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Work Plan
for
Risk Assessment
at
SWMUs 4, 5, 9, and 10

Naval Surface Warfare Center
Crane Division
Crane, Indiana

VOLUME II - APPENDICES

Southern Division
Naval Facilities Engineering Command
Contract Number N62467-94-D-0888
Contract Task Order 0010

August 2000

APPENDIX A

FIELD SAMPLING PLAN

Field Sampling Plan
for
Risk Assessment
at
SWMUs 4, 5, 9, and 10

Naval Surface Warfare Center
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Crane, Indiana

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ACRONYMS/ABBREVIATIONS

bgs	Below Ground Surface
Ca	Calcium
CEC	Cation Exchange Capacity
CLEAN	Comprehensive Long-Term Environmental Action, Navy
COC	Chain of Custody
CTO	Contract Task Order
DI	Deionized
DO	Dissolved Oxygen
DOT	Department of Transportation
DPT	Direct-Push Technology
°C	Degrees Celgius
Fe	Iron
FOL	Field Operations Leader
FSP	Field Sampling Plan
FTMR	Field Task Modification Request
HASP	Health and Safety Plan
HSA	Hollow Stem Auger
IAC	Indiana Annotated Codes
ID	Inside Diameter
IDW	Investigative Derived Waste
K	Potassium
Mn	Manganese
Mg	Magnesium
mS/cm	MilliSiemens per Centimeter
Na	Sodium
NSWC	Naval Surface Warfare Center
NTU	Nephelometric Turbidity Units
ORP	Oxidation-Reduction Potential
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
QA	Quality Assurance

QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RPM	Remedial Project Manager
SOPs	Standard Operating Procedures
SOUTHDIV	Southern Division Naval Facilities Engineering Command
SVOCs	Semivolatile Organic Compounds
SWMU	Solid Waste Management Unit
TOC	Total Organic Carbon
TOM	Task Order Manager
TSS	Total Suspended Solids
TtNUS	Tetra Tech NUS, Inc.
U.S. ACE	U.S. Army Corp of Engineers
U.S. EPA	United States Environmental Protection Agency
USCS	Unified Soil Classification System
VOC	Volatile Organic Compound
WP	Work Plan

1.0 INTRODUCTION

1.1 INTRODUCTION

This comprehensive Field Sampling Plan (FSP) describes the sampling and analysis procedures to be used for risk assessment activities conducted by Tetra Tech NUS, Inc. (TtNUS) under the Comprehensive Long-Term Environmental Action Navy Contract Number N62467-94-D-0888, Contract Task Order (CTO) 0010 at the Naval Surface Warfare Center (NSWC) Crane Division, Crane, Indiana (see Figure 1-1 in Work Plan). These activities will be conducted in accordance with applicable Resource Conservation and Recovery Act (RCRA) Corrective Action requirements as identified in the RCRA Part B Permit issued to NSWC Crane by U.S. Environmental Protection Agency (U.S. EPA) Region V.

In 1989 NSWC Crane was given a final RCRA Part B Permit. The permit contained corrective action requirements to be performed at its Solid Waste Management Units (SWMUs), including requirements for RCRA Facility Investigations (RFIs) to be performed at its hazardous waste disposal units. Phase II Soil RFIs have been conducted for the following four SWMUs: McComish Gorge (SWMU 4), Old Burn Pit (SWMU 5), Pest Control/R-150 Tank Area (SWMU 9), and Rockeye (SWMU 10) (see Figures 5-2, 6-2, 7-2, and 8-2 in Work Plan).

A Phase III Ground Water RFI was completed for Rockeye (SWMU 10) and the activities documented. For the other three SWMUs, work plans were only partially fulfilled with a round of samples collected from existing monitoring wells.

Conclusions on the nature and extent of contamination were drawn from these studies for each SWMU. The objective of this field investigation is to obtain sufficient information to perform human health and screening level ecological risk assessments for each SWMU. Conclusions from the risk assessments will be used in the risk management evaluation to determine if further activities are warranted at these sites.

This FSP specifies requirements for field work that may be undertaken at the NSWC Crane facility under this CTO and serves as a complete guide for use in the field by all field investigation team members. This investigation will comply with applicable Indiana, Southern Division Naval Facilities Engineering Command (SOUTHDIV), and USEPA regulations and guidance.

The field investigation at NSWC Crane will consist of the following tasks:

- Mobilization/demobilization
- Field equipment maintenance
- Drilling
  - Installation of soil borings
  - Installation of permanent monitoring wells
- Soil sampling
  - Surface soil sampling
  - Subsurface soil sampling
- Ground water sampling
  - New permanent monitoring wells
  - Existing permanent monitoring wells
- Surface water/sediment sampling
- Land survey of sample locations
- Equipment decontamination
- Ground water level measurements
- Investigation-derived waste handling and disposal
- Site restoration

This FSP consists of three sections. Section 1.0 presents an introduction to the sampling and analysis plan. Section 2.0 describes the field operations, investigation tasks, environmental sampling and analytical procedures, waste handling, site management and facility support, and recordkeeping. Section 3.0 details site-specific field sampling plans. . Site-specific Field Forms and Standard Operating Procedures (SOPs) for the proposed activities are included in Attachments A and B, respectively, of this FSP.

1.2 PROJECT ORGANIZATION AND RESPONSIBILITIES

TtNUS will be responsible for the implementation of the project, including the field inspection and implementation of all sampling activities. Personnel from the Navy will be actively involved in the investigation planning and will coordinate with personnel from TtNUS in a number of areas.

1.2.1 Project Organization

The key organizations and personnel involved in the investigation, as well as the chain of communication and responsibility of the project personnel, are described in Section 2.0 of the Work Plan.

2.0 FIELD OPERATIONS

2.1 GENERAL FIELD OPERATIONS

This section discusses sampling operations, procedures, and proper documentation for the field operations to be performed for the risk assessments for SWMUs 4, 5, 9, and 10 at NSWC Crane, Indiana.

2.1.1 Mobilization/Demobilization

Following approval of this comprehensive FSP, TtNUS will begin mobilization activities. In addition to this FSP, all field team members will review the planning documents [Work Plan (WP), Quality Assurance Project Plan (QAPP), and Health and Safety Plan (HASP)] prior to the start of project activities. In addition, a field team orientation meeting will be held by the Field Operations Leader (FOL) to ensure that personnel are familiar with the scope of the field activities. The FOL will coordinate the mobilization activities upon arrival at the Facility.

Before the initiation of field work, the FOL will arrive at the site to begin onsite mobilization activities. These activities will include coordination with base personnel and the clearing of drilling locations with the proper utilities. An existing trailer will be used as the field office. Equipment required for the field activities may be shipped or driven from the TtNUS Pittsburgh warehouse to the site. After field activities are completed, the FOL will be responsible for the demobilization of all equipment and the field office.

All site preparation will be coordinated through NSWC Crane personnel. When necessary, temporary barriers and traffic control will be provided at drilling locations as a safety precaution.

Additional details regarding responsibilities and authorities of key personnel are presented Section 2.0 of the Work Plan.

2.1.2 Site Restoration

All site restoration activities will be performed by TtNUS and its subcontractors. Site restoration may include, but is not limited to, regrading areas where drilling activities are performed, and asphalt and concrete replacement where disturbed by intrusive activities.

2.2 SUBSURFACE INVESTIGATIONS

2.2.1 Soil Boring Installation

Drilling of boreholes for soil sampling and monitoring well installation will be accomplished using direct-push and hollow-stem auger methods. The drilling method selected will depend on the type of samples being collected at a location, boring depths, and site characteristics. However, whenever possible, the direct-push drilling method will be used for the collection of soil samples for analytical and lithologic descriptive purposes. Hollow-stem auger techniques will be used to enlarge these borings to allow for the installation of monitoring wells. All borings for soil sampling will be drilled in accordance with CTO 10 SOP 7 and logged in accordance with CTO 10 SOP 14, both contained in Attachment B.

2.2.1.1 Direct-Push Drilling

The direct-push technique (DPT) involves pushing sampling tools hydraulically or mechanically downward into the ground to a desired depth. A primary advantage of DPT over conventional drilling techniques is that DPT generates little or no drill cuttings. Disadvantages include limited penetration depth of 15 to 40 feet and small sample volume.

2.2.1.2 Hollow-Stem Auger Drilling

The hollow-stem auger (HSA) drilling technique with split-spoon sampling may also be used for soil sampling. HSAs are advanced to a depth immediately above the sample depth. A split-spoon sampler is driven through the auger by means of a drill-rig-mounted hammer weighing 140 pounds falling 30 inches for each blow (standard penetration test). The interval at which a split-spoon sample is collected will be based on the specific purpose or needs of the sampling effort. As mentioned above, it is anticipated that the HSA technique will be used to enlarge DPT borings to allow for the installation of permanent monitoring wells. In this case, split-spoon samples will not be collected.

2.2.2 Borehole and Sample Logging

All DPT and/or split-spoon samples obtained from soil borings will be monitored immediately upon opening of the sample tool by passing a photoionization detector (PID) along the sample's length. These readings will be recorded on the boring log. Soil samples collected for chemical analysis should be done so in accordance with the procedures outlined in Section 2.4.2.

A lithologic description of each soil sample and a complete log of each boring should be maintained by the TtNUS geologist in accordance with CTO 10 SOP 14, contained in Attachment B. At a minimum, the boring log will contain the following information:

- Well identification (if applicable)
- Boring identification
- Name of geologist logging the boring
- Name of drilling contractor
- Sample numbers and types
- Sample depths
- Standard penetration test data
- Sample recovery/sample interval
- Soil density or cohesiveness
- Soil color
- Unified Soil Classification System (USCS) material description
- Location of boring
- Drilling and well construction problems/deviations from project specific FSP.

In addition, depths of changes in lithology, sample moisture observations, depth to water, presence of organic vapor (i.e., PID readings), drilling methods, and total depth of each borehole are included on each log, as well as any other pertinent observations. An example of the boring log form is attached in Attachment A. The driller shall prepare a separate written boring log for each boring drilled. The driller's boring log and/or a daily record of drilling activities are submitted to the field geologist at the conclusion of the daily field activities.

2.2.3 Borehole Abandonment

Once a boring is drilled to the desired depth, if it is not to be converted to a monitoring well, then it will be backfilled. Borings with standing water will be backfilled using a tremie pipe from the bottom up to the ground surface with a cement-bentonite slurry. Dry boreholes will be backfilled with bentonite chips and hydrated per manufacturer specifications; typically using 1 gallon of water per 1 foot of bentonite in an 8-inch hole. A standard batch of slurry consists of approximately one 94-pound bag of cement, 5 percent by weight (5 pounds) bentonite powder, and 6.5 to 7 gallons of potable water.

2.3 MONITORING WELL CONSTRUCTION AND INSTALLATION

The HSA drilling method will be used for the installation of ground water monitoring wells in overburden materials. This method will be implemented as a dry drilling method for the project. During all overburden drilling, continuous split-spoon sampling and borehole logging will be performed unless a boring (DPT) is converted to a well using HSA.

Soil drilling using the HSA method will be accomplished using a truck-mounted CME-55 auger rig, or equivalent, of sufficient size and power that will advance augers to the anticipated maximum drilling depth. The total depth of each borehole will be dictated by the depth where the water table is encountered. After the hollow-stem augers have been advanced to the designated depth below the water table at each borehole location, a 2.0-inch diameter polyvinyl chloride (PVC) ground water monitoring well will be installed.

When bedrock is encountered and soil borings cannot be continued using HSA drilling, drilling and sampling will be performed using a diamond bit corer. An NX-sized core barrel will be used and core samples will be collected and logged according to CTO 10 SOP 8 (see Attachment B). Once bedrock is reached, casing (typically PVC) is grouted in place to seal off the surface and drilling is continued to the desired depth. When the total depth of the well is reached, the borehole will be reamed to allow installation of a 2-inch diameter monitoring well.

Well construction and drilling methods will be performed in accordance with SOUTHDIV Monitoring Well Design, Installation, Construction, and Development Guidelines (SOUTHDIV, 1997). All monitoring wells shall be installed in a manner consistent with 310 Indiana Annotated Codes (IAC) 16-8-3 by a water well driller licensed by the State of Indiana.

2.3.1 Monitoring Well Construction

Monitoring wells will be constructed of 2-inch inside diameter (I.D.), Schedule 40 PVC and flush-joint, factory-slotted well screen. Well screens will be approximately 10 feet in length, with exact lengths based on the geologist's interpretation of the lithology. The well screens will have a slot size of 0.010 inch and will be supplied with a PVC end cap. Five-foot long well screens may be used where a shorter screened interval is desired or where total well depths are less than 10 feet below ground surface (bgs), based on site conditions determined during the investigation. The numbers, locations, estimated screened intervals, and approximate total well depths at each SWMU are described in Sections 3.1 through 3.4.

Once the screen and the riser pipe are in place, the annulus of the boring will be backfilled with clean silica sand from the bottom of the boring to 1 to 2 feet above the top of the well screen. A bentonite pellet seal (minimum 2-foot thickness) will then be installed and allowed to hydrate as per the manufacturer's recommendations. The remainder of the annulus of the borehole (from the bentonite seal to the ground surface) will be grouted by pumping a cement/bentonite slurry through a tremie pipe until the grout reaches the level where the concrete apron will be placed. The depths of the backfill materials will be constantly monitored during the installation of the monitoring well using a weighted stainless steel or plastic tape to ensure that no bridging of the sand pack or bentonite occurs during the installation process. Indiana State well installation requirements in 310 IAC 16 shall be followed for all well installation activities. A well construction log, as presented in Attachment A, will be completed for all wells.

When installing wells into aquifers below confining layers, telescope well or double well construction will be used to avoid cross contamination between the shallow and deeper aquifers. Surface casing (typically Schedule 80 PVC) with a sufficient diameter to install a multiple cased well shall be installed at least 4 feet into the confining layer underlying the shallow aquifer and pressure grouted in place with a cement-bentonite slurry. After the grout is allowed to cure for a minimum of 24 hours, a smaller diameter hollow-stem auger will be advanced through the center of the steel casing and through the aquifer to be monitored.

2.3.2 Monitoring Well Development

All existing wells to be sampled as part of this investigation will be redeveloped, and all newly installed monitoring wells will be developed no sooner than 24 hours after installation to remove fine material from around the well screen. Wells will be developed by bailing and surging and/or by pumping as determined by the field geologist. Recharge rates will be noted. Measurements of pH, temperature, specific conductance, and turbidity will be collected after each well casing volume and recorded in the field logbook. The wells will be developed until three consecutive readings are within the following criteria: pH +/- 0.1 standard units, temperature +/- 3% degrees Celsius (°C), specific conductance +/- 3% milliSiemens per centimeter (mS/cm), and turbidity less than 10 nephelometric turbidity units (NTU). If water quality parameters do not stabilize after 5 well volumes have been removed and a nonturbid sample cannot be collected, then the site geologist will document the event, notify the Task Order Manager (TOM) and commence sample collection. All well development will be performed in accordance with CTO 10 SOP 8.

2.3.3 Monitoring Well Protection

Once the monitoring well is completed and the annulus is grouted to the surface, a large diameter steel protective casing with a locking cap will be cemented in place over the riser pipe of each well. This stick-up type protective casing will extend approximately 2.5 feet above and below the ground surface, and a drain hole will be cut or drilled into the protective casing approximately 6 inches above the ground surface. Pea gravel may be used to fill the space between the outer protective casing and the well casing to prevent small animal or insect entrance through the lower drain hole. Figure 2-1 illustrates typical well construction details for overburden wells with stick-up type well protection. A 3-foot-square and 1- to 2-foot deep concrete apron will be cemented in place around the well casing, and three to four safety yellow barrier posts (nominal 4-inch diameter, 7-foot-long steel pipe filled with concrete) will be cemented at the four corners of the concrete apron, as directed by TtNUS personnel.

To maintain well security, all wells will be locked using locks that are keyed alike.

2.4 GENERAL SAMPLING OPERATIONS

This section discusses the sampling methodology for all ground water, surface soil, subsurface soil, surface water, and sediment sampling activities to be performed at NSWC Crane, Indiana. Sample locations and analytical requirements including field test methods for these samples will be detailed in Section 3.0 on a SWMU-specific basis. Summaries of sample containers, sample volume, preservation requirements, and analytical methodology are provided in Tables 2-1 for solid matrices and 2-2 for aqueous media.

2.4.1 Ground Water Sampling

Ground water samples will be collected and submitted for fixed-based laboratory analyses from new and existing monitoring wells at NSWC Crane. The specific wells that will be sampled are outlined in the site-specific field sampling plans (Section 3.0). The objective of this section is to provide guidance for the proper use of sampling equipment and proper techniques for ground water sample collection. All ground water sampling shall be conducted in accordance with the requirements of the project specific Work Plan and QAPP and in accordance with CTO 10 SOP 4, contained in Attachment B.

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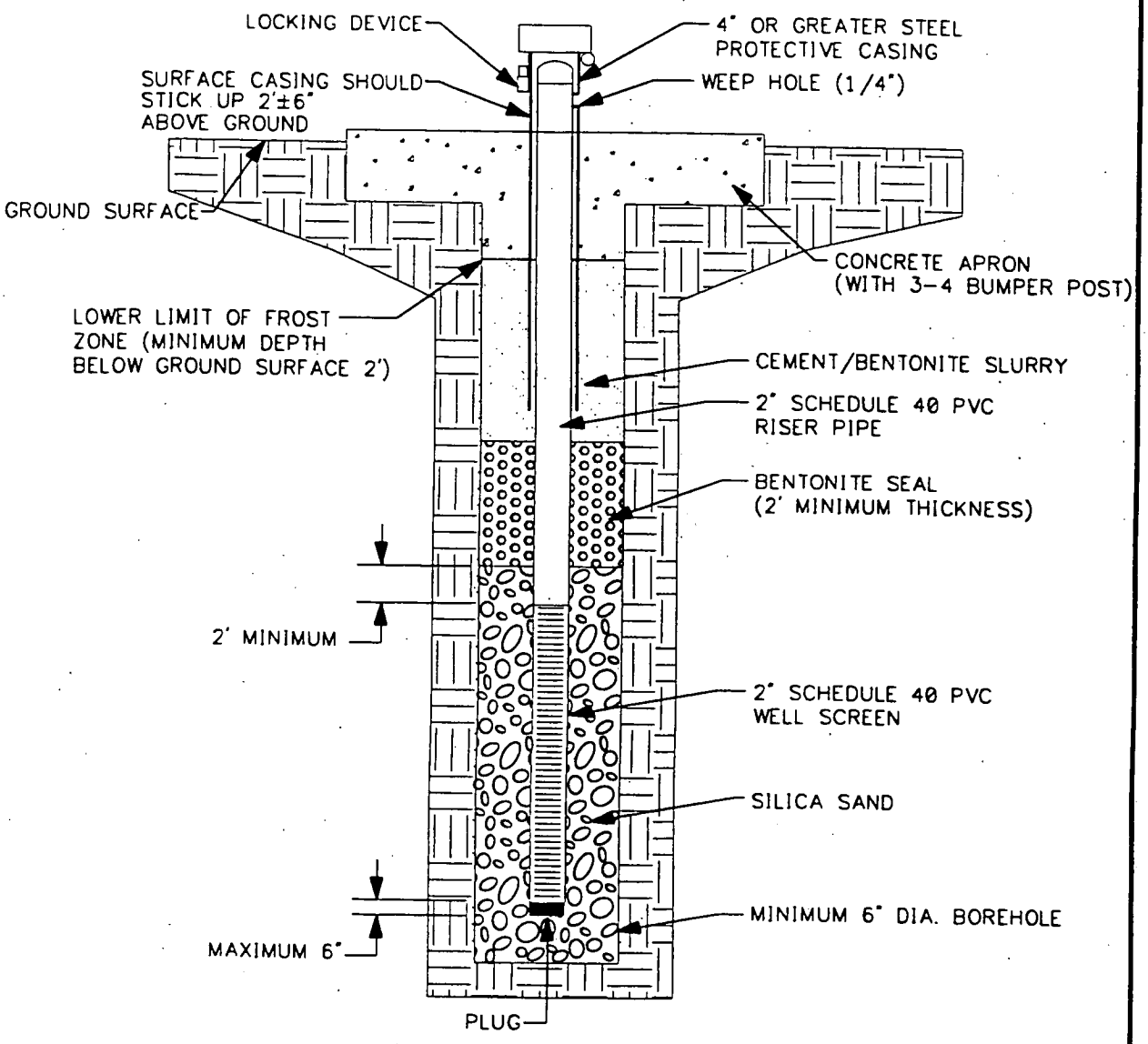

