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FINAL SAMPLING AND ANALYSIS PLAN (FIELD SAMPLING PLAN AND QUALITY ASSURANCE PROJECT PLAN) SOIL CHARACTERIZATION INVESTIGATION FOR THE OLD GUN TUB STORAGE LOT AND THE SPENT AMUNITION CASINGS DUMP NSA CRANE IN
06/01/2011
TETRA TECH NUS INC

Final
Sampling and Analysis Plan
(Field Sampling Plan and
Quality Assurance Project Plan)

Soil Characterization Investigation for
The Old Gun Tub Storage Lot and
The Spent Amunition Casings Dump

Naval Support Activity Crane
Crane, Indiana

NAVFAC
Naval Facilities Engineering Command
Midwest

Naval Facilities Engineering Command
Midwest

Contract Number N62470-08-D-1001

Contract Task Order F276

June 2011

Title and Approval Page

(UFP-QAPP Manual Section 2.1)

DRAFT FINAL
SAMPLING AND ANALYSIS PLAN
(Field Sampling Plan and Quality Assurance Project Plan)
June 2011

SOIL CHARACTERIZATION INVESTIGATION FOR

THE OLD GUN TUB STORAGE LOT
AND THE SPENT AMMUNITION CASINGS DUMP
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Prepared for:
Naval Facilities Engineering Command Midwest
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Prepared under:
Comprehensive Long-Term Environmental Action Navy
Contract No. N62470-08-D-1001
Contract Task Order F276

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NAVFAC QA Review

Title and Approval Page

(UFP-QAPP Manual Section 2.1)

DRAFT FINAL SAMPLING AND ANALYSIS PLAN (Field Sampling Plan and Quality Assurance Project Plan) June 2011

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EXECUTIVE SUMMARY

Tetra Tech NUS, Inc. (Tetra Tech) has prepared this Sampling and Analysis Plan (SAP) that encompasses Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP) requirements for an investigation to provide data necessary to determine the soil quality in one Area of Concern (AOC) called the Spent Ammunition Casings Dump (SACD), and the Old Gun Tub Storage Lot (OGTSL). The OGTSL is also known as Solid Waste Management Unit (SMWU) 34. These sites are located at Naval Support Activity (NSA) Crane, Crane, Indiana. This SAP was prepared under Contract Task Order (CTO) F276, Contract N62470-08-D-1001, Comprehensive Long-Term Environmental Action Navy (CLEAN).

This SAP complies with applicable United States (U.S.) Department of the Navy (Navy), U. S. Environmental Protection Agency (USEPA) Region 5, and Indiana Department of Environmental Management (IDEM) requirements, regulations, guidance, and technical standards. This includes the Department of Defense (DoD), Department of Energy (DOE), and USEPA Intergovernmental Data Quality Task Force (IDQTF) environmental requirements regarding federal facilities.

The organization, project management, objectives, planned activities, measurement, data acquisition, assessment, oversight, and data review procedures associated with the planned investigations at the two sites are documented in this SAP. Protocols for sample collection, handling and storage, chain-of-custody, laboratory and field analyses, data validation, and reporting are also addressed.

The sampling strategy for the OGTSL and the SACD is to collect and analyze only surface soils, because potential contaminant releases would have been limited to the surface and the majority of residual soil contamination is expected to have remained at shallow depths. If field observations indicate otherwise, this model of the sites may require revision. The soil samples from both sites will be analyzed for potentially site-related constituents. This requires analysis of samples from both sites for metals and polycyclic aromatic hydrocarbons (PAHs). In addition, it requires that soil samples from the OGTSL be analyzed for polychlorinated biphenyls (PCBs), and that the SACD soil samples be analyzed for explosives, nitroglycerine (NG), and petroleum hydrocarbons in the diesel fuel boiling point range.

The investigations to be conducted are preliminary, and will be used to update the conceptual site model (CSM) for each site. The data will not be used to make decisions as a direct result of this investigation; however, it will be fully validated in accordance with USEPA protocols to ensure the data will be suitable to support potential future human health and ecological risk assessments. It is expected that by collecting these data, the CSMs for these two sites can be further developed and that the collected data would support future investigations, if deemed necessary by the Navy.

Investigation procedures will comply with site-specific field Standard Operating Procedures (SOPs), included in Appendix A, and laboratory analytical procedures will comply with the Department of Defense Quality Systems Manual for Environmental Laboratories (DOD QSM), version 4.1, April 2009. The field work and sampling are scheduled to begin in June 2011.

Field activities under this SAP will be conducted in accordance with the site-specific health and safety plan (HASP) to be prepared for these activities.

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ACRONYMS AND ABBREVIATIONS

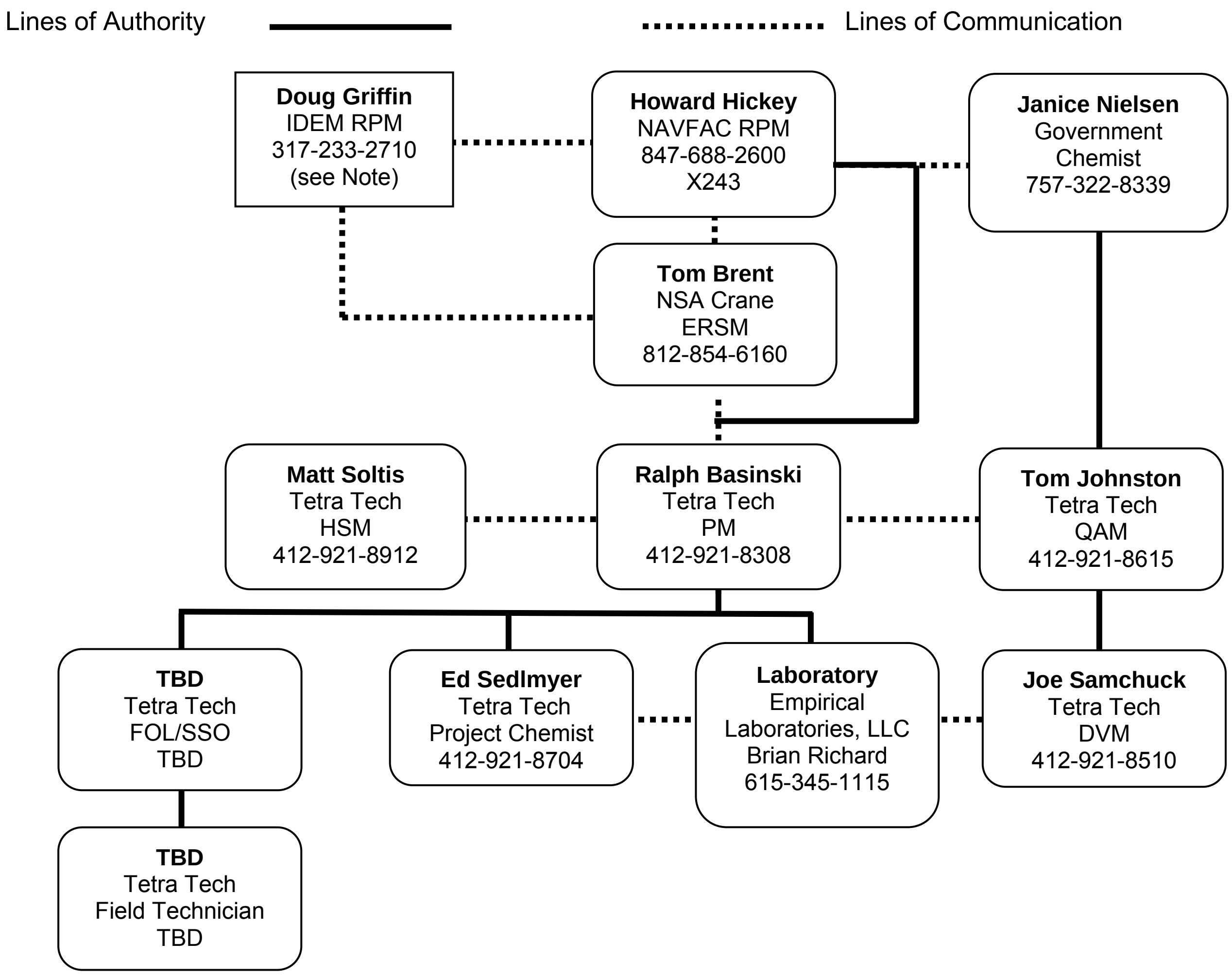
°C	Degree Celsius
°F	Degree Fahrenheit
%D	Percent Difference or Percent Drift
%R	Percent Recovery
AES	Atomic Emission Spectroscopy
AOC	Area of Concern
bgs	Below Ground Surface
CA	Corrective Action
CAS	Chemical Abstract Service
CLEAN	Comprehensive Long-Term Environmental Action Navy
CSM	Conceptual Site Model
CTO	Contract Task Order
DAF	Dilution Attenuation Factor
DL	Detection Limit
DoD	Department of Defense
DPT	Direct-Push Technology
DQI	Data Quality Indicator
DQO	Data Quality Objective
DRO	Diesel Range Organics
DVM	Data Validation Manager
Eco SSL	Site-Specific Ecological Soil Screening Level
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Approval Program
Empirical	Empirical Laboratories, LLC
ERSM	Environmental Restoration Site Manager
FD	Field Duplicate
FOL	Field Operations Leader
FSP	Field Sampling Plan
FTMR	Field Task Modification Request
GC/ECD	Gas Chromatography/Electron Capture Detector
GC/FID	Gas Chromatography/Flame Ionization Detector
GC/MS	Gas Chromatography/Mass Spectrometry
GPS	Global Positioning System
HASP	Health and Safety Plan
HMX	HMX Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine/ His / Her Majesty's Explosive

HPLC	High Performance Liquid Chromatography
HSM	Health and Safety Manager
ICAL	Initial Calibration
ICP-AES	Inductively Coupled Plasma Atomic Emission Spectroscopy
IDEM	Indiana Department of Environmental Management
IDQTF	Intergovernmental Data Quality Task Force
IDW	Investigation-Derived Waste
ILCR	Incremental Lifetime Cancer Risk
IS	Internal Standard
IUPPS	Indiana Underground Plant Protection Services
LANL	Los Alamos National Laboratory
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LLC	Limited Liability Corporation
LOD	Limit of Detection
LOQ	Limit of Quantitation
MCL	Maximum Contaminant Level
mg/kg	Milligram per Kilogram
MPC	Measurement Performance Criterion
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NA	Not Applicable
NAD	North American Datum
NAVFAC	Naval Facilities Engineering Command
Navy	U. S. Department of the Navy
NEDD	NIRIS Electronic Data Deliverable
NFA	No Further Action
NG	Nitroglycerine
NIRIS	Naval Installation Restoration Information Solution
NSA	Naval Support Activity
OGTSL	Old Gun Tub Storage Lot
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
oz	Ounce
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated Biphenyls
PETN	Pentaerythritol tetranitrate
PID	Photoionization Detector

PM	Project Manager
PPE	Personal Protective Equipment
PQLG	Project Quantitation Limit Goal
PSL	Project Screening Limit
QA	Quality Assurance
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QC	Quality Control
QSM	Quality Systems Manual
RCRA	Resource Conservation and Recovery Act
RDX	Octahydro-1,3,5,7-tetranitro-1,3,5-triazine / Royal Demolition Explosive
RFI	RCRA Facility Investigation
RPD	Relative Percent Difference
RPM	Remedial Project Manager
RSD	Relative Standard Deviations
R-RSL	Risk-Based Residential Soil Direct Contact Soil Screening Level
R-SSL	Risk-Based Migration-to-Groundwater Soil Screening Level
RT	Retention Time
SACD	Spent Ammunition Casings Dump
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
SPCS	State Plane Coordinate System
SSL	Soil Screening Level
SSO	Site Safety Officer
SVOC	Semivolatile organic compound
SWMU	Solid Waste Management Unit
TBD	To Be Determined
Tetra Tech	Tetra Tech NUS, Inc.
TNT	2,4,6-Trinitrotoluene
TPH	Total Petroleum Hydrocarbons
UFP-SAP	Uniform Federal Policy for Sampling Analysis Plan
U.S.	United States
USEPA	United States Environmental Protection Agency

Worksheet No. 1 -- Project Organizational Chart

(UFP-QAPP Manual Section 2.4.1 – Worksheet #5)



Note: Doug Griffen of IDEM serves in an advisory role.

DVM Data Validation Manager
ERSM Environmental Restoration Site Manager
FOL Field Operation Leader
HSM Health and Safety Manager
IDEM Indiana Department of Environmental Management
LLC Limited Liability Corporation
NAVFAC Naval Facilities Engineering Command
NSA Naval Support Activity
PM Project Manager
RPM Remedial Project Manager
SSO Site Safety Officer
TBD To Be Determined
Tetra Tech Tetra Tech NUS, Inc.

Worksheet No. 2 -- Communication Pathways

(UFP-QAPP Manual Section 2.4.2 – Worksheet #6) The communication pathways for the SAP are shown below.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Regulatory Agency Interface	IDEM PM Navy PM	Doug Griffin Howard Hickey	317-233-2710 847-688-2600 x243	The Navy RPM will contact the regulatory agency via phone and/or e-mail within 24 hours of recognizing an issue whenever issues arise.
Field Progress Reports	Tetra Tech FOL Tetra Tech PM	TBD Ralph Basinski	TBD 412-921-8308	The Tetra Tech FOL will contact the Tetra Tech PM on a daily basis via phone, and every 1-2 days summarizing progress via e-mail.
Gaining site access	Tetra Tech FOL NSA Crane ERSM	TBD Tom Brent	TBD 812-854-6160	The Tetra Tech FOL shall contact the NSA Crane ERSM verbally or via e-mail at least 3days prior to commencement of field work to arrange for access to the site for all field personnel.
Obtaining utility clearances	Tetra Tech FOL	TBD	TBD	The Tetra Tech FOL shall contact the Indiana Underground Plant Protection Services (IUPPS) verbally or via e-mail at least 3 days prior to commencement of field work to complete a utility clearance ticket for the areas under investigation.
Stop Work due to Safety Issues	Tetra Tech FOL/SSO Tetra Tech PM Tetra Tech HSM U.S. Department of the Navy (Navy) RPM NSA Crane ERSM	TBD Ralph Basinski Matt Soltis Howard Hickey Tom Brent	TBD 412-921-8308 412-921-8612 847-688-2600 x243 812-854-6160	If Tetra Tech is the responsible party for a stop work command, the Tetra Tech FOL will inform onsite personnel, subcontractor(s), the NSA Crane ERSM, and the identified Project Team members within 1 hour (verbally or by e-mail). If a subcontractor is the responsible party, the subcontractor PM must inform the Tetra Tech FOL within 15 minutes, and the Tetra Tech FOL will then follow the procedure listed above.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Sampling and Analyses Plan (SAP) Changes prior to Field/ Laboratory work	Tetra Tech FOL/SSO Tetra Tech PM Navy RPM NSA Crane ERSM	TBD Ralph Basinski Howard Hickey Tom Brent	TBD 412-921-8308 847-688-2600 x243 812-854-6160	The Tetra Tech PM will document the proposed changes via a Field Task Modification Request (FTMR) form within 5 days and send the Navy RPM a concurrence letter within 7 days of identifying the need for change if necessary. SAP amendments will be submitted by the Tetra Tech PM to the Navy RPM and NSA Crane ERSM for review and approval. The Tetra Tech PM will send scope changes to the Project Team via e-mail within 1 business day.
SAP Changes in the Field	Tetra Tech FOL/SSO Tetra Tech PM Navy RPM NSA Crane ERSM	TBD Ralph Basinski Howard Hickey Tom Brent	TBD 412-921-8308 847-688-2600 x243 812-854-6160	The Tetra Tech FOL will verbally inform the Tetra Tech PM on the day that the issue is discovered. The Tetra Tech PM will inform the Navy RPM and the NSA Crane ERSM (verbally or via e-mail) within 1 business day of discovery. The Navy RPM will issue a scope change (verbally or via e-mail), if warranted. The scope change is to be implemented before further work is executed. The Tetra Tech PM will document the change via an FTMR form within 2 days of identifying the need for change and will obtain required approvals within 5 days of initiating the form.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Field Corrective Actions	Tetra Tech PM Tetra Tech Quality Assurance Manager (QAM) Navy RPM	Ralph Basinski Tom Johnston Howard Hickey	412-921-8308 412-921-8615 847-688-2600 x243	The Tetra Tech QAM will notify the Tetra Tech PM verbally or by e-mail within 1 business day that the corrective action has been completed. The Tetra Tech PM will then notify the Navy RPM (verbally or by e-mail) within 1 business day
Analytical Corrective Actions	Empirical Laboratory PM Tetra Tech Project Chemist Tetra Tech DVM Tetra Tech PM Navy RPM	Brian Richard Ed Sedlmyer Joseph Samchuck Ralph Basinski Howard Hickey	615-345-1115 412-921-8704 412-921-8510 412-921-8308 847-688-2600 x243	The Laboratory PM will notify (verbally or via e-mail) the Tetra Tech Project Chemist within 1 business day of when an issue related to laboratory data is discovered. The Tetra Tech Project Chemist will notify (verbally or via e-mail) the DVM and the Tetra Tech PM within 1 business day. Tetra Tech DVM or Project Chemist notifies Tetra Tech PM verbally or via e-mail within 48 hrs of validation completion that a non-routine and significant laboratory quality deficiency has been detected that could affect this project and/or other projects. The Tetra Tech PM verbally advises the – Navy RPM within 24 hours of notification from the Tetra Tech Project Chemist or DVM. The Navy RPM takes corrective action appropriate for the identified deficiency. Examples of significant laboratory deficiencies include data reported that has a corresponding failed tune or initial calibration verification. Corrective actions may include a consult with the Navy Chemist.

Worksheet No. 3 -- Project Planning Session Participants Sheet

(UFP-QAPP Manual Section 2.5.1 – Worksheet #9)

Project Name: Soil Characterization Investigation **Projected Date(s) of Sampling**: Spring/Summer 2011 **Project Manager**: Ralph Basinski				**Site Name**: SACD and the OGTSL **Site Location**: Crane, Indiana	
Date of Session: May 17, 2011 **Scoping Session Purpose: Data Quality Objective (**DQO) Scoping Meeting					
Name	**Title**	**Affiliation**	**Phone #**	**E-Mail Address**	**Project Role**
Ralph Basinski	Crane Activity Coordinator/ PM	Tetra Tech	412-921-8308	ralph.basinski@tetratech.com	Management /Oversight
Ed Sedlmyer	Project Scientist	Tetra Tech	412-921-8704	ed.sedlmyer@tetratech.com	Technical Support
Bob Jupin	Senior Scientist	Tetra Tech	412-921-8195	bob.jupin@tetratech.com	Human health risk assessor
Preston Smith	Scientist	Tetra Tech	412-921-8167	preston.smith@tetratech.com	Ecological risk assessor
Tom Johnston	DQO Facilitator	Tetra Tech	412-921-8615	tom.johnston@tetratech.com	DQO Facilitator
John Ducar	Senior Geologist	Tetra Tech	412-921-8089	john.ducar@tetratech.com	Technical Support

Note: NSA Crane Environmental Site Manager (Tom Brent) was involved via phone on several occasions to discuss site history and investigative strategy. Outcomes of those conversations were incorporated directly into this SAP.

Comments/Decisions:

The Navy has identified the need to obtain the following data to make preliminary determinations of human health and ecological risks for the following locations:

- The Old Gun Tub Storage Lot (OGTSL). Approximately 8 surface soil samples to be collected for analysis for polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and the Resource Conservation and Recovery Act (RCRA) 8 metals. Upon further consideration, the Project Team, which included the Navy ERSM, Tom Brent, decided to alter the list of metals to include a wider array of industrial metals potentially associated with this site.

- The Spent Ammunition Casing Dump (SACD): The location is northwest of Building 225. Approximately five surface soil samples are to be collected for analysis for petroleum hydrocarbons in the diesel fuel boiling point range, nitroaromatic and nitramine explosives, the RCRA 8 metals, and nitroglycerine (NG). Use of Method 8330B (without the multi-incremental sampling or grinding) will ensure that the desired explosive target analytes, including NG, are analyzed. Upon further consideration, the Project Team, which included the Navy ERSM, Tom Brent, decided to alter the list of metals to include a wider array of industrial metals potentially associated with this site.

- Data must be validated. Additional detail needs to be collected before completing the conceptual site model (CSM). Screening against risk-based criteria will be the basis for data evaluation. A letter report will be prepared to summarize the findings.

Action Items:

- Tetra Tech will prepare a draft and final sampling and analyses plan (Tier II Uniform Federal Policy [UFP]-SAP).
- Tetra Tech will prepare a draft and final HASP

Consensus Decisions:

None.

Worksheet No. 4 -- Conceptual Site Model

(UFP-QAPP Manual Section 2.5.2 – Worksheet #10)

This SAP governs environmental investigations at two separate sites within NSA Crane (see Figures 4-1 and 4-2). One of these sites is an Area of Concern (AOC) called the SACD. The other site is the OGTSL, also known as Solid Waste Management Unit (SWMU) 34. Each of these sites has a different operational history. The two sites and associated CSMs share similar climate, geology, hydrology, and current land use. To the extent that these features are germane to this investigation, they are described immediately below. Following these descriptions are separate site-specific CSMs that describe characteristics unique to each site.

4.1 GENERAL SITE CHARACTERISTICS

NSA Crane (see Figure 4-1) was commissioned in 1941 as Ammunition Depot Burns City. This naval base has undergone several subsequent name changes from Naval Ammunition Depot Crane in 1943 to Naval Surface Warfare Center in 1975 to Naval Surface Warfare Center Crane in 1992, and Naval Support Activity Crane in 2003. Consequently, environmental plans and reports for this base incorporate these various names, depending on when the documents were prepared.

All portions of NSA Crane lie in a temperate climate. Temperature ranges from an average maximum July temperature of 89 degrees Fahrenheit (°F) to an average minimum January temperature of 26 °F. Precipitation is fairly evenly distributed throughout the calendar year; the maximum precipitation occurs during spring and early summer. Average annual precipitation at the facility is 44 inches.

NSA Crane is situated in a rugged, highly vegetated, dissected plateau bounded by the Mitchell Plain, which is a low, dissected limestone plateau characterized by sinkholes and karst topographic features, especially in the eastern portion of the base. The boundary between the Crawford Upland and the Mitchell Plain is marked by the highly irregular, eastern-facing Chester Escarpment. The terrain is predominantly rolling with moderately incised stream valleys throughout and occasional flat areas in the central and northern portions of NSA Crane. Topographic relief in the Crawford Upland generally ranges from 100 to 350 feet. Greater relief exists in the eastern part of NSA Crane (Murphy and Wade, 1995).

Unconsolidated overburden deposits at NSA Crane generally range from 0 to 65 feet thick (Nohrstedt, et al., 1998). These deposits generally consist of alluvial and colluvial deposits near the floodplains of streams and unconsolidated residual soil and loess on sides and tops of ridges. Residual soils on or near the tops of ridges, which is where the environmental sites of interest for this project are located, are generally classified as well drained to moderately drained. They have a brown organic silt loam at the surface (typically about 8 inches thick), which is underlain by 42 to 48 inches of mottled tan, gray, and yellow clay with varying percentages of sand and silt. Occasionally, a clay hardpan occurs between 25 and 32 inches below ground surface (bgs). Soil thickness on ridge tops is often thin and rock outcrops are common.

The surface drainages at NSA Crane have formed a dense, dendritic pattern throughout the installation (see Figure 4-2). Most of the major streams flow in a general southward or southwestward direction. Seven primary creeks in five drainage basins carry surface water off the installation, where they eventually drain into the eastern fork of the White River and then to the Wabash River to the southwest (not shown on figures).

Current land use at the two sites of interest for this investigation is industrial/military. There is no state or local planning within the vicinity of NSA Crane. Because most of the region is covered by vegetation, the area is classified as rural (Tetra Tech, 2001). The only zoning and land use regulations are in the municipalities in the region. None of the municipalities are close enough to impact NSA Crane and both sites being investigated under this SAP are at least one mile from the NSA Crane property boundary. None of the areas adjacent to NSA Crane are zoned, and zoning is not anticipated in the near future. No known land use or community actions are being considered or proposed at this time (Tetra Tech, 2001).

4.2 OLD GUN TUB STORAGE LOT CONCEPTUAL SITE MODEL

The OGTSL is a relatively open, level area in the north-central portion of NSA Crane (Figure 4-2). It is approximately 4 acres in size and is covered by gravel and bordered by woods on three sides (Figure 4-3). The site was used primarily for the outdoor storage of gun tubs formerly used to house large caliber guns on Navy ships, and were thus exposed to the elements and subject to weathering. Aerial photos from 1952 show the area being used for storage. However, according to the NSA Crane Historian, storage during the 1950s and early 1960s consisted of combat ready materials (e.g., vehicles, bomb trailers, weather-proof containers of various hardware, light and heavy gun mounts, etc.). Gun tub storage began during the Vietnam era of the late 1960s. Storage ceased in 2001, when the gun tubs were dismantled and sold for scrap metal.

There are no above ground, man-made structures located at the OGTSL. The closest man-made structures are Buildings 3032 and 3226, which are located approximately 100 feet northwest and 175 feet southwest of eastern boundary of the OGTSL, respectively. An active dog kennel exists at Building 3032. The OGTSL is flanked by steep slopes toward the north, east, and south (Figure 4-4).

Contaminants potentially associated with the OGTSL are chemicals commonly associated with storage of metal objects covered with paint from the World War II and more recent eras. Specifically, these are various industrial metals, and perhaps semivolatile organic compounds (SVOCs) and PCBs. The contaminant release mechanism would have been deposition onto surface soil as a result of weathering of the gun tubs and possibly other industrial objects. Being an industrial area, the potential for release of other chemicals exists but is not considered to be a significant concern because of the limited operational focus of this site.

No surface water, groundwater, or sediment sampling has been performed at the OGTSL. However, 12 surface soil samples, including a field duplicate sample, were collected during July 2002 by NSA Crane personnel. Soil sampling locations (not shown) were distributed across the OGTSL. The samples were analyzed for potentially site related SVOCs, PCBs, cadmium, chromium, and lead. Sporadic detections of SVOCs at trace levels were observed. No PCBs were detected but cadmium, chromium, and lead were detected. No planning document was prepared for the field effort, and the data were not validated; therefore, it is not known whether the data are accurate representations of site conditions. Chemical analysis detection limits were also higher than those currently achievable, which encumbered the ability to compare the 2002 results to current environmental screening criteria.

In 2005 an Environmental Indicator report was prepared for several sites, including the OGTSL (Tetra Tech, 2005). The nature of the report was to document the status of each site regarding contaminant levels, the potential for contaminant migration, and human health risks potentially incurred from exposure to the sites. Five surface soil samples were collected at locations shown on Figure 4-4 to support the investigation. These samples were analyzed for the chemicals shown in Table 4-1. Cadmium, chromium, iron, lead, arsenic, Aroclor-1260 (a mixture of PCBs), and benzo(a)pyrene concentrations each exceeded their numerical screening criteria in at least one sample. These criteria were USEPA and IDEM risk-based criteria protective of human residents and industrial workers. Benzo(a)pyrene is a member of the polycyclic aromatic hydrocarbon (PAH) group of compounds, which is a subset of the SVOCs commonly analyzed in environmental investigations. Screening criteria, when exceeded, indicate that a potentially unacceptable human health or ecological risk exists, depending on whether the criterion exceeded is a human health or ecological risk criterion.

Of the noted screening criteria exceedances, only one (chromium at a concentration of 573 milligram per kilogram [mg/kg]) exceeded both the residential and industrial soil screening criteria (30 and 64 mg/kg, respectively). All other exceedances were exceedances of residential criteria only (see Table 4-1). The maximum arsenic concentration (of 9.9 mg/kg) was at the upper end of the typical NSA Crane background metal concentration range of non-detect to approximately 10.2 mg/kg in surface soil (Tetra Tech, 2001). In samples in which Aroclor-1260 and benzo(a)pyrene were detected, their concentrations were less than three times the applicable screening criteria. The report concludes that these findings are a preliminary indication that if risks are unacceptable, they would not be unacceptable except for a receptor that experiences a relatively intimate and prolonged contact with the site.

