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BASELINE SAMPLING AND ASSESSMENT WORK PLAN FOR DEPOT GAS STATION BUILDING 170 DRAFT ACTING AS FINAL MCRD PARRIS ISLAND SC
3/1/2009
TETRA TECH NUS

Comprehensive Long-term Environmental Action Navy

CONTRACT NUMBER N62467-04-D-0055

REVISION 1
MARCH 2009

Baseline Sampling and Assessment Work Plan
for
Depot Gas Station (Building 170)

South Carolina Department of Health and Environmental Control
Site ID #01386

Marine Corp Recruit Depot
Parris Island, South Carolina

Contract Task Order 0136

March 2009

NAVFAC
Naval Facilities Engineering Command
NAVFAC SOUTHEAST
NAS Jacksonville
Jacksonville, Florida 32212-0030

TETRA TECH NUS, Inc.

010914/P

BASELINE SAMPLING AND ASSESSMENT WORK PLAN
DEPOT GAS STATION (BUILDING 170)

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL
SITE ID #01346

MARINE CORP RECRUIT DEPOT
PARRIS ISLAND, SOUTH CAROLINA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Naval Facilities Engineering Command
Southeast
NAS Jacksonville
Jacksonville, Florida 32212-0030

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CONTRACT TASK ORDER 0136

MARCH 2009

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LIST OF ACRONYMS AND ABBREVIATIONS

AST	Above-ground storage tank
bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, and xylenes
ºC	Degree Celsius
CAP	Corrective Action Plan
CLEAN	Comprehensive Long-Term Environmental Action Navy
COC	Constituent of concern
CTO	Contract Task Order
DO	Dissolved oxygen
DOT	Department of Transportation
DQO	Data Quality Objective
EPA	United States Environmental Protection Agency
FID	Flame ionization detector
FOL	Field Operations Leader
ft/ft	Feet per foot
ID	Inside-diameter
IDW	Investigative derived waste
iSOC	In-situ submerged oxygen curtain
MCRD	Marine Corps Recruit Depot
MTBE	Methyl tert butyl ether
mg/L	Milligram per liter
mV	Millivolt
NAVFAC SE	Naval Facilities Engineering Command Southeast
NTU	Nephelometric turbidity unit
ORP	Oxidation/reduction potential
PAH	Polynuclear aromatic hydrocarbon
PID	Photoionization detector
PVC	Polyvinyl chloride
RBSL	Risk-based screeneing level
SCDHEC	South Carolina Department of Health and Environmental Control
SSTL	Site-specific target level
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TOC	Total organic carbon
TtNUS	Tetra Tech NUS, Inc.

µg/L	Microgram per liter
µg/kg	Microgram per kilogram
UST	Underground storage tank
VOC	Volatile organic compound

1.0 INTRODUCTION

1.1 OVERVIEW

Tetra Tech NUS, Inc. (TtNUS) has prepared this Baseline Sampling and Assessment Work Plan for Naval Facilities Engineering Command Southeast (NAVFAC SE) under Contract Task Order (CTO) 0136 of the Comprehensive Long-Term Environmental Action Navy (CLEAN) IV Contract Number N62467-04-D-0055. This Work Plan for monitoring well installation and baseline groundwater sampling is designed to evaluate if new baseline site conditions exist following the soil excavation completed on March 15, 2005. In addition, the results from the baseline sampling event will provide a basis for final remedial technology selection and appropriate treatability testing.

1.2 SITE HISTORY

The Depot Gas Station began operations in the 1940s. The site formerly provided gasoline and diesel fuels to vehicles through two gasoline dispensers located at former Building 170 and one diesel dispenser at the above-ground storage tanks (ASTs) located east of former Building 170. A 2-inch diameter dispenser line from the ASTs to dispensers at Building 157 supplied fuel to facility vehicles. The fuel line reportedly had not been used for some time and the dispensers at Building 157 were later replaced by underground storage tanks (USTs). The dispensers and USTs at Building 157 have been removed and the fuel line was capped in 1997. The dispenser line passed by the corner of Buildings 139 and 155 and may have contributed to the impacted soil and groundwater at Buildings 139 and 155. Building 139 was used as a warehouse until it was demolished at the end of 1997. Past activities at Building 139 may also have included vehicle maintenance. Building 155 is the Depot vehicle maintenance facility.

In December 1983, approximately 97 gallons of gasoline spilled in the vicinity of Building 170 when a tank overflowed during filling operations. Contaminated soil was thereafter removed. Dispensers, tanks, and Building 170 including the dispensers and tanks were removed in March 2000.

1.3 SITE DESCRIPTION

Marine Corps Recruit Depot (MCRD) Parris Island is an active facility located approximately 5 miles south of Beaufort, Beaufort County, South Carolina. The MCRD is located on an island north of Port Royal Sound between the Broad and Beaufort Rivers (Figure 1-1). The Depot Gas Station is located at the northeastern region of the island near former Buildings 139 and 170 and Building 155 (Figure 1-2).

A Tier II Assessment report was prepared and submitted in April 2003 (TtNUS, 2003), which summarized the results of field screening and confirmatory sampling of soil and groundwater at the site. The Tier II

Assessment described petroleum hydrocarbon contamination in both soil and groundwater at concentrations greater than South Carolina Department of Health and Environmental Control (SCDHEC) risk-based screening levels (RBSLs).

Within the site area, groundwater is encountered at approximately 2- to 4-feet below ground surface (bgs). Based on potentiometric maps from previous reports, groundwater generally flows north-northwest in shallow monitoring wells with a hydraulic gradient of 0.002 feet per foot (ft/ft). Groundwater in monitoring wells screened within the deeper aquifer flows to the southeast with a corresponding hydraulic gradient of 0.0022 ft/ft.

During the Tier II Assessment, sixteen subsurface soil samples were collected for analysis of benzene, toluene, ethylbenzene, xylenes (BTEX), naphthalene, polynuclear aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPH), and inorganics. Benzene was detected in six of the soil samples above the RBSL protective of leaching to groundwater of 7 µg/kg for sandy soil. Naphthalene was detected in eight samples at concentrations in excess of the RBSL of 36 µg/kg. Ethylbenzene and xylenes were detected in two samples above RBSLs of 1,150 µg/kg and 93,000 µg/kg, respectively. Toluene was detected in one sample above the RBSL of 1,450 µg/kg.

Thirty-six groundwater samples were collected during the Tier II Assessment for analysis of BTEX, methyl tert butyl ether (MTBE), naphthalene, TPH, PAHs, and inorganics. Benzene exceeded the RBSL of 5 µg/L in 12 samples. Thirteen samples detected naphthalene and six 2-methyl naphthalene in groundwater above the RBSL of 25 µg/L. Ethylbenzene exceeded the RBSL of 700 µg/L in four groundwater samples. Toluene exceeded the RBSL for toluene in three samples. Inorganics including arsenic, chromium, iron, and lead were also detected above respective RBSLs.