DRAWN BY KW DATE 5/6/99	DEPARTMENT OF THE NAVY SOUTHERN DIV FACILITIES ENGINEERING COMD	TYPICAL STICK-UP CONSTRUCTION UNCONFINED AQUIFER MONITORING WELL NAVAL SURFACE WARFARE CENTER CRANE DIVISION CRANE, INDIANA	CONTRACT NO. 7141
CHECKED BY DATE			APPROVED BY K.M. Sneeder DATE 10/18/99
COST/SCHED-AREA			APPROVED BY DATE
SCALE NOT TO SCALE			DRAWING NO. FIGURE 2-1 REV. 0

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TABLE 2-1

SUMMARY OF SAMPLE ANALYSES, BOTTLE REQUIREMENTS, PRESERVATION REQUIREMENTS, AND HOLDING TIMES
SOIL/SEDIMENT SAMPLES
SWMUs 4, 5, 9 AND 10, NAVAL SURFACE WARFARE CENTER
CRANE DIVISION
CRANE, INDIANA
PAGE 1 OF 2

Parameter	Sample Container	Container Volume	Preservation	Maximum Holding Time[1]	Analytical Methodology
Explosives	Wide-mouthed jar; teflon-lined cap	8 oz [6]	Cool to 4°C	Extraction 14 days; analysis within 40 days of extraction	SW-846[2] Method 8330
Appendix IX Metals	Wide-mouthed jar; teflon-lined cap	8 oz [7]	Cool to 4°C	Within 180 days; Mercury within 28 days	SW-846 Method 6020; Mercury - SW-846 Method 7470A
Metals (Ca, Fe, Mg, Mn, K, Na)	Wide-mouthed jar; teflon-lined cap	8 oz [7]	Cool to 4°C	180 days	SW-846 Method 6010B
Appendix IX Volatile Organic Compounds	4 Encore samplers	Four 5 g containers	Low concentration method sodium bisulfate [3] in field or freeze –10°C at lab	48 hours to preservation; 14 days to analysis 7 days to analysis if samples are frozen	SW-846 Method 8260B (plus SW-846 Method 8015B for 1,4-dioxane, acetonitrile, isobutyl alcohol, and propionitrile)
	4 Encore samplers	Four 5 g containers	High concentration method - methanol	48 hours to preservation; 14 days to analysis	
Appendix IX Semivolatile Organic Compounds	Wide-mouthed jar; teflon-lined cap	8 oz [6]	Cool to 4°C	Extraction 14 days; analysis within 40 days of extraction	SW-846 Method 8270C (plus SW-846 Method 8270C with Selective Ion Monitoring for polynuclear aromatic hydrocarbons [PAHs])
Appendix IX Organochlorine Pesticides/Polychlorinated Biphenyls (PCBs)	Wide-mouthed jar; teflon-lined cap	8 oz [8]	Cool to 4°C	Extraction 14 days; analysis within 40 days of extraction	SW-846 Method 8081A and 8082
Appendix IX Herbicides	Wide-mouthed jar; teflon-lined cap	8 oz [8]	Cool to 4°C	Extraction 14 days; analysis within 40 days of extraction	SW-846 Method 8151A
Dioxins/Furans	Wide-mouthed jar; teflon-lined cap	8 oz	Cool to 4°C	Extraction 30 days; analysis within 45 days of extraction	SW-846 Method 8290
Cyanide	Wide-mouthed jar; teflon-lined cap	8 oz [7]	Cool to 4°C	Within 14 days	SW-846 Method 9012A

TABLE 2-1

SUMMARY OF SAMPLE ANALYSES, BOTTLE REQUIREMENTS, PRESERVATION REQUIREMENTS, AND HOLDING TIMES
SOIL/SEDIMENT SAMPLES
SWMUs 4, 5, 9 AND 10, NAVAL SURFACE WARFARE CENTER
CRANE DIVISION
CRANE, INDIANA
PAGE 2 OF 2

Parameter	Sample Container	Container Volume	Preservation	Maximum Holding Time[1]	Analytical Methodology
Nitrate	Wide-mouthed jar; teflon-lined cap	8 oz [7]	Cool to 4°C	48 hours [4]	SW-846 Method 9056
Nitrite	Wide-mouthed jar; teflon-lined cap	8 oz [7]	Cool to 4°C	48 hours [4]	SW-846 Method 9056
pH	Wide-mouthed jar; teflon-lined cap	8 oz [7]	Cool to 4°C	Analyze as soon as possible	SW-846 Method 9045C
Cation Exchange Capacity (CEC)	Wide-mouthed jar; teflon-lined cap	8 oz [7]	Cool to 4°C	Not specified	SW-846 Method 9081
Total Organic Carbon (TOC)	Wide-mouthed jar; teflon-lined cap	8 oz [7]	Cool to 4°C	28 days [4]	U.S. EPA 415.1

1 All holding times are from date of collection.
2 U.S. EPA, 1986. Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods. SW-846, 3rd ed, including updates.
3 Due to the presence of limestone on-site, sodium bisulfate may not be a viable option for low level preservation.
4 Not specified in analytical method. Holding time is based on requirement for aqueous matrices.
5 U.S. EPA, 1983. Methods for Chemical Analysis of Water and Wastes.
6 Explosives and SVOCs can be analyzed from the same 8 oz jar – 2 extra jars are rquired of MS/MSD.
7 Metals and inorganic parameters can be analyzed from one 8 oz jar – 1 extra jar is required for MS/MSD.
8 Pesticide and herbicides can be analyzed from the same 8 oz jar – 2 extra jars are required for MS/MSD

TABLE 2-2

SUMMARY OF SAMPLE ANALYSES, BOTTLE REQUIREMENTS, PRESERVATION REQUIREMENTS, AND HOLDING TIMES
GROUNDWATER AND SURFACE WATER SAMPLES
SWMUs 4, 5, 9 AND 10, NAVAL SURFACE WARFARE CENTER
CRANE DIVISION
CRANE, INDIANA
PAGE 1 OF 2

Parameter	Sample Container	Container Volume	Preservation[1]	Maximum Holding Time[2]	Analytical Methodology
Explosives	Amber glass, Teflon-lined cap	(2) 1000 mL[3]	Cool to 4°C, dark	Extraction 7 days; analysis within 40 days of extraction	SW-846[4] Method 8330
Appendix IX Metals (total and dissolved)[12]	Polyethylene bottle, plastic cap, plastic liner	(2)1000 mL[5, 8]	HNO_3 to pH < 2	Within 180 days; Mercury within 28 days	SW-846 Method 6020; Mercury - SW-846 Method 7470A
Metals (Ca, Fe, Mg, Mn, K, Na) total and dissolved[12]	Polyethylene bottle, plastic cap, plastic liner	(2)1000 mL[5]	HNO_3 to pH < 2	180 days	SW-846 Method 6010B
Appendix IX Volatile Organic Compounds	Glass, phenolic plastic screw cap, Teflon-lined septum	(6) 40 mL[7]	Cool to 4°C, dark, zero headspace, HCl to pH < 2	14 days	SW-846 Method 8260B[8] (plus SW-846 Method 8015B for 1,4-dioxane, acetonitrile, isobutyl alcohol, and propionitrile)
Appendix IX Semivolatile Organic Compounds	Amber glass, Teflon-lined cap	(3) 1000 mL[9]	Cool to 4°C, dark	Extraction 7 days; analysis within 40 days of extraction	SW-846 Method 8270C (plus SW-846 Method 8270C with Selective Ion Monitoring for polynuclear aromatic hydrocarbons [PAHs])
Appendix IX Organochlorine Pesticides/Polychlorinated Biphenyls (PCBs)	Amber glass, Teflon-lined cap	(3) 1000 mL[3]	Cool to 4°C, dark	Extraction 7 days; analysis within 40 days of extraction	SW-846 Method 8081A and 8082
Appendix IX Herbicides	Amber glass, Teflon-lined cap	(2) 1000 mL[3]	Cool to 4°C, dark	Extraction 7 days; analysis within 40 days of extraction	SW-846 Method 8151A
Dioxins/Furans	Amber glass, Teflon-lined cap	(2) 1000 mL[3]	Cool to 4°C, dark	Extraction 30 days; analysis within 45 days of extraction	SW-846 Method 8290
Cyanide (total and dissolved)[12]	Polyethylene bottle, plastic cap, plastic liner	500 mL	Cool to 4°C, NaOH to pH > 12	Within 14 days	SW-846 Method 9012A

TABLE 2-2

SUMMARY OF SAMPLE ANALYSES, BOTTLE REQUIREMENTS, PRESERVATION REQUIREMENTS, AND HOLDING TIMES
GROUNDWATER AND SURFACE WATER SAMPLES
SWMUs 4, 5, 9 AND 10, NAVAL SURFACE WARFARE CENTER
CRANE DIVISION
CRANE, INDIANA
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Parameter	Sample Container	Container Volume	Preservation[1]	Maximum Holding Time[2]	Analytical Methodology
Nitrate/Nitrite	Polyethylene bottle, plastic cap, plastic liner	250 mL[10]	Cool to 4°C, H_2SO_4 to pH <2	28 days	EPA 353.2 [11]
Total Suspended Solids	Polyethylene bottle, plastic cap, plastic liner	250 mL	Cool to 4°C	Analyze 7 days	U.S. EPA Method 160.2

1 HCl = Hydrochloric acid, H_2SO_4 = Sulfuric Acid, NaOH = Sodium Hydroxide, HNO_3 = Nitric Acid
2 All holding times are from date of collection.
3 Two additional 1000 mL bottles are required for samples designated for matrix spike/matrix spike duplicate analysis (minimum 1 in 20 samples).
4 U.S. EPA, 1986. Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods. SW-846, 3rd ed, including updates.
5 One 1000 mL bottle of unfiltered groundwater will provide sufficient sample volume for the analysis for Appendix IX metals (total) and/or total iron. Likewise, one 1000 mL bottle of filtered groundwater will provide sufficient sample volume for the analysis for Appendix IX metals (dissolved) and/or dissolved calcium, magnesium, and manganese.
6 One additional 1000 mL bottle is required for samples designated for matrix spike/duplicate analysis (minimum 1 in 20 samples).
7 Eight additional 40 mL vials are required for samples designated for matrix spike/matrix spike duplicate analysis (minimum 1 in 20 samples).
8 Analysis will be performed using a 25 mL sample volume to achieve lower quantitation limits for groundwater samples.
9 Four additional 1000 mL bottles are required for samples designated for matrix spike/matrix spike duplicate analysis (minimum 1 in 20 samples).
10 Nitrate/nitrite will be providied for anlaysis in the same 250 mL bottle.
11 U.S. EPA, 1983. Methods for Chemical Analysis of Water and Wastes.
12 Total and dissolved for surface water only.

2.4.1.1 Water Level Measurements

Measurements will be taken with an electrical water-level indicator (M-scope) or other approved instruments, using the top of the well riser as the reference point for determining depths to water. All measurements will be taken in accordance with CTO 10 SOP 2, contained in Attachment B. A notch or marking will be used at the top of the PVC riser pipe to ensure that measurements are taken consistently between measuring events. If a notch, mark, or surveyed reference point is not visible on the top of casing, a mark will be made. Water-level measurements will be recorded to the nearest 0.01 foot in the appropriate field log book and on a ground water-level measurement form, provided in Attachment A.

2.4.1.2 Well Purging

Purging and sampling will be accomplished using low-flow techniques in accordance with CTO 10 SOP 3. The low-flow procedures are based on the 1996 paper entitled "Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures, EPA/540/S-95/504 (Puls, R.W., and M.J. Barcelona, 1996). Low-flow purging and sampling is being implemented because this method will provide the least disturbance to the surrounding formation (i.e., less turbulence in sampling and hence less turbidity) and will allow for a more representative sample to be collected. Field measurements of pH, temperature, specific conductance, dissolved oxygen (DO), oxidation-reduction potential (ORP), turbidity, and water levels are taken before and during the purging process.

Wells will be purged prior to sampling using a peristaltic pump or bladder pump depending on well depths. Surface-type pumps (peristaltic pumps) will use disposable tubing that will be washed and disposed as trash (see Section 2.12). Submersible pumps (bladder pumps) will require decontamination between each well point.

Upon opening the well cap, a PID reading of air within the riser pipe will be taken prior to purging or sampling to determine appropriate personal protective equipment. Following collection and recording of the PID reading, the water level and the total depth of the monitoring well will be measured to within 0.01 foot accuracy from the marked location on the top of the well riser pipe using an M-scope. Water levels will be monitored every 5 to 10 minutes as purging occurs.

Initially, the pumping rate will be set at approximately 0.1 liters per minute, or lower if possible. The pumping rate will be reduced if turbidity is greater than 10 NTUs after all field parameters have stabilized.

The pumping rates will be adjusted to prevent drawdown from exceeding 0.3 feet during purging. If ground water is drawn down below the pump intake, purging will cease, and the well will be allowed to recover before purging continues. Slow recovering wells will be identified and purged at the beginning of the work day. If possible, samples will be collected from these wells within the same 8-hour workday. During purging, water quality parameters [pH, turbidity, specific conductance, temperature, ORP, and DO] will be measured and recorded every 5 to 10 minutes using a multi-parameter analyzer. Stabilization of the above parameters is defined as follows:

- Temperature $\pm$ 3%;
- pH $\pm$ 0.1 standard units;
- turbidity < 10 NTUs, and;
- specific conductance $\pm$ 3%, and;
- DO $\pm$ 10%.

Well purging will continue until all parameters have stabilized and the minimum purge volume (stabilized well volume plus the extraction tubing volume) has been removed. If the parameters have not stabilized within 4 hours or 3 well volumes have been purged, this information will be recorded and sampling will begin.

Purge water will be containerized into appropriate containers and discharged into the NSWC-permitted sanitary sewer system.

2.4.1.3 Sampling of Monitoring Wells

All monitoring wells will be sampled using low-flow purging and sampling techniques. Sample handling and custody procedures are discussed in Sections 2.5 and 2.6, respectively.

Monitoring wells will be sampled using the same pump (peristaltic or bladder) and tubing used during well purging. Immediately following the purging process and before sampling, the temperature, pH, specific conductance, DO, ORP, and turbidity of the water sample will be measured and recorded on the Groundwater Sample Log Sheet (included in Attachment A).

All sample containers will be filled by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence. Samples for volatile analysis will be collected first by the pipette

method (see Attachment B) and immediately sealed in a container so that no head space exists. Samples for semivolatile, pesticides/polychlorated biphenyls (PCBs) and metals analyses will be collected next. Immediately after collection, samples will be sealed and placed in a cooler at 4 °C.

2.4.2 Soil Sampling

Within most soil borings, two soil intervals will be collected as samples for quantitative laboratory analysis. The surface interval is collected in all cases but the subsurface interval will be selected in the field based on the presence of certain screening criteria or in the absence of criteria on a random basis.

2.4.2.1 Surface Soil Sampling

Surface soil samples will be collected from the ground surface to a maximum depth of 2 feet using DPT, split-spoon sampling techniques, stainless steel hand auger, or using a single-use, dedicated plastic trowel. Upon sample retrieval, all samples obtained will be monitored with a PID and then collected for lithologic and chemical analysis. Samples to be analyzed for organic parameters will be taken first along the 1- to 2-foot soil interval. Samples for volatile organic compound (VOC) analysis will be collected with EnCore samplers. Samples for non-volatile organics and inorganic parameters (metals, etc.) will be collected from 0 to 2 foot bgs. All samples will be placed in a cooler at 4 °C immediately after collection. Before samples are taken, all pertinent ambient conditions and field data are recorded in the field logbook and on the soil sample log sheet (included in Attachment A) as described in Section 2.5. For additional guidance regarding surface soil sampling refer to CTO 10 SOP 7, contained in Attachment B.

2.4.2.2 Sample Field Screening

A screening process will be used to select a subsurface soil interval to be sampled and sent for laboratory analyses. Screening will be based on qualitative volatile organic measurements with a PID, visual observation of staining, or wet soils defining the uppermost (surficial) ground water aquifer. In the absence of volatiles, staining or free water, a random interval will be collected to represent the exposure of receptors from subsurface soils. To minimize unused volatile samples, a random interval will be identified before pushing or drilling the soil boring. The primary objective of the screening process is to select the most contaminated subsurface soil interval by PID or staining. The secondary objective is to select the most relevant soil interval for quantification by laboratory analysis by identifying the soil interval immediately above (and most likely to impact) the uppermost ground water. If volatiles are not elevated, staining is not observed and ground water is not identified above the pre-defined random interval, then the samples for laboratory analysis will be collected from this random interval.

2.4.2.3 Subsurface Soil Sampling

Subsurface soil samples will be collected from soil borings using direct-push 4-foot core samplers or 2-foot split-spoon samplers, as appropriate. All subsurface soil sampling will be done in accordance with CTO 10 SOP 7, contained in Attachment B. Selection of intervals for sampling is based on elevated volatile organics, staining or saturation. All samples obtained from the borehole will be immediately screened with a PID and visually scanned for staining or saturation before collection for lithologic and/or chemical analysis, as appropriate. Borehole locations are described in site-specific field sampling plans outlined in Sections 3.1 through 3.4. The soil sample for laboratory analysis will be collected from a randomly selected 1-foot interval unless the soil exhibits an elevated PID reading, visual staining or non-native soils are observed, or ground water is reached. Several soil samples for VOC analysis may be collected at shallow depths before the highest PID measurement is observed. The soil sample with the highest PID reading will be sent to the laboratory for VOC analysis. The remaining soil samples from the other depths will be discarded, accordingly.

Upon sample retrieval, the soil to be analyzed for VOCs will be collected first using EnCore samplers and placed in a cooler of ice. All other soil to be analyzed for other parameters [i.e., semivolatile organic compounds (SVOCs), metals, etc.] will then be mixed, placed into the required containers, immediately sealed, and placed in a cooler at 4 °C. The 4-foot long clear plastic sleeves inside of the direct-push samplers will be disposed of as described in Section 2.12. If used, split spoon samplers will be decontaminated between sample collection as described in Section 2.11. All pertinent field data are recorded on a Soil Sample Log Sheet (included in Attachment A) and in the field logbook.

2.4.3 Surface Water Sampling

Surface water samples will be collected from the locations described in the site-specific sampling plans (Section 3.0) and submitted to a fixed-based laboratory. The objective of this section is to present the proper use of sampling equipment and proper techniques for sample collection. All surface water sampling will meet the requirements of the project Work Plan and QAPP and CTO 10 SOP 5, contained in Attachment B.

At each sampling location, surface water samples will be taken before sediment samples, at midstream, just below the water surface. For VOCs, sample containers will be filled directly from the surface water body using no transfer bottle. For all other parameters, the water will be sampled with any type of clean stainless-steel pitcher, jar, or extra unpreserved clean glass sample bottle supplied by the laboratory. Filtered and unfiltered surface water will be collected for metals analysis. For filtration of surface water

samples, unpreserved polyethylene bottles will be used to transfer samples. Immediately after collection, samples will be sealed and placed in a cooler at 4°C.

A sampling location description form (Attachment A) will be completed for each sampling point, either during an initial survey or at the time of sample collection. However, field measurements will be taken at the time of sampling, including DO, ORP, pH, specific conductance, temperature, and turbidity. Suitable meters that have been calibrated will be used for pH and temperature, but DO will be measured with an instrument with a polarographic probe.

2.4.4 Sediment Sampling

Sediment samples will be collected from the locations described in the site-specific sampling plans (Section 3.0) and submitted to a fixed-based laboratory. The objective of this section is to present the proper use of sampling equipment and proper techniques for sample collection. All sediment sampling will meet the requirements of the project Work Plan, QAPP, and CTO 10 SOP 6, contained in Attachment B.