The proximity of the active dog kennel to the OGTSL creates a concern over potential human and canine exposure to OGSTL-related chemical contaminants. In particular, the concern is associated with exposure of dogs and their human handlers to PAHs, PCBs, and metals, which could be site-related contaminants. Figure 4-5 presents a graphical CSM which identifies plausible primary and secondary contaminant release mechanisms, contaminant migration pathways, the various receptors of interest, and their possible exposure pathways. In general organic and inorganic surface soil contamination of the nature associated with the OGTSL would tend not to migrate rapidly into deeper soils because the contaminants are bound relatively tightly to the soils. Over prolonged time, the contaminants could work their way deeper into the soil and possibly to groundwater, but the greatest contaminant mass is expected to be in the surface soil. Therefore, contamination of groundwater is not currently a concern, and would only be a concern if site-related constituent concentrations are demonstrated to exceed concentrations that represent significant probability of migration to groundwater. Such concentrations are those that would exceed USEPA criteria for leaching of contaminants from soil to groundwater. Contaminant migration in surface soil runoff is a possibility, but because the area is relatively flat, runoff is not considered to be a significant migration pathway. Therefore, soil erosion is not a significant concern at this site.

Exposure of dogs (terrestrial vertebrates) to contaminated surface soil could occur via direct contact, incidental ingestion of the soil, and ingestion of small mammals and plants. However, ingestion of small mammals and plants is assumed not to be a significant exposure pathway because the dogs are routinely kept in closed pens and are cared for/fed by facility personnel. Similar exposure pathways exist for human receptors of concern. The human receptors of immediate concern are typical NSA Crane occupational worker exposed to surface soils as a result of daily work activities, a construction worker engaged in a construction project at the OGTSL, and personnel involved with maintaining the OGTSL grounds. However, a change of land use to residential use could result in exposure of more sensitive human receptors such as adult or child residents. The exposure to surface soils for all of these human receptors could occur through dermal contact, incidental ingestion, or inhalation of soil particles suspended as dust in the air. A trespasser could be exposed in the same ways.

In addition to dogs, ecological receptors potentially at risk of being exposed to contaminated surface soil and their plausible exposure pathways are as follows:

- Plants exposed to surface soil via uptake of contaminants from the soil as well as direct contact with the soil

- Soil invertebrates exposed as a result of ingestion of surface soil and direct contact with the soil

- Herbivorous and insectivorous mammals exposed via direct contact with surface soil, ingestion of soil, and contaminant assimilation via the food chain

Canine exposure is currently the greatest concern because of the close proximity of the kennel and because dogs have more intimate contact with surface soil than do humans.

4.3 SPENT AMMUNITION CASINGS DUMP CONCEPTUAL SITE MODEL

The SACD is located in the western portion of NSA Crane approximately120 feet northwest of Building 2720 (Figure 4-6). The site consists of two separate areas – a small northern area approximately 0.002 acres (100 square feet) in size and a larger, southern area approximately 2 acres (100,000 square feet) in size. The southern area forms a shallow topographic depression because of the railroad lines to the east and west that are at higher elevations, and a gentle slope from northeast to southwest. At the western edge of the southern area there is an area of red surface soil staining resembling iron oxide. There is no standing water in this location, but surface runoff from the site passes over this lower lying area to a culvert under the western rail line. The low lying area would tend to accumulate solids and soil. The soil appears to be rich in organic content because of its dark color, ample collections of pine needles on the surface, and generally moist, though not saturated, condition.

There are no structures at the SACD. Very little is known about this site in terms of operational history and no environmental sampling has been conducted previously at the SACD. Soil thickness is very limited, generally being less than 6 inches deep, except at the western edge of the site where the soils appear to be slightly thicker but the depth is unknown. Available photographs from May 2011 show the presence of spent shells on the ground in the northern and southern areas (see Figure 4-7). Based on these photographs, and the name of the site, it appears that this site, comprised of both northern and southern clearings, was used as a dumping ground for spent munitions, especially small arms shell casings. In addition, spent igniter tubes were also found in the southern area. Some of the clearing has revegetated since the site was first used as a dump site. It is possible that fuel oils were spread over the casings and the casings were “burned” in place, presumably to discharge stray live ammunition rounds. Volatile solvents have not been indicated as potential accelerants for this burning, and it is unlikely that volatile solvents would remain to this day in surface soil, even if these solvents had been used in the burning. The soil thickness is minimal, and the volatile compounds would have likely evaporated or migrated to bedrock. Chemicals associated with unburned fuel oils, however, may remain in soils. These chemicals are straight and branched molecular chain hydrocarbons, aromatic compounds such as PAHs, and possibly other very minor components. Of these chemicals the PAHs are the most environmentally significant.

Surface soil composition and physical characteristics are expected to be similar to the soils at the OGTSL. Potentially SACD-related contaminants are chemicals commonly associated with spent munitions and the fuel oils. These are the PAHs and other hydrocarbons identified in the previous paragraph, metals associated with ammunition shell casings, and explosives and propellants, such as NG contained within the shells or associated projectiles. The metal contaminants commonly associated with shell casings and associated projectiles are:

- **arsenic and antimony** - used as hardeners and impurities in the lead of bullets
- **copper** - form brass casings and possibly from bullet jackets
- **iron** - possibly from steel casings and bullets
- **lead** - from the bullets
- **zinc** - from the casings

The green patina (composed of copper carbonate and other metal salts) visible on many of the casings (Figure 4-7) is evidence that many of the casings are made of brass, an alloy of copper and zinc. Several casings do not exhibit a patina, indicating that they may be made of steel. Iron, the primary component of steel, is typically not a significant environmental concern. Arsenic and antimony are a minor concern because they are minor components of lead used in projectiles.

The initial release mechanism for fuel-related chemicals is direct release to soil. For metals and explosives, the initial release mechanism is dissolution or leaching from the metal shell casings or projectiles. The potential metal contaminants are moderately mobile in soil (e.g., arsenic, copper, iron, and zinc) to nearly immobile (e.g., lead) under typical environmental conditions. Explosives and propellants (e.g., NG), are generally more mobile. PAHs, the chemicals of greatest concern from unburned fuel are generally immobile to moderately mobile. Based on these mobility characteristics, the majority of SACD-related metal, explosives, and PAH contaminant mass, if present, is expected to reside in surface soil. Contamination in deeper soil is not likely because the soil layer is thin. Migration to groundwater is not currently a concern but would likely become a concern if contaminant concentrations are demonstrated to exceed concentrations that represent a significant probability of migration to groundwater. Such concentrations are those that would exceed the USEPA criteria for leaching of contaminants from soil to groundwater. The gentle slope culminating in a lower lying solids collection area is an indication that overland flow of surface soil is not a significant contaminant migration pathway unless contaminants are transported in a dissolved phase. Soil erosion is also not a significant concern at this site.

No sampling has been conducted at the SACD; therefore, no direct indications are available concerning the type of contaminants, if any, present at this site. With the exception of dogs, human and ecological receptors and the associated exposure pathways are the same as for the OGTSL (see Section 4.2). Dogs are not a receptor of concern for this site.

Figure 4-5 presents a graphical CSM, which identifies plausible primary and secondary contaminant release mechanisms, contaminant migration pathways, the various receptors of interest, and their possible exposure pathways.

Worksheet No. 5 -- Project Quality Objectives/Systematic Planning Process Statements

(UFP-QAPP Manual Section 2.6.1 – Worksheet #11)

5.1 PROBLEM STATEMENT

In response to a concern that dogs and humans may be exposed to surface soil contamination at the OGTSL, an expedited investigation is required to determine whether contaminants (specifically PCBs, metals, and PAHs) could be present in OGTSL surface soil at concentrations harmful to dogs and humans. Investigations are also needed to gather data that can be used to further develop the CSMs for the OGTSL and the SACD. The Navy will use the data for developing more definitive CSMs for the two sites of interest, and to plan further investigations as necessary.

All data collected under this project must be of sufficient quality to support a human health or ecological risk assessment, which may be conducted as part of future activities.

5.2 DATA NEEDS

The following data are needed to support the desired data collection described in Section 5.1 (see Worksheet No. 9 for a list of individual chemical associated with the chemical groups identified below):

- OGTSL: Concentrations of PAHs, PCBs, and industrial metals in surface soil. The expanded list of PCB aroclors are being analyzed to provide data on the specific aroclors in the event a human health or ecological risk assessment is required.

- SACD: Concentrations of explosives (including NG that may have been a component of gunpowder), industrial metals, PAHs, and other petroleum hydrocarbons in the diesel fuel boiling point range (i.e., diesel range organics (DRO), or total petroleum hydrocarbon (TPH)-DRO (C8-C28)) in surface soil. For convenience and to ensure that all plausible contamination is investigated, the metals investigated at this site will be the same as the metals investigated at the OGTSL.

- All sites: Screening criteria to which the surface soil data may be compared in the future and useful for selecting analytical methods that provide data suitable for future human health and ecological risk assessments. Refer to Worksheet No. 9 for a list of the chemicals of interest, their respective screening criteria, and the sources of the screening criteria.

- Global positioning system (GPS) coordinates (sub-meter accuracy) of previous and new data collection points in soil. Data collection point coordinates must be documented in the State Plane Coordinate System (SPCS) North American Datum (NAD) 1983 Indiana West (feet), in accordance with Standard Operating Procedure (SOP)-09.

- Depths of soil intervals to be investigated. The depth of the soil interval investigated must be obtained in accordance with SOP-05.

- Quality Control Sample Data. It is necessary to use temperature blanks in coolers containing samples scheduled for organic chemical analysis. Cooling of samples and use of temperature blanks is not required for coolers containing only samples scheduled for metals analysis. Field duplicate (FD) samples are not needed because the precision information obtained from them will be obtained after completion of the fieldwork and will not be useful for controlling the data quality. Equipment rinsate blanks are not needed because the Navy accepts the liability of accidentally contaminating a sample due to carryover from one location to another.

- Observations of physical characteristics. Notations of physical site features such as potential additional contaminant release points, type and composition of debris, environmental media visibly or potentially affected by contaminant releases, potential contaminants migration pathways, presence and location of standing or flowing water, surface runoff flow patterns, degree of vegetation and slope, evidence of soil erosion, and other characteristics that are suitable for further developing the CSMs of the OGTSL and SACD.

- The site conditions, including physical features and characteristics, will be described in sufficient detail to support further development of the CSM for each site.

5.3 STUDY BOUNDARIES

The population of interest for this preliminary investigation is surface soil (0 to 2 feet bgs) at locations where contaminant releases are most likely to have occurred within the limits of the OGTSL and the SACD. By targeting these locations, the Project Team has the greatest probability of detecting contamination to which humans or dogs could be exposed. Selection of these locations must be based on field conditions and visual observations (e.g., red staining in the northwestern area of the SACD) indicating the presence of potential chemical contaminant release points related to site operations, local topography near these points, and the presence or absence of spent ammunition casing debris piles for the SACD, that could indicate a contaminant release. Subsurface soil, sediment, surface water and groundwater are not currently environmental media of concern at these sites.

5.4 ANALYTIC APPROACH

The data collected during this effort will be used primarily to further develop the CSMs for each of the two sites. Recommendations on future actions will be made following evaluation of the data and CSMs. If all samples are below screening values, it is likely that no further action (NFA) would be recommended. Likewise, if concentrations are greater than screening values, a RCRA Facility Investigation (RFI) will be recommended as a next step. .

5.5 PERFORMANCE CRITERIA

This is a focused, preliminary investigation that requires collection of the planned samples to be successful. If all planned samples are collected, and no significant data quality deficiencies are identified, the Project Team will conclude that the data are sufficient to support planning for future environmental investigations. If the planned data are not collected, or significant data quality deficiencies are identified, the Project Team will meet to assess the effect of the deficiencies on attaining project objectives. The tendency will be to collect data to fill data gaps if any missing or rejected data are identified, unless the Project Team can demonstrate qualitatively or quantitatively that the deficiencies do not prevent attainment of project objectives.

5.6 SAMPLING DESIGN AND RATIONALE

The sampling design and rationale are presented on Worksheet No. 7.

Worksheet No. 6 – Field Quality Control Samples

(UFP-QAPP Manual Section 2.6.2 – Worksheet #12)

Quality Control (QC) Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria (MPCs)	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Cooler Temperature Indicator	All analytical groups	One per cooler.	Representativeness	Temperature must be less than 6 degrees Celsius (°C).	S

Note: Field duplicate samples are not needed for laboratory analyses because the precision information obtained from them will be obtained after completion of the field work and will not be useful for controlling the data quality. Equipment rinsate blanks are not needed because the Navy accepts the liability of accidentally contaminating a sample such that its concentration appears to exceed a screening criteria, when it really does not exceed the screening criteria.

Worksheet No. 7 -- Sampling Design and Rationale

(UFP-QAPP Manual Section 3.1.1 – Worksheet #17)

Sampling is required in two separate areas representing two environmental sites; the OGTSL and the northern and southern areas of the SACD (see Figure 4-2). For each site, the sampling design is a biased design targeting surface soil at locations within the OGTSL boundary most likely to have been contaminated under the assumption that a contaminant release occurred to surface soil. Targeted locations will be selected based on local physical conditions indicating a potential contaminant release.

The following describes the sampling areas, media to be sampled (surface soil only), and analyses to be conducted on the samples. Sampling areas are illustrated on Figures 7-1 and 7-2 for the OGTSL and SACD, respectively. A matrix table of samples is provided in Table 8-1. The sampling depth is 0 to 2 feet bgs for each sample. The surface soil samples will be collected with the use of hand augers or trowels. Sampling and other field task methodologies are described in Worksheet No. 8.1.

Groundwater occurs in bedrock at depths of approximately 15 to 25 feet bgs within the NSA Crane facility boundary; therefore, groundwater will not be encountered during this soil investigation.

Quick turnaround (one week) laboratory analysis is required for the OGTSL to meet the Navy's schedule.

In addition to collecting and submitting soil samples for chemical analysis, it is important that site features related to understanding contaminant releases, migration patterns, etc. be documented in the field notes. See Section 4.3, where additional detail can be found regarding the type of information to be collected.

7.1 OGTSL

For the OGTSL, within each grid cell shown on Figure 7-1, a location will be selected that exhibits evidence of a potential contaminant release (e.g., staining, paint chips, odors). The intent is to collect a biased sample from the location within a grid cell that represents what appears to be the most contaminated location based on visual and olfactory observations. If there is no visual or olfactory evidence of a contaminant release, a sample will be collected as near the center of the grid cell as possible.

Eight surface soil samples will be collected from 0 to 2 ft bgs. Each sample will be labeled according to the sample identifiers (Sample IDs) shown on Table 8-1. All eight surface soil samples will be analyzed for PCBs (as Aroclors), industrial metals, and PAHs.

7.2 SPENT AMMUNITION CASING DUMP

A sample will be collected in the red stained soil area, located in the northwestern area of the large southern portion of the SACD. This sample, which represents a known area of potential contamination, will fall within one of the four grid cells shown on Figure 7-2 for the large southern area of the SACD. In addition, a sample will be collected from each of the four remaining grid cells shown on Figure 7-2 (three in the southern area and one in the northern area) wherever evidence of a potential contaminant release is observed (e.g., where there is staining, carbon deposits, shell casings, odors). The intent is to collect a biased sample from the location within a grid cell that represents what appears to be the most contaminated location, based on visual and olfactory observations. If there is no visual or olfactory evidence of a contaminant release, a sample will be collected as near the center of the grid cell as possible.

Five surface soil samples (0 to 2 ft bgs) will be collected. Each sample will labeled according to the sample identifiers (Sample IDs) shown on Table 8-1. All five surface soil samples will be analyzed for explosives plus NG (SW-846 Method 8330B target analytes), industrial metals, low concentration PAHs and TPH-DRO (C8-C28).

Worksheet No. 8 – Field Project Implementation (Field Project Instructions)

(UFP-QAPP Manual Section 5.2.3)

8.1 Field Project Tasks

(UFP-QAPP Manual Section 2.8.1 – Worksheet #14)

Site-specific SOPs have been developed for field activities at NSA Crane and are located in Appendix A. Field tasks are summarized below with a short description for each task.

- Mobilization/Demobilization
- Utility Clearance
- Site-Specific Health and Safety Training
- Sample Collection Tasks
- Surface Soil Sampling
- GPS Locating
- Investigation-Derived Waste (IDW) Management
- Field Decontamination Procedures
- Sample Handling
- QC

Mobilization/Demobilization

Mobilization will consist of the delivery of all equipment, materials, and supplies to the site, complete assembly in satisfactory working order of all such equipment at the site, and satisfactory storage at the site of all such materials and supplies. The Tetra Tech FOL or designee will coordinate with the NSA Crane ERSM to identify appropriate locations for the storage of equipment and supplies. Site-specific health and safety training for all Tetra Tech field personnel and subcontractors will be provided as part of site mobilization.

Demobilization will consist of the prompt and timely removal of all equipment, materials, and supplies from the site following completion of the work. Demobilization includes the cleanup and removal of waste generated during the performance of the investigation.

Utility Clearance

One week prior to the commencement of any subsurface intrusive activities, the Tetra Tech FOL or designee will contact IUPPS to complete a utility clearance ticket for the areas under investigation. The Tetra Tech FOL will be responsible for coordinating these activities.

Site-Specific Health and Safety Training

There are no specialized/non-routine project-specific training requirements or certifications needed by personnel to successfully complete the project or tasks. All field personnel will have appropriate training to conduct the field activities to which they are assigned. Each site worker will be required to have completed the Occupational Safety and Health Administration (OSHA) 40-hour course (and 8-hour refresher, if applicable) in health and safety training. Safety requirements are addressed in greater detail in the site-specific HASP.

Sample Collection Tasks

The sampling and analysis program is outlined in Worksheet No. 7 and Table 8-1. Sample collection will be in accordance with the site-specific SOPs listed in Worksheet No. 8.2 and provided in Appendix A. The sampling requirements for each type of analysis (i.e., bottleware, preservation, holding time) are listed in Table 8-2. Field and laboratory QC samples will also be collected as outlined in Table 8-3.

Surface Soil Sampling

Surface soil samples will be collected in accordance with SOP-05 (Borehole Advancement and Soil Coring Using Direct PT and Hand Auger Techniques). Surface soil only samples will be collected with a hand auger or stainless steel trowel. The soil samples will be described by the field personnel in accordance with SOP-06 (Soil Sample Logging). Any qualitative visual signs of potential contamination (such as soil staining) will be noted on the soil boring log. The surface soil samples will be collected in accordance with SOP-07 (Surface and Subsurface Soil Sampling).

Global Positioning System Locating

A GPS unit will be used to survey the locations of all soil sampling points in accordance with SOP-09 (Global Positioning System). The GPS equipment will be checked on control monuments before and after each day's use; these checks will be documented in the field notebook. To ensure sub-meter accuracy, the GPS SOP requires a minimum of six satellites to capture a position. Data collection point coordinates must be documented in the SPCS NAD 1983 Indiana West (feet).

Investigation-Derived Waste Management

Solid or semi-solid IDW in the form of soil will be generated during field activities. Soil will be replaced into the boring from which it was removed.

IDW generated, including personal protective equipment (PPE) and decontamination fluids, will be handled in accordance with SOP-10 (Management of Investigation-Derived Waste).

Field Decontamination Procedures

Decontamination of sampling equipment will not be necessary for dedicated and disposable hand trowels. Decontamination of reusable sampling equipment (e.g., non-disposable hand trowels, hand augers) will be conducted prior to sampling and between samples at each location. Decontamination of equipment will be conducted according to the sequence established in SOP-08 (Decontamination of Field Sampling Equipment).

Field Documentation Procedures

Field documentation will be performed in accordance with SOP-03 (Sample Custody and Documentation of Field Activity).

Sample Handling

Methods and requirements for sample handling will be in accordance with SOP-03 (Sample Custody and Documentation of Field Activities). Sample containers will be provided certified-clean (I-Chem 300 or equivalent) from Empirical Laboratories, LLC (Empirical). Sample labeling will be in accordance with SOP-01 (Sample Labeling), and the sample numbering scheme will be in accordance with Table 8-1 and SOP-02 (Sample Identification and Nomenclature). The selection of sample containers, sample preservation, packaging, and shipping will be in accordance with Table 8-2 and SOP-04 (Sample Preservation, Packaging, and Shipping).

Quality Control Tasks

QA/QC samples will be collected at frequencies listed in Worksheet No. 6.

ADDITIONAL PROJECT-RELATED TASKS

Additional project-related tasks include:

- Analytical tasks
- Data management
- Data review
- Project reports

Analytical Tasks

Chemical analyses will be performed by Empirical, which is a Department of Defense (DoD) Environmental Laboratory Approval Program (ELAP)-accredited laboratory. A copy of the laboratory accreditation for Empirical is included in Appendix B. Analyses will be performed in accordance with the analytical methods identified in Table 8-2. Empirical will meet the Project Screening Limits (PSLs) specified in Worksheet No. 9 and will perform the chemical analyses following laboratory-specific SOPs (see Table 8-2 and Worksheet No. 10) developed based on the methods listed in Table 8-2. Laboratory SOPs are not included in this SAP, but have been reviewed to ensure they are suitable for use on this project.

All soil results will be reported by the laboratory on an adjusted dry-weight basis. Results of percent moisture will be reported in each analytical data package and associated electronic data files. This information will also be captured in the project database, which will eventually be uploaded to the Naval Installation Restoration Information Solution (NIRIS) database. Percent moisture information will also be captured in the site investigation report.

The analytical data packages provided by Empirical will be in a Contract Laboratory Program-like format and will be fully validatable and contain raw data, summary forms for all sample and laboratory method blank data, and summary forms containing all method-specific QC (results, recoveries, relative percent differences (RPDs), relative standard deviations (RSD), and/or percent differences, etc.).

Data Management

The principal data generated for this project will be from field data and laboratory analytical data. Field sampling log sheets will be organized by date and environmental medium, and filed in the project files. The field logbooks for this project will be used only for this site and will also be categorized and maintained in the project files after the completion of the field program. Project personnel completing concurrent field sampling activities may maintain multiple field logbooks. When possible, logbooks will be segregated by sampling activity. The field logbooks will be titled based on date and activity.

The data handling procedures to be followed by Empirical will meet the requirements of the laboratory technical specifications. Electronic data results will be automatically downloaded into the Tetra Tech database in accordance with proprietary Tetra Tech processes.

The Tetra Tech PM (or designee) is responsible for the overall tracking and control of data generated for the project.

- **Data Tracking**. Data are tracked from generation to archiving in the Tetra Tech project-specific files. The Tetra Tech Project Chemist (or designee) is responsible for tracking the samples collected and shipped to Empirical. Upon receipt of the data packages from Empirical, the Tetra Tech Project Chemist will monitor the data validation effort, which includes verifying that the data packages are complete and results for all samples have been delivered by Empirical.

- **Data Storage, Archiving, and Retrieval**. The data packages received from Empirical are tracked in the data validation logbook. After the data are validated, the data packages are entered into the Tetra Tech Comprehensive Long-Term Environmental Action Navy (CLEAN) file system and archived in secure files. The field records, including field log books, sample logs, chain-of-custody records, and field calibration logs, will be submitted by the Tetra Tech FOL to be entered into the Navy CLEAN file system prior to archiving in secure project files. Project files are audited for accuracy and completeness. At the completion of the Navy contract, the records will be stored by Tetra Tech.

- **Data Security**. Access to Tetra Tech project files is restricted to designated personnel only. Records can only be borrowed temporarily from the project file using a sign-out system. The Tetra Tech Data Manager maintains the electronic data files, and access to the data files is restricted to qualified personnel only. File and data backup procedures are routinely performed.

- **Electronic Data**. All electronic data will be compiled into a NIRIS Electronic Data Deliverable (NEDD) and loaded into NIRIS.

- **Data Review**. This review comprises data verification, validation, and a usability assessment. The data verification and validation processes and requirements are described in Worksheet No. 6. The data usability assessment will, at a minimum, constitute evaluation of the following characteristics to ensure that the amount, type, and quality of data are sufficient to achieve project objectives. The means of conducting these evaluations will vary depending on the nature of the data. Examples include:

- Comparing actual to intended sampling locations and verifying that the correct datum was used to delineate contamination
- Evaluating trends across sample delivery groups or sampling events
- Identifying potential errant or outlier data points
- Assessing planning assumption validity
- Evaluating the potential for contamination of samples by samplers

Data quality indicators to be evaluated during this assessment include:

1. **Precision.** A semiquantitative estimate of the uncertainty in contaminant concentrations.

2. **Accuracy.** Accuracy data will be evaluated to ensure sampling and measurement accuracy is within or exceeds analytical method specifications and may depend in part on the data validation findings.

3. **Representativeness.** This evaluation will assess whether the data are adequately representative of intended populations based on the sample collection and data generation requirements specified in this SAP.

4. **Completeness.** Failure to obtain critical data from planned locations will be documented. Minor variations in actual versus intended sampling locations (or depths) that do not adversely affect the attainment of project objectives will not be documented.

5. **Comparability.** This will be accomplished by comparing overall precision and bias among data sets for each matrix and analytical fraction for each sampled area.

6. **Sensitivity.** The Tetra Tech Project Chemist will determine whether project sensitivity goals were achieved by comparing non-detect values to PSLs.

If significant data quality deficiencies are detected that prevent the attainment of project objectives, the limitations on the affected data will be described in the project report. The Tetra Tech PM will bring these deficiencies to the attention of the project team for their evaluation and the team will determine an appropriate corrective action depending on the circumstances.

Project Reports

At the completion of this preliminary investigation a letter report will be compiled by Tetra Tech and submitted to the NAVFAC RPM. The report will identify the locations sampled, the concentrations of target analytes in each sample, and whether or not the concentrations exceed the applicable PSLs. The report will include no recommendations. However, site conditions, including physical features and characteristics, will be described in sufficient detail to support further development of the CSM for each site.