A Corrective Action Plan (CAP), subsequently submitted to SCDHEC in July 2005, recommended corrective action alternatives to address impacted soil and groundwater with contaminant concentrations exceeding site-specific target levels (SSTLs). SSTLs were derived utilizing the Domenico Fate and Transport Model as specified in SCDHEC guidance (SCDHEC, 2001). The CAP recommended soil remediation via excavation and off-site disposal and groundwater remediation via enhanced bioremediation using oxygen addition (TtNUS, 2005). A soil excavation of 540 tons was completed on March 15, 2005 and the excavation was backfilled with clean fill.

1.4 SEQUENCE OF EVENTS

Sampling and analysis activities at the site of the former Building 170 Depot Gas Station will proceed in two phases.

In the first phase, all existing monitoring wells will be sampled and analyzed. Results from this round of sampling will be evaluated to determine if conditions have not changed significantly since the last round of sampling. The sampling report will be forwarded to MCRD Parris Island and NAVFAC SE for approval. Once approval is received, the report will be submitted to SCDHEC.

In the second phase, SCDHEC will forward their comments on the sampling report to MCRD Parris Island and NAVFAC SE for review. At this point, determination will be made as to whether additional wells will be placed at the site.

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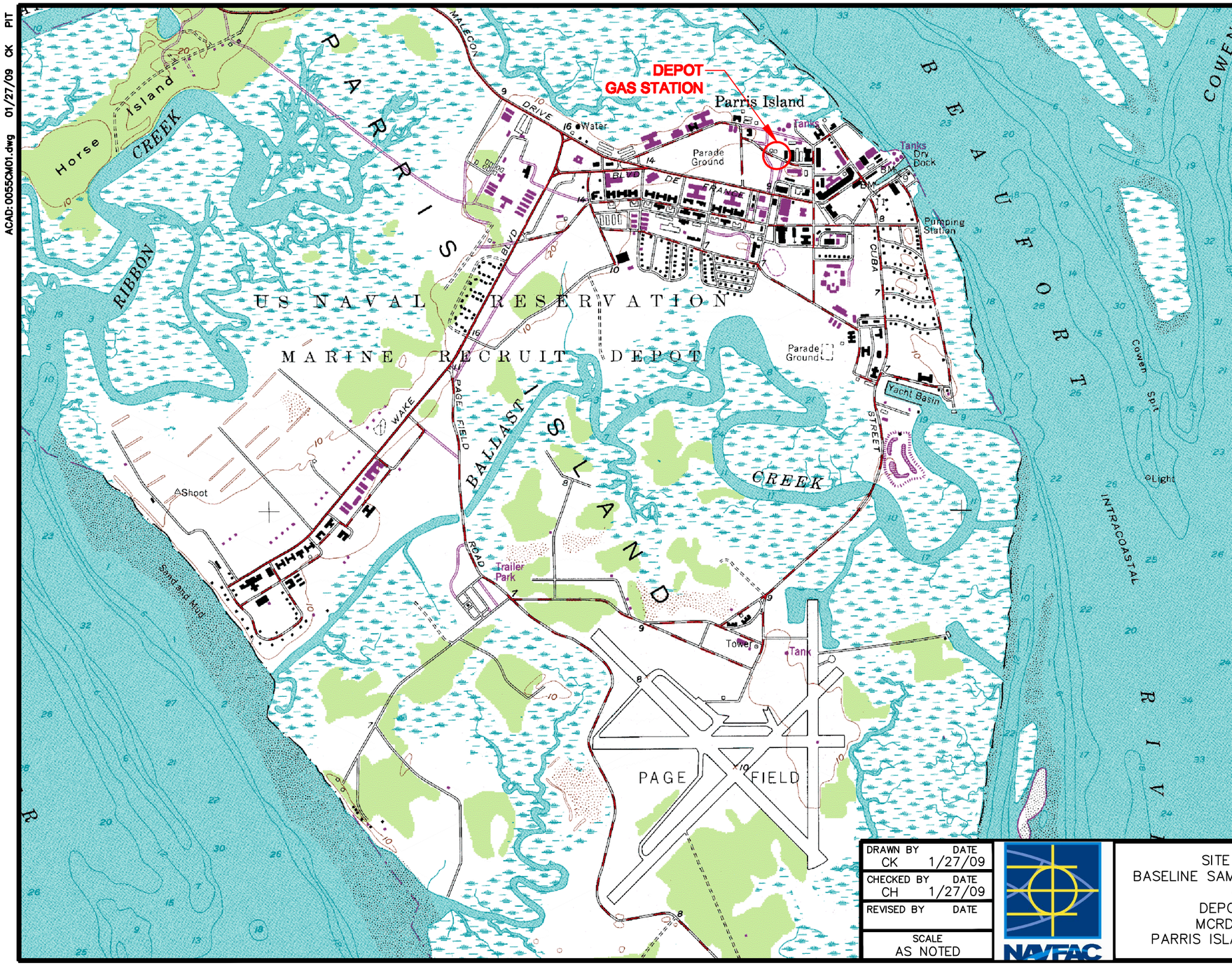