After surface water samples have been collected, sediment will be sampled in the same vicinity, but only in a depositional area. Depositional areas will have slowly moving water and predominately fine (clay and silt) particles. Sediment samples will be restricted to the aerobic zone, up to a maximum depth of six inches. (The anaerobic zone may be characterized by darker colors and sulfide odor.) Any sampler is suitable that can be decontaminated and that does not disturb the surface fines when sampling. Samples for VOC analysis will be taken first and immediately sealed. Immediately after collection, all samples will be placed in a cooler at 4 °C.

2.5 FIELD SAMPLE DOCUMENTATION

Sample documentation consists of the completion of COC forms and matrix-specific sample logsheets. COC forms are discussed in Section 5 of the QAPP. Additionally, COC forms are explained in the CTO 10 SOP 11. The sample logsheets contain information such as container source and description; sample type; and time, date, and method of sample collection. Any problems or unusual circumstances encountered during sample collection are noted on the form. Sample logsheets are sequentially numbered and placed in a sample logbook. Examples of sample logsheets for the various media are contained in Attachment A.

All samples taken at NSWC Crane will be properly labeled with a sample label affixed on the sample container. Detailed information to be written on the sample labels is outlined in CTO 10 SOP 10 (Attachment B).

2.6 SAMPLE HANDLING, PACKAGING, AND SHIPPING

Sample handling includes the field-related considerations concerning the selection of sample containers, preservatives, allowable holding times, and analyses requested. Sample nomenclature is addressed in CTO 10 SOP 10. Sampling containers will be wrapped in plastic bubble-wrap to minimize the possibility of breakage and secured in a sealed "Ziploc"-type plastic bag. The secured sample containers will then be placed in a sturdy cooler lined with a large plastic garbage bag. The cooler will be packed with a noncombustible, cushioning material (vermiculite or bubble wrap) to minimize container breakage. Samples will be cooled with bagged ice placed around the shoulders of the sample containers. A temperature blank will be placed in the cooler before shipment. The inside plastic bag liner will be sealed with a knot and the chain-of-custody (COC) form will be sealed in a "Ziploc"-type plastic bag and taped to the inside of the cooler lid. The cooler will be sealed according to CTO 10 SOP 12.

Tables 2-1 and 2-2 provide details concerning sample containers, volume requirements, preservatives, allowable holding times, and analyses requested.

2.7 QUALITY CONTROL (QC) SAMPLES

In addition to calibration of field equipment and appropriate documentation, QC samples are collected or generated during environmental sampling activities. QC samples include field duplicates, ambient condition blanks, source water blanks, equipment rinsate blanks, and trip blanks. Each type of field quality control sample, as well as additional sample aliquots needed to accommodate laboratory QC analyses, are explained in detail in the QAPP (Appendix C). These types of QC samples are briefly described below:

- Field Duplicates. Field duplicates are two samples collected either: 1) independently at a sampling location in the case of ground water and surface water; or 2) as a single sample split into two portions in the case of soil or sediment. Field duplicates are used to assess the overall precision of the sampling and analysis program.

- Ambient condition blanks. Ambient condition blanks consisting of distilled water will be submitted to the laboratory to provide the means to assess the quality of the data resulting from the field sampling

program. Ambient blanks are not collected using the same sampling equipment as the field sample, but are collected while at the field sampling site by placing analyte-free water directly into the same type of container (preserved and stored in the same manner) as the field samples. Ambient blank samples are analyzed to check for background contamination at the facility (e.g., vapors, dust, or exhaust fumes that are part of normal operations at the site) that may cause sample contamination. The exposure of the ambient blank to ambient conditions should be similar to the ambient exposure of the field samples. Ambient blanks will be collected based on conditions at the time of sampling at the discretion of the FOL, with a minimum of one ambient blank being collected during this investigation.

- Equipment Rinsate Blanks. Equipment rinsate blanks are obtained under representative field conditions by collecting the rinse water generated by running analyte-free water through or over sample collection equipment after decontamination and before use. One rinsate blank per 10 samples per matrix will be collected per each type of sampling equipment used (i.e., bailer, split-spoon samples, hand tools, etc.). At least one equipment rinsate blank will be collected per day, per sampling event. A sampling event is matrix-specific; therefore, an equipment rinsate blank must be collected for each matrix sampled. However, if pre-cleaned, dedicated, or disposable sampling equipment is used, one rinsate blank will be collected as a "batch blank." Rinsate blanks are analyzed for the same chemical constituents as the associated environmental samples.

- Trip blanks. Trip blanks are used to determine whether contamination of the sample or bottleware has occurred during transit or storage. Trip blanks consist of analyte-free water taken from the laboratory to the site and returned to the laboratory. Trip blanks are analyzed for volatile organic compounds only.

- Source water blanks. Source water blanks are obtained by sampling the analyte-free water and/or potable water source(s) used for decontamination of sampling equipment. If applicable, source water blanks are used to determine whether the analyte-free water or the potable water (used for steam cleaning) may be contributing to sample contamination. If nondedicated bailers/bladder pumps are used for existing wells or if new wells are installed, one source water blank will be collected for each source of water used for decontamination.

Unless otherwise provided for in the planning documents for SWMUs 4, 5, 9, and 10, 10 percent sample duplication per media, one field blank per decontamination water source, one trip blank per cooler containing VOC samples, and one rinsate blank obtained per 10 aqueous samples and one rinsate blank per 20 soil samples collected by each type of sampling device will be observed as QA/QC measures.

However, if pre-cleaned, dedicated, or disposable sampling equipment is used, one rinsate blank will be collected as a "batch blank."

2.8 FIELD MEASUREMENTS

Field measurements will be recorded during field sampling operations. These measurements include ambient air quality, water temperature, pH, turbidity, specific conductance, ORP, DO, and water-level measurements. Ambient air quality measurements include monitoring of organic vapors in the breathing zone during intrusive field investigation activities and monitoring of organic vapors emanating from site sources such as soil samples and well casings. Several instruments used during field activities to achieve these measurements include the following:

- PID
- YSI Model 6 series, Multi-Parameter Water Quality Meter
- M-scope

The YSI Model 6 (or equivalent) is to be used for both ground and surface water measurements. CTO 10 SOP 13 in Attachment B provides additional details concerning the PID.

2.8.1 Equipment Calibration

As a rule, instruments used in the field will be calibrated daily prior to use and calibration fluids will be measured at the end of each day. These instruments will be calibrated according to manufacturer requirements.

Calibration of the water quality meter is described in CTO 10 SOP 15 located in Attachment B.

For specific instructions on calibration procedures, calibration frequency, the acceptance criteria and the conditions that will require more frequent calibration regarding the PID, see CTO 10 SOP 13 (Attachment B).

2.8.2 Field Instrument Preventive Maintenance Procedure/Schedule

The field instruments for this project include the PID and a combination temperature, specific conductance, pH, turbidity, DO, and ORP meter. Specific preventive maintenance procedures to be followed for field equipment are those recommended by the manufacturer.

Field instruments will be checked and calibrated daily before use. Calibration checks will be documented on the calibration log sheet (Attachment A). The maintenance schedule and trouble-shooting procedures for the Photovac PID are indicated in CTO 10 SOP 13 (Attachment B).

The YSI has a maintenance procedure outlined in CTO 10 SOP 15 (Attachment B). Critical spare parts will be kept on site to reduce downtime. Spare parts for the PIDs are listed in the SOP. Spare parts for the YSI include batteries and a membrane kit (membranes and a bottle of solution). Backup instruments and equipment will be available on site or within 1 day via shipment to avoid delays in the field schedule.

2.9 FIELD CORRECTIVE ACTION

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or "out of quality control" performance that can affect data quality.

Corrective action in the field could result when the sample network is changed (e.g., more/less samples, sampling locations other than those specified, etc.), and sampling procedures and/or field analytical procedures require modification. Project personnel will be responsible for reporting all suspected technical or QA nonconformances or suspected deficiencies of any activity or issued document by reporting the situation to the FOL or designee. The TOM will be responsible for assessing the suspected problems in consultation with the project QA/QC Manager and making a decision based on the potential for the situation to affect the quality of the data. If it is determined that the situation warrants a reportable nonconformance requiring corrective action, then a nonconformance report will be initiated by the manager.

The FOL will be responsible for ensuring that corrective action for nonconformances is initiated by:

- Evaluating all reported nonconformances
- Controlling additional work on nonconforming items
- Determining disposition or action to be taken
- Maintaining a log of nonconformances
- Reviewing nonconformance reports and corrective action taken
- Ensuring nonconformance reports are included in the final site documentation in project files.

If appropriate, the FOL will ensure that no additional work that is dependent on the nonconforming activity is performed until the corrective actions are completed.

Corrective action for field measurements may include the following:

- Repeat the measurement to check the error
- Check for all proper adjustments for ambient conditions such as temperature
- Check the batteries
- Re-calibration
- Check the calibration
- Replace the instrument or measurement devices
- Stop work (if necessary).

The FOL or his or her designee is responsible for all site activities. In this role, the FOL at times is required to adjust the site programs to accommodate site-specific needs. When it becomes necessary to modify a program, the following field change procedure must take place:

- The responsible person notifies the FOL of the anticipated change.

- The FOL notifies the TOM of the need for the change.

- If necessary, the TOM discusses the change with the pertinent individuals (e.g., the Navy Remedial Project Manager [RPM], TtNUS Quality Assurance Manager [QAM]). Verbal or written approval or denial of the proposed change is then given to the FOL.

- If acceptable, the FOL then documents the change on a Field Task Modification Record (FTMR) form. The FTMR form documents the need for the change from original procedures outlined in the FSP, when the change was made and how the change was made.

- The FOL forwards the FTMR to the TOM at the earliest convenient time (e.g., end of the workweek).

- The TOM signs the form and distributes copies to the Navy RPM, TtNUS QAM, FOL, and project file. The RPMs will be notified whenever program changes are made in the field.

- A copy of the completed FTMR is attached to the field copy of the affected document.

Corrective action resulting from internal field audits will be implemented immediately if data may be adversely affected because of unapproved or improper use of approved methods. The TtNUS quality

assurance officer will identify deficiencies and recommend corrective action to the TOM. Implementation of corrective actions will be performed by the TtNUS field investigation team as directed by the FOL. Corrective action will be documented in quality assurance reports distributed to the entire project management team.

Corrective actions will be implemented and documented in the field logbook. No staff member will initiate corrective action without prior communication of findings through the proper channels. If corrective actions are insufficient, work may be stopped by the Navy and U.S. EPA RPMs.

Calibration is documented on an Equipment Calibration Log (see Attachment A). During calibration, an appropriate maintenance check is performed on each piece of equipment. If damaged or defective parts are identified during the maintenance check and it is determined that the damage could have an impact on the instrument's performance, the instrument is removed from service until the defective parts are repaired or replaced.

2.10 SURVEYING

All new monitoring wells, soil borings, surface soil locations, surface water, and sediment sample locations associated with this sampling event will be surveyed. The top of the riser pipe (where the uncapped well riser is notched), the top of the protective casing, and the ground surface elevation at each monitoring well location will be surveyed to within 0.01 foot vertical accuracy. For all other locations mentioned, the ground surface elevation will be surveyed to the nearest 0.10 foot. Vertical elevations will be referenced to the 1988 North American Vertical Datum (NAVD88). Existing survey monuments around NSWC Crane will be used as reference points. Horizontal locations of samples, borings, and wells will be surveyed to Indiana State Plane coordinates within the nearest 0.10 foot and referenced to the 1983 North American Datum (NAD83).

2.11 DECONTAMINATION

The equipment involved in field sampling activities will be decontaminated before beginning work, during drilling and sampling activities, and at the completion of the project. This equipment includes drilling rigs, down-hole tools, augers, well casing and screens, and soil and water sampling equipment.

2.11.1 Major Equipment

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

Well casing and screens, if not supplied at the site in certified clean packaging, will be cleaned with high-pressure hot water before installation into the borings.

All decontamination activities take place at a predetermined area within NSWC Crane. Additional requirements for drilling equipment decontamination are found in CTO 10 SOP 9 provided in Attachment B.

2.11.2 Sampling Equipment

All nondedicated reusable sampling equipment used for collecting samples will be decontaminated both before field sampling and between samples. This equipment includes hand augers, trowels, split-spoon samplers, mixing bowls, clamshell dredges, and hollow sample tubes. The following decontamination steps will be taken:

- Potable water, phosphate-free detergent wash (scrub if necessary)
- Potable water rinse
- Deionized (DI) water rinse
- Isopropanol (only if oily soil conditions are encountered).
- Deionized water rinse
- Air dry (if possible)
- Wrap in aluminum foil (if not to be used immediately)

Additional guidance for decontamination is supplied in CTO 10 SOP 9 contained in Attachment B.

Disposable equipment used for sampling activities shall be decontaminated using detergent wash and potable water rinse, placed in plastic garbage bags, and discarded in dumpsters at NSWC Crane in accordance with procedures described in Section 2.12 of this FSP.

Field analytical equipment such as pH, conductivity, and temperature probes will be rinsed first with analyte-free water, then with the sample liquid. Water level measurement devices will be rinsed with potable water.

2.12 INVESTIGATION DERIVED WASTE HANDLING

Field investigations can generate six types of potentially contaminated residues; namely, personal protective equipment (PPE), drill rig decontamination fluids, sampling equipment decontamination fluids, DPT plastic sleeves purge water, and soil cuttings. Based on the activities and types of contaminants present, none of the residues are expected to represent a significant risk to human health or the environment if properly managed. Planned management of each residue is provided in the following.

PPE - PPE will be double bagged and placed in NSWC Crane trash receptacles (i.e., dumpsters).

Drill Rig Decontamination Fluids - Drill rig decontamination fluids will be containerized in U.S. Department of Transportation (DOT) approved (Specification 17-C/H), 55-gallon drums and staged on wooden pallets in an area established by TtNUS personnel and the Navy. All drums will be sealed and labeled with drum contents, well/boring number, and date. One composite sample will be collected and analyzed to determine whether the material is hazardous. Based on the results of the analyses, a determination will be made whether offsite disposal and/or treatment are required. If investigative derived waste (IDW) materials are shown to be hazardous, TtNUS will arrange for proper removal and disposal of the drummed wastes although Navy representatives must sign all necessary manifest documentation.

Sampling Equipment Decontamination Fluids - Equipment decontamination fluids will be containerized and handled in the same manner as the drill rig decontamination fluids.

DPT Plastic Sleeves - The sample sleeves will be cleaned of visual soil and disposed as trash.

Purge Water/Development Water - Purge water and development liquids will be discharged into the NSWC-permitted sanitary sewer system.

Drill Cuttings - Soil cuttings will be containerized and handled in the same manner as the drill rig decontamination fluids.

2.13 SITE MANAGEMENT AND FACILITY SUPPORT

The FOL will be designated as the lead in coordinating all day-to-day activities during the investigation. The FOL is responsible for ensuring that all field team members (including subcontractors) are familiar with the FSP and site-specific HASP. Additionally, the FOL will be responsible for all sampling operations, QA/QC, field documentation requirements, and field change orders. The FOL will also regularly report to the TOM regarding the status of field work and any problems that may occur.

All site preparation, mobilization/demobilization, and sampling activities will be coordinated through NSWC Crane personnel.

2.14 RECORD KEEPING

Various hard cover, bound, record books will be maintained for each field activity in accordance with CTO 10 SOP 11, contained in Attachment B. The Master Site Logbook serves as the overall record of field activities. Information included daily in the Master Site Logbook includes daily field activities, weather conditions, identity and arrival and departure times of personnel, management issues, etc. Various field notebooks will also be maintained. For example, the geologist supervising drilling operations may also maintain a field notebook.

The FOL is responsible for the maintenance and security of all field records. Eventually, all field records (COCs, sample logsheets, logbooks, and notebooks) will be docketed and incorporated in the central project file.

The FOL is responsible for initiation and completion of FTMRs. These FTMRs are specific forms initiated when a change to or deviation from procedures provided for in the project planning documents occurs. The procedure for requesting and recording field changes is outlined in Section 2.9.

3.0 SITE-SPECIFIC FIELD SAMPLING PLANS

3.1 SWMU 4 – McCOMISH GORGE

Background information about McComish Gorge, including a site description and summary of previous investigations, can be found in Section 5.0 of the Work Plan. Also included in Section 5.0 of the Work Plan is a detailed description of the proposed investigation for SWMU 4. The objectives of the proposed investigation are as follows:

- To determine human health and ecological risks for potential receptors exposed to site media under current and future land use scenarios.
- To determine if off-SWMU groundwater, surface water and sediment have been impacted by the site.

Proposed sampling activities at McComish Gorge to meet these objectives is presented in Table 5-5 of the Risk Assessment Work Plan and summarized below. Figure 5-8 of Work Plan shows proposed sampling locations at SWMU 4. Sample containers, preservation requirements, and holding times are provided in Tables 2-1 and 2-2.

3.1.1 SWMU 4 Surface and Subsurface Soil Sampling

Two surface soil samples (04SS01 and 04SS02) will be collected at locations based on field observations of surface debris at the site. Section 2.4.2.1 describes specific procedures for collecting surface soil samples. Tables 3-1 and 3-2 present summaries of soil samples to be collected at SWMU 4, including numbers and types of QA/QC samples.

Eight soil borings will be installed by DPT or HSA at SWMU 4, including:

- Six borings designated 04SB01 through 04SB06 to be located at areas within SWMU 4 corresponding to detected geophysical anomalies.
- Two soil borings designated 04SB07 and 04SB08 to be spatially distributed along the western portion of the site.

TABLE 3-1

SOIL AND SEDIMENT SAMPLES
SWMU 4 – McCOMISH GORGE
NSWC CRANE, INDIANA
PAGE 1 OF 2

Sample/ Boring No.	Sample Depth	General Location	Analyses								
			App. IX VOCs (8260B)	App. IX VOCs (8015B)	App. IX SVOCs	App. IX Pest./PCBs	App. IX Herbicides	App. IX Metals	Ca, Fe, Mn, Mg, K, Na	Cyanide	CEC, pH, TOC
SURFACE/SUBSURFACE SOIL											
04SS01	0–2 feet	Near surface debris	X	X	X	X	X	X	X	X	(1)
04SS02	0–2 feet	Near surface debris	X	X	X	X	X	X	X	X	(1)
04SB01	0–2 feet TBD (2)	Based on geophysical anomalies	X	X	X	X	X	X	X	X	(1)
04SB02	0–2 feet TBD(2)	Based on geophysical anomalies	X	X	X	X	X	X	X	X	(1)
04SB03	0–2 feet TBD(2)	Based on geophysical anomalies	X	X	X	X	X	X	X	X	(1)
04SB04	0–2 feet TBD(2)	Based on geophysical anomalies	X	X	X	X	X	X	X	X	(1)
04SB05	0–2 feet TBD(2)	Based on geophysical anomalies	X	X	X	X	X	X	X	X	(1)
04SB06	0–2 feet TBD(2)	Based on geophysical anomalies	X	X	X	X	X	X	X	X	(1)
04SB07	0–2 feet TBD(2)	Along western portion of the site	X	X	X	X	X	X	X	X	(1)
04SB08	0–2 feet TBD(2)	Along western portion of the site	X	X	X	X	X	X	X	X	(1)
SEDIMENT											
04SD01	-	Culpepper Branch upstream of site	X	X	X	X	X	X	X	X	TOC
04SD02	-	Culpepper Branch downstream of site	X	X	X	X	X	X	X	X	TOC

TABLE 3-1

SOIL AND SEDIMENT SAMPLES
SWMU 4 – McCOMISH GORGE
NSWC CRANE, INDIANA
PAGE 2 OF 2

Sample/ Boring No.	Sample Depth	General Location	Analyses								
			App. IX VOCs (8260B)	App. IX VOCs (8015B)	App. IX SVOCs	App. IX Pest./PCBs	App. IX Herbicides	App. IX Metals	Ca, Fe, Mn, Mg, K, Na	Cyanide	CEC, pH, TOC
04SD03	-	Culpepper Branch downstream of site	X	X	X	X	X	X	X	X	TOC
04SD04	-	In wetland/marsh east of the site	X	X	X	X	X	X	X	X	TOC
04SD05	-	Unnamed tributary within site boundaries	X	X	X	X	X	X	X	X	TOC
04SD06	-	Unnamed tributary immediately downstream of site	X	X	X	X	X	X	X	X	TOC

1 CEC, pH and TOC to be collected for 30 percent of soil samples.
2 Sample to be collected at a discrete one-foot interval from 2 to 10 feet below ground surface based on the following: Elevated PID readings; Visual observations of contamination/non-native soils; Immediately above the water table (if encountered prior to 10 feet). See Section 2.4.2 for details.

