES II	3336A54138
GCV2	HP 5890 SERIES II	3033A33621
GCV 3	HP 5890 SERIES II	2921A22989
GCV 4	HP 5890 SERIES II	3027A29674
GCV 5	HP 5890 SERIES II	3203A41268
PURGE/TRAP INSTRUMENT 3	LSC 2000	90233008
PURGE/TRAP INSTRUMENT 5	LSC 2000	90211015
PURGE/TRAP INSTRUMENT 1	LSC 2000	93118004
PURGE/TRAP INSTRUMENT 4	OI ANALYTICAL 4560	
AUTOSAMPLER INSTRUMENT 3	TEKMAR ALS 2016	93154002
AUTOSAMPLER INSTRUMENT 3	TEKMAR ALS 2032	95084017
AUTOSAMPLER INSTRUMENT 5	TEKMAR ALS 2032	93076011
AUTOSAMPLER INSTRUMENT 5	TEKMAR ALS 2016	91192015
AUTOSAMPLER INSTRUMENT 1	TEKMAR DOHRMANN SOLATEK 72	USO227705
AUTOSAMPLER INSTRUMENT 4	OI ANALYTICAL DPM-16	
REFRIG/FREEZER	SEARS (#19)	
REFRIGERATOR	DANBY	
REFRIG/FREEZER	MASTERBILT (#18)	254034
BALANCE	METTLER AE200	265273
BALANCE	SARTORIUS AC211P	50305162
REFRIG/FREEZER	WHITE ROPER BY WHIRLPOOL (#25)/RT14BKXK002	VSM0483080
REFRIG/FREEZER	SEARS (#11)	BA01000875
REFRIG/FREEZER	KENMORE (#14)	BA04391055
REFRIG/FREEZER	KENMORE (#15)	BA04391057
REFRIG/FREEZER	KENMORE (#17)	BA03100524
FREEZER	WHITE WESTINGHOUSE (#26)	WB83724994
METALS		
ICP	PERKIN-ELMER OPTIMA 3000XL	069N4051802
ICP	PERKIN-ELMER OPTIMA 4300DV	077N0050202
GFAA	PERKIN-ELMER 4100ZL	6421
HG ANALYZER	PERKIN ELMER/FIMS 400	4515
FUME HOOD—FLOW SCIENCES	FS3100BKFVA	11-j-07-04
FUME HOOD	FS3100BKFVA	11-j-07-15
METALS PREP		
MICROWAVE	CEM MARS5	DS-6208

EQUIPMENT	MAKE/MODEL	SERIAL NUMBER
DIGESTION BLOCKS(3)	CPI MOD BLOCK	
FUME HOOD –FLOW SCIENCES (2)	FS 310	5-0-7
BALANCE	SARTORIUS BASIC B310S	40030070
BALANCE	METTLER AE200	L94570
EXTRACTIONS		
FUME HOODS (18)		
FREON RECYCLER	ENVIROSAVE 22 (NOT IN USE)	
GLASS WASHER	AMSCO 400	36911195001
SHAKER (4)	GLAS-COL 099A	
MILLIPORE(2)		
VACUUM PUMP	WELCH 1397	
GPC (2)	ABC AP-100	9161SI/AS007-9114-9114
CENTRIFUGE	IEC HN-SII	
OVEN	FISHER ISOTEMP 655G	11000184
TCLP/ZHE ROTATOR (7)	ASSOCIATED DESIGN	
ZHE EXTRACTORS (27)	ENVIRONMENTAL EXPRESS	
WATER BATH (3)		
SONICATOR (4)	MISONIX	
INCUBATOR SHAKER	NEW BRUNSWICK SCIENTIFIC/CLASSIC SERIES C24	100524881
BALANCE	METTLER PM 3000	M33557
BALANCE	SARTORIUS U4600 P+	36090160
BALANCE	METTLER PG 3001 S	1117331005
BALANCE	AND FX-300	5015502
PH METER	ORION SA520	QT20A
PH METER	ORION 720A	003964
PH METER	ORION 720A+	085153
PH PROBE/ATC PROBE	ORION SURE-FLOW ROSS 917006	917006
PH PROBE/ATC PROBE	ORION SURE-FLOW ROSS 917006	9107BN
COOLER	TRUE (#5)	1334961
REFRIG/FREEZER	WHITE WESTINGHOUSE (#8)	LA10903763
REFRIG/FREEZER	WHITE WESTINGHOUSE (#9)	BA04391056
REFRIG/FREEZER	KENMORE (#6)	E52036581
FREEZER	WHITE WESTINGHOUSE (#23)	WB40802629
ULTRASONIC CLEANER	FISHER SCIENTIFIC/FS30	RTB040265340
MUFFLE FURNACE	FISHER SCIENTIFIC/ISOTEMP 550 SERIES MODEL 126	410N0074
HPLC		
HPLC	HP 1050 AND ACCESSORIES	
HPLC	HP 1049A	331450G644
HPLC	HP1046A	3137G02313
COLUMN HEATER	EPPENDORF TC-45	
AIR		
MSA1	HP 5890 SERIES II	3336A53261
	HP 5972	3341A01343
DYNAMIC DILUTER	ENTECH INSTRUMENTS/MODEL 4600A	1071
OVEN	LAB-LINE/3513ENT	104-5903