8.2 – Field SOPs Reference Table

(UFP-QAPP Manual Section 3.1.2 – Worksheet #21)

Reference Number	Title, Revision Date, and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP-01	Sample Labeling, 05/11, Revision 0.	Tetra Tech	Not Applicable (NA)	N	Contained in Appendix A
SOP-02	Sample Identification Nomenclature, 05/11, Revision 0.	Tetra Tech	NA	Y	Contained in Appendix A
SOP-03	Sample Custody and Documentation of Field Activities, 05/11, Revision 0.	Tetra Tech	Field logbook, sample log sheets, boring logs	N	Contained in Appendix A
SOP-04	Sample Preservation, Packaging, and Shipping, 05/11, Revision 0.	Tetra Tech	NA	N	Contained in Appendix A
SOP-05	Borehole Advancement and Soil Coring Using Direct-Push Technology (DPT) and Hand Auger Techniques, 05/11, Revision 0.	Tetra Tech	DPT rig, stainless steel augers, extension rods, and T-handle	N	Contained in Appendix A
SOP-06	Soil Sample Logging, 05/11, Revision 0.	Tetra Tech	NA	N	Contained in Appendix A
SOP-07	Surface and Subsurface Soil Sampling, 05/11, Revision 0.	Tetra Tech	Stainless steel auger bucket, extension rods, and T-handle, photoionization detector (PID)	N	Contained in Appendix A
SOP-08	Decontamination of Field Sampling Equipment, 05/11, Revision 0.	Tetra Tech	Decontamination equipment, scrub brushes, 5-gallon buckets, spray bottles, phosphate free detergent, de-ionized water	N	Contained in Appendix A
SOP-09	Global Positioning System, 05/11, Revision 0.	Tetra Tech	GPS unit	N	Contained in Appendix A
SOP-10	Management of Investigation-Derived Waste, 05/11, Revision 0.	Tetra Tech	NA	N	Contained in Appendix A

Table 8-1 – Sample Details Table

(UFP-QAPP Manual Section 3.1.1 and 3.5.2.3 – Worksheet #18, 19, 20 and 30)

Sample Location	Sample ID[(1)]	Analyses					
		Explosives	NG	PCBs	Metals	PAHs	TPH-DRO (C8-C28)
SURFACE SOIL – OGTSL							
OGTSLSB006	OGTSLSS0060002	-- [(2)]	--	1	1	1	--
OGTSLSB007	OGTSLSS0070002	--	--	1	1	1	--
OGTSLSB008	OGTSLSS0080002	--	--	1	1	1	--
OGTSLSB009	OGTSLSS0090002	--	--	1	1	1	--
OGTSLSB010	OGTSLSS0100002	--	--	1	1	1	--
OGTSLSB011	OGTSLSS0110002	--	--	1	1	1	--
OGTSLSB012	OGTSLSS0120002	--	--	1	1	1	--
OGTSLSB013	OGTSLSS0130002	--	--	1	1	1	--
SURFACE SOIL – SACD							
SACDSB001	SADSSS0010002	1	1	--	1	1	1
SACDSB002	SADSSS0020002	1	1	--	1	1	1
SACDSB003	SADSSS0030002	1	1	--	1	1	1
SACDSB004	SADSSS0040002	1	1	--	1	1	1
SACDSB005	SADSSS0050002	1	1	--	1	1	1

1. The interval of the sample from below ground surface. For example, if the sample is collected from 0 to 2 feet bgs, the depth will be recorded as 0002.
2. Not analyzed

Explosives – Explosive compounds listed on Worksheet No. 9. To be analyzed by SW-846 Method 8330B without multi-incremental sampling or grinding.
NG – Nitroglycerine. To be analyzed by SW-846 Method 8330B.
Metals – Metals listed on Worksheet No. 9. To be analyzed by SW-846 Method 6010C.
PAHs – Polycyclic aromatic hydrocarbons listed on Worksheet No. 9. To be analyzed by SW-846 Method 8270C-Low.
PCB – Polychlorinated biphenyls as Aroclors (listed on Worksheet No. 9) – To be analyzed by SW-846 Method 8082A.
TPH-DRO (C8-C28) – Total Petroleum Hydrocarbons-Diesel Range Organics as defined in SW-846 Method 8015B

Table 8-2 -- Analytical SOP Requirements Table

Laboratory point of contact, e-mail address, and phone number: Brian Richard, brichard@empirlabs.com, (615) 345-1115
Laboratory Name and Address:
Empirical Laboratories, LLC
621 Mainstream Drive,
Suite 270
Nashville, TN 37228
Data Package Turnaround time: 7 days for OGTSL Samples; 28 days for SACD samples.
Tentative Sampling Dates: To be determined (TBD)

MATRIX	ANALYTICAL GROUP	ANALYTICAL AND PREPARATION METHOD/ SOP REFERENCE [(1)]	CONTAINERS (number, size, and type)	SAMPLE VOLUME (units)	PRESERVATION REQUIREMENTS (chemical, temperature, light protected)	MAXIMUM HOLDING TIME (preparation/ analysis)
Soil	Explosives (including NG)	SW-846 8330B Empirical SOP-327	One 4-oz glass jar with a Teflon-lined lid	30 g	Cool to ≤6 °C	14 days to extraction; 40 days to analysis
Soil	PAHs	SW-846 3546/ 8270C-Low, Empirical SOP-201/343	One 4-ounce (oz) glass jar with a Teflon-lined lid	30 g	Cool to ≤6 °C	14 days until extraction, 40 days to analysis
Soil	PCBs	SW-846 3540/3545/ 3550/8082A, Empirical SOP-211/343	One 4-ounce (oz.) glass jar	30 g	Cool to ≤ 6 °C	14 days until extraction, 40 days to analysis
Soil	TPH-DRO (C8-C28)	SW-846 3550B/8015B, Empirical SOP-219/320	One 4-oz glass jar with a Teflon-lined lid	5 g	Cool to ≤6 °C	14 days until extraction, 40 days to analysis
Soil	Metals	SW-846 3050B/ 6010C, Empirical SOP-100/105	One 4-oz glass jar	1 to 2 g	Cool to ≤ 6 °C	180 days to analysis

Table 8-3 -- Field Quality Control Sample Summary Table

Matrix	Analytical Group	No. of Samples	No. of MS/MSDs(1)	Total No. of Samples to Lab
Surface Soil	Explosives (including NG)	5	1/1	5
	PCBs	8	1/1	8
	Metals	13	1/1	13
	PAHs	13	1/1	13
	TPH-DRO (C8-C28)	5	1/1	5

1 Although Matrix Spike/Matrix Spike Duplicates (MS/MSDs) are not typically considered field QC samples, they are included here because location determination will be established in the field. The MS/MSDs are not included in the total number of samples sent to the laboratory.

Worksheet No. 9 – Reference Limits and Evaluation Tables

(UFP-QAPP Manual Section 2.8.1 – Worksheet #15)

Matrix: Soil

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Action Limit Reference[(1)]	PQLG (mg/kg)	Laboratory		
					Lab LOQ (mg/kg)	Lab LOD (mg/kg)	Lab DL (mg/kg)
Explosives							
1,3,5-Trinitrobenzene	99-35-4	0.376	R5	0.125	0.08	0.04	0.02
1,3-Dinitrobenzene	99-65-0	0.066	R-SSL	0.022	0.08	0.04	0.02
2,4,6-Trinitrotoluene (TNT)	118-96-7	0.26	R-SSL	0.087	0.08	0.04	0.02
2,4-Dinitrotoluene	121-14-2	0.0058	R-SSL	0.00193	0.08	0.04	0.02
2,6-Dinitrotoluene	606-20-2	0.0328	R5	0.01093	0.08	0.04	0.02
2-Amino-4,6-Dinitrotoluene	35572-78-2	1.12	R-SSL	0.373	0.08	0.04	0.02
2-Nitrotoluene	88-72-2	0.0058	R-SSL	0.00193	0.08	0.04	0.02
3,5-Dinitroaniline	618-87-1	NA	NA	NA	0.08	0.04	0.02
3-Nitrotoluene	99-08-1	0.068	R-SSL	0.0227	0.08	0.04	0.02
4-Amino-2,6-Dinitrotoluene	19406-51-0	1	LANL	0.333	0.08	0.04	0.02
4-Nitrotoluene	99-99-0	0.078	R-SSL	0.026	0.08	0.04	0.02
HMX	2691-41-0	29	LANL	9.67	0.08	0.04	0.02
Nitrobenzene	98-95-3	0.00158	R-SSL	0.0005267	0.08	0.04	0.02
Nitroglycerine	55-63-0	0.032	R-SSL	0.01067	0.4	0.2	0.1
PETN	78-11-5	0.5	R-SSL	0.167	0.4	0.2	0.1
RDX	121-82-4	0.0046	R-SSL	0.00153	0.08	0.04	0.02
Tetryl	479-45-8	1.1	LANL	0.367	0.08	0.04	0.02

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Action Limit Reference[1]	PQLG (mg/kg)	Laboratory		
					Lab LOQ (mg/kg)	Lab LOD (mg/kg)	Lab DL (mg/kg)
Polycyclic Aromatic Hydrocarbons							
1-Methylnaphthalene	90-12-0	0.24	R-SSL	0.08	0.00667	0.00333	0.00167
2-Methylnaphthalene	91-57-6	3.1	IDEM-RDCL	1.03	0.00667	0.00333	0.00167
Acenaphthene	83-32-9	29	Eco SSL	9.67	0.00667	0.00333	0.00167
Acenaphthylene	208-96-8	18	IDEM-RDCL	6	0.00667	0.00333	0.00167
Anthracene	120-12-7	29	Eco SSL	9.67	0.00667	0.00333	0.00167
Benzo(a)anthracene	56-55-3	0.15	R-RSL	0.05	0.00667	0.00333	0.00167
Benzo(a)pyrene	50-32-8	0.015	R-RSL	0.005	0.00667	0.00333	0.00167
Benzo(b)fluoranthene	205-99-2	0.15	R-RSL	0.05	0.00667	0.00333	0.00167
Benzo(g,h,i)perylene	191-24-2	1.1	Eco SSL	0.367	0.00667	0.00333	0.00167
Benzo(k)fluoranthene	207-08-9	1.1	Eco SSL	0.367	0.00667	0.00333	0.00167
Chrysene	218-01-9	1.1	Eco SSL	0.367	0.00667	0.00333	0.00167
Dibenzo(a,h)anthracene	53-70-3	0.015	R-RSL	0.005	0.00667	0.00333	0.00167
Fluoranthene	206-44-0	29	Eco SSL	9.67	0.00667	0.00333	0.00167
Fluorene	86-73-7	29	Eco SSL	9.67	0.00667	0.00333	0.00167
Indeno(1,2,3-cd)pyrene	193-39-5	0.15	R-RSL	0.05	0.00667	0.00333	0.00167
Naphthalene	91-20-3	0.0094	R-SSL	0.00313	0.00667	0.00333	0.00167
Phenanthrene	85-01-8	13	IDEM-RDCL	4.33	0.00667	0.00333	0.00167
Pyrene	129-00-0	1.1	Eco SSL	0.367	0.00667	0.00333	0.00167

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Action Limit Reference[(1)]	PQLG (mg/kg)	Laboratory		
					Lab LOQ (mg/kg)	Lab LOD (mg/kg)	Lab DL (mg/kg)
Polychlorinated Biphenyls							
Aroclor-1016	12674-11-2	0.000332	R5	0.00011067	0.0167	0.00833	0.00417
Aroclor-1221	11104-28-2	0.000332	R5	0.00011067	0.0167	0.00833	0.00417
Aroclor-1232	11141-16-5	0.000332	R5	0.00011067	0.0167	0.00833	0.00417
Aroclor-1242	53469-21-9	0.000332	R5	0.00011067	0.0167	0.00833	0.00417
Aroclor-1248	12672-29-6	0.000332	R5	0.00011067	0.0167	0.00833	0.00417
Aroclor-1254	11097-69-1	0.000332	R5	0.00011067	0.0167	0.00833	0.00417
Aroclor-1260	11096-82-5	0.000332	R5	0.00011067	0.0167	0.00833	0.00417
Aroclor-1262	37324-23-5	0.000332	R5	0.00011067	0.0167	0.00833	0.00417
Aroclor-1268	11100-14-4	0.000332	R5	0.00011067	0.0167	0.00833	0.00417
Metals							
Aluminum	7429-90-5	50	ORNL-pl	16.67	10	5	2.5
Antimony	7440-36-0	0.27	Eco SSL	0.09	0.5	0.4	0.25
Arsenic	7440-38-2	0.39	R-RSL	0.13	0.5	0.3	0.15
Barium	7440-39-3	330	Eco SSL	110	2	0.5	0.25
Cadmium	7440-43-9	0.36	Eco SSL	0.12	0.25	0.1	0.05
Chromium	7440-47-3	0.29	R-SSL	0.0967	250	100	50
Copper	7440-50-8	28	Eco SSL	9.33	0.5	0.2	0.1
Cobalt	7440-48-4	2.1	IDEM-RDCL	0.7	0.625	0.5	0.25
Iron	7439-89-6	2.1	IDEM-RDCL	0.7	0.5	0.4	0.2
Lead	7439-92-1	11	Eco SSL	3.67	5	3	1.5
Manganese	7439-96-5	2.1	IDEM-RDCL	0.7	0.25	0.15	0.075

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Action Limit Reference[(1)]	PQLG (mg/kg)	Laboratory		
					Lab LOQ (mg/kg)	Lab LOD (mg/kg)	Lab DL (mg/kg)
Nickel	7440-02-0	38	Eco SSL	12.67	0.75	0.3	0.15
Selenium	7782-49-2	0.52	Eco SSL	0.173	0.5	0.3	0.15
Vanadium	7440-62-2	7.8	Eco SSL	2.6	0.5	0.25	0.15
Zinc	7440-66-6	46	Eco SSL	15.3	0.625	0.5	0.25
Petroleum Hydrocarbons							
Diesel Range Organics (C8-C28)	NA	230	IDEM-RDCL	75.9	6.67	6.67	6.67

DL Detection Limit
Eco SSL US EPA Eco-SSL (Eco-SSL documents are available on-line at http://www.epa.gov/ecotox/ecossl/); lower of the plant, soil invertebrate, bird, or mammal screening level.
IDEM-RDCL The guidelines are from IDEM's RISC Default Closure Tables 2006 (Revised May 1, 2009) available online at: http://www.in.gov/idem/files/risctech_appendix1_2006_r1.pdf.
LANL Los Alamos National Laboratory , 2009 (December.). ECORISK Database (Release 2.4). LA-UR-04-7834. ER ID 107524. Environmental Programs Directorate, Los Alamos National Laboratory, Los Alamos, NM.
LOD Limit of Detection
LOQ Limit of Quantitation
NA Not applicable.
ORNL-pl Efroymson, R.A., M.E. Will, and G.W. Suter II. 1997. Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision. Oak Ridge National Laboratory. November. ES/ER/TM-126/R2.
R5 USEPA, 2003. Ecological Screening Levels. USEPA Region 5 (http://www.epa.gov/reg5rcra/ca/edql.htm). August.
R-RSL/R-SSL The residential soil direct contact (R-RSL) and migration to groundwater soil screening levels (R-SSL) screening level from the USEPA Regional Screening Levels Table, November, 2010 are available online at http://epa-prgs.ornl.gov/chemicals/index.shtml. The risk-based screening level is based on a target hazard quotient of 1 for non-carcinogens (denoted with a "N" flag), or an incremental lifetime cancer risk (ILCR) of 1E-6 for carcinogens (denoted with a "C" flag). If available the MCL-Based R-SSL is presented, if an MCL-Based R-SSL is not available then the risk-based R-SSL is presented. The EPA R-RSL (non-carcinogens is adjusted by dividing by 10, equivalent to a target hazard quotient of 0.1. The residential soil screening level for carcinogens (not adjusted) is equivalent to an ILCR of 1E-6. The USEPA R-SSL is adjusted for a dilution attenuation factor (DAF) of 20.
PQLG Project Quantitation Limit
HMX Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine/ His / Her Majesty's Explosive
PETN Pentaerythritol tetranitrate
RDX Octahydro-1,3,5,7-tetranitro-1,3,5-triazine / Royal Demolition Explosive

Worksheet No. 10 – Analytical SOP Reference Table

(UFP-QAPP Manual Section 3.2.1 – Worksheet #23)

LAB SOP NUMBER	TITLE, REVISION DATE, AND/OR NUMBER	DEFINITIVE OR SCREENING DATA	MATRIX AND ANALYTICAL GROUP	INSTRUMENT	ORGANIZATION PERFORMING ANALYSIS	VARIANCE TO QSM? (Y/N)	MODIFIED FOR PROJECT WORK? (Y/N)
Empirical SOP-100	Metals Digestion/ Preparation, Methods 3005A/ USEPA CLP ILMO 4.1 Aqueous, 3010A, 3030C, 3050B, USEPA CLP ILMO 4.1 (Soil/Sediment), 200.7, Standard Methods 3030C (Revision 21, 09/01/10)	Definitive	Soil, Metals Digestion	NA/Preparation	Empirical	NA	N
Empirical SOP-105	Metals by Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES) Technique, SW-846 Methods 6010B, 6010C, USEPA Method 200.7, Standard Methods 19th Edition 2340B, USEPA CLP ILMO 4.1 (Revision 16, 04/11/10)	Definitive	Soil, Metals	ICP-AES	Empirical	N	N
Empirical SOP-211	Gas Chromatography/ Electron Capture Detector (GC/ECD) Organochlorine Pesticides/ PCBs using USEPA Method 608608.2 or SW846 Method 8081A/8082 or 8081B/8082A (Revision 22, 07/07/10)	Definitive	Soil, PCBs	GC/ECD	Empirical	N	N
Empirical SOP-343	BNA, Pesticides/PCBs, and TPH non-Aqueous Matrix (Microwave Extraction) using SW-846 3546 (Revision 01, 09/09/10)	Definitive	Soil, SVOCs/PAHs and PCBs Extraction	NA/ Extraction	Empirical	NA	N

LAB SOP NUMBER	TITLE, REVISION DATE, AND/OR NUMBER	DEFINITIVE OR SCREENING DATA	MATRIX AND ANALYTICAL GROUP	INSTRUMENT	ORGANIZATION PERFORMING ANALYSIS	VARIANCE TO QSM? (Y/N)	MODIFIED FOR PROJECT WORK? (Y/N)
Empirical SOP-327	Nitoaromatics and Nitramines by High Performance Liquid Chromatography (HPLC) Method 8330, 8330A, 8330B and 8332 (Revision 14, 09/07/10)	Definitive	Soil, Explosives	HPLC/Ultraviolet (UV)	Empirical	N	N
Empirical SOP-201	Gas Chromatography Mass Spectrometry (GC/MS) semivolatiles and Low-Concentration PAHs using USEPA Method 625 and SW846 Method 8270C and 8270D, Including Appendix IX Compounds (Revision 20, 04/26/10)	Definitive	Soil, PAHs	GC/MS	Empirical	N	N
Empirical SOP-219	Gas Chromatography/ Flame Ionization Detector (GC/FID) Nonhalogentaed Volatile Organics and Total Petroleum Hydrocarbons (TPH) by Method 8015B/8015C/TN EPH/GRO (Revision 14, 12/01/10)	Definitive	Soil, TPH-DRO (C8-C28)	GC/FID	Empirical	NA	Y (IDEM-Specific Ranges)
Empirical SOP-320	Total Petroleum Hydrocarbons (TPH) Non-Aqueous Matrix (Low Level) by USEPA SW846 Method 8015B, Large Sonication Horn (Revision 10, 09/09/10)	Definitive	Soil TPH-DRO (C8-C28) Extraction	NA/ Extraction	Empirical	NA	N

Worksheet No. 11 – Laboratory QC Samples Tables

(UFP-QAPP Manual Section 3.4 – Worksheet #28)

Matrix	**Soil**
Analytical Group	**PAHs**
Analytical Method / SOP Reference	**SW-846 8270C-Low Empirical SOP-201**

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch of 20 or fewer samples of similar matrix.	All target analytes must be ≤ ½ LOQ, except common lab contaminants, which must be < LOQ.	Investigate source of contamination. Rerun method blank prior to analysis of samples if possible. Evaluate the samples and associated QC: if blank results are above RL, report sample results that are < RL or > 10X the blank concentration. Reanalyze blank and samples >RL and < 10X the blank.	Analyst, Supervisor	Bias/ Contamination	Same as QC Acceptance Limits
Laboratory Control Sample (LCS)/ Laboratory Control Sample Duplicate (LCSD) (not required)	One per preparatory batch of 20 or fewer samples of similar matrix.	Percent Recoveries (%Rs) must meet the DoD QSM Version 4.1 limits as per Appendix G of the DoD QSM. RPD must be ≤ 30% (for LCS/LCSD, if LCSD is performed).	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Refer to DOD QSM Version 4.1 Table G-1 for number of marginal exceedences allowed. Contact Client if samples cannot be reprepared within hold time.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits
MS/MSD	One per preparatory batch of 20 or fewer samples of similar matrix.	%Rs must meet the DoD QSM Version 4.1 limits as per Appendix G of the DoD QSM. The RPD between MS and MSD should be ≤ 30%.	CA will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met, unless RPDs indicate obvious extraction/ analysis difficulties, then re-prepare and reanalyze MS/MSD.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits

Matrix	**Soil**
Analytical Group	**PAHs**
Analytical Method / SOP Reference	**SW-846 8270C-Low** **Empirical SOP-201**

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Internal Standard (IS)	Every field sample, standard, and QC sample - six per sample 1,4-Dichlorobenzene-d_4 Naphthalene-d_8 Acenaphthene-d_{10} Phenanthrene-d_{10} Chrysene-d_{12} Perylene-d_{12}.	Retention Times (RTs) must be within ± 30 seconds and the response areas must be within -50% to +100% of the initial calibration midpoint standard for each IS.	Re-analyze affected samples.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits
Surrogates	All field and QC samples - six per sample 2-Fluorophenol Phenol-d_6 Nitrobenzene-d_5 2-Fluorobiphenyl 2,4,6-Tribromophenol Terphenyl-d_{14}.	%Rs must meet the DoD QSM Version 4.1 limits as per Appendix G of the DoD QSM	(1) Check chromatogram for interference; if found, then flag data. (2) If not found, then check instrument performance; if problem is found, then correct and reanalyze sample. (3) If still out, then re-extract and reanalyze sample. (4) If reanalysis is out, then flag data.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits
Results between DL and LOQ	NA.	Apply "J" qualifier to results detected between DL and LOQ.	NA.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits

Matrix	**Soil**					
Analytical Group	**PCBs**					
Analytical Method / SOP Reference	**SW-846 8082A Empirical SOP-211**					
QC Sample	**Frequency / Number**	**Method / SOP QC Acceptance Limits**	**CA**	**Person(s) Responsible for CA**	**DQI**	**MPC**
Method Blank	One per preparatory batch of 20 or fewer samples of similar matrix.	All target analytes must be ≤ ½ LOQ.	Investigate source of contamination. Evaluate the samples and associated QC: i.e., if the blank results are above the LOQ, then report sample results that are <LOQ or > 10X the blank concentration. Otherwise, re-prepare a blank and samples >LOQ and <10X LOQ.	Analyst, Supervisor	Bias/ Contamination	Same as QC Acceptance Limits
LCS	One per preparatory batch of 20 or fewer samples of similar matrix. PCB: Spike with Aroclor 1016/1260 mix.	%Rs must meet the DoD QSM Version 4.1 limits as per Appendix G of the DoD QSM.	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Refer to DOD QSM Version 4.1 Table G-1 for number of marginal exceedences allowed. Contact Client if samples cannot be reprepared within hold time.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits
MS/MSD	One per preparatory batch of 20 or fewer samples of similar matrix. (spike same as LCS).	%Rs must meet the DoD QSM Version 4.1 limits as per Appendix G of the DoD QSM. The RPD between MS and MSD should be ≤ 30%.	Evaluate the samples and associated QC and if the LCS results are acceptable, then narrate. If both the LCS and MS/MSD are unacceptable, then re-prepare the samples and QC.	Analyst, Supervisor	Accuracy/ Bias/ Precision	Same as QC Acceptance Limits

Matrix	**Soil**
Analytical Group	**PCBs**
Analytical Method / SOP Reference	**SW-846 8082A Empirical SOP-211**

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Surrogates	All field and QC samples - two per sample Tetrachloro-m-xylene Decachlorobiphenyl.	%Rs must meet the DoD QSM Version 4.1 limits as per Appendix G of the DoD QSM.	No corrective will be taken when one surrogate is within criteria. If surrogates recoveries are high and sample is <LOQ, then no CA is taken. If surrogates recoveries are low, then the affected samples are re-extracted and reanalyzed.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits
Second Column Confirmation	All positive results must be confirmed.	Results between primary and second column must be RPD ≤ 40%. For Method 8082, report the higher of the two concentrations, unless there is interference.	None. Apply “J” flag if RPD >40% and discuss in the case narrative.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits
Results between DL and LOQ	NA.	Apply “J” qualifier to results between DL and LOQ.	NA.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits

Matrix	**Soil**
Analytical Group	**Metals**
Analytical Method / SOP Reference	**SW-846 6010C Empirical SOP-105**

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch of 20 or fewer samples of similar matrix.	All target analytes must be ≤ ½ LOQ.	If the blank value > LOQ, then report sample results. If the blank value < LOQ or > 10x the blank value, then redigest. If blank value is less than negative LOQ, then report sample results. If > 10x the absolute value of the blank result, then redigest and reanalyze.	Analyst, Supervisor	Bias/ Contamination	Same as QC Acceptance Limits
LCS	One per preparatory batch of 20 or fewer samples of similar matrix.	%R must be within 80-120% of true value.	Evaluate and reanalyze, if possible. If the LCS recoveries are high, but the sample results are < LOQ, then narrate. Otherwise, re-digest and reanalyze all associated samples for failed target analyte(s).	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits
MS	One per preparatory batch of 20 or fewer samples of similar matrix.	%R should be within 80-120% of true value (if sample is < 4x spike added).	Flag results for affected analytes for all associated samples with “N”.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits
Sample Duplicate	One per preparatory batch of 20 or fewer samples of similar matrix.	The RPD should be ≤ 20% for duplicate samples for both water and soils.	Narrate any results that are outside control limits.	Analyst, Supervisor	Precision	Same as QC Acceptance Limits
Serial Dilution	One per preparatory batch with sample concentration(s) >50x LOD.	The 5-fold dilution result must agree within ±10%D of the original sample result if result is >50x LOD.	Perform post spike addition.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits

Matrix	**Soil**
Analytical Group	**Metals**
Analytical Method / SOP Reference	**SW-846 6010C Empirical SOP-105**

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Post Spike	One is performed when serial dilution fails or target analyte concentration(s) in all samples are < 50x LOD.	The %R must be within 75-125% of expected value to verify the absence of an interference. Spike addition should produce a concentration of 10-100x LOQ.	Flag results for affected analytes for all associated samples with “J”.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits
Results between DL and LOQ	NA.	Apply “J” qualifier to results between DL and LOQ.	NA.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits

Matrix	**Soil**
Analytical Group	**TPH-DRO (C8-C28)**
Analytical Method / SOP Reference	**SW-846 Method 8015B Empirical SOP-219**

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch of 20 or fewer samples.	All target analytes must be ≤ ½ LOQ.	If the method blank acceptance criteria are not met, identify and correct the source of contamination, and re-prepare and reanalyze the associated samples.	Analyst, Supervisor	Bias/ Contamination	Same as QC Acceptance Limits
LCS	One per preparatory batch of 20 or fewer samples of similar matrix.	%R must be within 50-150% of true value.	If LCS acceptance limits are not met, the LCS should be reanalyzed once to confirm that the original analysis is reliable. If the results are still outside control limits, the associated sample must be re-extracted and reanalyzed.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits
MS/MSD	One per preparatory batch of 20 or fewer samples of similar matrix.	%Rs should be within 50-15% of true value (if sample is < 4x spike added). The RPD between MS and MSD should be ≤ 30%.	CA will not be taken for samples when %Rs are outside limits and surrogate and LCS criteria are met unless RPDs indicate obvious extraction/ analysis difficulties, then re-prepare and reanalyze MS/MSD.	Analyst, Supervisor	Accuracy/ Bias/ Precision	Same as QC Acceptance Limits
Surrogate	All field and QC samples - one per sample o-Terphenyl.	The %R of the surrogate must fall within 50-150%.	If surrogate %R is outside the established limits, verify calculations, dilutions, and standard solutions. Also verify that the instrument performance is acceptable. If the surrogate %R is outside the established limits due to well-documented matrix effects, the results must be flagged and an explanation included in the report narrative.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits
Results between DL and LOQ	NA.	Apply “J” qualifier to results detected between DL and LOQ.	NA.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits

Matrix	**Soil**
Analytical Group	**Explosives**
Analytical Method / SOP Reference	**SW-846 8330B Empirical SOP-327**