Ca = Calcium
CEC = Cation exchange capacity
Fe = Iron
K = Potassium
Mg = Magnesium
Mn = Manganese
Na = Sodium
PCBs = Polychlorinated biphenyls
Pest = Pesticides
PID = Photoionization detector
TBD = To be determined
TOC = Total organic carbon
SVOCs = Semivolatile organic compounds
VOCs = Volatile organic compounds

TABLE 3-2

FIELD SAMPLE SUMMARY - SOIL/SEDIMENT
SWMU 4 - McCOMISH GORGE
NSWC CRANE, INDIANA

Analysis	Methodology	Samples	Duplicates	Rinsate Blanks	Trip Blanks	Ambient Blanks	Matrix Spike/ Matrix Spike Duplicates	Total[1]
Sediment								
Appendix IX VOCs	SW-846 Method 8260B (plus SW-846 Method 8015B for 1,4-dioxane, acetonitrile, isobutyl alcohol, and propionitrile)	6	1	1	TBD	TBD	1	9
Appendix IX VOCs	SW-846 Method 8015B for 1,4-dioxane, acetonitrile, isobutyl alcohol and propionitrile	6	1	1	TBD	TBD	1	9
Appendix IX SVOCs	SW-846 Method 8270C (plus SW-846 Method 8270C with Selective Ion Monitoring for PAHs)	6	1	1	NA	TBD	1	9
Appendix IX Pesticides/PCBs	SW-846 Method 8081A and 8082	6	1	1	NA	TBD	1	9
Appendix IX Herbicides	SW-846 Method 8151A	6	1	1	NA	TBD	1	9
Appendix IX Metals	SW-846 Method 6020; Mercury - SW-846 Method 7470A	6	1	1	NA	TBD	1	9
Miscellaneous Metals (Ca, Fe, Mg, Mn, K, Na)	SW-846 Method 6010B	6	1	1	NA	TBD	1	9
Cyanide	SW-846 Method 9012A	6	1	1	NA	TBD	1	9
Total Organic Carbon	EPA 415.1	6	NA	NA	NA	NA	NA	6
Surface/Subsurface Soil								
Appendix IX VOCs	SW-846 Method 8260B	18	2	1	TBD	TBD	1	22
Appendix IX VOCs	SW-846 Method 8015B for 1,4-dioxane, acetonitrile, isobutyl alcohol and propionitrile	18	2	1	TBD	TBD	1	22
Appendix IX SVOCs	SW-846 Method 8270C (plus SW-846 Method 8270C with Selective Ion Monitoring for PAHs)	18	2	1	NA	TBD	1	22
Appendix IX Pesticides/PCBs	SW-846 Method 8081A and 8082	18	2	1	NA	TBD	1	22
Appendix IX Herbicides	SW-846 Method 8151A	18	2	1	NA	TBD	1	22
Appendix IX Metals	SW-846 Method 6020; Mercury - SW-846 Method 7470A	18	2	1	NA	TBD	1	22
Miscellaneous Metals (Ca, Fe, Mg, Mn, K, Na)	SW-846 Method 6010B	18	2	1	NA	TBD	1	22
Cyanide	SW-846 Method 9012A	18	2	1	NA	TBD	1	22
Total Organic Carbon	EPA 415.1	5	NA	NA	NA	NA	NA	5
CEC	SW-846 Method 9081	5	NA	NA	NA	NA	NA	5
pH	SW-846 Method 9045C	5	NA	NA	NA	NA	NA	5

1 Totals do not include the number of Trip Blanks or Ambient Blanks.

Ca = Calcium
CEC = Cation exchange capacity
Fe = Iron
K = Potassium
Mg = Magnesium
Mn = Managanese
Na = Sodium
NA = Non Applicable

PAHs = Polyaromatic hydrocarbons
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds
TBD = To be determined. Number of samples will be determined on site depending on conditions during sampling.
VOCs = Volatile organic compounds

Two soil samples will be collected from each soil boring as follows:

- At the ground surface (0 to 2 feet bgs). Samples for volatile organic analyses will be collected from 1- to 2-foot interval and samples for non-volatile organic inorganic analyses will be collected from 0- to 2- foot interval.

- At a discrete depth from 2 to 10 feet bgs and based on a screening priority, the sample will be collected from the 1-foot interval with the highest PID reading. If no elevated PID readings are observed, the subsurface sample will be collected based on visual observations of staining or non-native soil. If the water table is encountered within 10 feet bgs, the subsurface sample will be collected from the 1-foot interval immediately above the water table. If none of these situations are encountered, the sample will be collected from a randomly selected 1-foot interval (see CTO 10 SOP 7).

Specific techniques for collecting subsurface soil samples are described in Section 2.4.2.3. Analytical parameters for surface and subsurface soil samples include the following:

- Appendix IX VOCs;
- Appendix IX SVOCs;
- Appendix IX Pesticides/Polychlorinated Biphenyls (PCBs);
- Appendix IX Herbicides;
- Appendix IX Metals;
- Miscellaneous Metals [calcium (Ca), iron (Fe), manganese (Mn), magnesium (Mg), potassium (K), and sodium (Na)]; and
- Cyanide.

In addition, 30 percent of soil samples will be collected and analyzed for cation exchange capacity (CEC), pH, and total organic carbon (TOC).

Further work is needed to define the southern boundary of the site. This will include additional geophysical work using a hand-held magnatometer to survey the mounded areas south of the site. Additional soil samples may be added if the results of the future delineation work show that disposal activities occurred further south of the current estimated site boundary.

3.1.2 SWMU 4 Monitoring Well Installation

Eight existing monitoring wells are present at SWMU 4. Six of the existing wells will be sampled during this event (see Table 3-3). Depths of the six monitoring wells installed in 1981 during the Initial Assessment Study (U.S. ACE WES, 1998) ranged from 17 to 40 feet bgs with the depth of water at 6 to 30 feet bgs. Available well construction information is presented in Table 3-3. The anticipated depths of three new monitoring wells to be installed at the site are not expected to exceed 40 feet or the thickness of the overburden.

3.1.3 SWMU 4 Ground Water Sampling

Nine ground water samples will be collected from six existing (04-01, 04-02, 04-03, 04-04, 04-05, 04-06) and three newly installed monitoring wells at locations within, upgradient, downgradient, and cross-gradient of the site. The upgradient well, to be installed at the western boundary, will be designated 04T01. The new cross-gradient well located at the southern boundary will be designated 04T02, and the new downgradient well at the eastern boundary will be designated 04T03. Monitoring well development and ground water purging and sampling procedures are described in Sections 2.3.2 and 2.4.1, respectively. Tables 3-4 and 3-5 present summaries of ground water samples to be collected at SWMU 4, including numbers of QA/QC samples.

Fixed-based laboratory analytical parameters for ground water samples at SWMU 4 include the following:

- Appendix IX VOCs;
- Appendix IX SVOCs;
- Appendix IX Pesticides/ PCBs;
- Appendix IX Herbicides;
- Appendix IX Metals;
- Miscellaneous Metals (Ca, Fe, Mn, Mg, K, Na); and
- Cyanide.

Filtered ground water samples will be collected for metals analysis only if a turbidity of less than 10 NTUs cannot be achieved during stabilization.

Field parameters to be measured for ground water samples at SWMU 4 include:

- DO;
- ORP;
- pH;
- Specific conductance;
- Temperature; and
- Turbidity.

If constituents detected at the SWMU or known to have been released to on-SWMU media are found in off-SWMU ground water, it will be concluded that this medium is impacted by releases at the SWMU.

3.1.4 SWMU 4 Surface Water and Sediment Sampling

Six surface water and collocated sediment sample sets will be collected including:

- One upstream of the site in Culpepper Branch Creek (outside the western site boundary) designated 04SW/SD01;
- Two downstream of the site from Culpepper Branch Creek designated 04SW/SD02 and 04SW/SD03;
- One within the wetland/marsh area within the suspected site boundary designated 04SW/SD04; and
- Two in an unnamed tributary south/southeast of the site designated 04SW/SD05 and 04SW/SD06. One of these samples will be located within the suspected site boundary and the other will be located downstream of the entire site.

Specific collection procedures for surface water and sediment samples are described in Sections 2.4.3 and 2.4.4, respectively. Tables 3-1 and 3-2 present summaries of sediment samples to be collected, and Tables 3-4 and 3-5 present summaries of surface water samples to be collected at SWMU 4, including numbers and types of QA/QC samples.

Fixed-base laboratory parameters to be analyzed for surface water/sediment samples include:

- Appendix IX VOCs;
- Appendix IX SVOCs;
- Appendix IX Pesticides/ PCBs;

TABLE 3-3

MONITORING WELL CONSTRUCTION INFORMATION
SWMU 4 - McCOMISH GORGE
NSWC CRANE, INDIANA

WELL NUMBER	IAS WELL DESIGNATION	CONSTRUCTION TYPE	REPORTED DEPTH (ft bgs)	ACTUAL DEPTH (ft)	DEPTH TO WATER (ft bgs)	SCREENED INTERVAL (ft bgs)	BENTONITE PLUG (ft bgs)
04-01	WES-4-1-81	2" I.D. Schedule 40 PVC	40	43	30	25.3 - 34.5	21.3 - 23.3
04-02	WES-4-2-81	2" I.D. Schedule 40 PVC	30	31	20	15.4 - 24.6	12.5 - 13.5
04-03	WES-4-3-81	2" I.D. Schedule 40 PVC	15	18	5.5	3.1 - 10.1	1.2 - 2.8
04-04	WES-4-4-81	2" I.D. Schedule 40 PVC	36.9	28.8	26.9	22.9 - 31.9	18.9 - 20.9
04-05	WES-4-5-81	2" I.D. Schedule 40 PVC	19.75	26	9.5	5.22 - 14.4	1.22 - 3.22
04-06	WES-4-6-81	2" I.D. Schedule 40 PVC	25.35	28	15.35	1.62 - 19.83	6.0 - 8.0
04T01	NA	2" I.D. Schedule 40 PVC	TBD	NA	TBD	TBD	TBD
04T02	NA	2" I.D. Schedule 40 PVC	TBD	NA	TBD	TBD	TBD
04T03	NA	2" I.D. Schedule 40 PVC	TBD	NA	TBD	TBD	TBD

bgs = Below ground surface.
ft = feet
IAS = Initial Assessment Study
I.D. = Inside diameter
NA =Not applicable
PVC = Polyvinyl chloride.
TBD = To be determined by geologist based on field conditions.

- Appendix IX Herbicides;
- Appendix IX Metals (total and dissolved for surface water samples);
- Miscellaneous Metals (Ca, Fe, Mn, Mg, K, Na) (total and dissolved for surface water samples);
- Cyanide
- Hardness and total suspended solids (TSS) for surface water samples; and
- TOC for sediment samples.

Field parameters to be measured for surface water samples at McComish Gorge include:

- DO;
- ORP;
- pH;
- Specific conductance;
- Temperature; and
- Turbidity.

No field parameters will be collected for sediment samples.

If constituents detected at the SWMU or known to have been released to on-SWMU media are found in off-SWMU surface water and/or sediment, it will be concluded that these media are impacted by releases at the SWMU.

3.2 SWMU 5 – OLD BURN PIT

Background information about the Old Burn Pit, including a site description and summary of previous investigations, can be found in Section 6.0 of the Work Plan. Also included in Section 6.0 of the Work Plan is a detailed description of the proposed investigation for SWMU 5. The objectives of the proposed investigation are as follows:

- To determine human health and ecological risks for potential receptors exposed to site media under current and future land use scenarios.

- To determine if off-SWMU ground water, surface water and sediment have been impacted by the site.

Proposed sampling activities at the Old Burn Pit to meet these objectives is presented in Table 6-5 of the Risk Assessment Work Plan and summarized below. Figure 6-8 of Work Plan shows proposed sampling

TABLE 3-4

GROUND WATER AND SURFACE WATER SAMPLES
SWMU 4 – McCOMISH GORGE
NSWC CRANE, INDIANA

Well/ Sample Number	General Location	ANALYSES								
		App. IX VOCs (8260B)	App. IX VOCs (8015B)	App. IX SVOCs	App. IX Pest./PCBs	App. IX Herbicides	App. IX Metals	Ca, Fe, Mg, Mn, K, Na	Cyanide	Hardness, TSS
GROUND WATER										
04-01[1]	Within site boundaries	X	X	X	X	X	X[3]	X[3]	X[3]	NA
04-02[1]	Within site boundaries	X	X	X	X	X	X[3]	X[3]	X[3]	NA
04-03[1]	Within site boundaries	X	X	X	X	X	X[3]	X[3]	X[3]	NA
04-04[1]	Within site boundaries	X	X	X	X	X	X[3]	X[3]	X[3]	NA
04-05[1]	Within site boundaries	X	X	X	X	X	X[3]	X[3]	X[3]	NA
04-06[1]	Within site boundaries	X	X	X	X	X	X[3]	X[3]	X[3]	NA
04T01[2]	Western site boundary	X	X	X	X	X	X[3]	X[3]	X[3]	NA
04T02[2]	Southern site boundary	X	X	X	X	X	X[3]	X[3]	X[3]	NA
04T03[2]	Eastern site boundary	X	X	X	X	X	X[3]	X[3]	X[3]	NA
SURFACE WATER										
04SW01	Upstream of site in Culpepper Branch Creek	X	X	X	X	X	X[4]	X[4]	X[4]	X
04SW02	Downstream of site in Culpepper Branch Creek	X	X	X	X	X	X[4]	X[4]	X[4]	X
04SW03	Downstream of site in Culpepper Branch Creek	X	X	X	X	X	X[4]	X[4]	X[4]	X
04SW04	In wetland/marsh east of the site	X	X	X	X	X	X[4]	X[4]	X[4]	X
04SW05	In unnamed tributary within site boundaries	X	X	X	X	X	X[4]	X[4]	X[4]	X
04SW06	In unnamed tributary immediately downstream of site	X	X	X	X	X	X[4]	X[4]	X[4]	X

1 Existing monitoring well
2 New monitoring well
3 Filtered ground water samples will be collected only if a reading of less than 10 NTUs is not achieved during stabilization.
4 Filtered and unfiltered surface water samples will be collected at all locations

Ca = Calcium
Fe = Iron
K = Potassium
Mg = Magnesium
Mn = Manganese
Na = Sodium

NA = Not applicable
PCBs = Polychlorinated biphenyls
TSS = Total suspended solids
SVOCs = Semivolatile organic compounds
VOCs = Volatile organic compounds
NTUs = Nephelometric Turbidity Units

TABLE 3-5

FIELD SAMPLE SUMMARY - GROUND WATER/SURFACE WATER
SWMU 4 - McCOMISH GORGE
NSWC CRANE, INDIANA

Analysis	Methodology	Samples	Duplicates	Rinsate Blanks	Trip Blanks	Ambient Blanks	Matrix Spike/ Matrix Spike Duplicates	Total[1]
Ground Water								
Appendix IX VOCs	SW-846 Method 8260B	9	1	1	TBD	TBD	1	12
Appendix IX VOCs	SW-846 Method 8015B for 1,4-dioxane, acetonitrile, isobutyl alcohol and propionitrile	9	1	1	TBD	TBD	1	12
Appenidx IX SVOCs	SW-846 Method 8270C (plus SW-846 Method 8270C with Selective Ion Monitoring for PAHs)	9	1	1	NA	TBD	1	12
Appendix IX Pesticides/PCBs	SW-846 Method 8081A and 8082	9	1	1	NA	TBD	1	12
Appendix IX Herbicides	SW-846 Method 8151A	9	1	1	NA	TBD	1	12
Appendix IX Metals	SW-846 Method 6020; Mercury - SW-846 Method 7470A	9	1	1	NA	TBD	1	12
Miscellaneous Metals (Ca, Fe, Mg, Mn, K, Na)	SW-846 Method 6010B	9	1	1	NA	TBD	1	12
Cyanide	SW-846 Method 9012A	9	1	1	NA	TBD	1	12
Field Parameters	Field Meter[2]	9	NA	NA	NA	NA	NA	9
Surface Water								
Appendix IX VOCs	SW-846 Method 8260B	6	1	1	TBD	TBD	1[2]	9
Appendix IX VOCs	SW-846 Method 015B for 1,4-dioxane, acetonitrile, isobutyl alcohol and propionitrile	6	1	1	TBD	TBD	1	9
Appenidx IX SVOCs	SW-846 Method 8270C (plus SW-846 Method 8270C with Selective Ion Monitoring for PAHs)	6	1	1	NA	TBD	1	9
Appendix IX Pesticides/PCBs	SW-846 Method 8081A and 8082	6	1	1	NA	TBD	1	9
Appendix IX Herbicides	SW-846 Method 8151A	6	1	1	NA	TBD	1	9
Appendix IX Metals Total and Dissolved	SW-846 Method 6020; Mercury - SW-846 Method 7470A	12	2	2	NA	TBD	2	18
Miscellaneous Metals (Ca, Fe, Mg, Mn, K, Na) Total and Dissolved	SW-846 Method 6010B	12	2	2	NA	TBD	2	18
Cyanide	SW-846 Method 9012A	12	2	2	NA	TBD	2	18
Hardness	Calculation	6	NA	NA	NA	NA	NA	6
Total Suspended Solids	EPA method 160.2	6	NA	NA	NA	NA	NA	6
Field Parameters	Field Meter[2]	6	NA	NA	NA	NA	NA	6

1 Totals do not include the number of Trip Blanks or Ambient Blanks.

2 Field parameters include temperature, pH, specific conductance, turbidity, ORP and dissolved oxygen.

Ca = Calcium
Fe = Iron
K = Potassium
Mn = Manganese
Mg = Magnesium
Na = Sodium
NA = Not applicable.
PAHs = Polyaromatic hydrocarbons
PCBs = Polychlorinated biphenyls

ORP = Oxidation reduction poential
Pest = Pesticides
TBD = To be determined. Number of samples will be determined on site depending on conditions during sampling.
SVOCs = Semivolatile organic compounds
VOCs = Volatile organic compounds

locations at SWMU 5. Sample containers, preservation requirements, and holding times are provided in Tables 2-1 and 2-2.

3.2.1 SWMU 5 Soil Sampling

Eight borings will be installed and sampled at SWMU 5, including:

- Three soil borings designated 05SB01 through 05SB03 located in the burn pit area.
- Five borings designated 05SB04 through 05SB08 to be located within the gully north of the burn pit.

Two soil samples will be collected from each of the eight borings as follows:

- At the ground surface (0 to 2 feet bgs). Samples for volatile organic analyses will be collected from the 1- to 2-foot interval and samples for non-volatile organic inorganic analyses will be collected from the 0- to 2-foot interval.

- At a discrete depth from 2 to 10 feet bgs based on a screening priority. If elevated PID readings are encountered, the sample will be collected from the 1-foot interval with the highest PID reading. If no elevated PID readings are observed, the subsurface sample will be collected based on visual observations of staining or non-native soil. If the water table is encountered within 10 feet bgs, the subsurface sample will be collected from the 1-foot interval immediately above the water table. If none of these situations are encountered, the sample will be collected from a randomly selected 1-foot interval (see CTO 10 SOP 7 in Attachment B).

Specific techniques for collecting subsurface soil samples are described in Section 2.4.2.3. Tables 3-6 and 3-7 present summaries of soil samples to be collected at SMWU 5, including types and numbers of QA/QC samples. Analytical parameters for surface and subsurface soil samples include:

- Appendix IX VOCs;
- Appendix IX SVOCs;
- Appendix IX Pesticides/PCBs;
- Appendix IX Herbicides;
- Dioxins/Furans;
- Appendix IX Metals;
- Miscellaneous Metals (Ca, Fe, Mn, Mg, K, Na); and
- Cyanide.