EQUIPMENT	MAKE/MODEL	SERIAL NUMBER
CANISTER CLEANER	ENTECH INSTRUMENTS/MODEL 3100A	1098
PRECONCENTRATOR	ENTECH INSTRUMENTS/MODEL 7100A	1166
WET CHEMISTRY		
TOX (2)	MITSUBISHI TOX-10E	
TOC (3)	SHIMADZU TOC-5050	30N28473/33829608/29118884
AUTOANALYZER	LACHET QUICK CHEM AE	200-474
IC	DIONEX LC20/ED40/AD20/AS40	900915
COD REACTOR (2)	HACH COD REACTOR	910404575/920800007697
TURBIDIMETER	HACH 2100P	960700011424
SPECTROPHOTOMETER	HACH DR/3000	920800003638
SPECTROPHOTOMETER	HACH DR/4000V	0304V0002021
TITRATOR	METTLER TOLEDO DL53	S119484414
VISCOMETER	BROOKFIELD DVII	32587
WATER BATH	BROOKFIELD TC-200	
CLOSED CUP FLASH PT	PRECISION SCIENTIFIC	10BR-12
FLASHPOINT TESTER	HERZOG PENSKY-MARTENS	013291531
AMMONIA PROBE	ORION 95-12	
OXYGEN BOMB CAL	PARR	6616
CONDUCTIVITY METER	OAKTON pH/CON 510 SERIES	79134
COLIFORM BATH	PRECISION SCIENTIFIC INCUBATOR	
PH METER	ORION 420A	7881
PH PROBE	ORION TRIODE	
PH PROBE/ATC PROBE	ORION COMB 915600/917006	
AUTOCLAVE	AMSCO EAGLE TEN /E105P	0429095113
DO METER	YSI MODEL 59/5905 PROBE	93A01946
DO METER	YSI MODEL 5100	99M0821-AF
OVENS (2)	BLUE M SW17TA-1	SW-5478/SW-5408
OVEN	LAB-LINE 3510	0687-0363
OVEN	GRIEVE PL-326	444341
FURNACE	THERMOLYNE 1500	
DESSICATORS (7)	DRY KEEPER	
INCUBATOR	FISHER SCIENTIFIC(#3)	WB93928030
BALANCE	METTLER AE163	C05693
BALANCE	METTLER AX504	1122043050
FUME HOODS (4)		
INCUBATOR (BOD)	REVCO	
INCUBATOR (BOD)	PRECISION SCIENTIFIC	
INCUBATOR (BOD)	FISHER SCIENTIFIC	WB 11908435
INCUBATOR (BOD)	FISHER SCIENTIFIC/MODEL 307C	WB 42941705
REFRIG/FREEZER	WHITE WESTINGHOUSE (#1)	WB10507478
LOG IN		
FUME HOOD (1)		
COOLER	TRUE (#2)	708391
COOLER	TRUE/GDM-72 (#3)	1-3792963
WALK-IN COOLER (2)		
REFRIG/FREEZER	KENMORE (#4)	BA01902878

EQUIPMENT	MAKE/MODEL	SERIAL NUMBER
ELECTRONIC THERMOMETER	RAYNGER ST2L RAYTEK	
FREEZER	FRIGIDAIRE(#12) MFU17F3GW6	WB03102969
SCANNER	HEWLETT PACKARD SCANJET 5470C/C9850A	CN1B41HOTZ
FREEZER	FRIGIDAIRE (#28) FFU20FC4CWO	WB34937210
FREEZER	FRIGIDAIRE (#29) FFC15C4CWO	WB40427812
MISCELLANEOUS		
BALANCE	AND FX-300 WEST-PAINE 0640	5015502
BALANCE	SARTORIUS B120S	40030105

CERTIFICATIONS

GCAL Certifications

- Louisiana Department of Environmental Quality, Environmental Laboratory Accreditation Program, NELAP, Certificate Number 01955 (Expiration 6/30/2005)
- Oklahoma Department of Environmental Quality, Laboratory Certification Program, ID # 9403 (Expiration 08/31/2005)
- State of North Carolina, Department of the Environment and Natural Resources, division of Water Quality, Laboratory Certification Program, Certificate # 618 (Expiration 12/31/2005)
- State of Arkansas, Department of Pollution Control and Ecology, Laboratory Certification Program (Expiration 08/02/2005)
- State of Florida, Department of Health, Bureau of Laboratories, NELAP, Lab ID: E87854 (Expiration 06/30/2005)
- State of California Environmental Laboratory Accreditation Program, Certificate Number 2242 (Expiration 05/31/2005)
- U.S. Army Corps of Engineers (USACE) validated laboratory (Expiration 04/16/2005)
- State of Kansas, Department of Health and Environment, NELAP, Certificate No. E-10354 (Expiration 10/31/2005)
- State of Georgia Environmental Protection Division accreditation based on LA –NELAP
- South Carolina Department of Health and Environment Control, Environmental Laboratory Certification Program, Certificate Number: 73006001 (Expiration 06/30/2005)
- State of Illinois Environmental Protection Agency, NELAP Accreditation #200048, Certificate No. 001202 (Expiration 02/17/2006)
- U.S.D.A Foreign Soils Import Permit

APPENDIX H

PLAN ADDENDA