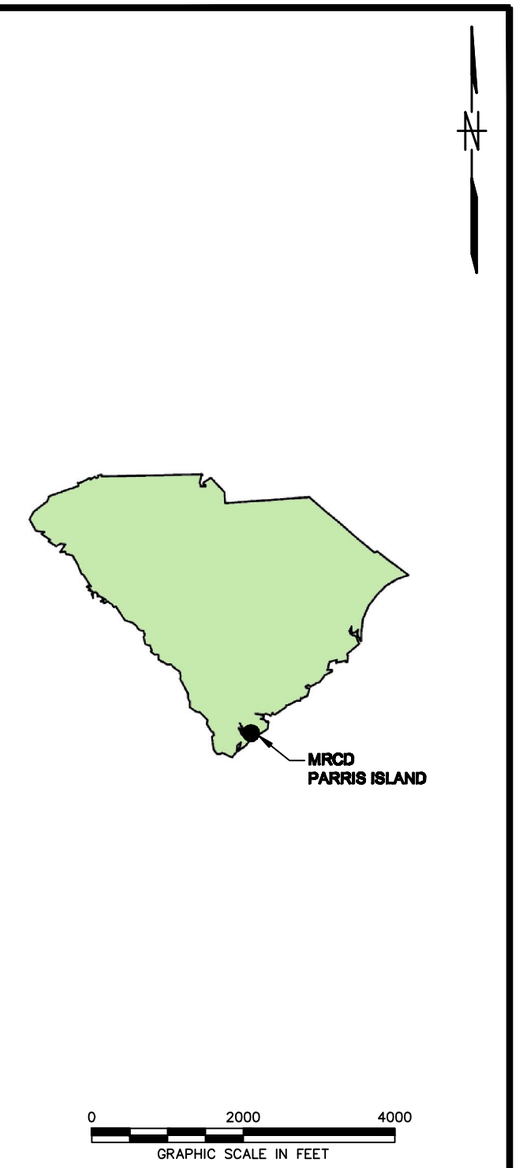

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CHECKED BY CH	DATE 1/27/09		OWNER NO. CTO 0136
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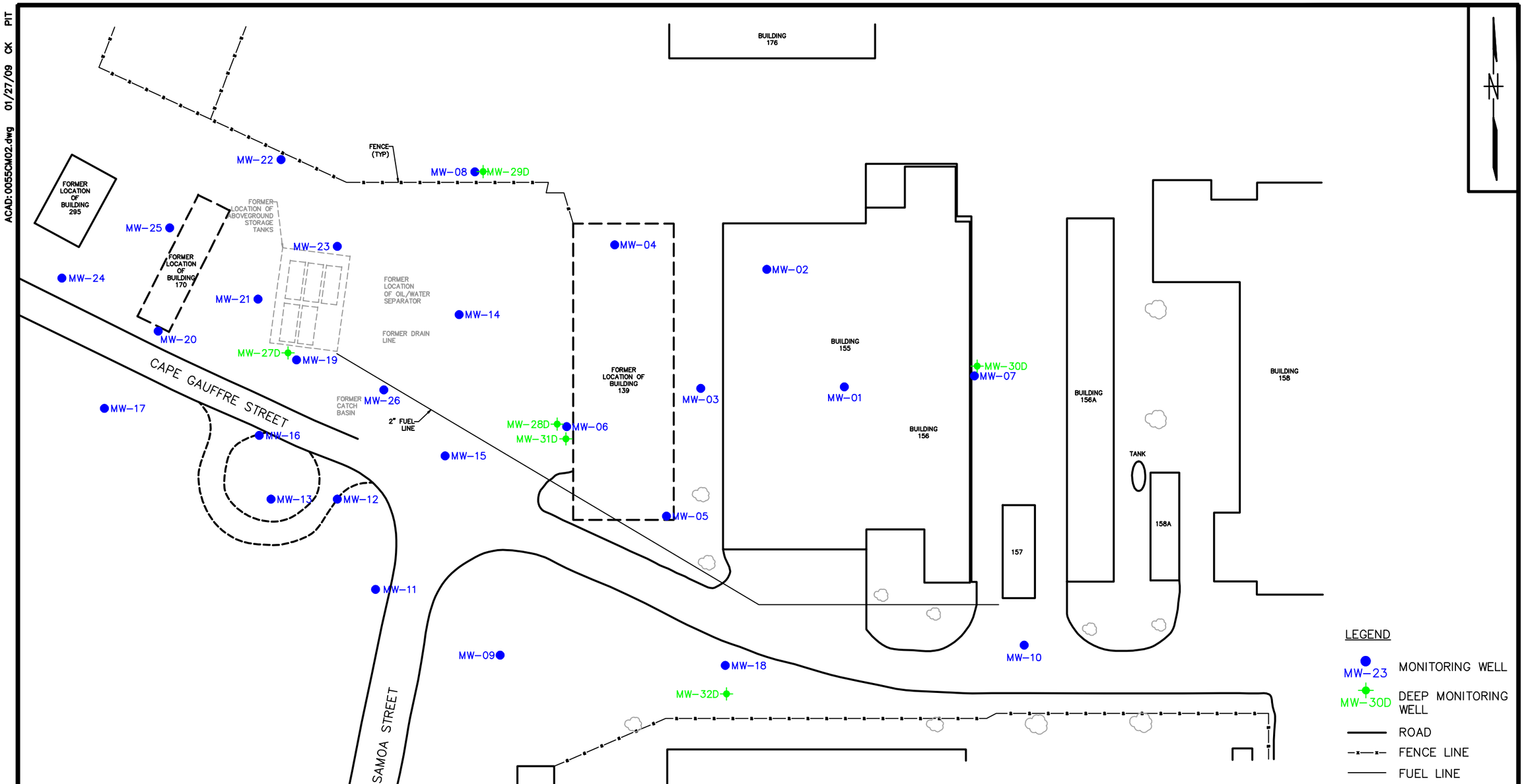

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SCALE AS NOTED			DRAWING NO. FIGURE 1-2 / REV. 0

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2.0 FIELD OPERATIONS

The following summarizes well installation and sampling activities, which will be conducted in order to complete baseline sampling and analysis at the Depot Gas Station. The field operations specified were designed to evaluate site conditions following soil excavation and prior to treatability testing.

2.1 MONITORING WELLS

One deep and one shallow monitoring well (PAI-MW-33D and PAI-MW-33S, respectively) are proposed immediately downgradient of MW-06 and MW-28D as shown on Figure 2-1, where benzene analytical results indicated the highest benzene concentrations. Well locations were selected based on groundwater flow direction and historical benzene contamination data. This section outlines the procedures for installation of the two monitoring wells, the data from which will be used as a baseline for the treatability study design for the MCRD Parris Island Depot Gas Station.

2.1.2 Preliminary Activities

All preliminary activities such as subcontractor procurement and coordination, procurement of monitoring well permits, authorizations, site access, and clearance of easements and utilities will be completed prior to mobilization to perform field activities. A utility map from the CAP is provided as Figure 2-2.

This project requires the use of subcontractors for utility clearance, monitoring well installation, surveying, and sample analysis and IDW disposal. The selected fixed-base analytical laboratory will be a South Carolina-certified analytical laboratory. A state-licensed driller will conduct the monitoring well drilling/installation. Similarly, a state-licensed surveyor will conduct a land survey to tie in the location of newly installed monitoring wells to existing well locations.

Following approval of this Baseline Sampling and Assessment Work Plan, mobilization activities will begin. The Field Operations Leader (FOL) will coordinate the mobilization activities for this project.

2.1.3 Utility Clearance

Utility clearance will be conducted by a subcontractor in coordination with MCRD Parris Island. A formal request letter will be submitted to SCDHEC prior to advancement of the permanent wells, and monitoring well records (1903 Form) will be submitted within 30 days after completion.

2.1.4 Monitoring Well Installation

Two permanent monitoring wells, including one shallow and one deep well, will be installed and constructed in accordance with applicable State of South Carolina regulations (e.g., Regulation 61-71 South Carolina Well Standards, April 2002). One shallow monitoring well will be installed to a depth of 15 feet bgs with a 10-foot screen and a screen interval installed such that the water table is straddled. The deep monitoring well will be installed to a maximum depth of 60 feet bgs and will be screened over a 10-foot interval. The proposed monitoring well locations will be used to further characterize contaminant migration immediately downgradient of the source area in both shallow and deep monitoring well aquifer zones. Monitoring wells MW-05 and MW-06 will be used as a comparison of upgradient conditions.