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch of 20 or fewer samples.	All target analytes must be ≤ ½ LOQ.	If the method blank acceptance criteria are not met, identify and correct the source of contamination, and re-prepare and reanalyze the associated samples.	Analyst, Supervisor	Bias/ Contamination	Same as QC Acceptance Limits
LCS	One per preparatory batch of 20 or fewer samples of similar matrix.	%Rs for aqueous and soil must be between 60-120%	Evaluate and reanalyze if possible. If an MS/MSD was performed in the same 12 hour clock and is acceptable narrate. If the LCS recoveries are high but the sample results are <QL then narrate, otherwise re-prepare and reanalyze.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits
MS/MSD	One per preparatory batch of 20 or fewer samples of similar matrix.	%Rs for aqueous and soil must be between 50 and 140% RPD ≤50%.	CA will not be taken for samples when %Rs are outside limits and surrogate and LCS criteria are met unless RPDs indicate obvious extraction/ analysis difficulties, then re-prepare and reanalyze MS/MSD.	Analyst, Supervisor	Accuracy/ Bias/ Precision	Same as QC Acceptance Limits
Surrogate	All field and QC samples - one per sample	1,2-dinitrobenzene: 60%-140% for aqueous 50-150% for soil	If surrogate %Rs are outside the established limits, verify calculations, dilutions, and standard solutions. Also verify that the instrument performance is acceptable. If the surrogate %R is outside the established limits due to well-documented matrix effects, the results must be flagged and an explanation included in the report narrative.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits
Results between DL and LOQ	NA.	Apply "J" qualifier to results detected between DL and LOQ.	NA.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits
Second Column Confirmation	All positive results must be confirmed.	Results between primary and second column must be RPD ≤ 40%.	None. Apply "J" flag if RPD >40% and discuss in the case narrative.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits

Worksheet No. 12 – Data Verification and Validation (Steps I and IIa/IIb) Process Table

(UFP-QAPP Manual Section 5.2.1, UFP-QAPP Manual Section 5.2.2,, Figure 37 UFP-QAPP Manual, Table 9 UFP-QAPP Manual – Worksheets #34, 35, 36)

Data Review Input	Description	Responsible for Verification (name, organization)	Internal/ External
Chain of Custody Forms	The Tetra Tech FOL or designee will review and sign the chain-of-custody form to verify that all samples listed are included in the shipment to the laboratory and the sample information is accurate. The forms will be signed by the sampler and a copy will be retained for the project file, the Tetra Tech PM, and the Tetra Tech Data Validators. The Tetra Tech FOL or designee will review the chain-of-custody form to verify that all samples listed in the SAP have been collected. All deviations should be documented in the report.	Sampler and FOL, Tetra Tech	Internal
Chain of Custody Forms	1 - The Laboratory Sample Custodian will review the sample shipment for completeness and integrity, and sign accepting the shipment. 2- The Tetra Tech Data Validators will check that the chain-of-custody form was signed and dated by the Tetra Tech FOL or designee relinquishing the samples and also by the Laboratory Sample Custodian receiving the samples for analyses.	1 - Laboratory Sample Custodian, Empirical 2 - Data Validators, Tetra Tech	1 – Internal 2 - External
Chain of Custody Forms and SAP	Ensure that the custody and integrity of the samples was maintained from collection to analysis and the custody records are complete and any deviations are recorded. Review that the samples were shipped and stored at the required temperature and preservation conditions for chemically-preserved samples meet the requirements listed in the SAP. Ensure that the analyses were performed within the holding times listed in the SAP.	Data Validators, Tetra Tech	External

Data Review Input	Description	Responsible for Verification (name, organization)	Internal/ External
Sample Log Sheets, Chain of Custody Forms, SAP, and Laboratory Sample Login Documentation	Verify that information recorded in the log sheets is accurate and complete. Verify that samples were correctly identified, that sampling location coordinates are accurate, and that documentation establishes an unbroken trail of documented chain-of-custody from sample collection to report generation. Verify that the correct sampling and analytical methods/SOPs were applied. Verify that the sampling plan was implemented and carried out as written and that any deviations are documented. Document any discrepancies in the final report.	PM, FOL, or designee, Tetra Tech	Internal
SAP, Analytical SOPs, and Analytical Data Packages	Ensure that all laboratory SOPs were followed. Verify that the correct analytical methods/SOPs were applied. Establish that all method QC samples were analyzed and in control as listed in the analytical SOPs. If method QA is not in control, the Laboratory QAM will contact the Tetra Tech PM verbally or via e-mail for guidance prior to report preparation.	Laboratory QAM, Empirical	Internal
SAP/ Chain-of-Custody Forms	Check that all field QC samples determined necessary were collected as required.	FOL or designee, Tetra Tech	Internal
Analytical Data Package	Verify all analytical data packages for completeness. The Laboratory QAM will sign the case narrative for each data package.	Laboratory QAM, Empirical	Internal

Data Review Input	Description	Responsible for Verification (name, organization)	Internal/ External
Electronic Data Deliverables (EDDs)/ Analytical Data Packages	Check each EDD against the chain-of-custody and hard copy data package for accuracy and completeness. Compare laboratory analytical results to the electronic analytical results to verify accuracy. Evaluate sample results for laboratory contamination and qualify false detections using the laboratory method/preparation blank summaries. Qualify analyte concentrations between the DL and the LOQ as estimated. Remove extraneous laboratory qualifiers from the validation qualifier.	Data Validators, Tetra Tech	External
Analytical Data Package	Verify each data package for completeness. Request missing information from the Laboratory PM.	Data Validators, Tetra Tech	External
SAP/ Laboratory Data Packages/ EDDs	Ensure that the laboratory QC samples were analyzed and that the MPCs listed in were met for all field samples and QC analyses. Check that specified field QC samples were collected and analyzed and that the analytical QC criteria set up for this project were met.	Data Validators, Tetra Tech	External
SAP/ Laboratory Data Packages/ EDDs	Check the field sampling precision by calculating RPDs for field duplicate samples. Check laboratory precision by reviewing the RPD or percent difference values from laboratory duplicate analyses; MS/MSDs; and LCS/LCSD, if available. Ensure compliance with the methods and project MPCs accuracy goals listed in the SAP.	Data Validators, Tetra Tech	External
SAP/ Laboratory Data Packages/ EDDs	Check that the laboratory recorded the temperature at sample receipt and the pH of samples preserved with acid or base to ensure sample integrity from sample collection to analysis.	Data Validators, Tetra Tech	External

Data Review Input	Description	Responsible for Verification (name, organization)	Internal/ External
SAP/ Laboratory Data Packages/ EDDs	Review the chain-of-custody forms generated in the field to ensure that the required analytical samples have been collected, appropriate sample identifications have been used, and correct analytical methods have been applied. The Tetra Tech Data Validator will verify that elements of the data package required for validation are present, and if not, the laboratory will be contacted and the missing information will be requested. Check that all data have been transferred correctly and completely to the Tt SQL database.	Data Validators, Tetra Tech	External
SAP/ Laboratory Data Packages/ EDDs	Ensure that the project LOQs listed in SAP were achieved.	Data Validators, Tetra Tech	External
SAP/ Laboratory Data Packages/ EDDs	Discuss the impact on DLs that are elevated because of matrix interferences. Be especially cognizant of and evaluate the impact of sample dilutions on low-concentration analytes when the dilution was performed because of the high concentration of one or more other contaminants. Document this usability issue and inform the Tetra Tech PM. Review and add PALs to the laboratory EDDs. Flag samples and notify the Tetra Tech PM of samples that exceed PALs listed in SAP.	Data Validators, Tetra Tech	External
SAP/ Laboratory Data Packages/ EDDs	Ensure that all QC samples specified in the SAP were collected and analyzed and that the associated results were within prescribed SAP acceptance limits. Ensure that QC samples and standards prescribed in analytical SOPs were analyzed and within the prescribed control limits. If any significant QC deviations occur, the Laboratory QAM shall have contacted the Tetra Tech PM.	Data Validators, Tetra Tech	External

Data Review Input	Description	Responsible for Verification (name, organization)	Internal/ External
SAP/ Laboratory Data Packages/ EDDs	Summarize deviations from methods, procedures, or contracts in the Data Validation Report. Determine the impact of any deviation from sampling or analytical methods and SOPs requirements and matrix interferences effect on the analytical results. Qualify data results based on method or QC deviation and explain all the data qualifications. Print a copy of qualified data stored the project database to depict data qualifiers and data qualifier codes that summarize the reason for data qualifications. Determine if the data met the MPCs and determine the impact of any deviations on the technical usability of the data.	Data Validators, Tetra Tech	External
Soil TPH (DRO), Explosives, PAHs, PCBs	Data validation will be performed using criteria for SW-846 Method 8015B,8330B, 8270C-Low, 8082A listed in Worksheet Nos. 6, 9 and 11 and the current DoD QSM. If not included in the aforementioned, then the logic outlined in the "USEPA CLP National Functional Guidelines for Organic Data Review" USEPA-540/R-99-008, (USEPA, October 1999) will be used to apply qualifiers to data.	Data Validators, Tetra Tech	External
Soil Metals	Data validation will be performed using criteria for SW-846 Method 6010C listed in Worksheet Nos. 6, 9 and 11 and the current DoD QSM. If not included in and the aforementioned, then the logic outlined in the "USEPA CLP National Functional Guidelines for Inorganic Data Review", USEPA 540-R-04-004, (USEPA, October 2004) will be used to apply qualifiers to data.	Data Validators, Tetra Tech	External

Notes: Verification includes field data verification and laboratory data verification. Verification inputs as per Worksheet No. 12 will be checked.

REFERENCES

Crane 2008. Ordnance Briefing Program for Explosives Safety Personnel, 4 September 2008 Session.

Murphy, W.L., and R. Wade, 1995. Draft Report, RCRA Facility Investigation, Phase II Groundwater Release Assessment, SWMU 06/09 Demolition Area and Phase III Release Characterization, SWMU 07/09 Old Rifle Range, Naval Surface Warfare Center, Crane, Indiana. U. S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.

Nohrstedt, J.S., et. al, 1998. RCRA Facility Investigation Phase II Soils Release Characterization, SWMU 04/02, McComish Gorge, NSWC Crane, Technical Report GL98-21, Final Report, Army Corps Waterways Experimental Station, September.

Tetra Tech, 2001. Basewide Background Soil Investigation Report, Naval Surface Warfare Center, Crane, Crane, Indiana, January.

Tetra Tech, 2005. Environmental Indicator Investigation for SWMU 18 (Load and Fill Area Buildings), SWMU 19 (Pyrotechnic Test Area), SWMU 20 (Crane Army Ammunition Activity Quality Assurance/Quality Control Test Area), and the Old Gun Tub Storage Lot, Naval Surface Warfare Center Crane, Crane, Indiana, June.

TABLE 4-1

SUMMARY OF CHEMICALS DETECTED - SURFACE SOIL
OLD GUN TUB STORAGE LOT
NSA CRANE
CRANE, INDIANA

LOCATION	Region 9 Residential Soil	Region 9 Industrial Soil	IDEM Residential Soil	IDEM Industrial Soil	OGSTLSB001	OGSTLSB002	OGSTLSB003	OGSTLSB004	OGSTLSB005
SAMPLE NUMBER					OGTSLSS0010002	OGTSLSS0020002	OGTSLSS0030002	OGTSLSS0040002	OGTSLSS0050002
SAMPLE CODE					NORMAL	NORMAL	ORIG	NORMAL	NORMAL
DEPTH RANGE					0 - 2	0 - 2	0 - 2	0 - 2	0 - 2
SAMPLE DATE					1/24/2005	1/24/2005	1/24/2005	1/24/2005	1/24/2005
Semivolatile Organics (ug/kg)									
ACENAPHTHYLENE	3700000	29000000	1100000	2800000	28	4.02 U	4.26 U	3.89 U	12
ANTHRACENE	22000000	100000000	47000000	120000000	24	4.02 U	4.26 U	3.89 U	9
BENZO(A)ANTHRACENE	620	2100	5000	15000	140	18	27	3.89 U	67
BENZO(A)PYRENE	62	210	500	1500	140	15	21 J	3.89 U	67
BENZO(B)FLUORANTHENE	620	2100	5000	15000	390	25	30 J	3.89 U	190
BENZO(G,H,I)PERYLENE	2300000	29000000	50000	150000	140	23	13 J	3.89 U	59
BENZO(K)FLUORANTHENE	6200	21000	50000	150000	180	21	9 J	3.89 U	100
BIS(2-ETHYLHEXYL)PHTHALATE	35000	120000	300000	980000	1500 J	81.7 UJ	86.5 UJ	78.9 UJ	140 J
CHRYSENE	62000	210000	500000	1500000	260	22	21	3.89 U	130
DIBENZO(A,H)ANTHRACENE	62	210	500	1500	38	4.02 U	4.26 UJ	3.89 U	19
FLUORANTHENE	2300000	22000000	6300000	16000000	310	35	44	3.89 U	210
INDENO(1,2,3-CD)PYRENE	620	2100	5000	15000	130	21	10 J	3.89 U	62
NAPHTHALENE	56000	190000	3200000	8000000	9	4.02 J	4.26 U	3.89 U	4 J
PHENANTHRENE	2300000	29000000	470000	1200000	41	10	4.26 U	3.89 U	26
PYRENE	2300000	29000000	4700000	12000000	310	40	44	3.89 U	170
Pesticides PCBs (ug/kg)									
AROCLOR-1260	220	740	---	---	390	130	11.6 U	10.6 U	110
Inorganics (mg/kg)[1]									
ALUMINUM	76000	100000	---	---	587	24200	19100	7760	2780
ANTIMONY	31	410	140	620	28 J	6.9 J	0.65 U	0.59 U	3.6 J
ARSENIC	0.39	1.6	3.9	20	5.6 J	8.1 J	9.2 J	9.9 J	4.9 J
BARIUM	5400	67000	23000	98000	15.1 J	43 J	62.7 J	60.8 J	26.8 J
BERYLLIUM	150	1900	680	2900	0.07 U	0.32 J	0.53 J	0.5 J	0.15 U
CADMIUM	37	450	12	990	12.2 J	3.6 J	0.46 J	0.34 U	3.1 J
CALCIUM	---	---	---	---	339000 J	82900 J	47000 J	38700 J	182000 J
CHROMIUM	30	64	---	---	573 J	34.9 J	12.4 J	13.8 J	32.8 J
COBALT	900	1900	---	---	11.1 J	4.9 J	6.1 J	6 J	2.8 J
COPPER	3100	41000	13000	57000	99.5 J	76.6 J	13.5 J	11.3 J	17.5 J
IRON	23000	100000	---	---	29500 J	31400 J	20800 J	17900 J	11100 J
LEAD	400	800	400	1300	543 J	467 J	22 J	14.7 J	74.9 J
MAGNESIUM	---	---	---	---	16400 J	16800 J	6080 J	3690 J	11000 J
MANGANESE	1800	19000	---	---	765 J	209 J	562 J	164 J	128 J
MERCURY	23	310	100	470	0.038 J	0.026 J	0.007 U	0.009 J	0.018 J
NICKEL	1600	20000	6900	31000	442 J	23.8 J	10.4 J	9.8 J	12.5 J
POTASSIUM	---	---	---	---	873 J	974 J	1300 J	1020 J	997 J
SELENIUM	390	5100	1700	7800	0.22 J	0.36 J	0.43 J	0.36 J	0.32 J
SODIUM	---	---	---	---	178 J	178 J	76.2 U	68.4 U	123 U
TIN	47000	100000	---	---	3.8 J	6 J	0.4 U	0.29 U	0.72 U
VANADIUM	78	1000	---	---	8.3 J	22.9 J	22.7 J	23.5 J	11.4 J
ZINC	23000	100000	100000	470000	1650 J	279 J	53.9 J	64.2 J	706 J

Note: Much of the metals data is qualified as estimated (J) because of associations with laboratory method and preparation blanks. Estimated concentrations are in excess of blank action levels and cannot be attributed to blank contamination. This is based on old EPA Region 5 data validation guidance in effect at the time and is no longer used.

Exceeds lower Industrial criteria

Exceeds lower Residential criteria

Field duplicate samples are excluded from these summaries because they are considered to be QC samples designed only to evaluate data quality

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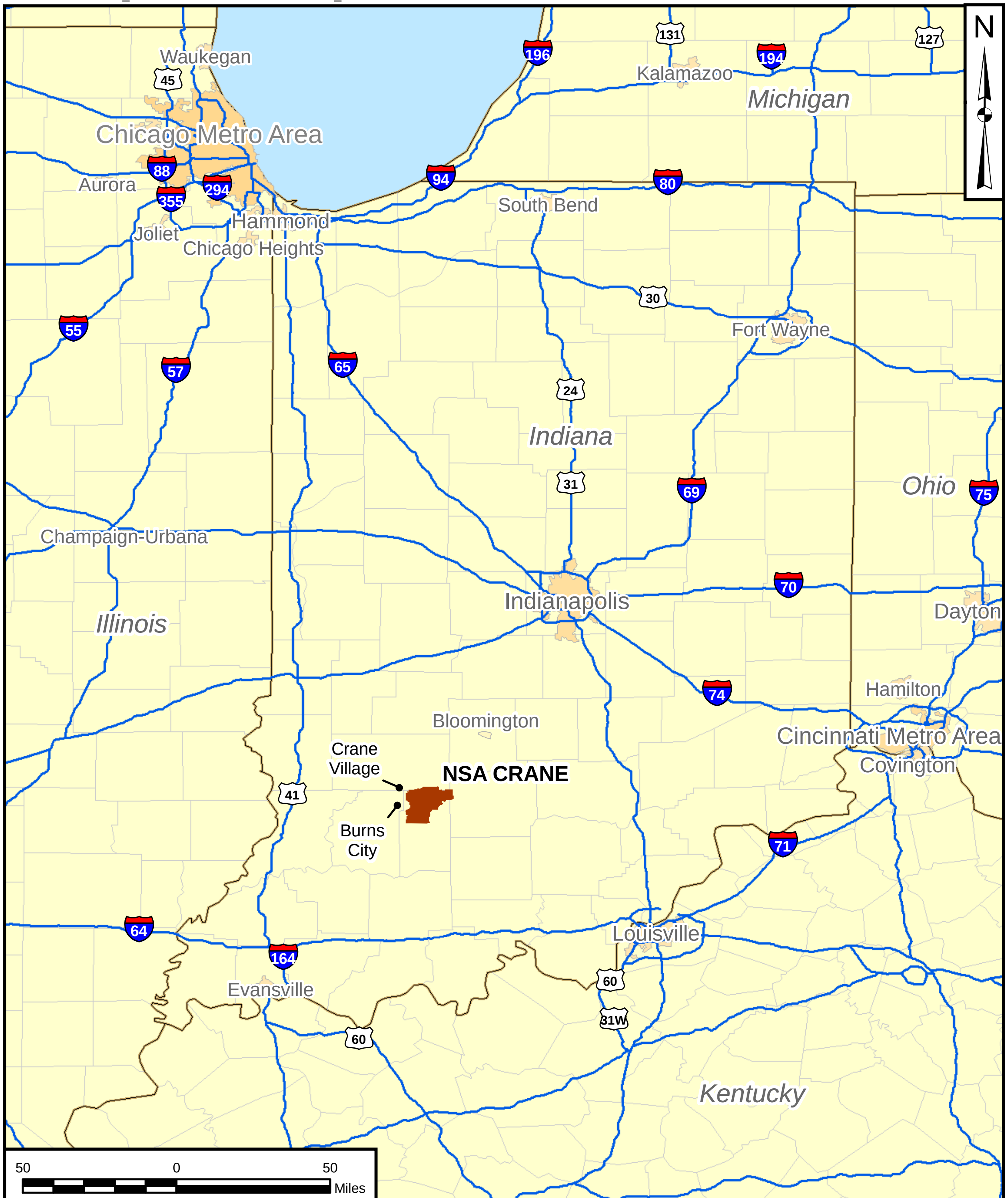

DRAWN BY	DATE
J. ENGLISH	03/10/11
CHECKED BY	DATE
J. DUCAR	06/08/11
REVISED BY	DATE

SCALE
AS NOTED

NAVFAC

GENERAL LOCATION MAP
OGTSL AND SACD SAMPLING
AND ANALYSIS PLAN
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	CTO NUMBER
	F276
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO. FIGURE 4-1	REV 0

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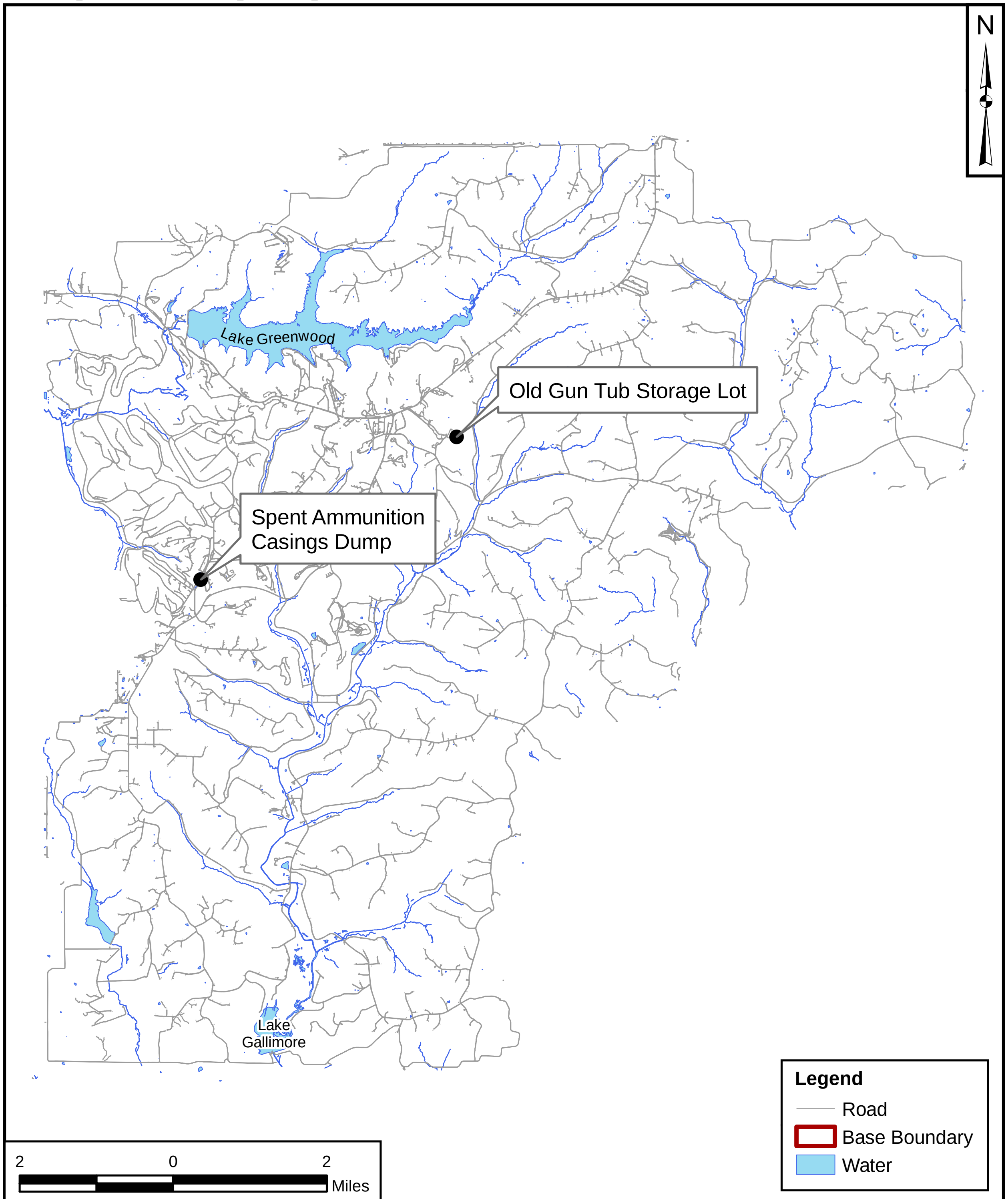

DRAWN BY S. STROZ DATE 05/17/11

CHECKED BY J. DUCAR DATE 06/07/11

REVISED BY __ DATE __

SCALE AS NOTED

NAVFAC

SITE LOCATION MAP
OGTSL AND SACD SAMPLING
AND ANALYSIS PLAN
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER CTO F276

APPROVED BY S. RUFFING DATE 03/02/11

APPROVED BY __ DATE __

FIGURE NO. FIGURE 4-2

REV 0

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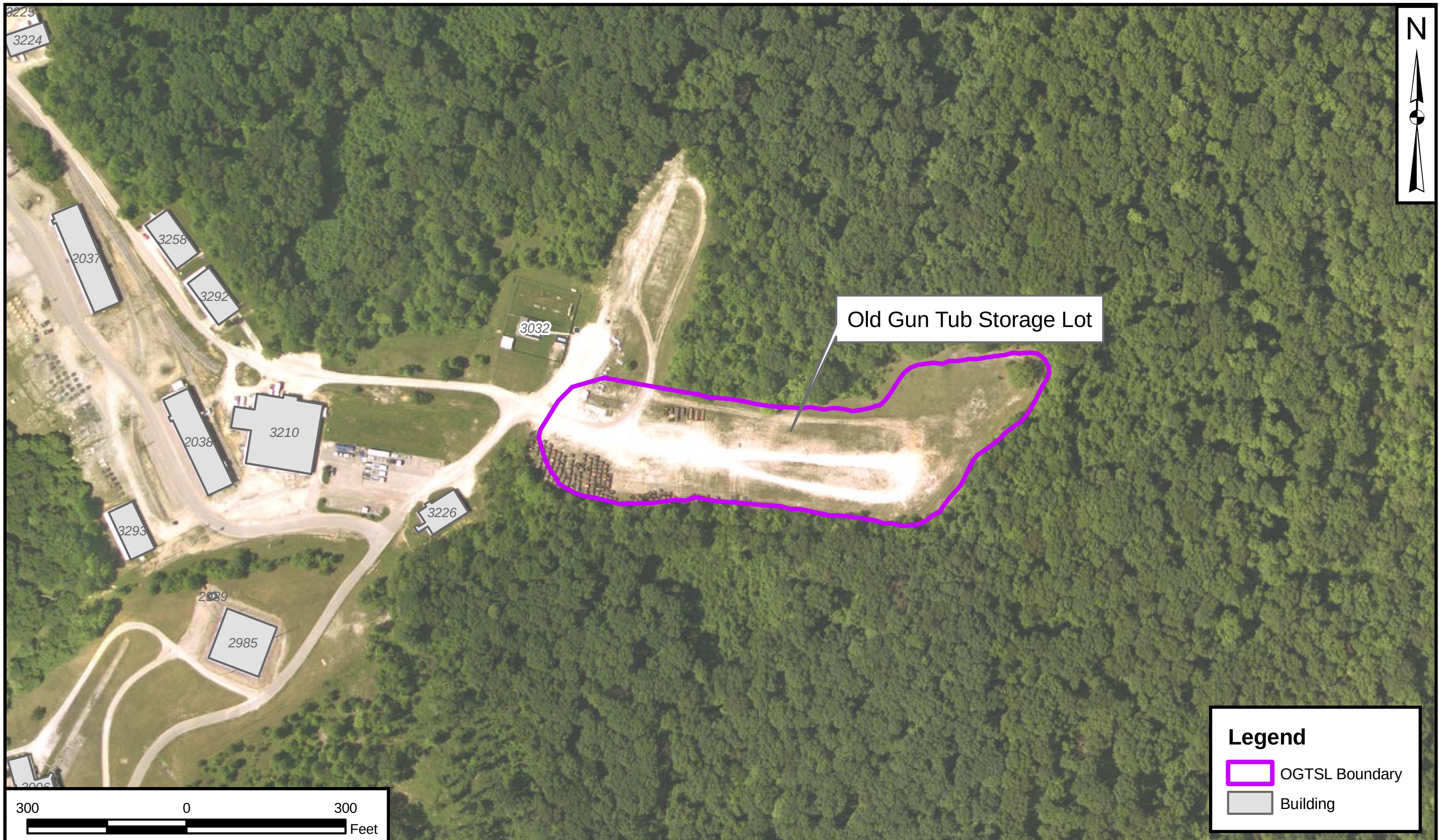

DRAWN BY S. STROZ	DATE 06/01/11	OLD GUN TUB STORAGE LOT LOCATION OGTSL AND SACD SAMPLING AND ANALYSIS PLAN NSA CRANE CRANE, INDIANA	CONTRACT NUMBER ___ / CTO NUMBER F276
CHECKED BY J. DUCAR	DATE 06/07/11		APPROVED BY __ / DATE __
REVISED BY ___	DATE ___		APPROVED BY __ / DATE __
SCALE AS NOTED			FIGURE NO. 4-3 / REV 0