In addition, 30 percent of soil samples will be collected and analyzed for CEC, pH, and TOC.

To further refine the northern boundary of the site, a site reconnaissance will be conducted in the northeast and northwest areas. If during the site inspection, debris or evidence of disposal activity is found, additional soil samples will be taken. At a maximum, two sample locations from the northeast and two sample locations from the northwest will be staked for sample collection.

3.2.2 SWMU 5 Monitoring Well Installation

SWMU 5 has 19 existing monitoring wells of which 12 will be sampled during this investigation (see Table 3-8). Depths of the 12 existing monitoring wells installed from 1981 to 1983 range from 14.8 to 35 feet bgs, and depths to water range from 0 to 25 feet bgs. Available well construction information is presented in Table 3-8. The anticipated depths of three new monitoring wells to be installed at the site are not expected to exceed 40 feet of the thickness of the overburden.

3.2.3 SWMU 5 Ground Water Sampling

Fifteen ground water samples will be collected from 12 existing and three newly installed monitoring wells at locations upgradient and downgradient of the burn pit and the gully. Tables 3-9 and 3-10 present summaries of ground water samples to be collected at SWMU 5, including numbers and types of QA/QC samples. Monitoring wells to be sampled as part of this investigation include:

- Upgradient wells include existing well 05-01 and new well 05T01, to be installed as part of this investigation. Well 05-01 is located at the eastern site boundary, and 05T01 will be installed at the southeastern site boundary.

- Eight existing wells, designated 05-02 through 05-04, 05-09, 05-13, 05-15, 05-16, and 05-19, are located outside and within site boundaries and will be sampled to evaluate ground water quality downgradient of the burn pit.

- Three existing wells within site boundaries in the north/northwest portion of the site, designated 05-06 through 05-08, will be sampled to evaluate ground water quality downgradient of the gully.

TABLE 3-6

SOIL AND SEDIMENT SAMPLES
SWMU 5 – OLD BURN PIT
NSWC CRANE, INDIANA
PAGE 1 OF 2

Sample/ Boring No.	Sample Depth	General Location	Analyses									
			App. IX VOCs (8260B)	App. IX VOCs (8015B)	App. IX SVOCs	App. IX Pest./PCBs	App. IX Herbicides	Dioxins/ Furans	App. IX Metals	Ca, Fe, Mn, Mg, K, Na	Cyanide	CEC, pH, TOC
SURFACE/SUBSURFACE SOIL												
05SB01	0–2 feet TBD[2]	At burn pit area	X	X	X	X	X	X	X	X	X	[1]
05SB02	0–2 feet TBD[2]	At burn pit area	X	X	X	X	X	X	X	X	X	[1]
05SB03	0–2 feet TBD[2]	At burn pit area	X	X	X	X	X	X	X	X	X	[1]
05SB04	0–2 feet TBD[2]	In gully north of burn pit	X	X	X	X	X	X	X	X	X	[1]
05SB05	0–2 feet TBD[2]	In gully north of burn pit	X	X	X	X	X	X	X	X	X	[1]
05SB06	0–2 feet TBD[2]	In gully north of burn pit	X	X	X	X	X	X	X	X	X	[1]
05SB07	0–2 feet TBD[2]	In gully north of burn pit	X	X	X	X	X	X	X	X	X	[1]
O5SB08	0–2 feet TBD[2]	In gully north of burn pit	X	X	X	X	X	X	X	X	X	[1]
SEDIMENT												
05SD01	-	Unnamed tributary upstream of site	X	X	X	X	X	X	X	X	X	TOC
05SD02	-	Unnamed tributary within site boundaries	X	X	X	X	X	X	X	X	X	TOC
05SD03	-	Unnamed tributary downstream of site	X	X	X	X	X	X	X	X	X	TOC

TABLE 3-6

SOIL AND SEDIMENT SAMPLES
SWMU 5 – OLD BURN PIT
NSWC CRANE, INDIANA
PAGE 2 OF 2

Sample/ Boring No.	Sample Depth	General Location	Analyses									
			App. IX VOCs (8260B)	App. IX VOCs (8015B)	App. IX SVOCs	App. IX Pest./PCBs	App. IX Herbicides	Dioxins/ Furans	App. IX Metals	Ca, Fe, Mn, Mg, K, Na	Cyanide	CEC, pH, TOC
05SD04	-	Unnamed tributary downstream of site	X	X	X	X	X	X	X	X	X	TOC
05SD05	-	Unnamed tributary downstream of site	X	X	X	X	X	X	X	X	X	TOC

1 To be collected for 30 percent of soil samples.
2 Sample to be collected at a discrete one-foot interval from 2 to 10 feet below ground surface based on the following: Elevated PID readings; Visual observations of contamination/non-native soils; Immediately above the water table (if encountered prior to 10 feet). See Section 2.4.2 for details.

Ca = Calcium
CEC = Cation exchange capacity
Fe = Iron
K = Potassium
Mg = Magnesium
Mn = Manganese
Na = Sodium
PCBs = Polychlorinated biphenyls
Pest = Pesticides
PID = Photoionization detector
TBD = To be determined
TOC = Total organic carbon
SVOCs = Semivolatile organic compounds
VOCs = Volatile organic compounds

TABLE 3-7

FIELD SAMPLE SUMMARY - SOIL/SEDIMENT
SWMU 5 - OLD BURN PIT
NSWC CRANE, INDIANA

Analysis	Methodology	Samples	Duplicates	Rinsate Blanks	Trip Blanks	Ambient Blanks	Matrix Spike/ Matrix Spike Duplicates	Total[1]
Sediment								
Appendix IX VOCs	SW-846 Method 8260B	5	1	1	TBD	TBD	1	8
Appendix IX VOCs	SW-846 Method 8015B for 1,4-dioxane, acetonitrile, isobutyl alcohol and propionitrile	5	1	1	BD	TBD	1	8
Appenidx IX SVOCs	SW-846 Method 8270C (plus SW-846 Method 8270C with Selective Ion Monitoring for PAHs)	5	1	1	NA	TBD	1	8
Appendix IX Pesticides/PCBs	SW-846 Method 8081A and 8082	5	1	1	NA	TBD	1	8
Appendix IX Herbicides	SW-846 Method 8151A	5	1	1	NA	TBD	1	8
Dioxins/Furans	SW-846 Method 8290	5	1	1	NA	TBD	1	8
Appendix IX Metals	SW-846 Method 6020; Mercury - SW-846 Method 7470A	5	1	1	NA	TBD	1	8
Miscellaneous Metals (Ca, Fe, Mg, Mn, K, Na)	SW-846 Method 6010B	5	1	1	NA	TBD	1	8
Cyanide	SW-846 Method 9012A	5	1	1	NA	TBD	1	8
Total Organic Carbon	EPA 415.1	5	NA	NA	NA	NA	NA	5
Soil								
Appendix IX VOCs	SW-846 Method 8260B	16	2	1	TBD	TBD	2	21
Appendix IX VOCs	SW-846 Method 8015B for 1,4-dioxane, acetonitrile, isobutyl alcohol and propionitrile	16	2	1	TBD	TBD	2	21
Appenidx IX SVOCs	SW-846 Method 8270C (plus SW-846 Method 8270C with Selective Ion Monitoring for PAHs)	16	2	1	NA	TBD	2	21
Appendix IX Pesticides/PCBs	SW-846 Method 8081A and 8082	16	2	1	NA	TBD	2	21
Appendix IX Herbicides	SW-846 Method 8151A	16	2	1	NA	TBD	2	21
Appendix IX Metals	SW-846 Method 6020; Mercury - SW-846 Method 7470A	16	2	1	NA	TBD	2	21
Dioxins/Furans	SW-846 Method 8290	16	2	1	NA	TBD	2	21
Miscellaneous Metals (Ca, Fe, Mg, Mn, K, Na)	SW-846 Method 6010B	16	2	1	NA	TBD	2	21
Cyanide	SW-846 Method 9012A	16	2	2	NA	TBD	2	21
Total Organic Carbon	EPA 415.1	5	NA	NA	NA	NA	NA	5
Cation Exchange Capacity	SW-846 Method 9081	5	NA	NA	NA	NA	NA	5
pH	SW-846 Method 9045C	5	NA	NA	NA	NA	NA	5

1 Totals do not include the number of Trip Blanks or Ambient Blanks

Ca = Calcium
Fe = Iron
K = Potassium
Mn = Manganese
Na = Sodium
NA - Not applicable

PAHs = Polyaromatic Hydrocarbons
PCBs = Polychlorinated biphenyls
TBD = To be determined. Number of samples will be determined on site depending on conditions during sampling.
SVOCs = Semivolatile organic compounds
VOCs = Volatile organic compounds

TABLE 3-8

MONITORING WELL CONSTRUCTION INFORMATION
SWMU 5 - OLD BURN PIT
NSWC CRANE, INDIANA

WELL NUMBER	IAS WELL DESIGNATION	CONSTRUCTION TYPE	REPORTED DEPTH (ft bgs)	ACTUAL DEPTH (ft)	DEPTH TO WATER (ft bgs)	SCREENED INTERVAL (ft bgs)	BENTONITE PLUG (ft bgs)
05-01	WES-5-1-81	2" I.D. Schedule 40 PVC	17.0	20.0	10.5	4 - 11.86	2.0 - 4.0
05-02	WES-5-2-81	2" I.D. Schedule 40 PVC	17.0	9.0	7.1	4.1 - 11.86	2.0 - 4.0
05-03	WES-5-3-81	2" I.D. Schedule 40 PVC	21.35	24.00	11.4	6.89 - 16.0	2.0 - 4.0
05-04	WES-5-4-81	2" I.D. Schedule 40 PVC	25.0	21.0	15.0	10.74 - 19.95	2.9 - 4.0
05-06	WES-5-6-81	2" I.D. Schedule 40 PVC	30.0	33.0	19.5	15.52 - 24.71	11.5 - 13.5
05-07	WES-5-7-81	2" I.D. Schedule 40 PVC	35.0	38.0	25.0	20.3 - 29.62	16.0 - 18.0
05-08	WES-5-8-81	2" I.D. Schedule 40 PVC	17.5	19.6	7.0	2.7 - 12.18	0.5 - 2.0
05-09	WES-5-9-82	2" I.D. Schedule 40 PVC	15.0	28.0	2.5	10.27 - 19.62	6.0 - 8.0
05-13	WES-5-13-82	2" I.D. Schedule 40 PVC	25.0	28.0	14.5	10.12 - 19.56	6.0 - 8.0
05-15	WES-5-15-83	2" I.D. Schedule 40 PVC	14.8	17.6	3.5	4.98 - 12.45	2.0 - 4.0
05-16	WES-5-16-83	2" I.D. Schedule 40 PVC	15.0	16.8	3.5	5.06 - 12.75	2.0 - 4.0
05-19	WES-5-19-83	2" I.D. Schedule 40 PVC	15.0	16.8	2.0	4.8 - 12.75	2.0 - 4.0
05T01	NA	2" I.D. Schedule 40 PVC	TBD	NA	TBD	TBD	TBD
05T02	NA	2" I.D. Schedule 40 PVC	TBD	NA	TBD	TBD	TBD
05T03	NA	2" I.D. Schedule 40 PVC	TBD	NA	TBD	TBD	TBD

bgs = Below ground surface.
IAS = Initial Assessment Study.
I.D. = Inside diameter
ft = feet
NA = Not applicable
PVC = Polyvinyl chloride.
TBD = To be determined by geologist based on field conditions.

TABLE 3-9

GROUND WATER AND SURFACE WATER SAMPLES
SWMU 5 – OLD BURN PIT
NSWC CRANE, INDIANA
PAGE 1 OF 2

Well/ Sample Number	General Location	Analyses									
		App. IX VOCs (8260B)	App. IX VOCs (8015B)	App. IX SVOCs	App. IX Pest./PCBs	App. IX Herbicides	Dioxins/ Furans	App. IX Metals	Ca, Fe, Mg, Mn, K, Na	Cyanide	TSS, Hardness
GROUND WATER											
05-01[1]	Eastern site boundary (upgradient)	X	X	X	X	X	X	X[3]	X[3]	X[3]	NA
05-02[1]	Within site boundaries	X	X	X	X	X	X	X[3]	X[3]	X[3]	NA
05-03[1]	Within site boundaries	X	X	X	X	X	X	X[3]	X[3]	X[3]	NA
05-04[1]	Within site boundaries	X	X	X	X	X	X	X[3]	X[3]	X[3]	NA
05-06[1]	North/northwest part of site	X	X	X	X	X	X	X[3]	X[3]	X[3]	NA
05-07[1]	North/northwest part of site	X	X	X	X	X	X	X[3]	X[3]	X[3]	NA
05-08[1]	North/northwest part of site	X	X	X	X	X	X	X[3]	X[3]	X[3]	NA
05-09[1]	Within site boundaries	X	X	X	X	X	X	X[3]	X[3]	X[3]	NA
05-13[1]	Within site boundaries	X	X	X	X	X	X	X[3]	X[3]	X[3]	NA
05-15[1]	To the west of the site	X	X	X	X	X	X	X[3]	X[3]	X[3]	NA
05-16[1]	To the west of the site	X	X	X	X	X	X	X[3]	X[3]	X[3]	NA
05-19[1]	To the west of the site	X	X	X	X	X	X	X[3]	X[3]	X[3]	NA
05T01[2]	Southeastern site boundary (upgradient)	X	X	X	X	X	X	X[3]	X[3]	X[3]	NA
05T02 [2]	Southern site boundary	X	X	X	X	X	X	X[3]	X[3]	X[3]	NA
05T03 [2]	Western site boundary	X	X	X	X	X	X	X[3]	X[3]	X[3]	NA
SURFACE WATER											
05SW01	Unnamed tributary upstream of site	X	X	X	X	X	X	X[4]	X[4]	X[4]	X
05SW02	Unnamed tributary within site boundaries	X	X	X	X	X	X	X[4]	X[4]	X[4]	X

TABLE 3-9

GROUND WATER AND SURFACE WATER SAMPLES
SWMU 5 – OLD BURN PIT
NSWC CRANE, INDIANA
PAGE 2 OF 2

Well/ Sample Number	General Location	Analyses									
		App. IX VOCs (8260B)	App. IX VOCs (8015B)	App. IX SVOCs	App. IX Pest./PCBs	App. IX Herbicides	Dioxins/ Furans	App. IX Metals	Ca, Fe, Mg, Mn, K, Na	Cyanide	TSS, Hardness
05SW03	Unnamed tributary downstream of site	X	X	X	X	X	X	X(4)	X(4)	X(4)	X
05SW04	Unnamed tributary downstream of site	X		X	X	X	X	X(4)	X(4)	X(4)	X
05SW05	Unnamed tributary downstream of site	X		X	X	X	X	X(4)	X(4)	X(4)	X

1 Existing monitoring well
2 New monitoring well
3 Filtered ground water samples will be collected only if a reading of less than 10 NTUs is not achieved during stabilization.
4 Filtered and unfiltered surface water samples will be collected at all locations

Ca = Calcium
Fe = Iron
K = Potassium
M = Magnesium
Mn = Magnesium
Na = Sodium
NA = Not applicable

PCBs = Polychlorinated biphenyls
Pest = Pesticides
TSS = Total suspended solids
SVOCs = Semivolatile organic compounds
VOCs = Volatile organic compounds
NTUs = Nephelometric Turbidity Units

TABLE 3-10

FIELD SAMPLE SUMMARY - GROUND WATER/SURFACE WATER
SWMU 5 - OLD BURN PIT
NSWC CRANE, INDIANA

Analysis	Methodology	Samples	Duplicates	Rinsate Blanks	Trip Blanks	Ambient Blanks	Matrix Spike/ Matrix Spike Duplicates	Total[1]
Ground Water								
Appendix IX VOCs	SW-846 Method 8260B	15	2	2	TBD	TBD	1	20
Appendix IX VOCs	SW-846 Method 8015B for 1,4-dioxane, acetonitrile, isobutyl alcohol, and propionitrile	15	2	2	TBD	TBD	1	20
Appenidx IX SVOCs	SW-846 Method 8270C (plus SW-846 Method 8270C with Selective Ion Monitoring for PAHs)	15	2	2	NA	TBD	1	20
Appendix IX Pesticides/PCBs	SW-846 Method 8081A and 8082	15	2	2	NA	TBD	1	20
Appendix IX Herbicides	SW-846 Method 8151A	15	2	2	NA	TBD	1	20
Dioxins/Furans	SW-846 Method 8290	15	2	2	NA	TBD	1	20
Appendix IX Metals	SW-846 Method 6020; Mercury - SW-846 Method 7470A	15	2	2	NA	TBD	1	20
Miscellaneous Metals (Ca, Fe, Mg, Mn, K, Na)	SW-846 Method 6010B	15	2	2	NA	TBD	1	20
Cyanide	SW-846 Method 9012A	15	2	2	NA	TBD	1	12
Field Parameters	Field Meter[2]	15	NA	NA	NA	NA	NA	15
Surface Water								
Appendix IX VOCs	SW-846 Method 8260B	5	1	1	TBD	TBD	1	8
Appendix IX VOCs	SW-846 Method 8015B for 1,4-dioxane, acetonitrile, isobutyl alcohol, and propionitrile	5	1	1	TBD	TBD	1	8
Appenidx IX SVOCs	SW-846 Method 8270C (plus SW-846 Method 8270C with Selective Ion Monitoring for PAHs)	5	1	1	NA	TBD	1	8
Appendix IX Pesticides/PCBs	SW-846 Method 8081A and 8082	5	1	1	NA	TBD	1	8
Appendix IX Herbicides	SW-846 Method 8151A	5	1	1	NA	TBD	1	8
Dioxins/Furans	SW-846 Method 8290	5	1	1	NA	TBD	1	8
Appendix IX Metals Total and Dissolved	SW-846 Method 6020; Mercury - SW-846 Method 7470A	10	1	1	NA	TBD	1	13
Miscellaneous Metals (Ca, Fe, Mg, Mn, K, Na) Total and Dissolved	SW-846 Method 6010B	10	1	1	NA	TBD	1	13
Cyanide	SW-846 Method 9012A	10	1	1	NA	TBD	1	13
Hardness	Calculation	5	NA	NA	NA	NA	NA	5
TSS	EPA Method 160.2	5	NA	NA	NA	NA	NA	5
Field Parameters	Field Meter[2]	5	NA	NA	NA	NA	NA	5

1 Totals do not include the number of Trip Blanks or Ambient Blanks.

2 Field parameters include temperature, pH, specific conductance, turbidity, ORP, and dissolved oxygen.

Ca = Calcium
Fe = Iron
K = Potassium
Mg = Magnesium
Mn = Manganese
Na = Sodium
NA = Not Applicable
ORP = Oxidation reduction potential
PAHs = Polyaromatic hydrocarbons
PCBs = Polychlorinated Biphenyls
TBD = To be determined. Number of samples will be determined on site depending on conditions during sampling.

- New monitoring well 05T02 and 05T03 will be installed at the southern and western site boundaries, respectively, to evaluate ground water quality immediately downgradient of the site. These wells also will be used to evaluate the impact of the paleostream channel on ground water migration at the site.

Monitoring well development and ground water purging and sampling procedures are described in Sections 2.3.2 and 2.4.1, respectively. Fixed-based laboratory analytical parameters for ground water samples at SWMU 5 include:

- Appendix IX VOCs;
- Appendix IX SVOCs;
- Appendix IX Pesticides/ PCBs;
- Appendix IX Herbicides;
- Dioxins/Furans;
- Appendix IX Metals;
- Miscellaneous Metals (Ca, Fe, Mn, Mg, K, Na); and
- Cyanide.

Filtered ground water samples will be collected for metals analysis only if a reading of less than 10 NTUs is not achieved during stabilization.

Field parameters to be measured for ground water samples at SWMU 5 include:

- DO;
- ORP;
- pH;
- Specific conductance;
- Temperature; and
- Turbidity.

If constituents detected at the SWMU or known to have been released to on-SWMU media are found in off-SWMU ground water, it will be concluded that this medium is impacted by releases at the SWMU.