Monitoring wells will be installed using hollow-stem augers with a 4- to 4.25-inch, inner diameter (ID) and 8- to 9-inch outer diameter that will allow for a minimum 2-inch-thick sand pack in the annulus between all sides of each new well and the sidewalls of the borehole. The monitoring wells will be installed through the augers upon completion of the borings. Split-spoon samples will be collected every 5 feet during borehole advancement to obtain lithologic information. Soil samples will not be collected during the monitoring well installation event. Soil cuttings will be containerized and managed as investigative-derived waste (IDW) in accordance with Sections 2.3 and 2.4. Decontamination procedures for soil boring and monitoring well installation will be in accordance with Section 2.8.

All wells will be constructed with certified-clean well construction material. Monitoring wells will be constructed of 2-inch inside diameter, flush-threaded, polyvinyl chloride (PVC) well screen and compatibly threaded PVC well casing. Monitoring wells will be installed with 0.010- or 0.020-slot screen (depending on lithologic grain size encountered) and constructed to meet the guidelines of South Carolina Well Regulations (SCDHEC, 2002).

The following well construction methods will be employed during the monitoring well installation event:

- Well screen intervals will be field determined/verified.

- A primary filter pack of clean silica sand will be installed flush with the bottom of the well to a minimum of 12 inches above the top of the well screen.

- A sand passing U.S. Standard Sieve No. 20-40 will be used for fine sand and silty sand formations (0.010-inch slot size), and a coarser sand (U.S Standard Sieve No. 16-30) will be used used with 0.020-inch slot size screens in coarser formations.

- A minimum 12-inch-thick seal of 100-percent sodium bentonite pellets will be installed above the primary filter pack and allowed to hydrate in accordance with the manufacturer's recommendations.

- A grout seal (minimum of 6-inch thickness) will be installed above the bentonite seal and around the casing.

The 2-foot by 2-foot concrete pad will be neatly cut, backfilled, and patched to match the surrounding surface. Wells will be constructed so that the concrete pad is a continuous pour from the ground surface to 2 feet bgs in the boring. The concrete will be placed after adequate hydration times for the bentonite have been allowed for the seal. Conventional Type I Portland cement will be used in the concrete for pads.

All wells will be flush-mounted and have provisions for hinged caps or J-plugs with keyed-alike padlocks for well security. Each monitoring well will have a well tag affixed in accordance with the South Carolina State Code. Identification tags will be mounted inside of the vault covers and contain the following information:

- Well identification number
- Date of construction
- Name of consultant
- Depth of well
- Screened interval
- Top of casing elevation
- Northing of well
- Easting of well
- Reference datum
- Well information contact
- Certification number of the driller

A boring log will be maintained for each monitoring well boring by the field geologist. Field screening results and lithologic descriptions of the subsurface units will be recorded on a soil boring log.

2.1.5 Monitoring Well Development

New and existing monitoring wells will be developed after well completion to remove fine material from the annular space around the sand pack and screened interval of the well. Wells will be developed by surging and bailing or pumping, as determined in the field. A minimum of three times the standing water

volume in the well casing plus three times the water volume in the saturated sand pack will be removed. An attempt will be made to develop each well to a turbidity less than 10 nephelometric turbidity units (NTUs). The wells will be developed until the discharge water is visibly clear and temperature, pH, and specific conductivity have stabilized within 10 percent variance for three consecutive measurements or as determined by the FOL. All water quality measurements and volumes removed will be recorded for each well on the well development form. Measurements of pH, temperature, turbidity, and specific conductivity will be collected during development. All development water will be containerized and managed as IDW.

2.1.6 Surveying

All proposed monitoring wells and selected reference features will be surveyed to tie into the existing base map. A third-order survey will be conducted by a professional surveyor licensed in the State of South Carolina. Existing survey monuments at MCRD Parris Island will be used as reference points.

The North American Datum of 1983 will be used as the horizontal datum. Horizontal locations of the well will be surveyed to MCRD Parris Island coordinates, which are tied to the South Carolina State Plane Coordinate System. Sample locations will be surveyed to the nearest 0.10 foot.

Vertical elevations will be referenced to National Geodetic Vertical Datum of 1988. Elevations for the monitoring wells will be determined at the measuring point where the uncapped PVC well riser pipe is notched and will be surveyed to the nearest 0.01 foot.

2.2 BASELINE SAMPLING

The results of baseline groundwater sampling at new and existing monitoring wells will be used to evaluate potential remedial options. Preliminary evaluations of potential remedial options that an in-situ submerged oxygen curtain (ISOC) may be an effective remedial technology. However, based on technical advances since the generation of the CAP (TtNUS, 2005), the appropriateness of this technology will need to be re-evaluated and a remedial option evaluation conducted. Contaminant data from the baseline sampling event will provide updated contaminant extent information and provide a basis for preliminary remedial design processes. Biological and geochemical data sets obtained from baseline groundwater sampling will be used as preliminary evaluation criterion for contaminant biodegradation. The following methodology will be utilized for the baseline sampling round at the MCRD Parris Island Depot Gas Station.

2.2.1 Water-Level Measurements

Water-level measurements will be collected from the existing and new monitoring wells. All water-level measurements will be taken within a short time period (maximum 2 hours) of consistent weather conditions to minimize atmospheric/precipitation effects on groundwater levels. Measurements will be taken with an electronic water-level indicator using the notch at the top of the well casing as the reference point for determining depths to water. Water-level measurements will be recorded to the nearest 0.01 foot in the appropriate groundwater-level measurement form.

2.2.2 Groundwater Purging

All monitoring wells will be purged before sampling using a low-flow peristaltic pump and polyethylene tubing. Well purging will be performed immediately before each well is sampled. The water level and total depth of the monitoring well will be measured before the start of purging.

Temperature, pH, turbidity, specific conductance, dissolved oxygen (DO), and salinity will be measured during purging. These measurements will be taken at the start of purging and every 5 to 10 minutes thereafter until the temperature, specific conductance, and salinity have stabilized to within 10 percent over a minimum of three readings, pH has stabilized to within ±0.2 pH units over a minimum of three readings, and turbidity is less than 10 NTUs. In the event that 10 NTUs cannot be achieved after 30 minutes, appropriate notation will be recorded in the field sheet and the sample will be collected. All purge water removed from the wells will be containerized and handled/disposed as IDW.

Groundwater samples will be collected using low-flow sampling procedures. All samples will be transferred directly from the peristaltic pump tubing to the sample container. Volatile organic samples will be collected first, directly from the discharge side of the tubing after reducing the pump's flow rate to minimize turbulence and making sure that zero headspace is present in the filled sample container. Natural attenuation samples will be collected thereafter.