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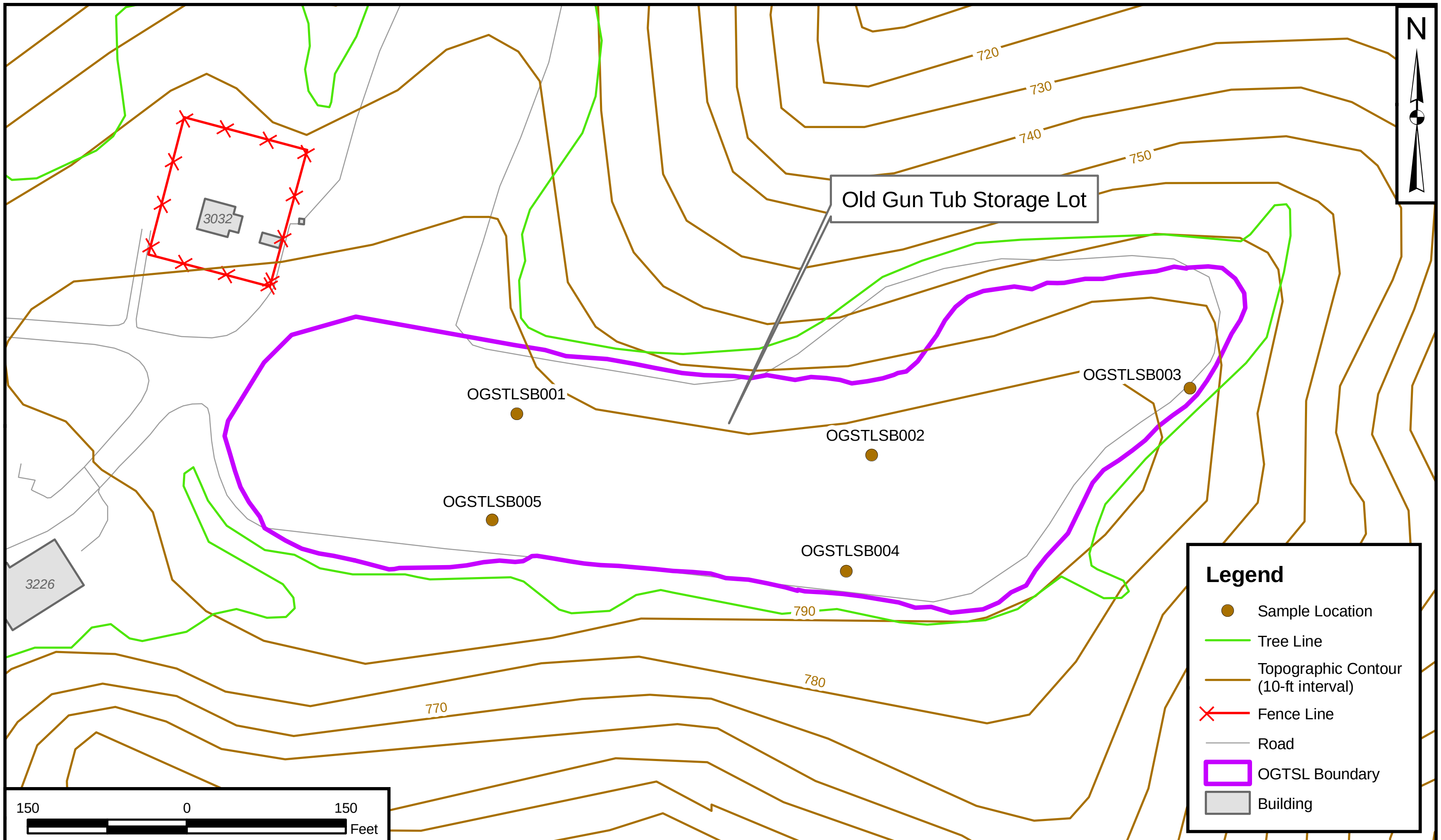

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SCALE AS NOTED	

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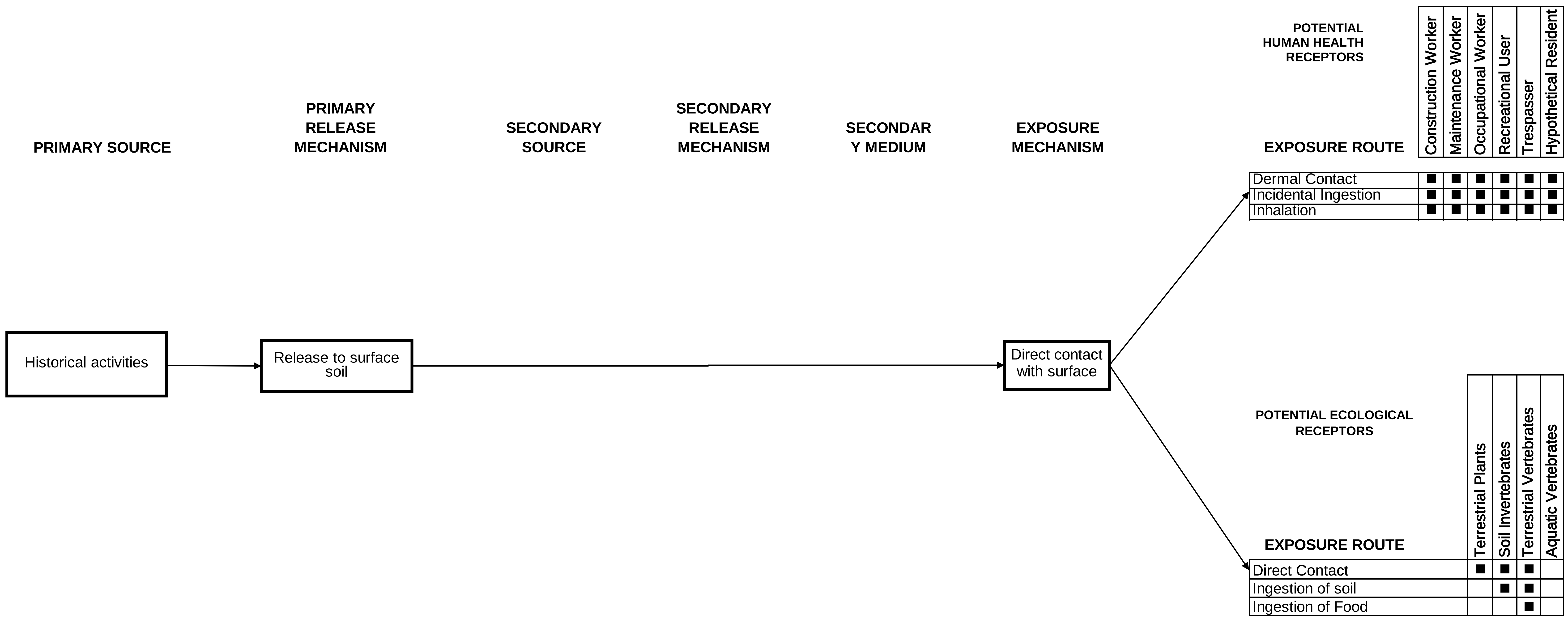
OLD GUN TUB STORAGE LOT
ENVIRONMENTAL INDICATOR SAMPLING LOCATIONS
OGTSL AND SACD SAMPLING AND ANALYSIS PLAN
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	CTO NUMBER
___	F276
APPROVED BY ___	DATE ___
APPROVED BY ___	DATE ___
FIGURE NO. 4-4	REV 0

FIGURE 4-5

CONCEPTUAL SITE MODEL
OGTSL AND SACD SAMPLING AND ANALYSIS PLAN
NSA CRANE
CRANE, INDIANA



■ = Potentially complete exposure pathway.

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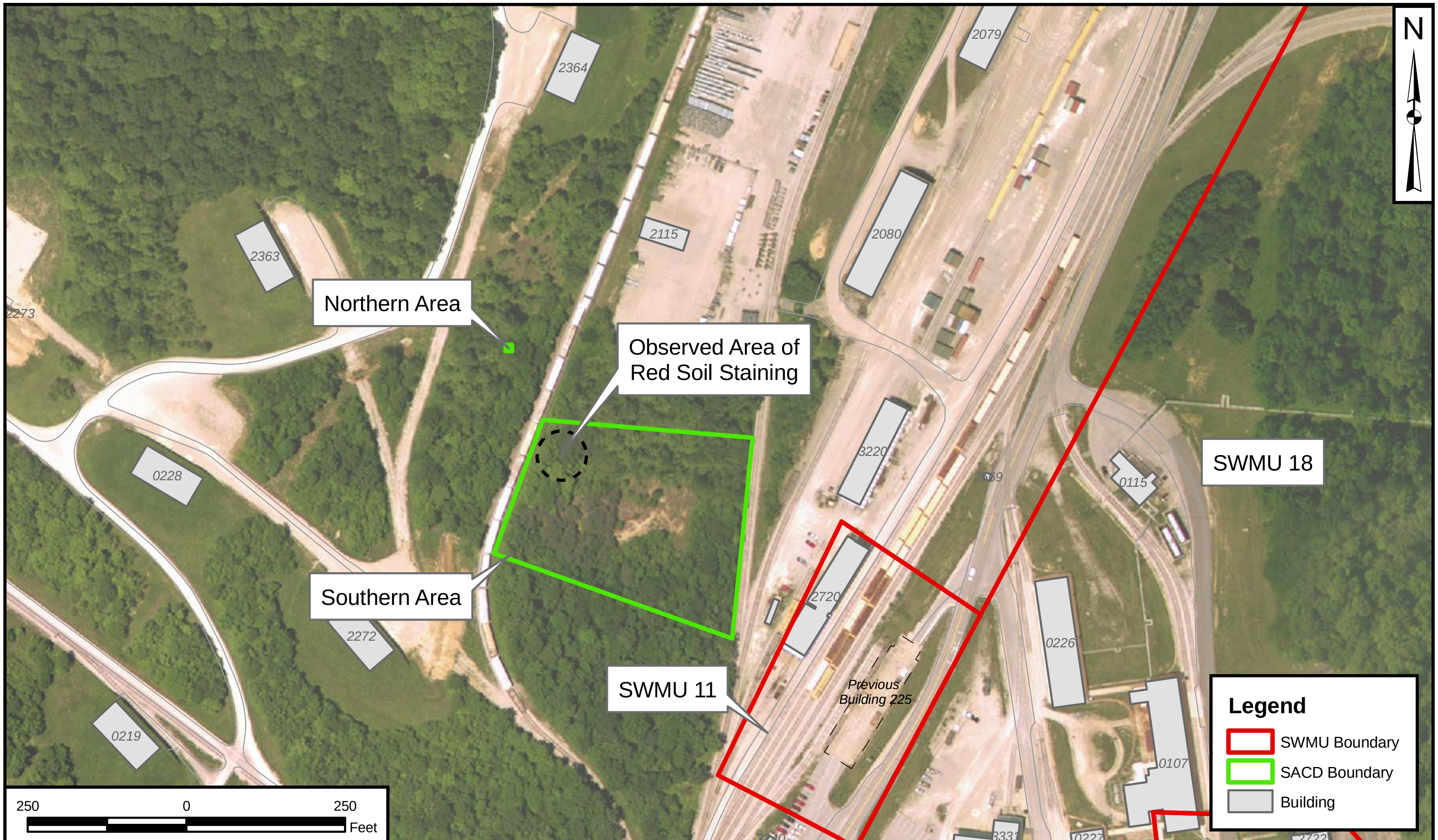

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J. DUCAR	06/10/11			___	___
REVISED BY	DATE			APPROVED BY	DATE
___	___			___	___
SCALE				FIGURE NO.	REV
AS NOTED				4-6	0

NAVFAC

SPENT AMMUNITION CASINGS DUMP LOCATION
OGTSL AND SACD SAMPLING AND ANALYSIS PLAN
NSA CRANE
CRANE, INDIANA

FIGURE 4-7

EXAMPLES OF AMMUNITION CASINGS DISCARDED AT THE SPENT AMMUNITION CASINGS DUMP

Examples of spent casings and other items found in main (southern) area.

1 of 3 cartridge casing found in northern area.

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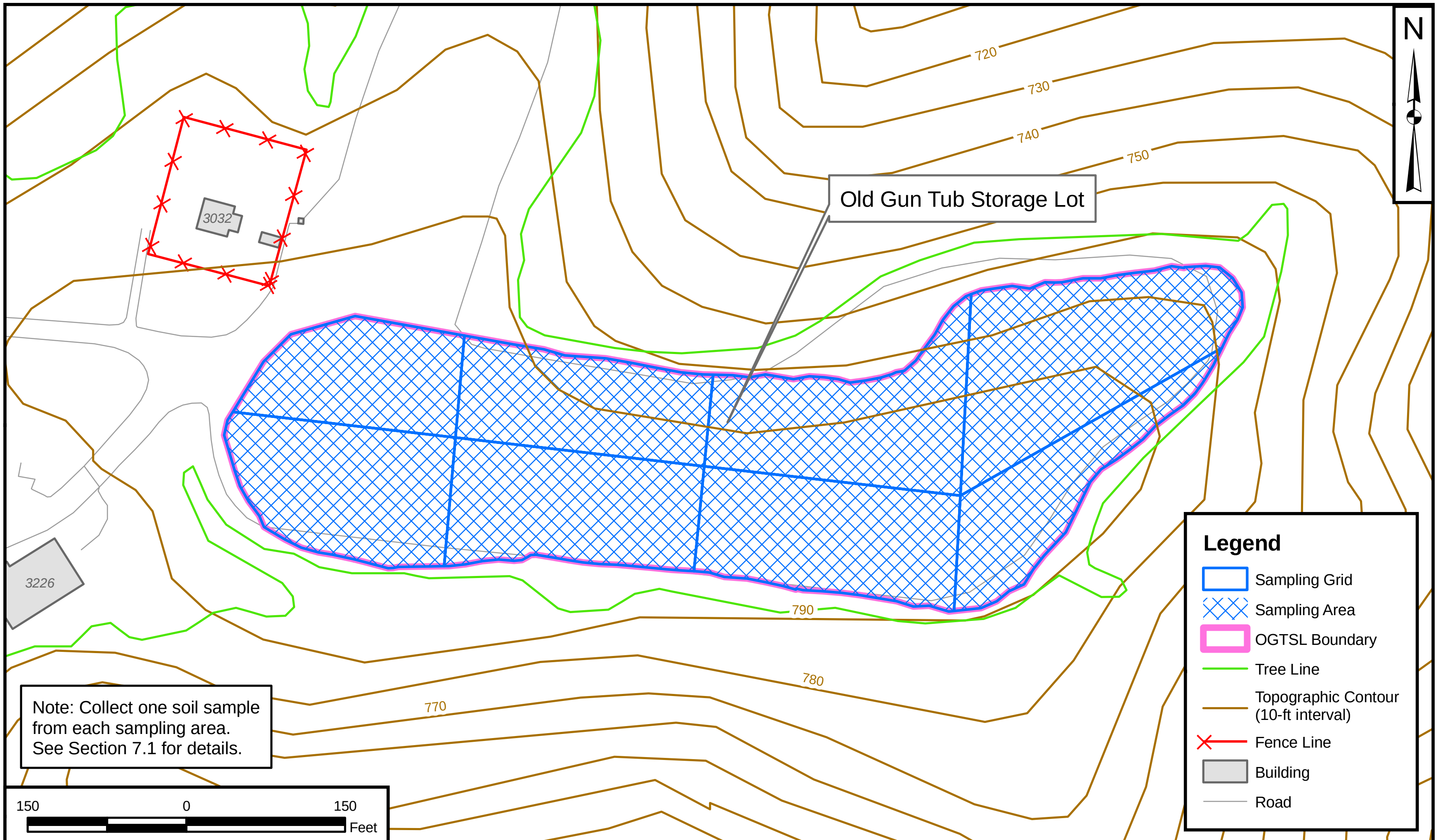

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REVISED BY __	DATE __	
SCALE AS NOTED		

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PROPOSED SOIL SAMPLING AREAS
OLD GUN TUB STORAGE LOT
OGTSL AND SACD SAMPLING AND ANALYSIS PLAN
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER __	CTO NUMBER F276
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APPROVED BY __	DATE __
FIGURE NO. 7-1	REV 0

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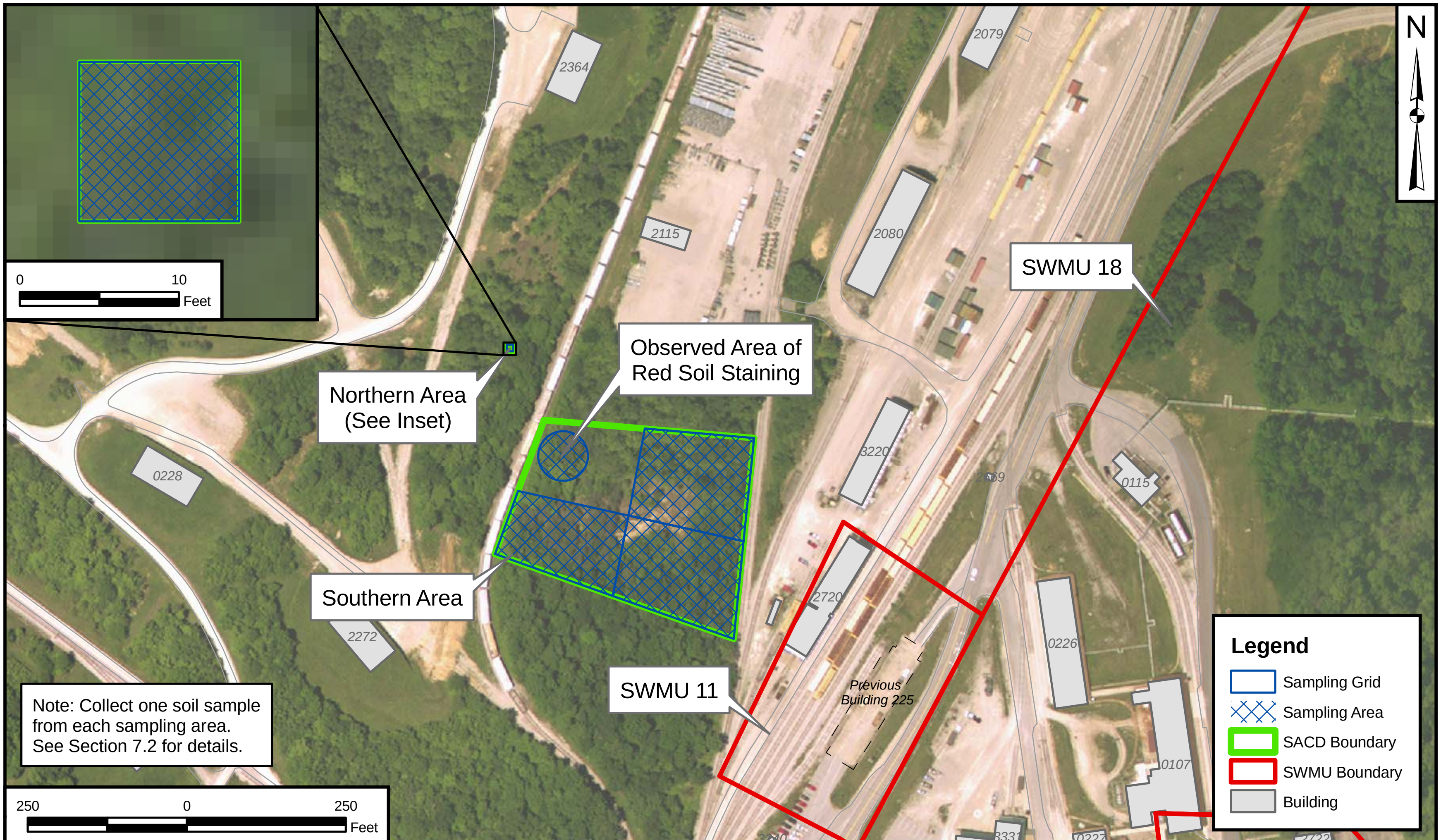

Note: Collect one soil sample from each sampling area. See Section 7.2 for details.

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J., ENGLISH	06/08/11	___	F276
CHECKED BY	DATE	APPROVED BY	DATE
J. DUCAR	06/10/11	___	___
REVISED BY	DATE	APPROVED BY	DATE
___	___	___	___
SCALE		FIGURE NO.	REV
AS NOTED		7-2	0

NAVFAC

PROPOSED SOIL SAMPLING AREAS
SPENT AMMUNITION CASINGS DUMP
OGTSL AND SACD SAMPLING AND ANALYSIS PLAN
NSA CRANE
CRANE, INDIANA

APPENDIX A

SITE-SPECIFIC FIELD STANDARD OPERATING PROCEDURES

STANDARD OPERATING PROCEDURE
SOP-01

SAMPLE LABELING

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures to be used for labeling sample containers. Sample labels are used to document the sample identification number (ID), date, time, analysis to be performed, preservative, matrix, sampler, and the analytical laboratory. A sample label will be attached to each sample container.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Writing utensil (preferably black pen with indelible ink)
Disposable medical-grade gloves (e.g. latex, nitrile)
Sample log sheets
Required sample containers: All sample containers for analysis by fix-based laboratories will be supplied and deemed certified-clean by the laboratory.
Sample labels
Chain-of-custody records
Sealable polyethylene bags
Heavy-duty cooler
Ice

3.0 PROCEDURES

3.1 The following information will be electronically printed on each sample label prior to mobilizing for field activities. Additional "generic" labels will also be printed prior to mobilization to be used for field QC and backups.

- Project Number
- Sample Location ID
- Contract Task Order Number (CTO F276)
- Sample ID

- Sample Matrix
- Preservative
- Analysis to be Performed
- Laboratory Name

3.2 Select the container(s) that are appropriate for a given sample. Select the sample-specific ID label(s), complete date, time, and sampler name, and affix to the sample container(s).

3.3 Fill the appropriate containers with sample material. Securely close the container lids without overtightening.

3.4 Place the sample container in a sealable polyethylene bag and place in a cooler containing ice.

Example of a sample label is attached at the end of this SOP.

4.0 ATTACHMENTS

1. Sample Label

ATTACHMENT 1

SAMPLE LABEL

Tetra Tech NUS, Inc. 661 Andersen Drive Pittsburgh, 15220 (412)921-7090	Project: Location: CTO:	
Sample No:		Matrix:
Date:	Time:	Preserve:
Analysis:		
Sampled by:	Laboratory	

STANDARD OPERATING PROCEDURE
SOP-02

SAMPLE IDENTIFICATION NOMENCLATURE

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish a consistent sample nomenclature system that will facilitate subsequent data management at the Naval Support Activity (NSA) Crane. The sample nomenclature system has been devised such that the following objectives can be attained.

- Sorting of data by site, location, or matrix
- Maintenance of consistency (field, laboratory, and database sample numbers)
- Accommodation of all project-specific requirements
- Accommodation of laboratory sample number length constraints
- Ease of sample identification

The NSA Crane Environmental Protection Department must approve any deviations from this procedure.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Writing utensil (preferably black pen with indelible ink)
Sample tags
Sample container labels

3.0 SAMPLE IDENTIFICATION NOMENCLATURE

3.1 <u>Environmental Samples</u>

All environmental samples will be properly labeled with a sample label affixed to the sample container. Each sample will be assigned a unique sample tracking number.

3.1.1 Environmental Sample Numbering Scheme

The sample tracking number will consist of a four- or five-segment alpha-numeric code that identifies the sample's associated Solid Waste Management Unit (SWMU) number, SWMU subarea letter (if applicable), sample type, location, and for soil or sediment samples, where applicable, sample depth, and for aqueous samples, where applicable, whether a sample is filtered. For soil samples, the final four tracking numbers will identify the depth in units of feet below ground surface (bgs) at which the sample was collected (rounded to the nearest foot). For sediment samples, the final four tracking numbers will identify the depth in units of inches bgs at which the sample was collected.

The alphanumeric coding to be used is explained in the following diagram and subsequent definitions:

AAAAA	**AA**	**NNN**	**NNNN (Soils)**
Site Name	Matrix	Sample Location Number	Sequential depth interval from freshly exposed surface

Character Type:

A = Alpha

N = Numeric

Site Name (AAAA):

OGTSL = Old Gun Tub Storage Lot

SACD = Spent Ammunition Casings Dump

Matrix Code (AA):

SS = Surface Soil Sample

Depth Interval (NNNN):

This code section will be used for soil samples. The depth code is used to note the depth below ground surface (bgs) at which a soil sample is collected. The first two numbers of the four-number code specify the top interval, and the third and fourth numbers specify the bottom interval of the sample depth. The depths will be noted in whole numbers only; further detail, if needed, will be recorded on the sample log sheet, boring log, logbook, etc.

Depth (for soil, in feet bgs)

0002 = soil collected from 0 to 2 feet bgs

3.1.2 Examples of Sample Nomenclature

A soil sample collected from soil boring location 006 at the Old Gun Tub Storage Lot, at a depth of 0- to 2-feet bgs would be labeled as “OGTSLSS0060002”.

3.2 Field Quality Assurance/Quality Control (QA/QC) Sample Nomenclature

Field QA/QC samples, as applicable, are described in the UFP-SAP. They will be designated using a different coding system than the one used for regular field samples.

3.2.1 QC Sample Numbering

The QC code will consist of a four-segment alpha-numeric code that identifies the SWMU number, sample QC type, the date the sample was collected, and the number of this type of QC sample collected on that date.

AAAAA	AA	NNNNNN	NN
Site Name	QC Type	Date	Sequence Number (per day)

The QC types are identified as:

TB = Trip Blank
RB = Rinsate Blank
FD = Field Duplicate
SB = Source Water Blank

The sampling time recorded on the Chain-of-Custody Form, labels, and tags for duplicate samples will be “0000” so that the samples are "blind" to the laboratory. Notes detailing the sample number, time, date, and type will be recorded on the sample log sheets and will document the location of the duplicate sample (sample log sheets are not provided to the laboratory).

3.2.2 Examples of Field QA/QC Sample Nomenclature

The first trip blank associated with samples collected on June 16, 2011 from the Old Gun Tub Storage Lot would be designated as “OGTSLTB06161101”.

STANDARD OPERATING PROCEDURE
SOP-03

SAMPLE CUSTODY AND DOCUMENTATION OF FIELD ACTIVITIES

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the procedures for sample custody and documentation of field sampling and field analyses activities.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

The following logbooks, forms, labels, and equipment are required.

Writing utensil (preferably black pen with indelible ink)
Site logbook
Field logbook
Sample label
Chain-of-Custody Form
Custody seals
Equipment calibration log
Soil Boring Log
Soil and Sediment Sample Log Sheet
Surface Water Sample Log Sheet

3.0 PROCEDURES

This section describes custody and documentation procedures. All entries made into the logbooks, custody documents, logs, and log sheets described in this SOP must be made in indelible ink (black is preferred). No erasures are permitted. If an incorrect entry is made, the entry will be crossed out with a single strike mark, initialed, and dated.

3.1 Site Logbook

The site logbook is a hard-bound, paginated, controlled-distribution record book in which all major on-site activities are documented. At a minimum, the following activities and events will be recorded (daily) in the site logbook:

- All field personnel present
- Arrival/departure of site visitors
- Arrival/departure of equipment
- Start or completion of sampling activities
- Daily on-site activities performed each day
- Sample pickup information
- Health and safety issues
- Weather conditions

The site logbook is initiated at the start of the first on-site activity (e.g., site visit or initial reconnaissance survey). Entries are to be made for every day that on-site activities take place.

The following information must be recorded on the cover of each site logbook:

- Project name
- Project number
- Book number
- Start date
- End date

Information recorded daily in the site logbook need not be duplicated in other field notebooks but must summarize the contents of these other notebooks and refer to specific page locations in these notebooks for detailed information (where applicable). At the completion of each day's entries, the site logbook must be signed and dated by the Tetra Tech Field Operations Leader (FOL).