3.2.4 SWMU 5 Surface Water and Sediment Sampling

Five surface water and collocated sediment sample sets will be collected at SWMU 5 including:

- One sample set designated 05SW/SD01 upstream of the site in an unnamed tributary outside the northern site boundary;

- One sample set designated 05SW/SD02 within site boundaries from an unnamed tributary at the gully northwest of the site; and

- Three sample sets designated 05SW/SD03 through 05SW/SD05 outside the western and southern site boundaries, downstream of the site, in unnamed tributaries.

Specific collection procedures for surface water and sediment samples are described in Sections 2.4.3 and 2.4.4, respectively. Tables 3-6 and 3-7 present summaries of sediment samples, and Tables 3-9 and 3-10 present summaries of surface water samples to be collected at SWMU 5, including numbers and types of QA/QC samples.

Fixed-base laboratory parameters to be analyzed for surface water/sediment samples include:

- Appendix IX VOCs;
- Appendix IX SVOCs;
- Appendix IX Pesticides/ PCBs;
- Appendix IX Herbicides;
- Dioxins/Furans;
- Appendix IX Metals (total and dissolved for surface water samples);
- Miscellaneous Metals (Ca, Fe, Mn, Mg, K, Na) (total and dissolved for surface water samples);
- Cyanide;
- Hardness and TSS for surface water samples; and
- TOC for sediment sampler.

Field parameters to be measured for surface water samples at SWMU 5 include:

- DO;
- ORP;
- pH;
- Specific conductance;
- Temperature; and

- Turbidity.

No field parameters will be measured for sediment samples.

If constituents detected at the SWMU or known to have been released to on-SWMU media are found in off-SWMU surface water and/or sediment, it will be concluded that these media are impacted by releases at the SWMU.

3.3 SWMU 9 – PESTICIDE CONTROL/R-150 TANK AREA

Background information about the Pesticide Control/R-150 Tank Area, including a site description and summary of previous investigations, can be found in Section 7.0 of the Work Plan. Also included in Section 7.0 of the Work Plan is a detailed description of the proposed investigation for SWMU 9. The objectives of the proposed investigation are as follows:

- To determine human health and ecological risks for potential receptors exposed to site media under current and future land use scenarios.

- To determine if off-SWMU ground water, surface water and sediment have been impacted by the site.

Proposed sampling activities at SWMU 9 to meet these objectives is presented in Table 7-5 in the Risk Assessment Work Plan and summarized below. Figure 7-8 of Work Plan shows proposed sampling locations at SWMU 9. Sample containers, preservation requirements, and holding times are provided in Tables 2-1 and 2-2.

3.3.1 SWMU 9 Soil Sampling

Eleven soil borings will be installed and sampled at SWMU 9 during this investigation including:

- Borings 09SB01 through 09SB03 to be located around Building 2189;

- Boring 09SB04 to be located west of Building 2189 where the ground surface slopes towards an unnamed tributary;

- Borings 09SB05 through 09SB08 to be located in the vicinity of the R-150 Tank Area;

- Borings 09SB09 and 09SB11 to be located north/northwest of Building 3023 (former location of Building 55); and

- Boring 09SB10 to be located northwest of Building 3023 where the ground surface slopes toward an unnamed tributary.

Two soil samples will be collected from each of the 11 borings as follows:

- At the ground surface (0 to 2 feet bgs). Samples for volatile organic analyses will be collected from the 1- to 2-foot interval and samples for non-volatile organic inorganic analyses will be collected from the 0- to 2-foot interval.

- At a discrete depth from 2 to 10 feet bgs and based on a screening priority, the sample will be collected from the 1-foot interval with the highest PID reading. If no elevated PID readings are observed, the subsurface sample will be collected based on visual observations of staining or non-native soil. If the water table is encountered within 10 feet bgs, the subsurface sample will be collected from the 1-foot interval immediately above the water table. If none of these situations are encountered, the sample will be collected from a randomly selected 1-foot interval (see CTO 10 SOP 7 in Attachment B).

Specific techniques for collecting subsurface soil samples are described in Section 2.4.2.3. Tables 3-11 and 3-12 present summaries of soil samples to be collected at SWMU 9, including numbers and types of QA/QC samples. Analytical parameters for surface and subsurface soil samples include:

- Appendix IX VOCs;
- Appendix IX SVOCs;
- Appendix IX Pesticides/PCBs;
- Appendix IX Herbicides;
- Appendix IX Metals;
- Miscellaneous Metals (Ca, Fe, Mn, Mg, K, Na); and
- Cyanide.

In addition, 30 percent of soil samples will be collected and analyzed for CEC, pH, and TOC.

TABLE 3-11

SOIL AND SEDIMENT SAMPLES
SWMU 9 – PESTICIDE CONTROL AREA/R-150 TANK AREA
NSWC CRANE, INDIANA
PAGE 1 OF 2

Sample/ Boring No.	Sample Depth	General Location	Analyses								
			App. IX VOCs (8260B)	App. IX VOCs (8015B)	App. IX SVOCs	App. IX Pest./PCBs	App. IX Herbicides	App. IX Metals	Ca, Fe, Mg, Mn, K, Na	Cyanide	CEC, pH, TOC
SURFACE/SUBSURFACE SOIL											
09SB01	0–2 feet TBD[2]	Building 2189 area	X	X	X	X	X	X	X	X	[1]
09SB02	0–2 feet TBD[2]	Building 2189 area	X	X	X	X	X	X	X	X	[1]
09SB03	0–2 feet TBD[2]	Building 2189 area	X	X	X	X	X	X	X	X	[1]
09SB04	0–2 feet TBD[2]	West of Building 2189	X	X	X	X	X	X	X	X	[1]
09SB05	0–2 feet TBD[2]	R-150 tank area	X	X	X	X	X	X	X	X	[1]
09SB06	0–2 feet TBD[2]	R-150 tank area	X	X	X	X	X	X	X	X	[1]
09SB07	0–2 feet TBD[2]	R-150 tank area	X	X	X	X	X	X	X	X	[1]
09SB08	0–2 feet TBD[2]	R-150 tank area	X	X	X	X	X	X	X	X	[1]
09SB09	0–2 feet TBD[2]	North/northwest of Building 3023 (former Building 55 location)	X	X	X	X	X	X	X	X	[1]
09SB10	0–2 feet TBD[2]	North/northwest of Building 3023 (former Building 55 location)	X	X	X	X	X	X	X	X	[1]
09SB11	0–2 feet TBD[2]	Northwest of Building 3023 on slope to unnamed tributary	X	X	X	X	X	X	X	X	[1]

TABLE 3-11

SOIL AND SEDIMENT SAMPLES
SWMU 9 – PESTICIDE CONTROL AREA/R-150 TANK AREA
NSWC CRANE, INDIANA
PAGE 2 OF 2

Sample/ Boring No.	Sample Depth	General Location	Analyses								
			App. IX VOCs (8260B)	App. IX VOCs (8015B)	App. IX SVOCs	App. IX Pest./PCBs	App. IX Herbicides	App. IX Metals	Ca, Fe, Mg, Mn, K, Na	Cyanide	CEC, pH, TOC
SEDIMENT											
09SD01	-	Unnamed tributary upstream of site (northwest of Building 2189)	X	X	X	X	X	X	X	X	TOC
09SD02	-	Unnamed tributary within site boundaries	X	X	X	X	X	X	X	X	TOC
09SD03	-	Unnamed tributary within site boundaries	X	X	X	X	X	X	X	X	TOC
09SD04	-	Unnamed tributary downstream of site	X	X	X	X	X	X	X	X	TOC
09SD05	-	Unnamed tributary within site boundaries	X	X	X	X	X	X	X	X	TOC

1 To be collected for 30 percent of soil samples.
2 Sample to be collected at a discrete one-foot interval from 2 to 10 feet below ground surface based on the following: Elevated PID readings; Visual observations of contamination/non-native soils; Immediately above the water table (if encountered prior to 10 feet). See Section 2.4.2 for details.

Ca = Calcium
CEC = Cation exchange capacity
Fe = Iron
K = Potassium
Mg = Magnesium
Mn = Manganese
Na = Sodium
PCBs = Polychlorinated biphenyls
Pest = Pesticides
PID = Photoionization detector
TBD = To be determined
TOC = Total organic carbon
SVOCs = Semivolatile organic compounds
VOCs = Volatile organic compounds

TABLE 3-12

FIELD SAMPLE SUMMARY - SOIL/SEDIMENT
SWMU 9 - PESTICIDE CONTROL AREA / R-150 TANK AREA
NSWC CRANE, INDIANA

Analysis	Methodology	Samples	Duplicates	Rinsate Blanks	Trip Blanks	Ambient Blanks	Matrix Spike/ Matrix Spike Duplicates	Total[1]
Sediment								
Appendix IX VOCs	SW-846 Method 8260B	5	1	1	TBD	TBD	1	8
Appendix IX VOCs	SW-846 Method 8015B for 1,4-dioxane, acetonitrile, isobutyl alcohol, and propionitrile	5	1	1	TBD	TBD	1	8
Appenidx IX SVOCs	SW-846 Method 8270C (plus SW-846 Method 8270C with Selective Ion Monitoring for PAHs)	5	1	1	NA	TBD	1	8
Appendix IX Pesticides/PCBs	SW-846 Method 8081A and 8082	5	1	1	NA	TBD	1	8
Appendix IX Herbicides	SW-846 Method 8151A	5	1	1	NA	TBD	1	8
Appendix IX Metals	SW-846 Method 6020; Mercury - SW-846 Method 7470A	5	1	1	NA	TBD	1	8
Miscellaneous Metals (Ca, Fe, Mg, Mn, K, Na)	SW-846 Method 6010B						1	
Cyanide	SW-846 Method 9012A	5	1	1	NA	TBD	1	8
Total Organic Carbon	EPA 415.1	5	NA	NA	NA	NA	NA	5
Soil								
Appendix IX VOCs	SW-846 Method 8260B	22	3	2	TBD	TBD	2	29
Appendix IX VOCs	SW-846 Method 8015B for 1,4-dioxane, acetonitrile, isobutyl alcohol, and propionitrile	22	3	2	TBD	TBD	2	29
Appenidx IX SVOCs	SW-846 Method 8270C (plus SW-846 Method 8270C with Selective Ion Monitoring for PAHs)	22	3	2	NA	TBD	2	29
Appendix IX Pesticides/PCBs	SW-846 Method 8081A and 8082	22	3	2	NA	TBD	2	29
Appendix IX Herbicides	SW-846 Method 8151A	22	3	2	NA	TBD	2	29
Appendix IX Metals	SW-846 Method 6020; Mercury - SW-846 Method 7470A	22	3	2	NA	TBD	2	29
Miscellaneous Metals (Ca, Fe, Mg, Mn, K, Na)	SW-846 Method 6010B	22	3	2	NA	TBD	2	29
Cyanide	SW-846 Method 9012A	22	3	2	NA	TBD	2	29
Total Organic Carbon	EPA 415.1	7	1	NA	NA	NA	NA	8
Cation Exchange Capacity	SW-846 Method 9081	7	1	NA	NA	NA	NA	8
pH	SW-846 Method 9045C	7	1	NA	NA	NA	NA	8

1 Totals do not include the number of Trip Blanks or Ambient Blanks.

Ca = Calcium
Fe = Iron
K = Potassium
Mg = Magnesium
Mn = Manganese
Na = Sodium

NA = Not applicable
PAHs = Polyaromatic hydrocarbons
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds
TBD = To be determined. Number of samples will be determined on site depending on conditions during sampling.
VOCs = Volatile organic compounds

3.3.2 SWMU 9 Monitoring Well Installation

SWMU 9 has 22 existing monitoring wells, of which eight will be sampled as part of this investigation (see Table 3-13). Well construction information is not available for all existing wells; however, available data show total well depths ranging from 13.3 to 50 feet bgs and depths to water ranging from 3 to 16 feet bgs (see Table 3-13). All wells for which construction information is available were screened in the Lower Pennsylvanian Formation. Five monitoring wells to be installed as a part of this investigation. These new wells will be screened in the first water-bearing zone, expected to be the Lower Pennsylvanian sandstone.

3.3.3 SWMU 9 Ground Water Sampling

Thirteen ground water samples will be collected from eight existing and five newly installed monitoring wells at locations upgradient and downgradient of the site. Monitoring wells to be sampled as part of this investigation include:

- Well 09T01, to be installed as part of this investigation, will be located east of Building 2189 to evaluate upgradient conditions;
- Existing wells 09-02 and 09-07 are located northwest/west (downgradient) of Building 2189;
- Existing wells 09-WTP6 and 09-10 are located east (upgradient) of the R-150 Tank Area;
- Existing wells 09-03, 09-04, and 09-WTP5 are located in the area of the R-150 Tank Area;
- Existing well 09-12 and new well 09T02 to be installed as part of this investigation are located northwest/west (downgradient) of the R-150 tank;
- New well 09T05 is to be installed east (upgradient) of Building 3023 (former location of Building 55); and
- Proposed wells 09T03 and 09T04 are to be installed north/northwest of Building 3023 (former location of Building 55).

Monitoring well development and ground water purging and sampling procedures are described in Sections 2.3.2 and 2.4.1, respectively. Tables 3-14 and 3-15 presents summaries of ground water

TABLE 3-13

MONITORING WELL CONSTRUCTION INFORMATION
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, INDIANA

WELL NUMBER	IAS WELL DESIGNATION	CONSTRUCTION TYPE	REPORTED DEPTH (ft bgs)	ACTUAL DEPTH (ftC)	DEPTH TO WATER (ft bgs)	SCREENED INTERVAL (ft bgs)	BENTONITE PLUG (ft bgs)
09-02	WES-9-2-81	2" I.D. Schedule 40 PVC	NA	22	NA	NA	NA
09-03	WES-9-3-81	2" I.D. Schedule 40 PVC	NA	12.6	NA	NA	NA
09-04	WES-9-4-81	2" I.D. Schedule 40 PVC	NA	33	NA	NA	NA
09-07	WES-9-7-81	2" I.D. Schedule 40 PVC	NA	38	NA	NA	NA
09-10	WES-9-10-83	2" I.D. Schedule 40 PVC	27.0	29	16.0	11.45 - 20.55	8.0 - 10.0
09-12	WES-9-12-83	2" I.D. Schedule 40 PVC	25.0	28	9.0	10.32 - 19.49	6.0 - 8.0
09T01	NA	2" I.D. Schedule 40 PVC	TBD	NA	TBD	TBD	TBD
09T02	NA	2" I.D. Schedule 40 PVC	TBD	NA	TBD	TBD	TBD
09T03	NA	2" I.D. Schedule 40 PVC	TBD	NA	TBD	TBD	TBD
09T04	NA	2" I.D. Schedule 40 PVC	TBD	NA	TBD	TBD	TBD
09T05	NA	2" I.D. Schedule 40 PVC	TBD	NA	TBD	TBD	TBD
09WTP5	WT5P	2" I.D. Schedule 40 PVC + Teflon pipe	13.3	15	5.9	8.0 - 13.0	4.0 - 6.0
09WTP6	WT6P	2" I.D. Schedule 40 PVC + Teflon pipe	26.7	29	14.0	20.7 - 25.7	16.7 - 18.7

bgs = Below ground surface.
ft = feet.
IAS = Initial Assessment Study.
I.D. = Inside diameter.
NA = Not applicable/not available.
PVC = Polyvinyl chloride.
TBD = To be determined by geologist based on field conditions.

TABLE 3-14

GROUND WATER AND SURFACE WATER SAMPLES
SWMU 9 – PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, INDIANA

Well/Sample Number	General Location	ANALYSES								
		App. IX VOCs (8260B)	App. IX VOCs (8015B)	App. IX SVOCs	App. IX Pest./PCBs	App. IX Herbicides	App. IX Metals	Ca, Fe, Mg, Mn, K, Na	Cyanide	Hardness, TSS
GROUND WATER										
09-02[1]	North/northwest of Building 2189	X	X	X	X	X	X[3]	X[3]	X[3]	NA
09-03[1]	R-150 tank area	X	X	X	X	X	X[3]	X[3]	X[3]	NA
09-04[1]	R-150 tank area	X	X	X	X	X	X[3]	X[3]	X[3]	NA
09-07[1]	Northwest/west of building 2189	X	X	X	X	X	X[3]	X[3]	X[3]	NA
09-10[1]	East of R-150 tank area	X	X	X	X	X	X[3]	X[3]	X[3]	NA
09-12[1]	North/northwest of tank	X	X	X	X	X	X[3]	X[3]	X[3]	NA
09T01[2]	East of Building 2189	X	X	X	X	X	X[3]	X[3]	X[3]	NA
09T02[2]	North/northwest of tank	X	X	X	X	X	X[3]	X[3]	X[3]	NA
09T05[2]	East of Building 3023 (former Building 55 location)	X	X	X	X	X	X[3]	X[3]	X[3]	NA
09T03[2]	North/northwest of Building 2189	X	X	X	X	X	X[3]	X[3]	X[3]	NA
09T04[2]	North/northwest of Building 2189	X	X	X	X	X	X[3]	X[3]	X[3]	NA
09-WTP5[1]	R-150 tank area	X	X	X	X	X	X[3]	X[3]	X[3]	NA
09-WTP6[1]	East R-150 tank area	X	X	X	X	X	X[3]	X[3]	X[3]	NA
SURFACE WATER										
09SW01	Unnamed tributary upstream of site (northwest of Building 2189)	X	X	X	X	X	X[4]	X[4]	X[4]	X
09SW02	Unnamed tributary within site boundaries	X	X	X	X	X	X[4]	X[4]	X[4]	X
09SW03	Unnamed tributary within site boundaries	X	X	X	X	X	X[4]	X[4]	X[4]	X
09SW04	Unnamed tributary downstream of site	X	X	X	X	X	X[4]	X[4]	X[4]	X
09SW05	Unnamed tributary within site boundaries	X	X	X	X	X	X[4]	X[4]	X[4]	X

TABLE 3-14

GROUND WATER AND SURFACE WATER SAMPLES
SWMU 9 – PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, INDIANA

1 Existing monitoring well
2 New monitoring well
3 Filtered ground water samples will be collected only if a reading of 10 NTUs is not achieved during stabilization.
4 Filtered and unfiltered surface water samples will be collected at all locations

Ca = Calcium
Fe = Iron
K = Potassium
Mg = Magnesium
Mn = Manganese
Na = Sodium
NA = Not applicable

PCBs = Polychlorinated biphenyls
Pest = Pesticides
TSS = Total suspended solids
SVOCs = Semivolatile organic compounds
VOCs = Volatile organic compounds
NTUs = Nephelometric Turbidity Units

TABLE 3-15

FIELD SAMPLE SUMMARY - GROUND WATER/SURFACE WATER
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, INDIANA

Analysis	Methodology	Samples	Duplicates	Rinsate Blanks	Trip Blanks	Ambient Blanks	Matrix Spike/ Matrix Spike Duplicates	Total[1]
Ground Water								
Appendix IX VOCs	SW-846 Method 8260B	13	2	2	TBD	TBD	1	17
Appendix IX VOCs	SW-846 Method 8015B for 1,4-dioxane, acetonitrile, isobutyl alcohol, and propionitrile	13	2	2	TBD	TBD	1	17
Appenidx IX SVOCs	SW-846 Method 8270C (plus SW-846 Method 8270C with Selective Ion Monitoring for PAHs)	13	2	2	NA	TBD	1	17
Appendix IX Pesticides/PCBs	SW-846 Method 8081A and 8082	13	2	2	NA	TBD	1	17
Appendix IX Herbicides	SW-846 Method 8151A	13	2	2	NA	TBD	1	17
Appendix IX Metals	SW-846 Method 6020; Mercury - SW-846 Method 7470A	13	2	2	NA	TBD	1	17
Miscellaneous Metals (Ca, Fe, Mg, Mn, K, Na)	SW-846 Method 6010B	13	2	2	NA	TBD	1	17
Cyanide	SW-846 Method 9012A	13	2	2	NA	TBD	1	17
Field Parameters	Field Meter[2]	13	2	2	NA	TBD	1	15
Surface Water								
Appendix IX VOCs	SW-846 Method 8260B	5	1	1	TBD	TBD	1	8
Appendix IX VOCs	SW-846 Method 8015B for 1,4-dioxane, acetonitrile, isobutyl alcohol, and propionitrile	5	1	1	TBD	TBD	1	8
Appenidx IX SVOCs	SW-846 Method 8270C (plus SW-846 Method 8270C with Selective Ion Monitoring for PAHs)	5	1	1	TBD	TBD	1	8
Appendix IX Pesticides/PCBs	SW-846 Method 8081A and 8082	5	1	1	NA	TBD	1	8
Appendix IX Herbicides	SW-846 Method 8151A	5	1	1	TBD	TBD	1	8
Appendix IX Metals Total and Dissolved	SW-846 Method 6020; Mercury - SW-846 Method 7470A	10	1	1	NA	TBD	1	13
Miscellaneous Metals (Ca, Fe, Mg, Mn, K, Na) Total and Dissolved	SW-846 Method 6010B	10	1	1	TBD	TBD	1	13
Cyanide	SW-846 Method 9012A	10	1	1	NA	TBD	1	13
Hardness	Calculation	5	NA	NA	NA	NA	NA	5
TSS	EPA Method 160.2	5	NA	NA	NA	NA	NA	5
Field Parameters	Field Meter[2]	5	NA	NA	NA	NA	NA	5

1 Totals do not include the number of Trip Blanks or Ambient Blanks.

2 Field parameters include temperature, pH, specific conductance, ORP turbidity, and dissolved oxygen.

Ca = Calcium
Fe = Iron
K = Potassium
Mg = Magnesium
Mn = Manganese
Na = Sodium
NA = Not Applicable
ORP = Oxidation reduction potential

PAHS = Polyaromatic hydrocarbons
PCBs = Polychlorinated biphenyls
Pest = Pesticides
TBD = To be determined. Number of samples will be determined on site depending on conditions during sampling.
TOC = Total organic carbon
SVOCs = Semivolatile organic compounds
VOCs = Volatile organic compounds

samples to be collected at SWMU 9 as part of this investigation, including numbers and types of QA/QC samples. Fixed-based laboratory analytical parameters for ground water samples at SWMU 9 include:

- Appendix IX VOCs;
- Appendix IX SVOCs;
- Appendix IX Pesticides/ PCBs;
- Appendix IX Herbicides; and
- Miscellaneous Metals (Ca, Fe, Mn, Mg, K, Na); and
- Cyanide.