2.2.3 Groundwater Sampling

Groundwater samples will be collected from 29 monitoring wells, as identified in Table 2-1, per SCDHEC requirements (SCDHEC, 2005) for the following analyses:

- VOCs: Benzene, toluene, ethylbenzene, xylenes (total), methyl-tert-butyl ether, naphthalene, and 1,2-dichloroethane via SW-846 United States Environmental Protection Agency (EPA) Method 5030B and 8260B.

- 1,2-Dibromoethane via SW-846 EPA Method 8011.
- Polynuclear aromatic hydrocarbons (PAHs) via SW-846 EPA Method 8310.
- Oxygenates: Ethyl tert-butyl ether, ethyl tert-butyl alcohol, tertiary-amyl methyl ether, diisopropyl ether, tert-butyl formate, tert-butyl alcohol, tert-amyl alcohol, and ethanol via SW-846 EPA Method 5030B and 8260B.
- Methane via the Kerr Method.
- Ferrous iron via SW-846 EPA Method 6010B.
- Lead via SW-846 EPA Method 7421.
- Nitrate and sulfate via SW-846 EPA Method 9056
- Total organic carbon (TOC) via SW-846 EPA Method 9060

In addition, four existing wells will be sampled for biological parameters including alkalinity, ammonia nitrogen, hydrocarbon-degrading bacteria, and heterotrophic plate count. The four sampling locations include one upgradient (MW-05), one downgradient (MW-14), and two area of impact locations (MW-06 and MW-28D).

2.2.4 Quality Assurance/Quality Control Sample Collection

Quality control samples to be collected during environmental sampling activities include field duplicates, field blanks, equipment rinse blanks, and trip blanks.

2.3 INVESTIGATIVE-DERIVED WASTE SAMPLING

All IDW will be sampled and profiled for disposal following field activities. Handling of IDW is discussed in Section 2.9. All fluids (decontamination, purge, and development water) will be composited and analyzed for Target Compound List (TCL) volatile organic compounds (VOCs). All soil IDW will be composited and analyzed for ignitability, corrosivity, reactivity, and Toxicity Characteristic Leaching Procedure (TCLP) organics and inorganics. All disposable items (e.g., gloves, paper towels, etc.) will be double bagged and disposed in accordance with MCRD Parris Island's IDW Management Plan.

2.4 INVESTIGATIVE-DERIVED WASTE HANDLING

Disposal requirements for IDW will be in accordance with current NAVFAC SE IDW management guidance. IDW generated during drilling, purging, development, sampling, and decontamination activities will be containerized in Department of Transportation (DOT)-approved (specification 17C) 55-gallon drums. IDW will be stored in a centralized location designated by MCRD Parris Island. The drums will be labeled, sealed, and left at the facility pending completion of analytical results. Upon receipt of analytical results, they will be disposed by a contractor to TtNUS, via MCRD signed manifest documentation. Additional detail is provided in the MCRD Parris Island IDW Management Plan.

2.5 OTHER FIELD MEASUREMENTS

Field measurements to be recorded during field and sampling operations include screening the breathing air around the workspace area, screening soil samples, and screening air quality within the well casing. Also, field groundwater measurements of temperature, pH, turbidity, dissolved oxygen, oxidation/reduction potential (ORP), specific conductance, static water levels in new and existing monitoring wells will be taken.

The following instruments are anticipated to be used during the field activities:

- Photo ionization detector (PID) or flame ionization detector (FID)
- Horiba® (or equivalent) water-quality meter
- Electronic water-level meter
- Lamotte turbidity meter

Field instruments will be calibrated according to the manufacturers' requirements and before each day's use, and all instrument calibration will be recorded on an equipment calibration log sheet. During calibration, a maintenance check will be performed on each piece of equipment. If damaged or defective parts are identified during the maintenance check and it is determined that the damage could have an impact on the instrument's performance, the instrument will be removed from service until the defective parts can be repaired or the instrument replaced.

2.6 SAMPLE AND WELL NOMENCLATURE

Each groundwater and IDW sample will be assigned a unique codified sample identification number. The labeling system established for this sampling event is based on the following:

1		2		3		4
AAA	-	AA	-	NNN	-	NN
Site Location and Site Number		Medium		Sample Location		Sample Depth or Sampling Round

1 PAI - MCRD Parris Island
2 GW - Groundwater
FB - Field Blank
TB - Trip Blank
RB - Rinsate Blank
WS - Waste
IDW - IDW
DU - Duplicate
3 An ascending sequential number of samples collected or well number
4 Bottom of sample interval in feet, or sequence, as noted
Also, an additional suffix, "-F", will be added to field-filtered samples

The following are medium-specific nomenclature to be used in this program.

Monitoring Wells

Monitoring wells installed as part of the baseline sampling will be denoted by "PAI-DGS-MW" to distinguish. To maintain continuity from existing wells, the shallow and deep monitoring wells will be labeled PAI-DGS-MW-33-S and PAI-DGS-MW-33-D, respectively.

Groundwater Samples

1		2		3		4
PAI	-	GW	-	XXX	-	NN
Site Location		Medium		Well Number,"		Sampling Round

3 Well number and depth suffix, excluding MW.
4 Sampling round in this program, starting at 01.

For example, the first sample from monitoring well MW-01-S would be PAI-GW-1S-01.

Blanks, IDW Sample, and Duplicates

1		2		3		4
PAI	-	MM	-	XXXXXX	-	NN
Site Location		Sample Type		Date		Identifier

1 Repeat from above
2 Sample type, as noted at the beginning of this subsection.
3 Date of sample in the format MMDDYY.
4 An ascending sequential number to differentiate samples collected on the same date, starting at 01.

For example, the first solid IDW sample collected on July 15, 2009, would be numbered PAI-IDW-071509-01.

2.7 CHAIN OF CUSTODY

Sample custody will be maintained and documented at all times. Custody begins at the time of collection and ends at the time of sample disposal by the laboratory. Custody will be documented on laboratory-supplied or generic multi-layer chain-of-custody forms.

2.8 DECONTAMINATION

The equipment involved in field sampling activities will be decontaminated prior to beginning work, between locations, during drilling and sampling activities, and at the completion of the project.

2.8.1 Major Equipment

All downhole drilling equipment, including downhole drilling tools, will be cleaned with high-pressure hot water prior to beginning work, between boreholes, whenever the drill rig leaves the site prior to completing a boring, and at the conclusion of the drilling program.

Decontamination operations will consist of washing equipment using a high-pressure steam wash from a potable water supply. All decontamination activities will be take place at a predetermined area within the site.

2.8.2 Development Equipment

Nondisposable equipment will be decontaminated prior to beginning well development and at the conclusion of development at each well. Sampling equipment will be washed with hot water and Alconox (or equivalent), rinsed with potable water, and then rinsed with deionized water. For samples collected for volatile analysis, sampling equipment will also be rinsed with isopropanol prior to being rinsed with deionized water. Disposable sampling equipment used for sampling activities will be discarded as IDW.