3.2 Field Logbooks

The field logbook is a separate, dedicated notebook used by field personnel to document his or her activities in the field. This notebook is hardbound and paginated. At a minimum, the following activities and events will be recorded (daily) in the field logbooks:

- Field personnel for activities in the field logbook
- Arrival/departure of site visitors
- Arrival/departure of equipment
- Start or completion of sampling activities
- Daily on-site activities performed each day
- Sample pickup information
- Health and safety issues
- Weather conditions

Entries are to be made for every day that on-site activities take place.

The following information must be recorded on the cover of each field logbook:

- Project name
- Project number
- Book number
- Start date
- End date

3.3 Sample Labels

Adhesive sample container labels must be completed and applied to every sample container. Information on the label includes the project name, location, sample number, date, time, preservative, analysis, matrix, sampler's initials, and the name of the laboratory performing the analysis. Sample labeling and nomenclature are described in SOP-01 and SOP-02, respectively.

3.4 Chain-of-Custody Form

The Chain-of-Custody Form (COC) is a multi-part form that is initiated as samples are acquired and accompanies a sample (or group of samples) as it is transferred from person to person. This form must accompany any samples collected for laboratory chemical analysis. Each COC will be uniquely numbered. A copy of a blank COC form is attached at the end of this SOP.

The FOL must include the name of the laboratory in the upper right hand corner section to ensure that the samples are forwarded to the correct location. If more than one COC is necessary for any cooler, the FOL will indicate "Page __ of __" on each COC. The original (top) signed copy of the COC will be placed inside a sealable polyethylene bag and taped inside the lid of the shipping cooler. Once the samples are received at the laboratory, the sample custodian checks the contents of the cooler(s) against the enclosed COC(s). Any problems are noted on the enclosed COC Form (bottle breakage, discrepancies between the sample labels, COC form, etc.) and will be resolved through communication between the laboratory point-of-contact and the Tetra Tech Project Manager (PM). The COC form is signed and retained by the laboratory and becomes part of the sample's corresponding analytical data package.

3.5 Custody Seal

The custody seal is an adhesive-backed label and is part of the chain-of-custody process. Custody seals are used to prevent tampering with samples after they have been collected in the field and sealed in coolers for transit to the laboratory. Custody seals will be signed and dated by the samplers and affixed across the opening edges of each cooler (two seals per cooler on opposite sides) containing environmental samples. The laboratory sample custodian will examine the custody seal for evidence of tampering and will notify the Tetra Tech PM if evidence of tampering is observed.

3.6 Equipment Calibration Log

The Equipment Calibration Log is used to document calibration of measuring equipment used in the field. The Equipment Calibration Log documents that the manufacturer's instructions were followed for calibration of the equipment, including frequency and type of standard or calibration device. An Equipment Calibration Log must be maintained for each electronic measuring device requiring calibration. Entries must be made for each day the equipment is used.

3.7 Sample Log Sheets

The Soil and Sediment Sample Log Sheets are used to document the sampling of soil and sediment. Copies of the sample log sheets are attached at the end of the SOP. A sample log sheet will be prepared for each sample collected and submitted for laboratory analysis.

4.0 ATTACHMENTS

1. Chain-of-Custody Record
2. Equipment Calibration Log
3. Soil and Sediment Sample Log

ATTACHMENT 1

CHAIN-OF-CUSTODY RECORD

CHAIN OF CUSTODY | **NUMBER** | **PAGE ____ OF ______**

PROJECT NO:	**SITE NAME:**	**PROJECT MANAGER AND PHONE NUMBER**	**LABORATORY NAME AND CONTACT:**
SAMPLERS (SIGNATURE)		**FIELD OPERATIONS LEADER AND PHONE NUMBER**	**ADDRESS**
		CARRIER/WAYBILL NUMBER	**CITY, STATE**

STANDARD TAT ☐
RUSH TAT ☐
☐ **24 hr.** ☐ **48 hr.** ☐ **72 hr.** ☐ **7 day** ☐ **14 day**

CONTAINER TYPE PLASTIC (P) or GLASS (G)

PRESERVATIVE USED

DATE YEAR ____	**TIME**	**SAMPLE ID**	**MATRIX**	**GRAB (G) COMP (C)**	**No. OF CONTAINERS**	**TYPE OF ANALYSIS**								**COMMENTS**

1. RELINQUISHED BY	DATE	TIME	1. RECEIVED BY	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME
COMMENTS					

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

EQUIPMENT CALIBRATION LOG

PROJECT NAME : ______________________ INSTRUMENT NAME/MODEL: ______________________

SITE NAME: ______________________ MANUFACTURER: ______________________

PROJECT No.: ______________________ SERIAL NUMBER: ______________________

Date of Calibration	Instrument I.D. Number	Person Performing Calibration	Instrument Settings		Instrument Readings		Calibration Standard (Lot No.)	Remarks and Comments
			Pre-calibration	Post-calibration	Pre-calibration	Post-calibration		

ATTACHMENT 3

SOIL AND SEDIMENT SAMPLE LOG SHEET

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: ____________________
Project No.: ____________________

[] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other: ____________________
[] QA Sample Type: ____________________

Sample ID No.: ____________
Sample Location: ____________
Sampled By: ____________
C.O.C. No.: ____________

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:			
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

STANDARD OPERATING PROCEDURE
SOP-04

SAMPLE PRESERVATION, PACKAGING, AND SHIPPING

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures for sample preservation, packaging, and shipping to be used in handling soil, sediment, and aqueous samples.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Shipping labels
Custody seals
Chain-of-custody (COC) form(s)
Sample containers with preservatives: All sample containers for analysis by fixed-base laboratories will be supplied, with preservatives added (if required) and deemed certified clean by the laboratory.
Sample shipping containers (coolers): All sample shipping containers are supplied by the laboratory.
Packaging material: Bubble wrap, sealable polyethylene bags, strapping tape, etc.

3.0 PROCEDURES FOR SAMPLE PRESERVATION, PACKAGING, AND SHIPPING

3.1 The laboratory provides sample containers with preservative already included (as required) for the analytical parameter for which the sample is to be analyzed. All samples will be held, stored, and shipped at 4 degrees Celsius (°C). This will be accomplished through refrigeration (used to hold samples prior to shipment) and/or ice.

3.2 The sampler shall maintain custody of the samples until the samples are relinquished to another custodian or to the common carrier.

3.3 Check that each sample container is properly labeled, the container lid is securely fastened, and the container is sealed in a polyethylene bag.

3.4 If the container is glass, place the sample container into a bubble-out shipping bag and seal the bag using the self-sealing, pressure sensitive tape supplied with the bag.

3.5 Inspect the insulated shipping cooler. Check for any cracks, holes, broken handles, etc. If the cooler has a drain plug, make certain it is sealed shut, both inside and outside of the cooler. If the cooler is questionable for shipping, the cooler must be discarded.

3.6 Line the cooler with large plastic bag, and line the bottom of the cooler with a layer of bubble wrap. Place the sample containers into the shipping cooler in an upright position (containers will be upright, with the exception of any 40-milliliter vials). Continue filling the cooler with ice until the cooler is nearly full and the movement of the sample containers is limited.

3.7 Wrap the large plastic bag closed and secure with tape.

3.8 Place the original (top) signed copy of the COC form inside a sealable polyethylene bag. Tape the bag to the inside of the lid of the shipping cooler.

3.9 Close the cooler and seal the cooler with approximately four wraps of strapping tape at each end of the cooler. Prior to wrapping the last wrap of strapping tape, apply a signed and dated custody seal to each side of the cooler (one per side). Cover the custody seal with the last wrap of tape. This will provide a tamper evident custody seal system for the sample shipment.

3.10 Affix shipping labels to each of the coolers, ensuring all of the shipping information is filled in properly. Overnight (e.g., FedEx Priority Overnight) courier services will be used for all sample shipments.

3.11 All samples will be shipped to the laboratory no more than 72 hours after collection. Under no circumstances should sample hold times be exceeded.

STANDARD OPERATING PROCEDURE
SOP-05

BOREHOLE ADVANCEMENT AND SOIL CORING USING DIRECT-PUSH TECHNOLOGY AND HAND AUGER TECHNIQUES

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures for collecting surface and subsurface soil cores from unconsolidated overburden materials using direct-push technology (DPT) and hand augering techniques at the NSA Crane facility.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Cut-resistant non-latex Impermeable Gloves
Cotton gloves
Disposable medical-grade gloves (e.g., latex, nitrile)
Writing utensil
Boring log sheets: A copy of this form is included in SOP-06.
DPT Equipment:
- **DPT Probe Rig**
- **Geoprobe® Macrocore Sampler or equivalent**
- **Geoprobe® Sampling Kit or equivalent**
- **Clear acetate liners:** one new liner for each soil core

Hand Auger Equipment:
- **Stainless Steel Auger Buckets**
- **Stainless Steel Extension Rods**
- **Cross Handle**

Required decontamination materials (see SOP-08)
Bentonite pellets

3.0 BOREHOLE ADVANCEMENT AND SOIL SAMPLING USING A DPT

DPT refers to sampling tools and sensors that are driven directly into the ground without the use of conventional rotary drilling equipment. DPT typically utilizes hydraulic pressure and/or percussion hammers to advance the sampling tools. Geoprobe® is a manufacturer of a hydraulically powered, percussion/probing machine utilizing DPT to collect subsurface environmental samples.

3.1 Clear the area to be sampled of any surface debris (herbaceous vegetation, twigs, rocks, litter, etc.).

3.2 Place a new clear acetate liner in the detachable sampling core barrel, and attach the coring device to the DPT rig.

3.3 Drive the sampler (lined with an acetate sleeve) into the ground to the desired depth using hydraulic pressure.

3.4 Retract the sampler from the borehole, and remove the acetate liner and the soil core from the sampler barrel.

3.5 Attach the metal trough from the sampling kit firmly to a suitable surface.

3.6 Place the acetate liner containing the soil core in the trough.

3.7 While wearing cut-resistant gloves (constructed of non-latex over cotton), cut the acetate liner through its entire length using the double-bladed knife that accompanies the Geoprobe® Sampling Kit. Then remove the strip of acetate from the trough to gain access to the collected soils. **CAUTION:** Do not attempt to cut the acetate liner while holding it in your hand.

3.8 Log the soil core on the Boring Log Sheet (see SOP-06).

3.09 Place the soil core in a stainless-steel mixing bowl, thoroughly homogenize, and collect the remainder of the soil sample aliquots, as described in SOP-07.

3.10 Repeat steps 3.2 through 3.11 for the next depth intervals.

3.11 Upon completion of the boring, backfill the borehole with the soil from the location. If insufficient soil is available to fill the hole to the ground surface, then bentonite pellets mixed with the soil will be used to backfill the hole. If soil materials from the boring are suspected of being contaminated, the soil boring will be backfilled with bentonite pellets up to the ground surface.

The contaminated material will be securely staged until arrangements are made for proper off-site disposal.

3.12 Decontaminate all soil sampling equipment in accordance with SOP-08 before collecting the next sample.

4.0 BOREHOLE ADVANCEMENT AND SOIL SAMPLING USING A HAND AUGER

Hand augers will be employed to collect soil cores. A hand augering system generally consists of a variety of all stainless steel bucket bits (i.e. cylinders 6-1/2” long and 2-3/4”, 3-1/4”, and 4” in diameter), a series of extension rods (available in 2’, 3’, 4’ and 5’ lengths), a cross handle. A larger diameter bucket bit is commonly used to bore a hole to the desired sampling depth and then withdrawn. In turn, the larger diameter bit is replaced with a smaller diameter bit, lowered down the hole, and slowly turned into the soil at the completion depth or refusal. The apparatus is then withdrawn and the soil sample collected.

The hand auger can be used in a wide variety of soil conditions. It can be used to sample soil, both from the surface, or to depths in excess of 12 feet. However, the presence of rock layers and the collapse of the borehole normally contribute to its limiting factors.

4.1 Attach a properly decontaminated bucket bit into a clean extension rod and further attach the cross handle to the extension rod.

4.2 Clear the area to be sampled of any surface debris (vegetation, twigs, rocks, litter, etc.)

4.3 Begin augering to the desired sample depth (periodically removing accumulated soils from the bucket bit into a properly decontaminated stainless steel mixing bowl), and add additional rod extensions as necessary. Discard the top of the core (approximately 1”), which represents any loose material collected by the bucket bit before penetrating the sample material.

4.4 Log the soil core each time soil is placed into the mixing bowl on the Boring Log Sheet (see SOP-06). Also, note (in a field notebook or on standardized data sheets) the changes in the color, texture or odor of the soil.

4.5 After reaching the desired sample depth, slowly and carefully withdraw the apparatus from the borehole.

4.6 Utilizing a properly decontaminated stainless steel trowel or disposable trowel, remove the last of the sample material from the bucket bit and place into the properly decontaminated stainless steel mixing bowl and thoroughly homogenize the sample material prior to filling the sample containers, as described in SOP-07.

4.12 Excess soil core materials will be returned to the hole and tamped. If insufficient soil is available to fill the hole to the ground surface, then bentonite pellets mixed with the soil will be used to backfill the hole.

4.13 If soil materials from the boring are suspected of being contaminated, the soil boring will be backfilled with bentonite pellets up to the ground surface.

4.14 Decontaminate all soil sampling equipment in accordance with SOP-08 before collecting the next sample.

STANDARD OPERATING PROCEDURE
SOP-06

SOIL SAMPLE LOGGING

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the standard procedures and technical guidance on the logging of soil samples.

2.0 FIELD FORMS AND EQUIPMENT

Knife
Ruler (marked in tenths and hundredths of feet)
Boring Log: An example of this form is attached.
Writing utensil (preferably black pen with indelible ink)

3.0 RESPONSIBILITIES

A field geologist or engineer is responsible for supervising all activities and assuring that each soil sample is properly and completely logged.

4.0 PROCEDURES FOR SAMPLE LOGGING

To maintain a consistent classification of soil, it is imperative that the field geologist understands and accurately uses the field classification system described in this SOP. This identification is based on visual examination and manual tests.

4.1 <u>USCS Classification</u>

Soils are to be classified according to the Unified Soil Classification System (USCS). This method of classification is detailed in Figure 1 (attached to this SOP). This method of classification identifies soil types on the basis of grain size and cohesiveness.

Fine-grained soils, or fines, are smaller than the No. 200 sieve and are of two types: silt (M) and clay (C). Some classification systems define size ranges for these soil particles, but for field classification purposes, they are identified by their respective behaviors. Organic material (O) is a common component of soil but has no distinguishable size range; it is recognized by its composition. The careful study of the USCS will aid in developing the competence and consistency necessary for the classification of soils.

Coarse-grained soils will be divided into categories: rock fragments, sand, or gravel. The terms "sand" (S) and "gravel" (G) not only refer to the size of the soil particles but also to their depositional history. To insure accuracy in description, the term "rock fragments" will be used to indicate angular granular materials resulting from the breakup of rock. The sharp edges that are typically observed indicate little or no transport from their source area; and therefore, the term provides additional information in reconstructing the depositional environment of the soils encountered. When the term "rock fragments" is used, it will be followed by a size designation such as "(1/4-inch or ½-inch diameter)" or "coarse-sand size" either immediately after the entry or in the remarks column. The USCS classification would not be affected by this variation in terms.

4.2 Color

Soil colors will be described utilizing a single color descriptor preceded, when necessary, by a modifier to denote variations in shade or color mixtures. A soil could therefore be referred to as "gray" or "light gray" or "blue-gray." Because color can be utilized in correlating units between sampling locations, it is important for color descriptions to be consistent from one boring to another.

Colors must be described while the sample is still moist. Soil samples will be broken or split vertically to describe colors. Samplers tend to smear the sample surface, creating color variations between the sample interior and exterior.

The term "mottled" will be used to indicate soils irregularly marked with spots of different colors. Mottling in soils usually indicates poor aeration and lack of good drainage.

4.3 Relative Density and Consistency

To classify the relative density and/or consistency of a soil, the geologist is to first identify the soil type. Granular soils contain predominantly sands and gravels. They are non-cohesive (particles do not adhere well when compressed). Finer-grained soils (silts and clays) are cohesive (particles will adhere together when compressed).

Granular soils are given the USCS classifications GW, GP, GM, SW, SP, SM, GC, or SC (see Figure 1).

The consistency of cohesive soils is determined by performing field tests and identifying the consistency as shown in the following table.

CONSISTENCY FOR COHESIVE SOILS

Consistency	Standard Penetration Resistance (Blows per Foot)	Unconfined Compressive Strength (Tons/Sq. Foot by pocket penetration)	Field Identification
Very soft	0 to 2	Less than 0.25	Easily penetrated several inches by fist.
Soft	2 to 4	0.25 to 0.50	Easily penetrated several inches by thumb.
Medium stiff	4 to 8	0.50 to 1.0	Can be penetrated several inches by thumb with moderate effort.
Stiff	8 to 15	1.0 to 2.0	Readily indented by thumb but penetrated only with great effort.
Very stiff	15 to 30	2.0 to 4.0	Readily indented by thumbnail.
Hard	Over 30	More than 4.0	Indented with difficulty by thumbnail.

Cohesive soils are given the USCS classifications ML, MH, CL, CH, OL, or OH (see Figure 1).

The consistency of cohesive soils is determined by hand by determining the resistance to penetration by the thumb. The thumb determination methods are conducted on a selected sample of the soil, preferably the lowest 0.5-foot of the sample. The sample will be broken in half and the thumb pushed into the end of the sample to determine the consistency. Do not determine consistency by attempting to penetrate a rock fragment. If the sample is decomposed rock, it is classified as a soft decomposed rock rather than a hard soil. One of the other methods will be used in conjunction with it. The designations used to describe the consistency of cohesive soils are shown in the above-listed table.

4.4 Weight Percentages

In nature, soils are consist of particles of varying size and shape and are combinations of the various grain types. The following terms are useful in the description of soil:

Terms of Identifying Proportion of the Component	Defining Range of Percentages by Weight
Trace	0 - 10 percent
Some	11 - 30 percent

Adjective form of the soil type (e.g., sandy)	31 - 50 percent

Examples:

- Silty fine sand: 50 to 69 percent fine sand, 31 to 50 percent silt.
- Medium to coarse sand, some silt: 70 to 80 percent medium to coarse sand, 11 to 30 percent silt.
- Fine sandy silt, trace clay: 50 to 68 percent silt, 31 to 49 percent fine sand, 1 to 10 percent clay.
- Clayey silt, some coarse sand: 70 to 89 percent clayey silt, 11 to 30 percent coarse sand.

4.5 Moisture

Moisture content is estimated in the field according to four categories: dry, moist, wet, and saturated. In dry soil, there appears to be little or no water. Saturated samples obviously have all the water they can hold. Moist and wet classifications are somewhat subjective and often are determined by the individual's judgment. A suggested parameter for this would be calling a soil wet if rolling it in the gloved hand or on a porous surface liberates water (i.e., dirties or muddies the surface). Whatever method is adopted for describing moisture, it is important that the method used by an individual remains consistent throughout an entire field activity.

4.6 Classification of Soil Grain Size for Chemical Analysis

To determine the gross grain size classification (e.g., clay, silt, and sand) from the USCS classification described above, the following table will be used.

Gross Soil Grain Size Classification	USCS Abbreviation	Description
Clay	CL	inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
	CH	inorganic clays of high plasticity, fat clays.
	OH	organic clays of medium to high plasticity, organic silts.
Silt	ML	inorganic silts and very fine sands, rock four, silty or clayey fine sands with slight plasticity.
	OL	organic silts and organic silty clays of low plasticity.
	MH	inorganic silts, micaceous or diatomaceous fine sand or silty soils.
Sand	SW	well graded sands, gravelly sands, little or no fines.
	SP	poorly graded sands, gravelly sands, little or no fines.
	SM	silty sands, sand-silt mixtures.
	SC	clayey sands, sand-clay mixtures.

4.7 Summary of Soil Classification

In summary, soils will be classified in a similar manner by each geologist/engineer at a project site. The hierarchy of classification is as follows:

- Density and/or consistency
- Color
- Plasticity (optional)
- Soil types
- Moisture content
- Other distinguishing features
- Grain size
- Depositional environment

5.0 ATTACHMENTS

1. Figure 1 - Unified Soil Classification System
2. Boring Log

ATTACHMENT 1

FIGURE 1 - UNIFIED SOIL CLASSIFICATION SYSTEM

Unified Soil Classification System

Coarse Grained Soils (more than half of soil > No. 200 sieve)	Gravels (More than half of coarse fraction > no. 4 sieve size)		GW	Well graded gravels or gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels or gravel-sand mixtures, little or no fines
			GM	Sandy gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-silt mixtures
	Sands (More than half of coarse fraction < no. 4 sieve size)		SW	Well graded sands or gravelly sands, little or no fines
			SP	Poorly graded sands or gravelly sands, little or no fines
			SM	Silty sands, sand-silt mixtures
			SC	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
Fine Grained Soils (more than half of soil < No. 200 sieve)	Silts and Clays LL = < 50		ML	Inorganic silts and very fine sands, rock flour, silty fine sands or clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	Silts and Clays LL = > 50		MH	Inorganic silts, micaceous or diatomaceous fine sand or silty soils, elastic silts
			CH	Inorganic silts of high plasticity, fat clays
			OH	Organic clays of high plasticity, organic silty clays, organic silts
Highly Organic Soils			Pt	Peat and other highly organic soils

Grain Size Chart

Classification	Range of Grain Sizes	
	U.S. Standard Sieve Size	Grain Size In Millimeters
Boulders	Above 12"	Above 305
Cobbles	12" to 3"	305 to 76.2
Gravel	3" to No. 4	76.2 to 7.76
coarse	3" to 3/4"	76.2 to 4.76
fine	3/4" to No.4	19.1 to 4.76
Sand	No. 4 to No. 200	4.76 to 0.074
coarse	No.4 to No. 10	4.76 to 2.00
medium	No. 10 to No. 40	2.00 to 0.420
fine	No. 40 to No. 200	0.420 to 0.074
Silt and Clay	Below No. 200	Below 0.074

Relative Density (SPT)

SANDS AND GRAVELS	BLOWS/FOOT
VERY LOOSE	0 – 4
LOOSE	4 – 10
MEDIUM DENSE	10 – 30
DENSE	32 – 50
VERY DENSE	OVER 50

Consistency (SPT)

SILTS AND CLAYS	BLOWS/FOOT
VERY SOFT	0 – 2
SOFT	2 – 4
MEDIUM STIFF	4 – 8
STIFF	8 – 16
VERY STIFF	16 – 22
HARD	OVER 32

ATTACHMENT 2

BORING LOG

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: ____________________ BORING No.: ____________________
PROJECT NUMBER: ____________________ DATE: ____________________
DRILLING COMPANY: ____________________ GEOLOGIST: ____________________
DRILLING RIG: ____________________ DRILLER: ____________________

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION			U S C S *	Remarks	PID/FID Reading (ppm)			
					Soil Density/ Consistency or Rock Hardness	Color	Material Classification			Sample	Sampler BZ	Borehole**	Driller BZ**

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: ____________________

Drilling Area Background (ppm): [ ]

Converted to Well: Yes _______ No _______ Well I.D. #: ____________________

STANDARD OPERATING PROCEDURE

SOP-07

SURFACE AND SUBSURFACE SOIL SAMPLING

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures to be used for surface and subsurface soil sampling using direct-push technology (DPT) or hand augers during field activities at the NSA Crane facility. This procedure also describes the collection of samples for analysis of volatile organic compounds (VOCs) using EnCore samplers and the use of field screening [i.e., photoionization detector (PID)] to select the most appropriate subsurface soil interval for VOC sampling.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Writing utensil (preferably black pen with indelible ink)
Disposable medical-grade gloves (i.e. latex, nitrile)
Boring log
Soil sample logsheets
Stainless-steel mixing bowls
Stainless-steel trowel or soup spoon
EnCore handle and samplers
Disposable trowels
Photoionization Detector (PID) or similar
Required sample containers: All sample containers including shipping coolers for analysis by fixed-base laboratories will be supplied and certified clean by the laboratory.
Required decontamination materials
Chain-of-custody records
Required personnel protective equipment (PPE)
Wooden stakes or pin flags
Survey tape
Marking Paint
Sealable polyethylene bags
Heavy-duty cooler
Ice

Razor knife

DPT Probe Rig and sampling equipment

Sample labels

3.0 COLLECTION OF SOIL SAMPLES FOR VOLATILE ORGANIC COMPOUNDS (VOCs)

When soil cores are collected using DPT, such as Geoprobe®, 4- to 5-foot soil intervals will be collected in clear acetate tubes, which can be extracted from the Geoprobe® core barrel upon retrieval at the surface (see SOP-05). Note: A surface soil sample is collected from the 0- to 2-foot depth. Additional subsurface soil samples each consist of 2-foot core segments.

3.1 Slit the acetate liner lengthwise with a razor knife, remove a section of the liner, and expose the length of the soil interval (see SOP-05).

3.2 Scan the soil core interval with a PID, slowly moving the intake nozzle along the length of the core where the acetate liner has been slit open. Note on the boring log the range of PID readings that are detected and the specific location(s) along the sample interval where above-background readings are encountered. If elevated volatile organics are measured via the PID, collect the VOC samples from the specific interval where the highest PID reading is measured. If no above-background PID readings are measured, then the VOC sample will be collected from a specific interval where visual signs of contamination (staining, etc.) are observed. If no above-background PID reading is measured and no discoloration or odor in the soil core indicates potential contamination, then collect the VOC sample from near the center of a core.

3.3 A small quantity of undisturbed soil (approximately *6* oz.) is removed from the sampler (e.g., Macrocore®, split-spoon sampler, etc.) and immediately placed in a sealing (Ziploc®-type) plastic bag. Once sealed in the bag, the sample is gently massaged to break apart any large soil clumps. The bag is then warmed for 15 minutes in order to volatilize the potential contaminants from the soil sample into the head-space of the bag. After 15 minutes, the tip of the PID is carefully pushed directly through the plastic bag and a direct reading is obtained of the maximum detection. All head-space readings (maximum detection per sample) will be noted on the appropriate soil boring log and/or sample log form.

3.4 The 0- to 2-foot core interval will be collected as a surface soil sample. Determine where in this core interval the highest PID reading was encountered. Soil samples collected for volatile organics will be obtained directly from soil cores using four EnCore samplers for each VOC sample. These samples are to be collected by pushing the EnCore samplers directly into the soil core where the highest PID readings were measured, ensuring that the sampler is packed tight with soil and leaving no headspace between cap and container. All four EnCore sample containers will be collected as close to each other as possible. Make sure that all caps are securely fastened to the samplers and locked in place with both clips (see instructions that come with samplers). Write the sample identification on the strip labels that come with the samplers and place a label on each of the four samplers.

3.5 Place the four EnCore samplers in the ziplock pouches that come with the samplers and fill in appropriate information, including sample identification, date, time, and other information on the label. Place the four pouches in a plastic bag and place the tag on the bag, identifying the sample identification and other necessary information (see SOP-01).

3.6 Once the samples are properly labeled and bagged, place the sample into the cooler containing ice and a trip blank. The cooler should be kept at 4°C and shipped to the analytical laboratory for preservation or extraction within 48 hours.

3.7 Fill in the required information on the Soil Sample Log Sheet (attached at the end of this SOP) and fill in the required information on the Chain-of-Custody (COC) Form.

4.0 COLLECTION OF OTHER SOIL SAMPLE ALIQUOTS

4.1 After the VOC sample has been collected for the soil interval of interest (see 3.0 above), the remainder of the remainder of the soil interval will be composited and used to fill the sample containers. Any surface debris (e.g., herbaceous vegetation, twigs, rocks, litter, etc.) should first be removed from the top of the surface soil core. For other core intervals, the top 2 inches of each core should be discarded because it often contains material scraped from the side of the borehole and not fresh material from the bottom of the borehole.