Filtered ground water samples will be collected for metals analyses only if a reading of 10 NTUs is not achieved during stabilization.

Field parameters to be measured for ground water samples at SWMU 9 include:

- DO;
- ORP;
- pH;
- Specific conductance;
- Temperature; and
- Turbidity.

If constituents detected at the SWMU or known to have been released to on-SWMU media are found in off-SWMU ground water, it will be concluded that this medium is impacted by releases at the SWMU.

3.3.4 SWMU 9 Surface Water and Sediment Sampling

Five surface water and associated sediment sample sets will be collected at SWMU 9 including:

- One sample set designated 09SW/SD01 upstream of the site in an unnamed tributary northwest of Building 2189;

- Three sample sets designated 09SW/SD02, 05SW/SD03, and 09SW/SD05 within site boundaries from an unnamed tributary west/southwest of Building 2189, and the tank area, and Building 3023; and

- One sample set designated 09SW/SD04 outside the western site boundary in unnamed tributaries, downstream of the majority of the site (Building 2189 and the tank area).

Specific collection procedures for surface water and sediment samples are described in Sections 2.4.3 and 2.4.4, respectively. Tables 3-11 and 3-12 present summaries of sediment samples, and Tables 3-14 and 3-15 present summaries of surface water samples to be collected at SWMU 9, including numbers and types of QA/QC samples.

Fixed-base laboratory parameters to be analyzed for surface water/sediment samples include:

- Appendix IX VOCs;
- Appendix IX SVOCs;
- Appendix IX Pesticides/ PCBs;
- Appendix IX Herbicides;
- Appendix IX Metals (total and dissolved for surface water samples);
- Miscellaneous Metals (Ca, Fe, Mn, Mg, K, Na) (total and dissolved for surface water samples);
- Cyanide;
- Hardness and TSS for surface water samples; and
- TOC for sediment samples.

Field parameters to be measured for surface water samples at SWMU 9 include:

- DO;
- ORP;
- pH;
- Specific conductance;
- Temperature; and
- Turbidity.

No field parameter measurements will be collected for sediment samples.

If constituents detected at the SWMU or known to have been released to on-SWMU media are found in off-SWMU surface water and/or sediment, it will be concluded that these media are impacted by releases at the SWMU.

3.4 SWMU 10 - ROCKEYE

Background information about the Rockeye site including a site description and summary of previous investigations can be found in Section 8.0 of the Work Plan. Also included in Section 8.0 of the Work Plan is a detailed description of the proposed investigation for SWMU 10. The objectives of the proposed investigation are as follows:

- To determine human health and ecological risks for potential receptors exposed to site media under current and future land use scenarios.

- To determine if off-SWMU ground water, surface water and sediment have been impacted by the site.

Proposed sampling activities at SWMU 10 to meet these objectives is presented in Table 8-9 in the Risk Assessment Work Plan and summarized below. Figure 8-10 of Work Plan shows proposed sampling locations at SWMU 10. Sample containers, preservation requirements, and holding times are provided in Tables 2-1 and 2-2.

3.4.1 SWMU 10 Soil Sampling

Ten soil borings, designated 10SB01 through 10SB10, will be installed and sampled at SWMU 10 during this investigation at locations throughout the active area of the site (see Figure 8-10 of Work Plan). Two soil samples will be collected from each of the 10 borings as follows:

- At the ground surface (0 to 2 feet bgs). Samples for volatile organic analyses will be collected from the 1- to 2-foot interval and samples for non-volatile organic inorganic analyses will be collected from the 0- to 2-foot interval.

- At a discrete depth from 2 to 10 feet bgs and based on a screening priority, the sample will be collected from the 1-foot interval with the highest PID reading. If no elevated PID readings are observed, the subsurface sample will be collected based on visual observations of staining or non-native soil. If the water table is encountered within 10 feet bgs, the subsurface sample will be collected from the 1-foot interval immediately above the water table. If none of these situations are encountered, the sample will be collected from a randomly selected foot interval (see CTO 10 SOP 7 in Attachment B).

Specific techniques for collecting subsurface soil samples are described in Section 2.4.2.3. Tables 3-16 and 3-17 present summaries of soil samples to be collected at SWMU 10, including numbers and types of QA/QC samples. Analytical parameters for surface and subsurface soil samples include:

- Appendix IX SVOCs
- Explosives;
- Appendix IX Metals;
- Miscellaneous Metals (Ca, Fe, Mn, Mg, K, Na); and
- Cyanide.

In addition, 30 percent of the soil samples will be collected and analyzed for CEC, pH, and TOC.

3.3.2 SWMU 10 Ground Water Sampling

Twenty ground water samples will be collected from 20 existing monitoring wells including wells 10-2, 10-03, 10-16, 10-17, 10C26, 10C26P3, 10C31, 10C31P3, 10C33, 10C33P2, 10C35, 10C35P2, 10C37, 10C37P3, 10C41, 10C41P3, 10C52, 10C55, 10C55P2 and 10C57. Well construction information for the wells is presented in Table 3-18. Tables 3-19 and 3-20 present summaries of ground water samples to be collected at SWMU 10, including numbers and types of QA/QC samples. Rationale for the selection of these monitoring wells is presented in Section 8.5.2 (Proposed Sampling and Analysis) of the Work Plan.

Monitoring well development and ground water purging and sampling procedures are described in Sections 2.3.2 and 2.4.1, respectively. Fixed-based laboratory analytical parameters for ground water samples at SWMU 10 include:

- Appendix IX VOCs
- Explosives;
- Appendix IX Metals;
- Miscellaneous Metals (Ca, Fe, Mn, Mg, K, Na);
- Nitrite/Nitrate; and
- Cyanide

Table 3-19 presents the analysis for each sample.

Filtered ground water samples will be collected for metals analysis only if a reading of less than 10 NTUs is not achieved during stabilization.

TABLE 3-16

SOIL AND SEDIMENT SAMPLES
SWMU 10 – ROCKEYE
NSWC CRANE, INDIANA
PAGE 1 OF 2

Sample/ Boring No.	Sample Depth	General Location	Analyses					
			Appendix IX SVOCs	Explosives	Appendix IX Metals	Ca, Fe, Mn, Mg, K, Na	Cyanide	CEC, pH, TOC
SURFACE/SUBSURFACE SOIL								
10SB01	0–2 feet TBD[2]	Within active area of SWMU at sump/discharge area	NA	X	X	X	X	[1]
10SB02	0–2 feet TBD[2]	Within active area of SWMU at sump/discharge area	NA	X	X	X	X	[1]
10SB03	0–2 feet TBD[2]	Within active area of SWMU at sump/discharge area	X	X	X	X	X	[1]
10SB04	0–2 feet TBD[2]	Within active area of SWMU at sump/discharge area	NA	X	X	X	X	[1]
10SB05	0–2 feet TBD[2]	Within active area of SWMU at sump/discharge area	NA	X	X	X	X	[1]
10SB06	0–2 feet TBD[2]	Within active area of SWMU at sump/discharge area	NA	X	X	X	X	[1]
10SB07	0–2 feet TBD[2]	Within active area of SWMU at sump/discharge area	NA	X	X	X	X	[1]
10SB08	0–2 feet TBD[2]	Within active area of SWMU at sump/discharge area	NA	X	X	X	X	[1]
10SB09	0-2 feet TB[2]	Area E discharge area	NA	X	X	X	X	[1]
10SB10	0-2 feet TBD[2]	Historical location of solvent tank near Building 2726C	NA	X	X	X	X	[1]
SEDIMENT								
10SD01	-	Tributary downstream of site (outside southeast boundary)	NA	X	X	X	X	TOC
10SD02	-	Tributary east of site	NA	X	X	X	X	TOC
10SD03	-	Tributary east of site	NA	X	X	X	X	TOC
10SD04	-	Northeast of site	NA	X	X	X	X	TOC
10SD05	-	Tributary east of site	NA	X	X	X	X	TOC
10SD06	-	Tributary east of site	NA	X	X	X	X	TOC
10SD07	-	Area E discharge area	NA	X	X	X	X	TOC
10SD08	-	Tributary downstream of site to the north	NA	X	X	X	X	TOC
10SD09	-	Tributary west of site	NA	X	X	X	X	TOC

TABLE 3-16

SOIL AND SEDIMENT SAMPLES
SWMU 10 – ROCKEYE
NSWC CRANE, INDIANA
PAGE 2 OF 2

Sample/ Boring No.	Sample Depth	General Location	Analyses					
			Appendix IX SVOCs	Explosives	Appendix IX Metals	Ca, Fe, Mn, Mg, K, Na	Cyanide	CEC, pH, TOC
10SD10	-	Tributary west of site	NA	X	X	X	X	TOC
10SD11	-	Tributary downstream of site to the south	NA	X	X	X	X	TOC
10SD12	-	Tributary downstream of site to the south	NA	X	X	X	X	TOC

1 To be collected for 30 percent of soil samples.
2 Sample to be collected at a discrete one-foot interval from 2 to 10 feet below ground surface based on the following: Elevated PID readings; Visual observations of contamination/non-native soils; Immediately above the water table (if encountered prior to 10 feet). See Section 2.4.2 for details.

Ca = Calcium
CEC = Cation exchange capacity
Fe = Iron
K = Potassium
Mg = Magnesium
Mn = Manganese
Na = Sodium
PCBs = Polychlorinated biphenyls
Pest = Pesticides
PID = Photoionization detector
TBD = To be determined
TOC = Total organic carbon
SVOCs = Semivolatile organic compounds
VOCs = Volatile organic compounds

TABLE 3-17

FIELD SAMPLE SUMMARY - SOIL/SEDIMENT
SWMU 10 - ROCKEYE
NSWC CRANE, INDIANA

Analysis	Methodology	Samples	Duplicates	Rinsate Blanks	Trip Blanks	Ambient Blanks	Matrix Spike/ Matrix Spike Duplicates	Total[1]
Sediment								
Explosives	SW-846 Method 8330	12	2	1	TBD	TBD	1	16
Appendix IX Metals	SW-846 Method 6020; Mercury - SW-846 Method 7470A	12	2	1	NA	TBD	1	16
Miscellaneous Metals (Ca, Fe, Mg, Mn, K, Na)	SW-846 Method 6010B	12	2	1	NA	TBD	1	16
Total Organic Carbon	EPA 415.1	12	NA	NA	NA	NA	NA	12
Cyanide	SW-846 Method 9012A	12	2	1	NA	TBD	1	16
Soil								
Appendix IX SVOCs	SW-846 Method 8270C (plus SW-846 Method 8270C with Selective Ion monitoring for PAHs).	1	NA	1	NA	TBD	1	3
Explosives	SW-846 Method 8330	20	2	2	TBD	TBD	2	26
Appendix IX Metals	SW-846 Method 6020; Mercury - SW-846 Method 7470A	20	2	2	NA	TBD	2	26
Miscellaneous Metals (Ca, Fe, Mg, Mn, K, Na)	SW-846 Method 6010B	20	2	2	NA	TBD	2	26
Cyanide	SW-846 Method 9012A	20	2	1	NA	TBD	1	24
Total Organic Carbon	EPA 415.1	7	NA	NA	NA	NA	NA	7
Cation Exchange Capacity	SW-846 Method 9081	7	NA	NA	NA	NA	NA	7
pH	SW-846 Method 9045C	7	NA	NA	NA	NA	NA	7

1 Totals do not include the number of Trip Blanks or Ambient Blanks.

TBD = To be determined. Number of samples will be determined on site depending on conditions during sampling.

Ca = Calcium
Fe = Iron
K = Potassium
Mn = Manganese
Mg = Magnesium
Na = Sodium
NA = Not applicable
PAH = Polyaromatic Hydrocarbons
SVOCs = Semivolatile Organic Compounds
TBD = To be determined. Number of samples will be determined on site depending on conditions during sampling.

TABLE 3-18

MONITORING WELL CONSTRUCTION INFORMATION
SWMU 10 - ROCKEYE
NSWC CRANE, INDIANA

WELL NUMBER	IAS WELL DESIGNATION	CONSTRUCTION TYPE	TOTAL DEPTH ACTUAL (ft)	TOTAL DEPTH BORING LOGS (ft bgs)	DEPTH TO WATER (ft bgs)	SCREENED INTERVAL (ft bgs)	BENTONITE PLUG (ft bgs)
10-2	WES-10-2-81	2" I.D. Schedule 40 PVC	26.2	24.9	15.8	10.58-19.80	6.6-8.6
10-03	WES-10-3-83	2" I.D. Schedule 40 PVC	32.3	29.5	19.0	14.83-24.15	10.5-12.5
10-16	WES-10-16-83	2" I.D. Schedule 40 PVC	36.1	33.0	23.0	18.45-27.59	13.5-15.5
10-17	WES-10-17-83	2" I.D. Schedule 40 PVC	28.0	25.0	13.0	10.34-19.51	6.0-8.0
10C26	WES-10-26C-88	2" ID Schedule 40 PVC	88.0	88.0	45.0	79.5-84.5	53-56
10C26P3	WES-10-26P3-88	2" ID Schedule 40 PVC	34.5	32.0	13.0	21-31	15-17
10C31	WES-10-31C-88	2" I.D. Schedule 40 PVC	66.9	64.0	NA	53.0-63.0	45.0-47.5
10C31P3	WES-10-31CP3-88	2" I.D. Schedule 40 PVC	23.5	21.0	NA	10.0-20.0	6.0-8.0
10C33	WES-10-33C-88	2" I.D. Schedule 40 PVC	63.3	61.5	NA	50.5-60.5	40.0-43.5
10C33P2	WES-10-33CP2-88	2" I.D. Schedule 40 PVC	36.3	34.0	NA	23.0-33.0	12.0-15.0
10C35	WES-10-35C-88	2" I.D. Schedule 40 PVC	84.4	80.0	NA	69.0-79.0	56.0-59.0
10C35P2	WES-10-35CP2-88	2" I.D. Schedule 40 PVC	52.6	50.0	NA	39.0-49.0	33.0-36.0
10C37	WES-10-37C-88	2" I.D. Schedule 40 PVC	94.6	92.0	NA	81.0-91.0	66.0-69.5
10C37P3	WES-10-37CP3-88	2" I.D. Schedule 40 PVC	36.6	34.0	NA	23.0-33.0	10.0-13.0
10C41	WES-10-41C-88	2" I.D. Schedule 40 PVC	103.6	101.0	NA	90.0-100.0	60.0-63.0
10C41P3	WES-41CP3-88	2" I.D. Schedule 40 PVC	39.2	NA	NA	NA	NA
10C52	WES-10-52C-88	2" I.D. Schedule 40 PVC	70.5	69.0	NA	58.0-68.0	50.0-55.0
10C55	WES-10-55C-88	2" I.D. Schedule 40 PVC	33.5	31.0	NA	20.0-30.0	10.0-12.0
10C55P2	WES-10-55CP2-88	2" I.D. Schedule 40 PVC	10.6	8.0	NA	3.0-8.0	0.0-2.5
10C57	WES-10-57C-88	2" I.D. Schedule 40 PVC	22.6	20.0	NA	9.0-19.0	5.0-7.0

bgs = Below ground surface
IAS = Initial Assessment Study
I.D. = Inside diameter
ft = feet
NA = Information not available
PVC = Polyvinyl chloride.