Field analytical equipment such as water-level meter, turbidity meter, pH, conductivity, and temperature instrument probes will be rinsed with deionized water.

TABLE 2-1

SAMPLING AND ANALYSIS SUMMARY
BASELINE SAMPLING AND ASSESSMENT WORK PLNA
DEPOT GAS STATION
MCRD PARRIS ISLAND, SOUTH CAROLINA

Location	Well Depth* (feet)	LABORATORY PARAMETERS														FIELD TESTS					Rationalle
		VOCs	1,2-Dibromomethane	PAHs	Oxygenates	TOC	Methane	Ferrous Iron	Lead	Nitrate	Sulfate	Ammonia Nitrogen	Alkalinity	Hydrocarbon Degrading Bacteria	Heterotrophic Plate Count	pH	Temperature	Dissolved Oxygen	Oxidation/Reduction Potential	Groundwater Elevation	
MW-01	11.77	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	Shallow, Building 139 Plume Location
MW-02	12.00	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	Shallow, Sidegradient of Building 139 Plume
MW-03	12.00	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	Shallow, Building 139 Plume, Source Location
MW-04	12.00	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	Shallow, Sidegradient of Building 139 Plume
MW-05	12.00	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Shallow, Building 139 Plume Location
MW-06	12.50	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Shallow, Building 139 Plume, Source Location
MW-07	12.50	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	Shallow, Upgradient of Building 139 Plume
MW-08	12.50	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	Shallow, Side/Upgradient of Former AST Plume
MW-09	12.50	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	Shallow, Sidegradient of Building 139 Plume
MW-11	12.50	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	Shallow, Sidegradient of Building 139 Plume
MW-12	12.50	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	Shallow, Sidegradient of Building 139 Plume
MW-14	12.50	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Shallow, Between Building 139 and Former AST Plumes
MW-15	12.50	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	Shallow, Building 139 Plume, Source Location
MW-16	12.50	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	Shallow, Side/Upgradient of Former AST Plume
MW-17	12.50	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	Shallow, Side/Upgradient of Former AST Plume
MW-19	12.50	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	Shallow, Former AST Plume, Source Location
MW-20	12.50	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	Shallow, Former AST Plume Location
MW-21	12.50	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	Shallow, Former AST Plume, Source Location
MW-22	12.50	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	Shallow, Downgradient of Former UST Plume
MW-23	12.50	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	Shallow, Former AST Plume, Source Location
MW-24	12.50	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	Shallow, Downgradient of Former AST Plume

TABLE 2-1

SAMPLING AND ANALYSIS SUMMARY
BASELINE SAMPLING AND ASSESSMENT WORK PLNA
DEPOT GAS STATION
MCRD PARRIS ISLAND, SOUTH CAROLINA

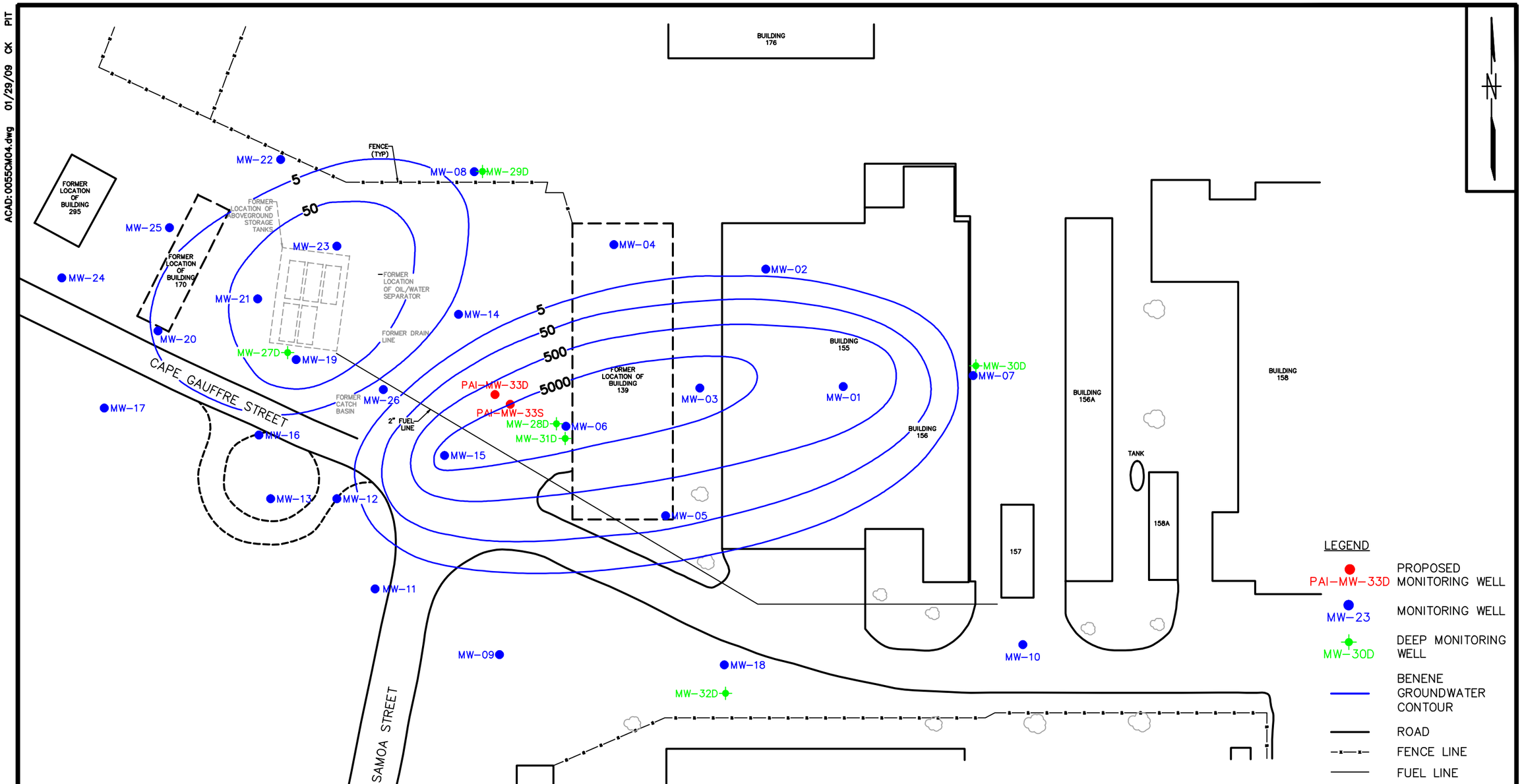
Location	Well Depth* (feet)	LABORATORY PARAMETERS														FIELD TESTS					Rationalle
		VOCs	1,2-Dibromomethane	PAHs	Oxygenates	TOC	Methane	Ferrous Iron	Lead	Nitrate	Sulfate	Ammonia Nitrogen	Alkalinity	Hydrocarbon Degrading Bacteria	Heterotrophic Plate Count	pH	Temperature	Dissolved Oxygen	Oxidation/Reduction Potential	Groundwater Elevation	
MW-25	12.50	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔					✔	✔	✔	✔	✔	Shallow, Downgradient of Former AST Plume
MW-26	11.76	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔					✔	✔	✔	✔	✔	Shallow, Between Building 139 and Former AST Plumes
MW-27D	33.87	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔					✔	✔	✔	✔	✔	Deep, Former AST Plume, Source Location
MW-28D	34.17	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	Deep, Building 139 Plume, Source Location
MW-29D	35.09	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔					✔	✔	✔	✔	✔	Deep, Sidegradient of Former AST Plume
MW-30D	34.50	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔					✔	✔	✔	✔	✔	Deep, Upgradient of Building 139 Plume
MW-31D	57.70	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔					✔	✔	✔	✔	✔	Deep, Building 139 Plume, Source Location
MW-33S**	15.00	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔					✔	✔	✔	✔	✔	Shallow, Building 139 Plume, New Location
MW-34D**	60.00	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔					✔	✔	✔	✔	✔	Deep, Building 139 Plume, New Location