4.2 Slide the remaining core material out of the acetate liner and into a clean, decontaminated stainless-steel mixing bowl. Mix the soil thoroughly with a stainless-steel spoon and remove gravel, large pebbles, and other coarse materials. Fill the required sample containers in the following order:

- Containers for other organic analyses (including energetics, TPH, and perchlorate)
- Container for metals

- Container for pH

4.3 Complete all required information on the sample labels and secure the label to the sample container (see SOP-01).

4.4 Place the sample container in a ziplock plastic bag and seal shut. Place the bag in a cooler containing ice and cool to 4°C ± 2°C.

4.5 Record the required information on the Soil Sample Log Sheet and the COC Record form.

5.0 COLLECTION OF SOIL SAMPLES USING A HAND AUGER

5.1 Utilizing a properly decontaminated stainless steel trowel or disposable trowel, remove the sample material from the bucket bit and remove gravel, large pebbles, and other coarse materials.

5.2 Collect sample aliquot for VOCs directly from the hand auger bucket prior to disturbing the material. (See Sections 3.4 and 3.5 above.)

5.3 Slide the remaining core material out of the hand auger bucket and into a clean, decontaminated stainless-steel mixing bowl. Mix the soil thoroughly with a stainless-steel spoon and remove gravel, large pebbles, and other coarse materials. Fill the required sample containers in the following order:

5.4 Fill the remaining required sample containers for analysis.

5.5 Complete all required information on the sample labels and secure the label to the sample container (see SOP-01).

5.4 Place the sample container in a ziplock plastic bag and seal shut. Place the bag in a cooler containing ice and cool to 4°C ± 2°C.

5.6 Record the required information on the Soil Sample Log Sheet and the COC Record form.

6.0 PACKAGING AND SHIPPING OF SAMPLES

Samples will be packaged and shipped according to SOP-04.

7.0 ATTACHMENTS

1. Soil and Sediment Sample Log Sheet

ATTACHMENT 1

SOIL AND SEDIMENT SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: ____________________
Project No.: ____________________

[] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other: ____________________
[] QA Sample Type: ____________________

Sample ID No.: ____________
Sample Location: ____________
Sampled By: ____________
C.O.C. No.: ____________

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:			
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

STANDARD OPERATING PROCEDURE
SOP-08

DECONTAMINATION OF FIELD SAMPLING EQUIPMENT

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the procedures to be followed when decontaminating non-dedicated field sampling equipment during the field investigations.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Writing utensil (preferably black pen with indelible ink)
Non-latex rubber or plastic gloves
Cotton gloves
Field logbook
Potable water
Deionized water
Isoproponal (optional)
Liqui-Nox® or Alconox® detergent
Brushes, spray bottles, paper towels, etc.
Container to collect and transport decontamination fluids

3.0 DECONTAMINATION PROCEDURES

3.1 Don non-latex and/or cotton gloves and decontaminate sampling equipment (in accordance with the following steps) prior to field sampling and between samples.

3.2 Rinse the equipment with potable water. Rinsing may be conducted by spraying with water from a spray bottle or by dipping. Collect the potable water rinsate into a container.

3.3 Wash the equipment with a solution of Liqui-Nox® or Aloconox® detergent. Prepare the detergent wash solution in accordance with the instructions on the detergent container. Collect the wash solution into a container. Use brushes or sprays as appropriate for the equipment. If oily residue has accumulated on the sampling equipment, remove the residue with an isopropanol wash and repeat the detergent wash.

3.4 Rinse the equipment with potable water. Rinsing may be conducted by spraying with water from a spray bottle or by dipping. Collect the potable water rinsate into a container.

3.5 Rinse the equipment with deionized water. Rinsing may be conducted by spraying with water from a spray bottle or by dipping. Collect the deionized water rinsate into a container.

3.6 Remove excess water by air drying and shaking or by wiping with paper towels as necessary.

3.7 Document decontamination by recording it in the field logbook.

3.8 Containerized decontamination solutions will be managed in accordance with the procedures described in SOP-10.

STANDARD OPERATING PROCEDURE

SOP-09

GLOBAL POSITIONING SYSTEM

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide the field personnel with basic instructions for operating a handheld Global Positioning System (GPS) unit allowing them to set GPS parameters in the receiver, record GPS positions on the field device, and update existing Geographic Information System (GIS) data. This SOP is specific to GIS quality data collection for Trimble®-specific hardware and software.

If possible, the Trimble® GeoXM™ or GeoXH™ operators manual should be downloaded onto the operator's personal computer for reference before or while in the field. The manual can be downloaded at http://trl.trimble.com/docushare/dsweb/Get/Document-311749/TerraSyncReferenceManual.pdf

Unless the operator is proficient in the setup and operation of the GPS unit, the Project Manager (or designee) should have the GPS unit shipped to the project-specific contact listed below in the Pittsburgh, Pennsylvania, office at least five working days prior to field mobilization so project-specific shape files, data points, background images, and correct coordinate systems can be uploaded into the unit.

Tetra Tech NUS, Inc.
Attn: John Wright
661 Anderson Drive, Bldg #7
Pittsburgh, PA 15220

2.0 REQUIRED EQUIPMENT

The following hardware and software should be utilized for locating and establishing GPS points in the field:

2.1 Required GPS Hardware

- Hand-held GPS unit capable of sub-meter accuracy (i.e. Trimble® GeoXM™ or Trimble® GeoXH™). This includes the docking cradle, A/C adapter, stylus, and USB cable for data transfer.

Optional Accessories:

- External antenna
- Range pole
- Hardware clamp (for mounting GPS unit to range pole)
- GeoBeacon

- Writing utensil (preferably black pen with indelible ink)
- Non-metallic pin flags for temporary marking of positions

2.2 Required GPS Software

The following software is required to transfer data from the handheld GPS unit to a personal computer:

- Trimble® TerraSync version 2.6 or later (pre-loaded onto GPS unit from vendor)

- Microsoft® ActiveSync® version 4.5 or later. Download to personal computer from: http://www.microsoft.com/windowsmobile/en-us/downloads/microsoft/activesync-download.mspx

- Trimble® Data Transfer Utility (freeware version 2.1 or later). Download to personal computer from: http://www.trimble.com/datatransfer.shtml

3.0 START-UP PROCEDURES

Prior to utilizing the GPS in the field, ensure the unit is fully charged. The unit may come charged from the vendor, but an overnight charge is recommended prior to fieldwork.

The Geo-series GPS units require a docking cradle for both charging and data transfer. The Geo-series GPS unit is docked in the cradle by first inserting the domed end in the top of the cradle, then gently seating the contact end into the latch. The power charger is then connected to the cradle at the back end using the twist-lock connector. Attach a USB cable as needed between the cradle (B end) and the laptop/PC (A end).

It is recommended that the user also be familiar and check various Windows Mobile settings. One critical setting is the Power Options. The backlight should be set as needed to conserve power when not in use.

Start Up:

1) Power on the GPS unit by pushing the small green button located on the lower right front of the unit.

2) Utilizing the stylus that came with the GPS unit, launch **TerraSync** from the Windows Operating System by tapping on the start icon located in the upper left hand corner of the screen and then tap on **TerraSync** from the drop-down list.

3) If the unit does not default to the Setup screen, tap the Main Menu (uppermost left tab, just below the Windows icon) and select Setup.

4) If the unit was previously shipped to the Pittsburgh office for setup, you can skip directly to Section 4.0. However, to confirm or change settings, continue on to Section 3.1.

3.1 Confirm Setup Settings

Use the Setup section to confirm the TerraSync software settings. To open the Setup section, tap the Main Menu and select Setup.

1) Coordinate System
   a. Tap on the Coordinate System.
   b. Verify the project specs are correct for your specific project by scrolling through the various settings. Edit as needed and then tap OK; otherwise, tap Cancel to return to Setup Menu. **Note:** It is always best to utilize the Cancel tab rather than the OK tab if no changes are made since configurations are easily changed by mistake.
   c. Tap on the Units.
   d. Verify the user preferences are correct for your specific project by scrolling through the various settings. Edit as needed and then tap OK; otherwise, tap Cancel to return to Setup Menu.
   e. Tap Real-time Settings.
   f. Verify the Real-time Settings are correct for your specific project by scrolling through the various settings. Edit as needed and then tap OK; otherwise, tap Cancel to return to Setup Menu.
   g. The GPS unit is now configured correctly for your specific project.

4.0 ANTENNA CONNECTION

1) If a connection has been properly made with the internal antenna, a satellite icon along with the number of usable satellites will appear at the top of the screen next to the battery icon. If no connection is made (e.g.: no satellite icon), tap on the GPS tab to connect antenna.
2) At this point the GPS unit is ready to begin collecting data.

5.0 COLLECTING NEW DATA IN THE FIELD

1) From the Main Menu select Data.
2) From the Sub Menu (located below the Data tab) select New which will bring up the New Data File menu.
3) An auto-generated filename appears and should be edited for your specific project. If the integral keyboard does not appear, tap the small keyboard icon at the bottom of the screen.
4) After entering the file name, tap Create to create the new file.
5) Confirm antenna height if screen appears. Antenna height is the height that the GPS unit will be held from the ground surface (Typically 3 to 4 feet).
6) The Choose Feature screen appears.

5.1 Collecting Features

1) If not already open, the Collect Feature screen can be opened by tapping the Main Menu and selecting Data. The Sub Menu should default to Collect.
2) **Do not begin the data logging process until you are at the specific location for which you intend to log the data.**
3) A known reference or two should be shot at the beginning and at the end of each day in which the GPS unit is being used. This allows for greater accuracy during post-processing of the data.
4) Upon arriving at the specific location, tap on Point_generic as the Feature Name.
5) Tap Create to begin data logging.
6) In the Comment Box enter sample ID or location-specific information.
7) Data logging can be confirmed by viewing the writing pencil icon in the upper part of the screen. Also, the logging counter will begin. As a Rule of Thumb, accumulate a minimum of 20 readings on the counter, per point, as indicated by the logging counter before saving the GPS data.
8) Once the counter has reached a minimum number of counts (i.e. 20), tap on OK to save the data point to the GPS unit. Confirm the feature. All data points are automatically saved within the GPS unit.
9) Repeat steps 2 through 8, giving each data point a unique name or number.

Note: If the small satellite icon or the pencil icon is blinking, this is an indication the GPS unit is not collecting data. A possible problem may be too few satellites. While still in data collection mode, tap on Main Menu in upper left hand corner of the screen and select Status. Skyplot will display as the default showing the number of available satellites. To increase productivity (number of usable satellites) use the stylus to move the pointer on the productivity and precision line to the left. This will decrease precision, but increase productivity. The precision and productivity of the GPS unit can be adjusted as the number of usable satellites changes throughout the day. To determine if GPS is correctly recording data, see Section 5.2.

5.2 Viewing Data or Entering Additional Data Points to the Current File

1) To view the stored data points in the current file, tap on the Main Menu and select Map. Stored data points for that particular file will appear. Use the +/- and <-/-> icons in lower left hand corner of screen to zoom in/out and to manipulate current view.
2) To return to data collection, tap on the Main Menu and select Data. You are now ready to continue to collect additional data points.

5.3 Viewing Data or Entering Data Points from an Existing File

1) To view data points from a previous file, tap on Main Menu and select Data, then select File Manager from the Sub Menu.
4) Highlight the file you want to view and select Map from the Main Menu.
5) To add data points to this file, tap on Main Menu and select Data. Continue to collect additional data points.

6.0 NAVIGATION

This section provides instructions on navigating to saved data points in an existing file within the GPS unit.

1) From the Main Menu select Map.
2) Using the Select tool, pick the point on the map to where you want to navigate.
3) The location you select will have a box placed around the point.
4) From the Options menu, choose the Set Nav Target (aka set navigation target).
5) The location will now have double blue flags indicating this point is you navigation target.
6) From the Main Menu select Navigation.

7) The dial and data on this page will indicate what distance and direction you need to travel to reach the desired target.
8) Follow the navigation guide until you reach the point you select.
9) Repeat as needed for any map point by going back to Step 1.

7.0 PULLING IN A BACKGROUND FILE

This section provides instructions on pulling in a pre-loaded background file. These files are helpful in visualizing your current location.

1) From the Main Menu select Map, then tap on Layers, select the background file from drop down list.
2) Select the project-specific background file from the list of available files.
3) Once the selected background file appears, the operator can manipulate the screen utilizing the +/- and <-/-> functions at the bottom of the screen.
4) In operating mode, the operator's location will show up on the background file as a floating "x".

8.0 DATA TRANSFER

This section provides instructions on how to transfer stored data on the handheld GPS unit to a personal computer. Prior to transferring data from the GPS unit to a computer, Microsoft ActiveSync and Trimble Data Transfer Utility software must be downloaded to the computer from the links provided in Section 2.2 (Required GPS Software). If a leased computer is utilized in which the operator cannot download files, see the Note at the end of Section 8.0.

1) See Attachment A at the end of this SOP for instructions on how to transfer data from the GPS to a personal computer.

Note: If you are unable to properly transfer data from the GPS unit to a personal computer, the unit should be shipped to the project-specific contact listed in Section 1.0 where the data will be transferred and the GPS unit then shipped back to the vendor.

9.0 SHUTTING DOWN

This section provides instruction for properly shutting down the GPS unit.

1) When shutting down the GPS unit for the day, first click on the "X" in the upper right hand corner.

2) You will be prompted to ensure you want to exit TerraSync. Select Yes.
3) Power off the GPS unit by pushing the small green button located on the bottom face of the unit.
4) Place the GPS unit in its cradle to recharge the battery overnight. Ensure the green charge light is visible on the charging cradle.

ATTACHMENT A

How to Transfer Trimble GPS Data between Data Collector and PC
original 11/21/06 (5/1/08 update) – John Wright

Remember – Coordinate System, Datum, and Units are critical!!!

Trimble Data Collection Devices:
Standard rental systems include the Trimble® ProXR/XRS backpack and the newer handheld GeoXT™ or GeoXH™ units. Some of the older backpack system may come with either a RECON "PDA-style" or a TSCe or TSC1 alpha-numeric style data collector.

The software on all of the above units should be Trimble® TerraSync (v 2.53 or higher – current version is 3.20) and to the user should basically look and function similar. The newer units and software versions (which should always be requested when renting) include enhancements for data processing, real-time display functions, and other features.

Data Transfer:
Trimble provides a free transfer utility program to aid in the transfer of GIS and field data. The Data Transfer Utility is a standalone program that will run on a standard office PC or laptop.

To connect a field data collector such as a RECON, GeoXM, GeoXT, GeoXH, or ProXH, you must first have Microsoft® ActiveSync® installed to allow the PC and the data collector to talk to one another. A standard USB cable is also needed to connect the two devices.

A CD or USB drive is provided with the data collector for use in data transfer. If needed, these programs are also available without charge via the web at:

• **Trimble Data Transfer Utility** (v 1.38) program to download the RECON or GeoXH field data to your PC: http://www.trimble.com/datatransfer.shtml

• **ActiveSync** from Microsoft to connect the data collector to the PC. The latest version (v4.5) can be found at: http://www.microsoft.com/windowsmobile/en-us/downloads/microsoft/activesync-download.mspx
(see page 2 for data transfer instructions)

To Transfer Data Collected in the Field:

• Install the Data Transfer and ActiveSync software installed on your PC
• Connect the RECON or GeoXH to your PC via an A/B USB cable (blade end and square end type "HP printer" style)
• ActiveSync should auto-detect the connection and recognize the data collector
• Make sure the data file desired is CLOSED in TerraSync prior to transfer
• Connect via ActiveSync as a guest (not a partnership)
• Run the Trimble Data Transfer Utility program on your PC
• Select "***GIS Datalogger on Windows CE***" or similar selection
• Hit the green connect icon to the right - the far right area should say "***Connected to ....***" if successful
• Select the "***Receive***" data tab (under device)
• Select "***Data***" from file types on the right
• Find the file(s) needed for data transfer. You can sort the data files by clicking on the date/time header
• Select or browse to a C-drive folder you can put this file for emailing
• When the file appears on the list, hit the “***Transfer All***”
• Go to your Outlook or other email, send a message to: John.Wright@tetratech.com (or GIS department)
• Attach the file(s) you downloaded from your C-drive. For each TerraSync data file created you should have a packet of multiple data files. All need to be sent as a group – make sure you attach all files (the number of files may vary – examples include: ssf, obx, obs, gix, giw, gis, gip, gic, dd, and car)

To Transfer GIS Data from PC to the Field Device (must be converted in Pathfinder Office):

• Obtain GIS file(s) desired from GIS Department and have converted to Trimble extension
• Contact John Wright (John.Wright@tetratech.com) if needed for file conversion and upload support
• The GIS file(s) can be quickly converted if requested and sent back to the field user in the needed “Trimble xxx.imp” extension via email – then quickly downloaded from Outlook to your PC for transfer
• Install the Data Transfer and ActiveSync software installed on your PC
• Connect the RECON or GeoXH to your PC via an A/B USB cable (blade end and square end type "HP printer" style)
• ActiveSync should auto-detect the connection and recognize the data collector
• Connect via ActiveSync as a guest (not a partnership)
• Run the Trimble Data Transfer Utility program on your PC
• Select "***GIS Datalogger on Windows CE***" or similar selection
• Hit the green connect icon to the right - the far right area should say "***Connected to ....***" if successful
• Select the "**Send**" data tab (under device)
• Select "**Data**" from file types on the right (you can also send background files)
• Browse to the location of the data on your PC (obtain the file from Pathfinder Office or from the person who converted the data for field use)
• Select the options as appropriate for the name and location of the data file to go on the data collector (usually you can choose main memory or a data storage card)
• When the file(s) appears on the list, hit the “***Transfer All***”
• Run TerraSync on the field device and open the existing data files. Your transferred file should appear (make sure you have selected Main Memory, Default, or Storage Card as appropriate)

STANDARD OPERATING PROCEDURE

SOP-10

MANAGEMENT OF INVESTIGATION-DERIVED WASTE

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes how investigation-derived waste (IDW) will be collected, segregated, classified, and managed during the field investigations at Naval Support Activity (NSA) Crane. The following types of IDW may be generated during this investigation:

- Soil sampling residues
- Decontamination solutions
- Personal protective equipment (PPE) and clothing
- Miscellaneous trash and incidental items

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Health and safety equipment (with PPE)
Bucket (with collected development/purge water)
Decontamination equipment
Field logbook
Writing utensil (preferably black pen with indelible ink)
Plastic sheeting and/or tarps
55-gallon drums with sealable lids
IDW labels for drums
Plastic garbage bags

3.0 PROCEDURES

Management of IDW includes the collection, segregation, temporary storage, classification, final disposal, and documentation of the waste-handling activities if necessary.

3.1 Liquid Wastes

Liquid wastes that may be generated during the site activities include decontamination solutions from sampling equipment. These wastes will be collected and containerized in a central location at NSA Crane for proper disposal.

3.2 Solid Wastes

Solid wastes that may be generated during site activities include soil and sediment sampling residues. Excess soil core/sampling materials will be returned to the hole and tamped. If insufficient soil is available to fill the hole to the ground surface, then bentonite pellets mixed with the soil will be used to backfill the hole and hydrated with potable water. Excess sediment sampling materials will be returned to the point of collection. The disposition of this materials will be carried out in a manner such as not to contribute further environmental degradation or pose a threat to public health or safety.

3.3 PPE and Incidental Trash

All PPE wastes and incidental trash materials (e.g., wrapping or packing materials from supply cartons, waste paper, etc.) will be decontaminated (if contaminated), double bagged, securely tied shut, and placed in a designated waste receptacle at NSA Crane.

APPENDIX B

LABORATORY DOD ELAP ACCREDITATION

LABORATORY ACCREDITATION BUREAU

Certificate of Accreditation

ISO/IEC 17025:2005 ***Certificate Number L2226***

Empirical Laboratories, LLC

621 Mainstream Drive, Suite 270
Nashville, TN 37228

has met the requirements set forth in L-A-B's policies and procedures, all requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).*

The accredited lab has demonstrated technical competence to a defined "Scope of Accreditation" and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation Granted through: November 30, 2012

R. Douglas Leonard, Jr., Managing Director
Laboratory Accreditation Bureau
Presented the 30th of November 2009

*See the laboratory's Scope of Accreditation for details of the DoD ELAP requirements
Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).

Scope of Accreditation
For
Empirical Laboratories, LLC

621 Mainstream Drive, Suite 270
Nashville, TN 37228
Marcia K. McGinnity
877-345-1113

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.1) based on the National Environmental Laboratory Accreditation Conference Chapter 5 Quality Systems Standard (NELAC Voted Revision June 5, 2003), accreditation is granted to Empirical Laboratories, LLC to perform the following tests:

Accreditation granted through: **November 30, 2012**

Testing - Environmental

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B	1,1,1-Trichloroethane (1,1,1-TCA)
GC/MS	EPA 8260B	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B	1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113; Freon 113)
GC/MS	EPA 8260B	1,1,2-Trichloroethane
GC/MS	EPA 8260B	1,1-Dichloroethane (1,1-DCA)
GC/MS	EPA 8260B	1,1-Dichloroethene (1,1-DCE)
GC/MS	EPA 8260B	1,1-Dichloropropene
GC/MS	EPA 8260B	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B	1,2,3-Trichloropropane
GC/MS	EPA 8260B	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B	1,2-Dibromoethane (EDB)
GC/MS	EPA 8260B	1,2-Dichlorobenzene
GC/MS	EPA 8260B	1,2-Dichloroethane (EDC)
GC/MS	EPA 8260B	1,2-Dichloropropane
GC/MS	EPA 8260B	1,3,5-Trimethylbenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	1,3-Dichlorobenzene
GC/MS	EPA 8260B	1,3-Dichloropropane
GC/MS	EPA 8260B	1,4-Dichlorobenzene
GC/MS	EPA 8260B	1,4-Dioxane
GC/MS	EPA 8260B	1-Chlorohexane
GC/MS	EPA 8260B	2,2-Dichloropropane
GC/MS	EPA 8260B	2-Butanone (Methyl ethyl ketone; MEK)
GC/MS	EPA 8260B	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B	2-Chlorotoluene
GC/MS	EPA 8260B	2-Hexanone (Methyl butyl ketone; MBK)
GC/MS	EPA 8260B	4-Chlorotoluene
GC/MS	EPA 8260B	4-Methyl-2-pentanone (Methyl isobutyl ketone; MIBK)
GC/MS	EPA 8260B	Acetone
GC/MS	EPA 8260B	Acetonirile
GC/MS	EPA 8260B	Acrolein
GC/MS	EPA 8260B	Acrylonitrile
GC/MS	EPA 8260B	Allyl chloride
GC/MS	EPA 8260B	Benzene
GC/MS	EPA 8260B	Bromobenzene
GC/MS	EPA 8260B	Bromochloromethane
GC/MS	EPA 8260B	Bromodichloromethane
GC/MS	EPA 8260B	Bromoform
GC/MS	EPA 8260B	Bromomethane
GC/MS	EPA 8260B	Carbon Disulfide
GC/MS	EPA 8260B	Carbon Tetrachloride
GC/MS	EPA 8260B	Chlorobenzene
GC/MS	EPA 8260B	Chloroethane
GC/MS	EPA 8260B	Chloroform
GC/MS	EPA 8260B	Chloromethane
GC/MS	EPA 8260B	Chloroprene
GC/MS	EPA 8260B	cis-1,2-Dichloroethene (cis-1,2-DCE)
GC/MS	EPA 8260B	cis-1,3-Dichloropropene
GC/MS	EPA 8260B	cis-1,4-Dichloro-2-butene

LABORATORY ACCREDITATION BUREAU

Certificate # L2226

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	Cyclohexane
GC/MS	EPA 8260B	Dibromochloromethane
GC/MS	EPA 8260B	Dibromomethane
GC/MS	EPA 8260B	Dichlorodifluoromethane (CFC-12)
GC/MS	EPA 8260B	Di-isopropyl ether
GC/MS	EPA 8260B	ETBE
GC/MS	EPA 8260B	Ethyl methacrylate
GC/MS	EPA 8260B	Ethylbenzene
GC/MS	EPA 8260B	Hexachlorobutadiene
GC/MS	EPA 8260B	Hexane
GC/MS	EPA 8260B	Iodomethane
GC/MS	EPA 8260B	Isobutyl alcohol
GC/MS	EPA 8260B	Isopropylbenzene (Cumene)
GC/MS	EPA 8260B	Methacrylonitrile
GC/MS	EPA 8260B	Methyl Acetate
GC/MS	EPA 8260B	Methyl methacrylate
GC/MS	EPA 8260B	Methyl Tertiary Butyl Ether (MTBE)
GC/MS	EPA 8260B	Methylcyclohexane
GC/MS	EPA 8260B	Methylene Chloride, or Dichloromethane
GC/MS	EPA 8260B	Naphthalene
GC/MS	EPA 8260B	n-Butylbenzene
GC/MS	EPA 8260B	n-Propylbenzene
GC/MS	EPA 8260B	p-Isopropyltoluene
GC/MS	EPA 8260B	Propionitrile
GC/MS	EPA 8260B	sec-Butylbenzene
GC/MS	EPA 8260B	Styrene
GC/MS	EPA 8260B	t-Butyl alcohol
GC/MS	EPA 8260B	tert-Amyl methyl ether
GC/MS	EPA 8260B	tert-Butylbenzene
GC/MS	EPA 8260B	Tetrachloroethene (PCE; PERC)
GC/MS	EPA 8260B	Tetrahydrofuran
GC/MS	EPA 8260B	Toluene
GC/MS	EPA 8260B	trans-1,2-Dichloroethene (trans-1,2-DCE)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	trans-1,3-Dichloropropene
GC/MS	EPA 8260B	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B	Trichloroethene (TCE)
GC/MS	EPA 8260B	Trichlorofluoromethane (CFC-11)
GC/MS	EPA 8260B	Vinyl acetate
GC/MS	EPA 8260B	Vinyl Chloride (VC)
GC/MS	EPA 8260B	Xylenes (Total)
GC/MS	EPA 8270C/D	1,1'-Biphenyl
GC/MS	EPA 8270C/D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270C/D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270C/D	1,2-Dichlorobenzene
GC/MS	EPA 8270C/D	1,2-Diphenylhydrazine
GC/MS	EPA 8270C/D	1,3-Dichlorobenzene
GC/MS	EPA 8270C/D	1,4-Dichlorobenzene
GC/MS	EPA 8270C/D	1,4-Dioxane
GC/MS	EPA 8270C/D	1-Methylnaphthalene
GC/MS	EPA 8270C/D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270C/D	2,4,5-Trichlorophenol
GC/MS	EPA 8270C/D	2,4,6-Trichlorophenol (TCP)
GC/MS	EPA 8270C/D	2,4-Dichlorophenol (DCP)
GC/MS	EPA 8270C/D	2,4-Dimethylphenol
GC/MS	EPA 8270C/D	2,4-Dinitrophenol
GC/MS	EPA 8270C/D	2,4-Dinitrotoluene (DNT)
GC/MS	EPA 8270C/D	2,6-Dichlorophenol
GC/MS	EPA 8270C/D	2,6-Dinitrotoluene
GC/MS	EPA 8270C/D	2-Chloronaphthalene
GC/MS	EPA 8270C/D	2-Chlorophenol
GC/MS	EPA 8270C/D	2-Methylnaphthalene
GC/MS	EPA 8270C/D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270C/D	2-Nitroaniline
GC/MS	EPA 8270C/D	2-Nitrophenol (ONP)
GC/MS	EPA 8270C/D	3,3'-Dichlorobenzidine (DCB)
GC/MS	EPA 8270C/D	3-Methylphenol