VOCs - Volatile Organic Compounds
PAHs - polynuclear aromatic hydrocarbons
TOC - total organic carbon
✔ - denotes selected analysis

* As reported in the Corrective Action Plan (TtNUS, 2005)

** Proposed monitoring well location

ACAD: 0055CM04.dwg 01/29/09 CK PIT



DRAWN BY	DATE
CK	1/29/09
CHECKED BY	DATE
CH	1/29/09
REVISED BY	DATE
SCALE	
AS NOTED	

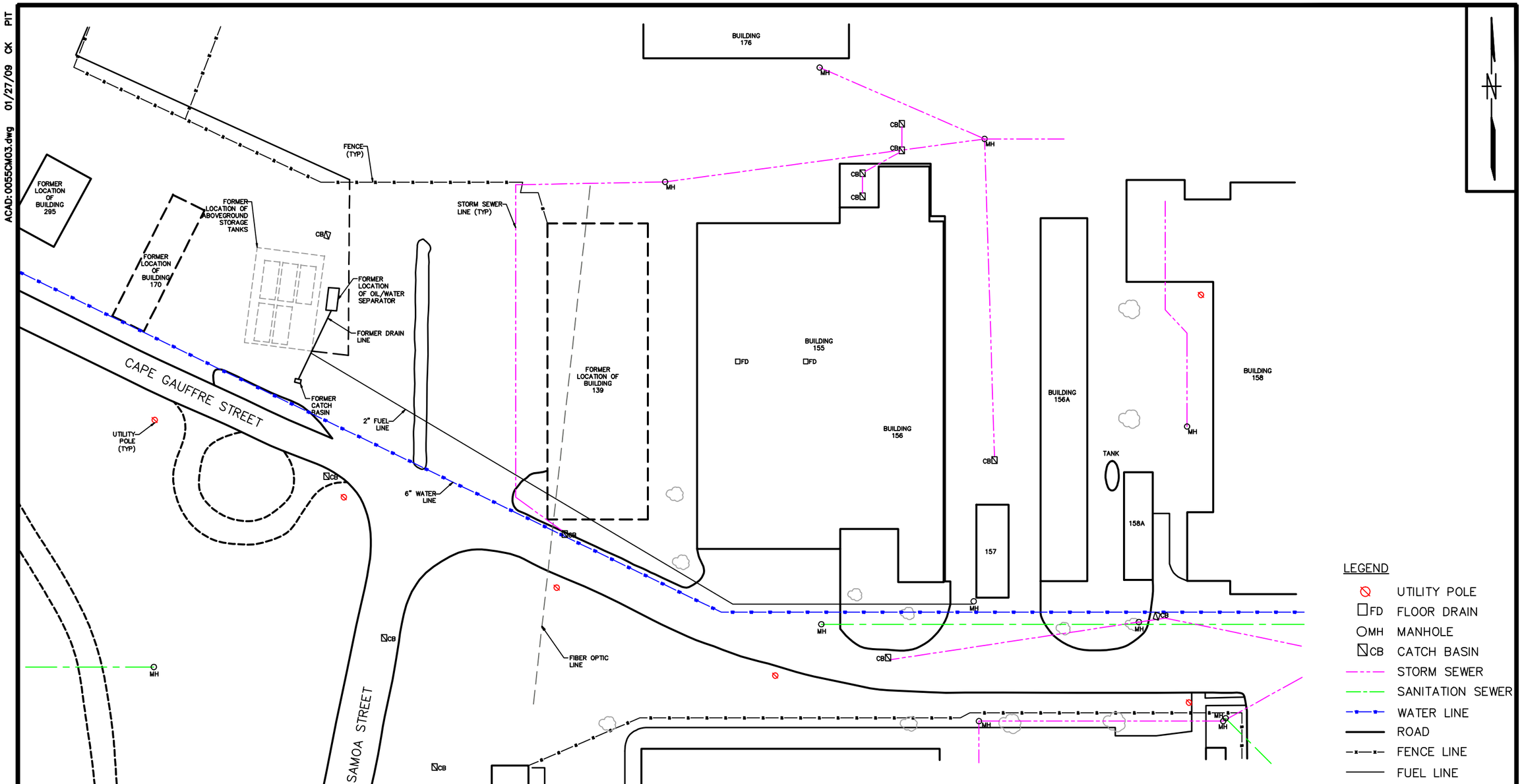
NAVFAC

PROPOSED MONITORING WELL LOCATION MAP
BASELINE SAMPLING AND ASSESSMENT WORK PLAN
DEPOT GAS STATION
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NO.	
0055	
OWNER NO.	
CTO 0136	
APPROVED BY	DATE
DRAWING NO.	REV.
FIGURE 2-1	0

FORM CADD NO. SDIV-SH.DWG - REV 1 - 9/16/98

ACAD: 0055CM03.dwg 01/27/09 CK PIT



DRAWN BY	DATE
CK	1/27/09
CHECKED BY	DATE
CH	1/27/09
REVISED BY	DATE
SCALE AS NOTED	

NAVFAC

UTILITY MAP
BASELINE SAMPLING AND ASSESSMENT WORK PLAN
DEPOT GAS STATION
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NO. 0055
OWNER NO. CTO 0136
APPROVED BY DATE
DRAWING NO. FIGURE 2-2
REV. 0

FORM CADD NO. SDIV-SH.DWG - REV 1 - 9/16/88

3.0 DATA EVALUATION AND PRESENTATION

3.1 DATA EVALUATION CRITERIA

Data from the baseline sampling event will be used to assess biological and geochemical groundwater conditions at the Depot Gas Station to evaluate current contaminant conditions and to establish baseline conditions for biological contaminant degradation. The following parameters will be used as evaluation criteria:

- Alkalinity (as $CaCO_3$): Values greater than two times background levels indicate that complete degradation of organic COCs may be occurring.

- Ammonia Nitrogen: This is a limiting nutrient in many anaerobic biological processes. Concentrations less than 1 milligrams per liter (mg/L) may suggest ammonia is a limiting agent.

- Dissolved Oxygen (DO): Oxygen is a terminal electron acceptor in biodegradation processes. Values greater than 1.0 mg/L indicate aerobic conditions. Anaerobic biodegradation is expected to occur if levels appear to be locally depleted (less than 1.0 mg/L) in zones of dissolved-phase contamination.

- Ferrous Iron (Fe^{2+}): Used to predict the potential biodegradation of fuel hydrocarbon mass via iron reduction (ferric to ferrous iron). Values of ferrous iron greater than 0.5 mg/L suggest anaerobic ferric iron reduction.

- Heterotrophic-Plate Count: Used as a general quantitative measurement of viable aerobic and anaerobic bacteria that use organic compounds as an energy source.

- Hydrocarbon Degrading Bacteria: Used to quantify indigenous bacterial populations capable of degrading hydrocarbons.

- Methane (CH_4): Indicator of anaerobic biological processes, specifically through methanogenesis.

- Nitrate (NO_3^{2-}): Will act as an electron acceptor when oxygen levels are depleted. Nitrate levels in an anaerobic environment will decrease as a result of nitrate-reducing biological activity.

- Oxidation/Reduction Potential (ORP): ORP values of less than +50 millivolts (mV) indicate that reducing conditions are possible, and values of less than -100 mV indicate a high possibility of reducing conditions.

- pH: The optimal range of pH values for biodegradation is from 5 to 9 standard units.

- Sulfate (SO_4^{2-}): Will act as an electron acceptor primarily when nitrate, ferrous iron, and oxygen levels are depleted. Decreasing sulfate and increasing sulfide levels in the direction of groundwater flow may indicate biodegradation due to sulfate reduction. Sulfate, at levels greater than 20 mg/L, can act as a competing electron acceptor in reducing conditions.

- Temperature: Biochemical processes are accelerated at temperatures greater than approximately 20°C.

- Total Organic Carbon (TOC): TOC concentrations greater than 20 mg/L in an aquifer indicate a sufficient supply of carbon to act as the primary substrate for microbial growth.

3.2 DATA PRESENTATION AND REPORTING

Data obtained from the baseline sampling event will be presented in an Evaluation Report that will include a summary of data generated during the baseline sampling event, including graphical and tabular presentations of the data. The report will also provide recommendations for applicable remedial technologies in addition to a treatability testing approach to aid in remedial process design. At a minimum, the Evaluation Report will include the following:

- Introduction/Site History
- Work Performed
- Interpretation of Results
- Remedial Technology Evaluation
- Treatability Study Design Summary
- Recommendations and Conclusions
- Figures:
  - Site Map
  - Photographs of the Site
  - Potentiometric Groundwater Contours (shallow and deep screening intervals)
  - Isoconcentration Figures
  - Treatability Study Layout
- Tables:
  - Groundwater Elevation Data
  - Groundwater Sampling and Analysis Data

- Appendices:
  - Well Logs for Newly Installed Monitoring Wells
  - Laboratory Analytical Data

4.0 DATA QUALITY OBJECTIVES

The EPA has developed the Data Quality Objective (DQO) Process (USEPA, 2006), a systematic, strategic planning tool based on scientific method, to assist in establishing criteria for data quality and in developing sampling and analysis designs. The following seven steps comprise the DQO Process.

4.1 DEFINITION OF THE ENVIRONMENTAL CONCERN OR PROBLEM

Groundwater benzene concentrations greater than SSTLs at the MCRD Parris Island Depot Gas Station require remedial action. To reduce risks associated with benzene impacts, SSTLs have been developed for open areas (425 µg/L) and Building 155 (7.92 µg/L).

Preliminary baseline data for a treatability test is required to verify the study area, quantify biological degradation parameters, and provide a basis for remedial technology evaluation.

4.2 IDENTIFICATION OF THE DECISION STATEMENTS

Baseline groundwater sampling at the Depot Gas Station is required to evaluate biological and geochemical groundwater conditions and contaminant fate and transport to prepare an approach for remedial treatability testing.

4.3 IDENTIFICATION OF INPUTS REQUIRED TO MAKE DECISIONS

To achieve the requirements stated in the previous section, inputs discussed in Sections 2.2.3 are required.

4.4 DEFINITION OF BOUNDARIES OF THE PROBLEM TO BE SOLVED

To ensure that sufficient and representative data are available, the boundary for the sampling program includes all monitoring wells listed in Table 1. Specifically, biological parameters will be evaluated in one upgradient location (MW-05), one downgradient location (MW-14), and two locations within the impacted zone (MW-06 and MW-28D).

4.5 DEVELOPMENT OF A DECISION RULE

A decision rule will be developed to verify whether the study area shown on Figure 14 of the CAP is the proper location for a treatability study.

If groundwater analytical results indicate elevated concentrations at the source area as shown in the CAP, then a remedial approach may be created and a treatability study performed in this location.

Alternately, if contaminant transport has resulted in significant variances in contaminant concentration and location, then an alternate location for the treatability study may be proposed as sampling results may suggest.

If contaminant concentrations have dramatically decreased site wide, then an evaluation will be made regarding the need for further action or the applicability of an alternate remedial action.

4.6 SPECIFICATION OF POTENTIAL ERRORS

If sampling results are not sufficient in preparation for a final corrective action and treatability study approach, additional sampling may be required.

4.7 DEVELOPMENT AND OPTIMIZATION OF A DESIGN FOR DATA ACQUISITION

This Work Plan was developed to ensure that the sampling locations support the DQOs identified above.

REFERENCES

EPA, 2006. Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4. February.

SCDHEC (South Carolina Department of Health and Environmental Control), 2001. South Carolina Risk-Based Corrective Action for Petroleum Releases. South Carolina Department of Health and Environmental Control, Columbia, South Carolina. May.

SCDHEC, 2002. Regulation R.61-71 South Carolina Well Standards. South Carolina Department of Health and Environmental Control, Columbia, South Carolina. April.

SCDHEC, 2005. Analytical Methodology for Groundwater and Soil Assessment Guidelines. Underground Storage Tank Program, Columbia, South Carolina. August.

TtNUS (Tetra Tech NUS, Inc), 2003. Tier II Assessment Report for Depot Gas Station. Marine Corp Recruit Depot Parris Island, Parris Island, South Carolina. April.

TtNUS, 2005. Corrective Action Plan for Depot Gas Station. Marine Corp Recruit Depot Parris Island, Parris Island, South Carolina. July