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Certificate # L2226

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C/D	3-Nitroaniline
GC/MS	EPA 8270C/D	4,6-Dinitro-2-methylphenol (DNOC)
GC/MS	EPA 8270C/D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270C/D	4-Chloro-3-methylphenol
GC/MS	EPA 8270C/D	4-Chloroaniline
GC/MS	EPA 8270C/D	4-Chlorophenyl phenyl ether
GC/MS	EPA 8270C/D	4-Methylphenol (p-Cresol)
GC/MS	EPA 8270C/D	4-Nitroaniline (PNA)
GC/MS	EPA 8270C/D	4-Nitrophenol (PNP)
GC/MS	EPA 8270C/D	7,12-Dimethylbenz(a)anthracene
GC/MS	EPA 8270C/D	Acenaphthene
GC/MS	EPA 8270C/D	Acenaphthylene
GC/MS	EPA 8270C/D	Acetaphenone
GC/MS	EPA 8270C/D	Aniline
GC/MS	EPA 8270C/D	Anthracene
GC/MS	EPA 8270C/D	Atrazine
GC/MS	EPA 8270C/D	Benzaldehyde
GC/MS	EPA 8270C/D	Benzidine
GC/MS	EPA 8270C/D	Benzo(a)anthracene
GC/MS	EPA 8270C/D	Benzo(a)pyrene
GC/MS	EPA 8270C/D	Benzo(b)fluoranthene
GC/MS	EPA 8270C/D	Benzo(g,h,i)perylene
GC/MS	EPA 8270C/D	Benzo(k)fluoranthene
GC/MS	EPA 8270C/D	Benzoic Acid
GC/MS	EPA 8270C/D	Benzyl alcohol
GC/MS	EPA 8270C/D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270C/D	bis(2-Chloroethyl)ether (BCEE)
GC/MS	EPA 8270C/D	Bis(2-chloroisopropyl)ether, or 2,2'-oxybis (1-Chloropropane)
GC/MS	EPA 8270C/D	bis(2-Ethylhexyl)phthalate (BEHP)
GC/MS	EPA 8270C/D	Butyl benzyl phthalate (BBP)
GC/MS	EPA 8270C/D	Caprolactam
GC/MS	EPA 8270C/D	Carbazole

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C/D	Chrysene
GC/MS	EPA 8270C/D	Dibenz(a,h)anthracene
GC/MS	EPA 8270C/D	Dibenzofuran (DBF)
GC/MS	EPA 8270C/D	Diethyl phthalate (DEP)
GC/MS	EPA 8270C/D	Dimethyl phthalate (DMP)
GC/MS	EPA 8270C/D	Di-n-butyl phthalate (DBP)
GC/MS	EPA 8270C/D	Di-n-octyl phthalate (DNOP)
GC/MS	EPA 8270C/D	Fluoranthene
GC/MS	EPA 8270C/D	Fluorene
GC/MS	EPA 8270C/D	Hexachlorobenzene (HCB)
GC/MS	EPA 8270C/D	Hexachlorobutadiene (HCBD)
GC/MS	EPA 8270C/D	Hexachlorocyclopentadiene (HCCPD)
GC/MS	EPA 8270C/D	Hexachloroethane (HCE)
GC/MS	EPA 8270C/D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270C/D	Isophorone
GC/MS	EPA 8270C/D	Naphthalene
GC/MS	EPA 8270C/D	Nitrobenzene
GC/MS	EPA 8270C/D	N-Nitrosodimethylamine
GC/MS	EPA 8270C/D	N-Nitroso-di-n-propylamine (NDPA)
GC/MS	EPA 8270C/D	N-nitrosodiphenylamine (NDPHA)
GC/MS	EPA 8270C/D	Pentachlorophenol
GC/MS	EPA 8270C/D	Phenanthrene
GC/MS	EPA 8270C/D	Phenol
GC/MS	EPA 8270C/D	Pyrene
GC/MS	EPA 8270C/D	Pyridine
GC/ECD	EPA 8081A/B	4,4'-DDD
GC/ECD	EPA 8081A/B	4,4'-DDE
GC/ECD	EPA 8081A/B	4,4'-DDT
GC/ECD	EPA 8081A/B	Aldrin
GC/ECD	EPA 8081A/B	alpha-BHC (alpha-HCH)
GC/ECD	EPA 8081A/B	alpha-Chlordane
GC/ECD	EPA 8081A/B	beta-BHC (beta-HCH)
GC/ECD	EPA 8081A/B	delta-BHC (delta-HCH)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8081A/B	Dieldrin
GC/ECD	EPA 8081A/B	Endosulfan I
GC/ECD	EPA 8081A/B	Endosulfan II
GC/ECD	EPA 8081A/B	Endosulfan sulfate
GC/ECD	EPA 8081A/B	Endrin
GC/ECD	EPA 8081A/B	Endrin aldehyde
GC/ECD	EPA 8081A/B	Endrin ketone
GC/ECD	EPA 8081A/B	gamma-BHC (Lindane; gamma-HCH)
GC/ECD	EPA 8081A/B	gamma-Chlordane
GC/ECD	EPA 8081A/B	Heptachlor
GC/ECD	EPA 8081A/B	Heptachlor epoxide
GC/ECD	EPA 8081A/B	Methoxychlor
GC/ECD	EPA 8081A/B	Chlordane
GC/ECD	EPA 8081A/B	Toxaphene
GC/ECD	EPA 8082 /A	Aroclor-1016
GC/ECD	EPA 8082 /A	Aroclor-1221
GC/ECD	EPA 8082 /A	Aroclor-1232
GC/ECD	EPA 8082 /A	Aroclor-1242
GC/ECD	EPA 8082 /A	Aroclor-1248
GC/ECD	EPA 8082 /A	Aroclor-1254
GC/ECD	EPA 8082 /A	Aroclor-1260
GC/ECD	EPA 8082 /A	Aroclor-1262
GC/ECD	EPA 8082 /A	Aroclor-1268
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4,5-TP (Silvex)
GC/ECD	EPA 8151A	2,4-D
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichlorprop
GC/ECD	EPA 8151A	Dinoseb
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP (Mecoprop)

Non-Potable Water

Technology	Method	Analyte
HPLC/UV	EPA 8330A/B	1,3,5-Trinitrobenzene
HPLC/UV	EPA 8330A/B	1,3-Dinitrobenzene
HPLC/UV	EPA 8330A/B	2,4,6-Trinitrophenylmethylnitramine (Tetryl)
HPLC/UV	EPA 8330A/B	2,4,6-Trinitrotoluene (TNT)
HPLC/UV	EPA 8330A/B	2,4-Dinitrotoluene (DNT)
HPLC/UV	EPA 8330A/B	2,6-Dinitrotoluene
HPLC/UV	EPA 8330A/B	2-Amino-4,6-dinitrotoluene
HPLC/UV	EPA 8330A/B	2-Nitrotoluene (ONT)
HPLC/UV	EPA 8330A/B	3,5-Dinitroaniline
HPLC/UV	EPA 8330A/B	3-Nitrotoluene
HPLC/UV	EPA 8330A/B	4-Amino-2,6-dinitrotoluene
HPLC/UV	EPA 8330A/B	4-Nitrotoluene (PNT)
HPLC/UV	EPA 8330A/B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC/UV	EPA 8330A/B	Nitrobenzene
HPLC/UV	EPA 8330A/B	Nitroglycerin
HPLC/UV	EPA 8330A/B	Nitroguanidine
HPLC/UV	EPA 8330A/B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	EPA 8330A/B	3,5-Dinitroaniline
HPLC/UV	EPA 8330A/B	PETN
GC/FID	FLPRO	Petroleum Range Organics
GC/FID	EPA 8015B	TPH DRO
GC/FID	EPA 8015B	TPH GRO
GC/FID	RSK-175	Methane
GC/FID	RSK-175	Ethane
GC/FID	RSK-175	Ethene
GC/ECD	EPA 8011	1,2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1,2-Dibromo-3-chloropropane (DBCP)
HPLC/MS	EPA 6850	Perchlorate
ICP	EPA 6010B/C	Aluminum
ICP	EPA 6010B/C	Antimony
ICP	EPA 6010B/C	Arsenic
ICP	EPA 6010B/C	Barium
ICP	EPA 6010B/C	Beryllium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP	EPA 6010B/C	Boron
ICP	EPA 6010B/C	Cadmium
ICP	EPA 6010B/C	Calcium
ICP	EPA 6010B/C	Chromium, total
ICP	EPA 6010B/C	Cobalt
ICP	EPA 6010B/C	Copper
ICP	EPA 6010B/C	Iron
ICP	EPA 6010B/C	Lead
ICP	EPA 6010B/C	Magnesium
ICP	EPA 6010B/C	Manganese
CVAA	EPA 7470A	Mercury
ICP	EPA 6010B/C	Molybdenum
ICP	EPA 6010B/C	Nickel
ICP	EPA 6010B/C	Potassium
ICP	EPA 6010B/C	Selenium
ICP	EPA 6010B/C	Silver
ICP	EPA 6010B/C	Sodium
ICP	EPA 6010B/C	Strontium
ICP	EPA 6010B/C	Thallium
ICP	EPA 6010B/C	Tin
ICP	EPA 6010B/C	Titanium
ICP	EPA 6010B/C	Vanadium
ICP	EPA 6010B/C	Zinc
IC	EPA 300.0	Chloride
IC	EPA 300.0	Fluoride
IC	EPA 300.0	Nitrate
IC	EPA 300.0	Nitrite
IC	EPA 300.0	Sulfate
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Nitrate
IC	EPA 9056A	Nitrite
IC	EPA 9056A	Sulfate

Non-Potable Water		
Technology	**Method**	**Analyte**
Titration	SM 2320B 20th/21st edition	Alkalinity
Colorimetric	SM 4500 B, G, 20th/21st edition	Ammonia
Colorimetric	EPA 410.4	COD
UV/Vis	EPA 7196A	Hexavalent Chromium
Colorimetric	EPA 353.2	Nitrocellulose
Colorimetric	EPA 353.2	Nitrate/Nitrite
Gravimetric	EPA 1664A	O&G
Titration	Chap.7, Sect. 7.3.4 Mod.	Reactive Sulfide
Titration	SM 4500 S-2CF, 20th/21st edition	Sulfide
UV/Vis	SM 4500 P B5, E, 20th/21st edition	Total Phosphorus (as P)
UV/Vis	SM 4500 PE, 20th/21st edition	Ortho-Phosphate (as P)
TOC	9060A/SM5310C, 20th/21st edition	Total Organic Carbon
Gravimetric	SM 2540C, 20th/21st edition	TDS
Gravimetric	SM 2540D, 20th/21st edition	TSS
Colorimetric	EPA 9012A/B	Cyanide
Physical	EPA 1010A	Ignitability
Physical	EPA 9095B	Paint Filter
Probe	EPA 9040B/C	pH
Preparation	**Method**	**Type**
Preparation	EPA 1311	TCLP
Preparation	EPA 3005A	Metals digestion
Preparation	EPA 3010A	Metals digestion
Preparation	EPA 3510C	Organics Liquid Extraction
Preparation	EPA 5030A/B	Purge and Trap Water

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	1,1,1-Trichloroethane (1,1,1-TCA)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B	1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113; Freon 113)
GC/MS	EPA 8260B	1,1,2-Trichloroethane
GC/MS	EPA 8260B	1,1-Dichloroethane (1,1-DCA)
GC/MS	EPA 8260B	1,1-Dichloroethene (1,1-DCE)
GC/MS	EPA 8260B	1,1-Dichloropropene
GC/MS	EPA 8260B	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B	1,2,3-Trichloropropane
GC/MS	EPA 8260B	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B	1,2-Dibromoethane (EDB)
GC/MS	EPA 8260B	1,2-Dichlorobenzene
GC/MS	EPA 8260B	1,2-Dichloroethane (EDC)
GC/MS	EPA 8260B	1,2-Dichloropropane
GC/MS	EPA 8260B	1,3,5-Trimethylbenzene
GC/MS	EPA 8260B	1,3-Dichlorobenzene
GC/MS	EPA 8260B	1,3-Dichloropropane
GC/MS	EPA 8260B	1,4-Dichlorobenzene
GC/MS	EPA 8260B	1,4-Dioxane
GC/MS	EPA 8260B	2,2-Dichloropropane
GC/MS	EPA 8260B	2-Butanone (Methyl ethyl ketone; MEK)
GC/MS	EPA 8260B	2-Chlorotoluene
GC/MS	EPA 8260B	2-Hexanone (Methyl butyl ketone; MBK)
GC/MS	EPA 8260B	4-Chlorotoluene
GC/MS	EPA 8260B	4-Methyl-2-pentanone (Methyl isobutyl ketone; MIBK)
GC/MS	EPA 8260B	Acetone
GC/MS	EPA 8260B	Acetonitrile
GC/MS	EPA 8260B	Acrolein
GC/MS	EPA 8260B	Acrylonitrile
GC/MS	EPA 8260B	Allyl chloride

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	Benzene
GC/MS	EPA 8260B	Bromobenzene
GC/MS	EPA 8260B	Bromochloromethane
GC/MS	EPA 8260B	Bromodichloromethane
GC/MS	EPA 8260B	Bromoform
GC/MS	EPA 8260B	Bromomethane
GC/MS	EPA 8260B	Carbon Disulfide
GC/MS	EPA 8260B	Carbon Tetrachloride
GC/MS	EPA 8260B	Chlorobenzene
GC/MS	EPA 8260B	Chloroethane
GC/MS	EPA 8260B	Chloroform
GC/MS	EPA 8260B	Chloromethane
GC/MS	EPA 8260B	Chloroprene
GC/MS	EPA 8260B	cis-1,2-Dichloroethene (cis-1,2-DCE)
GC/MS	EPA 8260B	cis-1,3-Dichloropropene
GC/MS	EPA 8260B	cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260B	Cyclohexane
GC/MS	EPA 8260B	Dibromochloromethane
GC/MS	EPA 8260B	Dibromomethane
GC/MS	EPA 8260B	Dichlorodifluoromethane (CFC-12)
GC/MS	EPA 8260B	Ethyl methacrylate
GC/MS	EPA 8260B	Ethylbenzene
GC/MS	EPA 8260B	Hexachlorobutadiene
GC/MS	EPA 8260B	Hexane
GC/MS	EPA 8260B	Iodomethane
GC/MS	EPA 8260B	Isobutyl alcohol
GC/MS	EPA 8260B	Isopropylbenzene (Cumene)
GC/MS	EPA 8260B	Methacrylonitrile
GC/MS	EPA 8260B	Methyl Acetate
GC/MS	EPA 8260B	Methyl methacrylate
GC/MS	EPA 8260B	Methyl Tertiary Butyl Ether (MTBE)
GC/MS	EPA 8260B	Methylcyclohexane

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	Methylene Chloride, or Dichloromethane
GC/MS	EPA 8260B	Naphthalene
GC/MS	EPA 8260B	n-Butylbenzene
GC/MS	EPA 8260B	n-Propylbenzene
GC/MS	EPA 8260B	p-Isopropyltoluene
GC/MS	EPA 8260B	Propionitrile
GC/MS	EPA 8260B	sec-Butylbenzene
GC/MS	EPA 8260B	Styrene
GC/MS	EPA 8260B	tert-Butylbenzene
GC/MS	EPA 8260B	Tetrachloroethene (PCE; PERC)
GC/MS	EPA 8260B	Toluene
GC/MS	EPA 8260B	trans-1,2-Dichloroethene (trans-1,2-DCE)
GC/MS	EPA 8260B	trans-1,3-Dichloropropene
GC/MS	EPA 8260B	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B	Trichloroethene (TCE)
GC/MS	EPA 8260B	Trichlorofluoromethane (CFC-11)
GC/MS	EPA 8260B	Vinyl acetate
GC/MS	EPA 8260B	Vinyl Chloride (VC)
GC/MS	EPA 8260B	Xylenes (Total)
GC/MS	EPA 8270C/D	Bis(2-chloroisopropyl)ether, or 2,2'-oxybis (1-Chloropropane)
GC/MS	EPA 8270C/D	1,1'-Biphenyl
GC/MS	EPA 8270C/D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270C/D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270C/D	1,2-Dichlorobenzene
GC/MS	EPA 8270C/D	1,2-Diphenylhydrazine
GC/MS	EPA 8270C/D	1,3-Dichlorobenzene
GC/MS	EPA 8270C/D	1,4-Dichlorobenzene
GC/MS	EPA 8270C/D	1,4-Dioxane
GC/MS	EPA 8270C/D	1-Methylnaphthalene
GC/MS	EPA 8270C/D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270C/D	2,4,5-Trichlorophenol
GC/MS	EPA 8270C/D	2,4,6-Trichlorophenol (TCP)

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Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C/D	2,4-Dichlorophenol (DCP)
GC/MS	EPA 8270C/D	2,4-Dimethylphenol
GC/MS	EPA 8270C/D	2,4-Dinitrophenol
GC/MS	EPA 8270C/D	2,4-Dinitrotoluene (DNT)
GC/MS	EPA 8270C/D	2,6-Dichlorophenol
GC/MS	EPA 8270C/D	2,6-Dinitrotoluene
GC/MS	EPA 8270C/D	2-Chloronaphthalene
GC/MS	EPA 8270C/D	2-Chlorophenol
GC/MS	EPA 8270C/D	2-Methylnaphthalene
GC/MS	EPA 8270C/D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270C/D	2-Nitroaniline
GC/MS	EPA 8270C/D	2-Nitrophenol (ONP)
GC/MS	EPA 8270C/D	3,3'-Dichlorobenzidine (DCB)
GC/MS	EPA 8270C/D	3-Methylphenol
GC/MS	EPA 8270C/D	3-Nitroaniline
GC/MS	EPA 8270C/D	4,6-Dinitro-2-methylphenol (DNOC)
GC/MS	EPA 8270C/D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270C/D	4-Chloro-3-methylphenol
GC/MS	EPA 8270C/D	4-Chloroaniline
GC/MS	EPA 8270C/D	4-Chlorophenyl phenyl ether
GC/MS	EPA 8270C/D	4-Methylphenol (p-Cresol)
GC/MS	EPA 8270C/D	4-Nitroaniline (PNA)
GC/MS	EPA 8270C/D	4-Nitrophenol (PNP)
GC/MS	EPA 8270C/D	Acenaphthene
GC/MS	EPA 8270C/D	Acenaphthylene
GC/MS	EPA 8270C/D	Acetaphenone
GC/MS	EPA 8270C/D	Aniline
GC/MS	EPA 8270C/D	Anthracene
GC/MS	EPA 8270C/D	Atrazine
GC/MS	EPA 8270C/D	Benzaldehyde
GC/MS	EPA 8270C/D	Benzidine
GC/MS	EPA 8270C/D	Benzo(a)anthracene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C/D	Benzo(a)anthracene
GC/MS	EPA 8270C/D	Benzo(a)pyrene
GC/MS	EPA 8270C/D	Benzo(b)fluoranthene
GC/MS	EPA 8270C/D	Benzo(g,h,i)perylene
GC/MS	EPA 8270C/D	Benzo(k)fluoranthene
GC/MS	EPA 8270C/D	Benzoic Acid
GC/MS	EPA 8270C/D	Benzyl alcohol
GC/MS	EPA 8270C/D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270C/D	bis(2-Chloroethyl)ether (BCEE)
GC/MS	EPA 8270C/D	bis(2-Ethylhexyl)phthalate (BEHP)
GC/MS	EPA 8270C/D	Butyl benzyl phthalate (BBP)
GC/MS	EPA 8270C/D	Caprolactam
GC/MS	EPA 8270C/D	Carbazole
GC/MS	EPA 8270C/D	Chrysene
GC/MS	EPA 8270C/D	Dibenz(a,h)anthracene
GC/MS	EPA 8270C/D	Dibenzofuran (DBF)
GC/MS	EPA 8270C/D	Diethyl phthalate (DEP)
GC/MS	EPA 8270C/D	Dimethyl phthalate (DMP)
GC/MS	EPA 8270C/D	Di-n-butyl phthalate (DBP)
GC/MS	EPA 8270C/D	Di-n-octyl phthalate (DNOP)
GC/MS	EPA 8270C/D	Fluoranthene
GC/MS	EPA 8270C/D	Fluorene
GC/MS	EPA 8270C/D	Hexachlorobenzene (HCB)
GC/MS	EPA 8270C/D	Hexachlorobutadiene (HCBD)
GC/MS	EPA 8270C/D	Hexachlorocyclopentadiene (HCCPD)
GC/MS	EPA 8270C/D	Hexachloroethane (HCE)
GC/MS	EPA 8270C/D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270C/D	Isophorone
GC/MS	EPA 8270C/D	Naphthalene
GC/MS	EPA 8270C/D	Nitrobenzene
GC/MS	EPA 8270C/D	N-Nitrosodimethylamine
GC/MS	EPA 8270C/D	N-Nitroso-di-n-propylamine (NDPA)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C/D	N-nitrosodiphenylamine (NDPHA)
GC/MS	EPA 8270C/D	Pentachlorophenol
GC/MS	EPA 8270C/D	Phenanthrene
GC/MS	EPA 8270C/D	Phenol
GC/MS	EPA 8270C/D	Pyrene
GC/MS	EPA 8270C/D	Pyridine
GC/ECD	EPA 8081A/B	4,4'-DDD
GC/ECD	EPA 8081A/B	4,4'-DDE
GC/ECD	EPA 8081A/B	4,4'-DDT
GC/ECD	EPA 8081A/B	Aldrin
GC/ECD	EPA 8081A/B	alpha-BHC (alpha-HCH)
GC/ECD	EPA 8081A/B	alpha-Chlordane
GC/ECD	EPA 8081A/B	beta-BHC (beta-HCH)
GC/ECD	EPA 8081A/B	delta-BHC (delta-HCH)
GC/ECD	EPA 8081A/B	Chlordane
GC/ECD	EPA 8081A/B	Dieldrin
GC/ECD	EPA 8081A/B	Endosulfan I
GC/ECD	EPA 8081A/B	Endosulfan II
GC/ECD	EPA 8081A/B	Endosulfan sulfate
GC/ECD	EPA 8081A/B	Endrin
GC/ECD	EPA 8081A/B	Endrin aldehyde
GC/ECD	EPA 8081A/B	Endrin ketone
GC/ECD	EPA 8081A/B	gamma-BHC (Lindane; gamma-HCH)
GC/ECD	EPA 8081A/B	gamma-Chlordane
GC/ECD	EPA 8081A/B	Heptachlor
GC/ECD	EPA 8081A/B	Heptachlor epoxide
GC/ECD	EPA 8081A/B	Methoxychlor
GC/ECD	EPA 8081A/B	Toxaphene
GC/ECD	EPA 8082 /A	Aroclor-1016
GC/ECD	EPA 8082 /A	Aroclor-1221
GC/ECD	EPA 8082 /A	Aroclor-1232
GC/ECD	EPA 8082 /A	Aroclor-1242

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8082 /A	Aroclor-1248
GC/ECD	EPA 8082 /A	Aroclor-1254
GC/ECD	EPA 8082 /A	Aroclor-1260
GC/ECD	EPA 8082 /A	Aroclor-1262
GC/ECD	EPA 8082 /A	Aroclor-1268
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4,5-TP (Silvex)
GC/ECD	EPA 8151A	2,4-D
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichlorprop
GC/ECD	EPA 8151A	Dinoseb
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP (Mecoprop)
HPLC/UV	EPA 8330A	1,3,5-Trinitrobenzene
HPLC/UV	EPA 8330A	1,3-Dinitrobenzene
HPLC/UV	EPA 8330A	2,4,6-Trinitrophenylmethylnitramine (Tetryl)
HPLC/UV	EPA 8330A	2,4,6-Trinitrotoluene (TNT)
HPLC/UV	EPA 8330A	2,4-Dinitrotoluene (DNT)
HPLC/UV	EPA 8330A	2,6-Dinitrotoluene
HPLC/UV	EPA 8330A	2-Amino-4,6-dinitrotoluene
HPLC/UV	EPA 8330A	2-Nitrotoluene (ONT)
HPLC/UV	EPA 8330A	3-Nitrotoluene
HPLC/UV	EPA 8330A	3,5-Dinitroaniline
HPLC/UV	EPA 8330A	4-Amino-2,6-dinitrotoluene
HPLC/UV	EPA 8330A	4-Nitrotoluene (PNT)
HPLC/UV	EPA 8330A	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC/UV	EPA 8330A	Nitroglycerin
HPLC/UV	EPA 8330A	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	EPA 8330A	Nitrobenzene
HPLC/UV	EPA 8330A	Nitroguanidine

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
HPLC/UV	EPA 8330A	PETN
HPLC/UV	EPA 8330B	1,3,5-Trinitrobenzene
HPLC/UV	EPA 8330B	1,3-Dinitrobenzene
HPLC/UV	EPA 8330B	2,4,6-Trinitrophenylmethylnitramine (Tetryl)
HPLC/UV	EPA 8330B	2,4,6-Trinitrotoluene (TNT)
HPLC/UV	EPA 8330B	2,4-Dinitrotoluene (DNT)
HPLC/UV	EPA 8330B	2,6-Dinitrotoluene
HPLC/UV	EPA 8330B	2-Amino-4,6-dinitrotoluene
HPLC/UV	EPA 8330B	2-Nitrotoluene (ONT)
HPLC/UV	EPA 8330B	3-Nitrotoluene
HPLC/UV	EPA 8330B	3,5-Dinitroaniline
HPLC/UV	EPA 8330B	4-Amino-2,6-dinitrotoluene
HPLC/UV	EPA 8330B	4-Nitrotoluene (PNT)
HPLC/UV	EPA 8330B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC/UV	EPA 8330B	Nitroglycerin
HPLC/UV	EPA 8330B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	EPA 8330B	Nitrobenzene
HPLC/UV	EPA 8330B	Nitroguanidine
HPLC/UV	EPA 8330B	PETN
GC/FID	FLPRO	Petroleum Range Organics
GC/FID	EPA 8015B	TPH DRO
GC/FID	EPA 8015B	TPH GRO
HPLC/MS	EPA 6850	Perchlorate
ICP	EPA 6010B/C	Aluminum
ICP	EPA 6010B/C	Antimony
ICP	EPA 6010B/C	Arsenic
ICP	EPA 6010B/C	Barium
ICP	EPA 6010B/C	Beryllium
ICP	EPA 6010B/C	Boron
ICP	EPA 6010B/C	Cadmium
ICP	EPA 6010B/C	Calcium
ICP	EPA 6010B/C	Chromium, total

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Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP	EPA 6010B/C	Cobalt
ICP	EPA 6010B/C	Copper
ICP	EPA 6010B/C	Iron
ICP	EPA 6010B/C	Lead
ICP	EPA 6010B/C	Magnesium
ICP	EPA 6010B/C	Manganese
CVAA	EPA 7471A/B	Mercury
ICP	EPA 6010B/C	Molybdenum
ICP	EPA 6010B/C	Nickel
ICP	EPA 6010B/C	Potassium
ICP	EPA 6010B/C	Selenium
ICP	EPA 6010B/C	Silver
ICP	EPA 6010B/C	Sodium
ICP	EPA 6010B/C	Strontium
ICP	EPA 6010B/C	Tin
ICP	EPA 6010B/C	Titanium
ICP	EPA 6010B/C	Thallium
ICP	EPA 6010B/C	Vanadium
ICP	EPA 6010B/C	Zinc
UV/Vis	EPA 7196A	Hexavalent Chromium
TOC	Lloyd Kahn	Total Organic Carbon
Colorimetric	EPA 353.2	Nitrocellulose
Colorimetric	EPA 9012A/B	Cyanide
Titration	Chap.7, Sect. 7.3.4 Mod.	Reactive Sulfide
Titration	EPA 9034	Sulfide
Probe	EPA 9045C/D	pH
Preparation	**Method**	**Type**
Preparation	EPA 1311	TCLP
Preparation	EPA 1312	SPLP
Preparation	NJ Modified 3060A	Hexavalent Chromium
Preparation	EPA 3050B	Metals Digestion
Preparation	EPA 3546	Organics Microwave Extraction

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Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Preparation	EPA 3550B/C	Organics Sonication
Preparation	SM 2540B 20th/21st edition	Percent Solids (Percent Moisture)
Preparation	EPA 5035 /A	Purge and Trap Solid

Notes:

1) This laboratory offers commercial testing service.

Approved By: ______________________ Date: April 8, 2011

R. Douglas Leonard
Chief Technical Officer

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