TABLE 3-19

GROUND WATER AND SURFACE WATER SAMPLES
SWMU 10 – ROCKEYE
NSWC CRANE, INDIANA
PAGE 1 OF 2

Well/ Sample Number	General Location	ANALYSES						
		Appendix IX VOCs (8260B)	Appendix IX VOCs (8015B)	Explosives	App. IX Metals	Ca, Fe, Mn, Mg, K, Na	Cyanide	NO_3/NO_4, Hardness, TSS
GROUND WATER								
10-02[1]	East of the site	NA	NA	X	X[2]	X[2]	X[2]	NO_3/NO_4
10-03[1]	South of the site	X	X	X	X[2]	X[2]	X[2]	NO_3/NO_4
10-16[1]	East of the site	NA	NA	X	X[2]	X[2]	X[2]	NO_3/NO_4
10-17[1]	Northeast/northcentral area of site	NA	NA	X	X[2]	X[2]	X[2]	NO_3/NO_4
10C31[1]	Center of active site area	X	X	X	X[2]	X[2]	X[2]	NO_3/NO_4
10C31P3[1]	Center of active site area	X	X	X	X[2]	X[2]	X[2]	NO_3/NO_4
10C26	South central of the site	X	X	NA	NA	NA	NA	NA
10C26P3	South central of the site	X	X	NA	NA	NA	NA	NA
10C33[1]	Northeast/northcentral area of site	NA	NA	X	X[2]	X[2]	X[2]	NO_3/NO_4
10C33P2[1]	Northeast/northcentral area of site	NA	NA	X	X[2]	X[2]	X[2]	NO_3/NO_4
10C35[1]	Northeast/northcentral area of site	NA	NA	X	X[2]	X[2]	X[2]	NO_3/NO_4
10C35P2[1]	Northeast/northcentral area of site	NA	NA	X	X[2]	X[2]	X[2]	NO_3/NO_4
10C37[1]	Western side of site, west of Highway 45	NA	NA	X	X[2]	X[2]	X[2]	NO_3/NO_4
10C37P3[1]	Western side of site, west of Highway 45	NA	NA	X	X[2]	X[2]	X[2]	NO_3/NO_4
10C41[1]	South of the site	X	X	X	X[2]	X[2]	X[2]	NO_3/NO_4
10C41P3[1]	South of the site	X	X	X	X[2]	X[2]	X[2]	NO_3/NO_4
10C52[1]	South of the site	X	X	X	X[2]	X[2]	X[2]	NO_3/NO_4
10C55[1]	Northeast/northcentral area of site	X	X	X	X[2]	X[2]	X[2]	NO_3/NO_4
10C55P2[1]	Northeast/northcentral area of site	X	X	X	X[2]	X[2]	X[2]	NO_3/NO_4
10C57[1]	Northeast/northcentral area of site	NA	NA	X	X[2]	X[2]	X[2]	NO_3/NO_4

TABLE 3-19

GROUND WATER AND SURFACE WATER SAMPLES
SWMU 10 – ROCKEYE
NSWC CRANE, INDIANA
PAGE 2 OF 2

Well/ Sample Number	General Location	ANALYSES						
		Appendix IX VOCs (8260B)	Appendix IX VOCs (8015B)	Explosives	App. IX Metals	Ca, Fe, Mn, Mg, K, Na	Cyanide	NO_3/NO_4, Hardness, TSS
SURFACE WATER								
10SW01	Tributary downstream of site (outside southeast boundary)	NA	NA	X	X(3)	X(3)	X(3)	X
10SW02	Tributary east of site	NA	NA	X	X(3)	X(3)	X(3)	X
10SW03	Tributary east of site	NA	NA	X	X(3)	X(3)	X(3)	X
10SW04	Northeast of site	NA	NA	X	X(3)	X(3)	X(3)	X
10SW05	Tributary east of site	NA	NA	X	X(3)	X(3)	X(3)	X
10SW06	Tributary east of site	NA	NA	X	X(3)	X(3)	X(3)	X
10SW07	Area E discharge area	NA	NA	X	X(3)	X(3)	X(3)	X
10SW08	Tributary downstream of site to the north	NA	NA	X	X(3)	X(3)	X(3)	X
10SW09	Tributary west of site	NA	NA	X	X(3)	X(3)	X(3)	X
10SW10	Tributary west of site	NA	NA	X	X(3)	X(3)	X(3)	X
10SW11	Tributary downstream of site to the south	NA	NA	X	X(3)	X(3)	X(3)	X
10SW12	Tributary downstream of site to the south	NA	NA	X	X(3)	X(3)	X(3)	X

1 Existing monitoring well
2 Filtered ground water samples will be collected for metals analysis only if a reading of 10 NTUs is not achieved during stabilzation.
3 Filtered and unfiltered surface water samples will be collected at all locations

Ca = Calcium
Fe = Iron
K = Potassium
Mg = Magnesium
Mn = Manganese
Na = Sodium
NA = Not applicable
NO_3 = Nitrite
NO_4 = Nitrate
NTUs = Nephelometric Turbidity Units

TABLE 3-20

FIELD SAMPLE SUMMARY - GROUND WATER/SURFACE WATER
SWMU 10 - ROCKEYE
NSWC CRANE, INDIANA

Analysis	Methodology	Samples	Duplicates	Rinsate Blanks	Trip Blanks	Ambient Blanks	Matrix Spike/ Matrix Spike Duplicates	Total[1]
Ground Water								
Appendix IX VOCs	SW-846 Method 8260B	8	1	1	TBD	TBD	1	11
Appendix IX VOCs	SW-846 Method 8015B for 1,4-dioxane, acetonitrile, isobutyl alcohol and proprionitrile	8	1	1	TBD	TBD	1	11
Explosives	SW-846 Method 8330	18	2	2	TBD	TBD	1	23
Appendix IX Metals	SW-846 Method 6020; Mercury - SW-846 Method 7470A	18	2	2	NA	TBD	1	23
Miscellaneous Metals (Ca, Fe, Mg, Mn, K, Na)	SW-846 Method 6010B	18	2	2	NA	TBD	1	23
Nitrate/Nitrite	EPA Method 353.2	18	2	2	NA	TBD	1	23
Cyanide	SW-846 Method 9012A	18	2	2	NA	NA	1	23
Field Parameters	Field Meter[2]	18	NA	NA	NA	NA	NA	18
Surface Water								
Explosives	SW-846 Method 8330	12	2	1	TBD	TBD	1	16
Appendix IX Metals (total and dissolved)	SW-846 Method 6020; Mercury - SW-846 Method 7470A	12	3	2	NA	TBD	2	31
Miscellaneous Metals (Ca, Fe, Mg, Mn, K, Na) (total and dissolved)	SW-846 Method 6010B	12	3	2	NA	TBD	2	31
Cyanide	SW-846 Method 9012A	12	3	2	NA	TBD	2	31
Nitrate/Nitrite	EPA Method 353.2	12	2	1	NA	TBD	1	16
Hardness	Calculation	12	NA	NA	NA	NA	NA	12
Total Suspended Solids	EPA Method 160.2	12	NA	NA	NA	NA	NA	12
Field Parameters	Field Meter[2]	12	NA	NA	NA	NA	NA	12

1 Totals do not include the number of Trip Blanks or Ambient Blanks.

2 Field parameters include temperature, pH, specific conductance, turbidity, ORP, and dissolved oxygen.

Ca = Calcium
Fe = Iron
K = Potassium
Mg = Magnesium
Mn = Manganese
Na = Sodium
NA = Not applicable

TBD = To be determined. Number of samples will be determined on site depending on conditions during sampling.
ORP = oxidation reduction potential
VOCs = Volatile Organic Compounds

Field parameters to be measured for ground water samples at SWMU 10 include:

- DO;
- ORP;
- pH;
- Specific conductance;
- Temperature; and
- Turbidity.

If constituents detected at the SWMU or known to have been released to on-SWMU media are found in off-SWMU ground water, it will be concluded that this medium is impacted by releases at the SWMU.

3.3.3 SWMU 10 Surface Water and Sediment Sampling

Twelve surface water and collocated sediment samples will be collected at SWMU 10 including:

- One sample set, designated 10SW/SD01, located southeast of the site in a tributary;
- Four sample sets, designated 10SW/SD02, 10SW/SD03, 10SW/SD05, and 10SW/SD06, located east of the site near an area where wash water from munitions production was released (drainpipe) and locations further downstream of the drainpipe in the tributary;
- One sample set, designated 10SW/SD04, located northeast of the site near Area E where wash water from munitions production was released;
- One sample set, designated 10SW/SD07, located at Area E where pink water discharged pooled;
- One sample set, designated 10SW/SD08, located outside of the northern site boundary in a tributary;
- Two sample sets, designated 10SW/SD09 and 10SW/SD10, located west of the site near an area where wash water from munitions production was released (drainpipe) and locations further downstream of the drainpipe in the tributary; and
- Two sample sets, designated 10SW/SD11 and 10SW/SD12, located south of the site near an area where wash water from munitions production was released (drainpipe) and locations further downstream of the drainpipe in the tributary.

Specific collection procedures for surface water and sediment samples are described in Sections in 2.4.3 and 2.4.4, respectively. Tables 3-16 and 3-17 present summaries of sediment samples, and Tables 3-19 and 3-20 present summaries of surface water samples to be collected at SWMU 10, including numbers and types of QA/QC samples.

Fixed-base laboratory parameters to be analyzed for surface water/sediment samples include:

- Explosives;
- Appendix IX Metals (total and dissolved for surface water samples);
- Miscellaneous Metals (Ca, Fe, Mn, Mg, K, Na) (total and dissolved for surface water samples);
- Cyanide;
- Hardness for surface water only;
- Total Suspended Solids for surface water only;
- Nitrate/Nitrite for surface water only; and
- TOC for sediments only.

Field parameters to be measured for surface water samples at SWMU 10 include:

- DO;
- ORP;
- pH;
- Specific conductance;
- Temperature; and
- Turbidity.

No field parameter measurements will be collected for sediment samples.

If constituents detected at the SWMU are known to have been released to on-SWMU media are found in the off-SWMU surface water and/or sediment, it will be concluded that these media are impacted by releases at the SWMU.

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ATTACHMENT A

FIELD FORMS

GROUND WATER SAMPLE LOG FORM

Page___ of ___

Project Site Name:	NSWC CRANE, IN	Sample ID No.:	
Project No.:	CTO 0010	Sample Location:	
		Sampled By:	
		C.O.C. No.:	

SAMPLING DATA:

Date:	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Odor
Time-Start: End:	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	
Method:								

PURGE DATA:

Date:	Total Well Depth (TD):	End Purge (hrs):
Method:	Static Water Level (WL):	Total Purge Time (min):
Well Casing: 2" PVC	Start Purge (hrs):	Total Vol. Purged (gal):
One Casing Volume(gal):		

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Time Collected

OBSERVATIONS / NOTES:

PID reading in PVC riser pipe = (ppm)

PID reading in Breathing Zone = (ppm)

Reaction of sample to preservative:

QA Samples Collected:

MS/MSD	Duplicate ID No.:

Signature(s):

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: NSWC CRANE

PROJECT NUMBER: CTO 10

WELL ID.: _____

DATE: _____

Time (Hrs.)	Water Level (Ft. below TOC)	Pump Rate (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP mV	Comments

SIGNATURE(S): _____

PAGE___OF___

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: _____
Project No.: _____

[] Stream
[] Spring
[] Pond
[] Lake
[] Other: _____
[] QA Sample Type: _____

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

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

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	Salinity %	Other
Date:								
Time:								
Depth:								
Method:								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

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

COMPOSITE SAMPLE DATA:

	Time	Depth	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):

CHAIN OF CUSTODY RECORD

PROJECT NO.:	SITE NAME:
SAMPLERS (SIGNATURE):	

STATION NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CON-TAINERS							REMARKS

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY(SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY(SIGNATURE):
RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY(SIGNATURE):
RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED FOR LABORATORY BY (SIGNATURE):	DATE / TIME:	REMARKS:	

Order No. 70440 (0693)

WATER LEVEL MEASUREMENT SHEET

Project Name: NSWC Crane
Location: Crane, IN
Weather Conditions: _____

Project No.: CTO 10
Personnel: _____
Measuring Device: _____
Remarks: _____

Well ID	Date	Time	Water Level *	Thickness of Free Product	PID Reading ppm		Comments
					RP	BZ	

* All measurements to the nearest 0.01 foot

Signature(s): _____

MONITORING WELL INSPECTION SHEET

Well ID: _____

Time: _____ **Date:** _____ **Inspector's Name:** _____

Inspection Item	Types of Problems	Status		Observation
		S	U	
Well Tag	Is it in-place, legible			
Well security	Condition protective case, cap, lock			
Well pad	Concrete or gravel & condition			
Well seal	Condition of…			
Area Immediately around well pad	Record any evidence of/or standing water in area of well			
Dedicated sampling equipment	Condition of…			
PVC Riser	Condition of riser & survey reference point			

Comments:

Signature(s)_____

Note: S= Satisfactory, U= Unsatisfactory
Check one, if unsatisfactory explain

MONITORING WELL DEVELOPMENT RECORD

Page ___ of ___

Well: _____ Depth to Bottom (ft.): _____ Responsible Personnel: _____
Site: _____ Static Water Level Before (ft.): _____ Drilling Co.: _____
Date Installed: _____ Static Water Level After (ft.): _____ Project Name: _____
Date Developed: _____ Screen Length (ft.): _____ Project Number: _____
Dev. Method: _____ Specific Capacity: _____
Pump Type: _____ Casing ID (in.): _____

Time	Estimated Sediment Thickness (Ft.)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units ____)	Turbidity (NTU)	R emarks (odor,color,etc.)

EQUIPMENT CALIBRATION LOG

INSTRUMENT NAME/MODEL : _____

PROJECT NAME : NSWC Crane

MANUFACTURER : _____

PROJECT NUMBER : CTO 48

CALIBRATION DATE	INITIAL SETTINGS	STANDARDS USED	PROCEDURE	ADJUSTMENTS MADE	FINAL SETTINGS	SIGNATURE	COMMENTS

Instrument Rented From:

DAILY ACTIVITIES RECORD

PROJECT NAME: _____ PROJECT NUMBER: _____

CLIENT: _____ LOCATION: _____

DATE: _____ ARRIVAL TIME: _____

PERSONNEL: _____ DEPARTURE TIME: _____

CONTRACTOR: _____ DRILLER: _____

ITEM	QUANTITY ESTIMATE	QUANTITY TODAY	PREVIOUS TOTAL QUANTITY	CUMULATIVE QUANTITY TO DATE

COMMENTS: _____

APPROVED BY:

_____ _____

REPRESENTATIVE DRILLER

DATE: _____

BORING LOG

PROJECT NAME: ____________________ BORING NUMBER: ____________________
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: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	U S C S *	Remarks	PID/FID Reading (ppm): Sample	PID/FID Reading (ppm): Sampler BZ	PID/FID Reading (ppm): Borehole**	PID/FID Reading (ppm): Driller BZ**

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

Drilling Area Background (ppm): ____

Remarks: ____________________

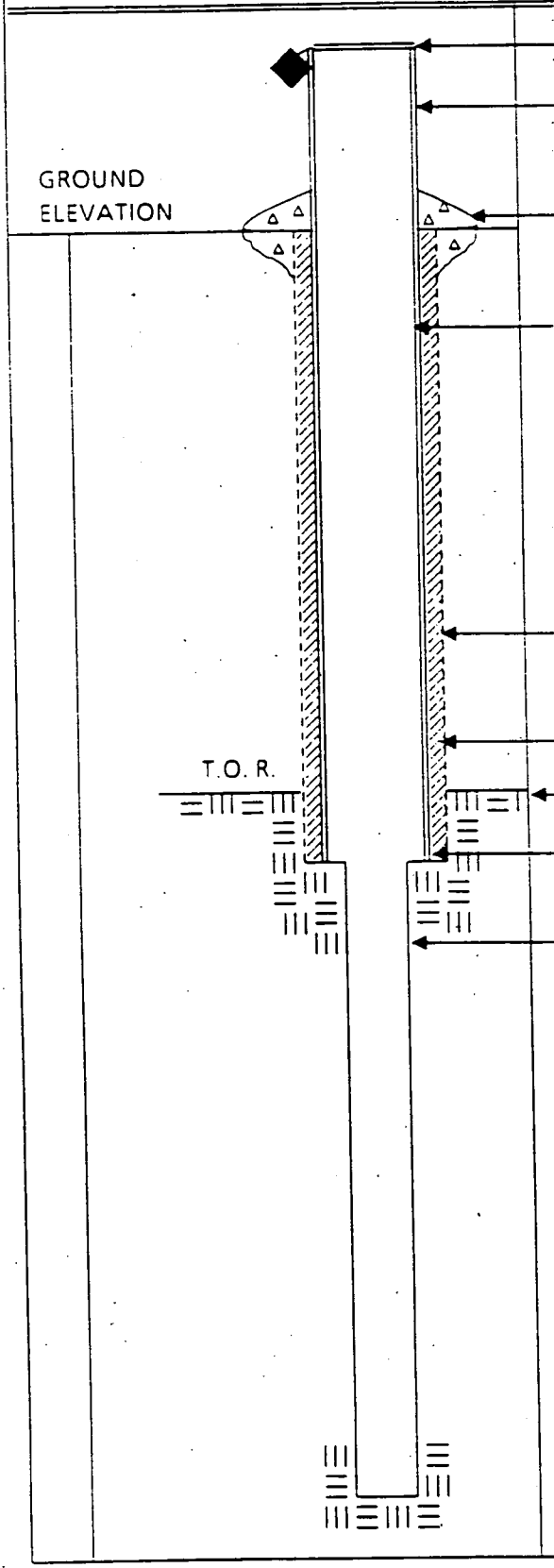
Converted to Well: Yes ______ No ______ Well I.D. #: ____________________

BORING NO.: _____

BEDROCK
MONITORING WELL SHEET
OPEN HOLE WELL

PROJECT _____ LOCATION _____
PROJECT NO. _____ BORING _____
ELEVATION _____ DATE _____
FIELD GEOLOGIST _____

DRILLER _____
DRILLING METHOD _____
DEVELOPMENT METHOD _____



ELEVATION OF TOP OF CASING: _____

STICK UP OF CASING ABOVE GROUND SURFACE: _____

TYPE OF SURFACE SEAL: _____

I.D. OF CASING: _____

TYPE OF CASING: _____

TEMP. / PERM.: _____

DIAMETER OF HOLE: _____

TYPE OF CASING SEAL: _____

DEPTH TO TOP OF ROCK: _____

DEPTH TO BOTTOM CASING: _____

DIAMETER OF HOLE IN BEDROCK: _____

DESCRIBE IF CORE / REAMED WITH BIT:

_____

_____

_____

DESCRIBE JOINTS IN BEDROCK AND DEPTH:

_____

_____

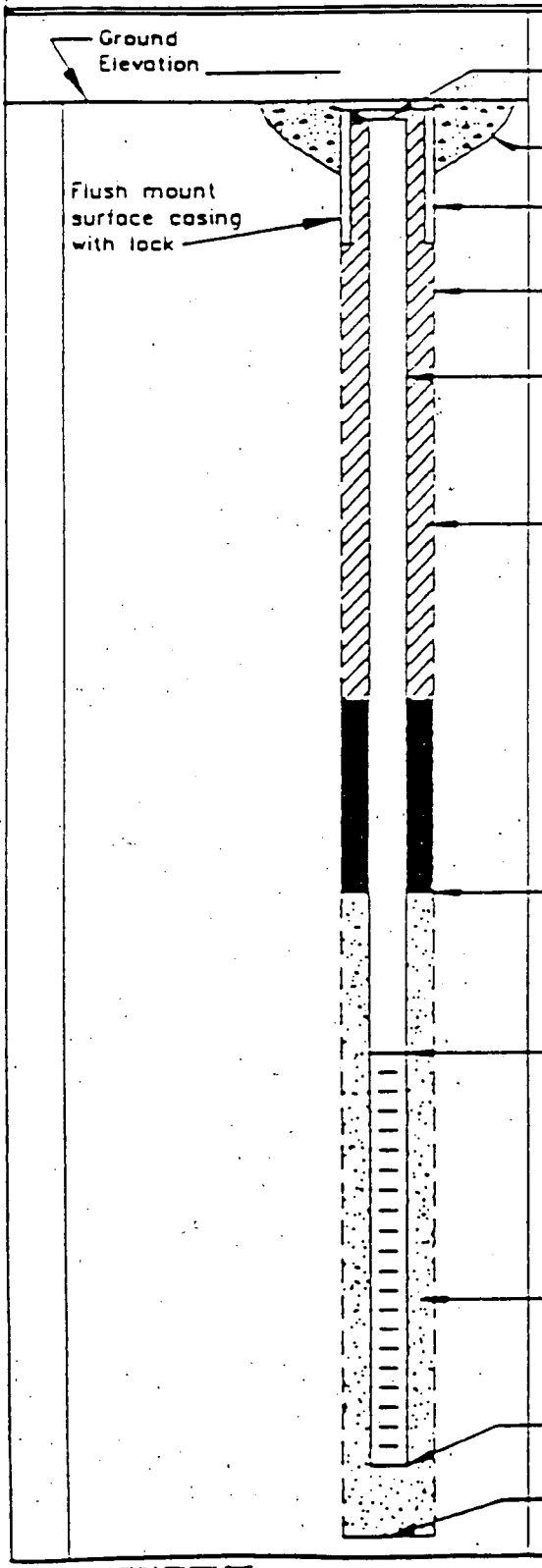
_____

ELEVATION / DEPTH OF HOLE: _____ / _____

BORING NO.: _____

MONITORING WELL SHEET

PROJECT _____	LOCATION _____	DRILLER _____
PROJECT NO. _____	BORING _____	DRILLING METHOD _____
ELEVATION _____	DATE _____	DEVELOPMENT METHOD _____
FIELD GEOLOGIST _____		



ELEVATION TOP OF RISER: _____

TYPE OF SURFACE SEAL: _____

TYPE OF PROTECTIVE CASING: _____

I.D. OF PROTECTIVE CASING: _____

DIAMETER OF HOLE: _____

TYPE OF RISER PIPE: _____

RISER PIPE I.D.: _____

TYPE OF BACKFILL/SEAL: _____

_____

DEPTH/ELEVATION TOP OF SAND: _____ / _____

DEPTH/ELEVATION TOP OF SCREEN: _____ / _____

TYPE OF SCREEN: _____

SLOT SIZE x LENGTH: _____

TYPE OF SAND PACK: _____

DIAMETER OF HOLE IN BEDROCK: _____

DEPTH/ELEVATION BOTTOM OF SCREEN: _____ / _____

DEPTH/ELEVATION BOTTOM OF SAND: _____ / _____

DEPTH/ELEVATION BOTTOM OF HOLE: _____ / _____

BACKFILL MATERIAL BELOW SAND: _____

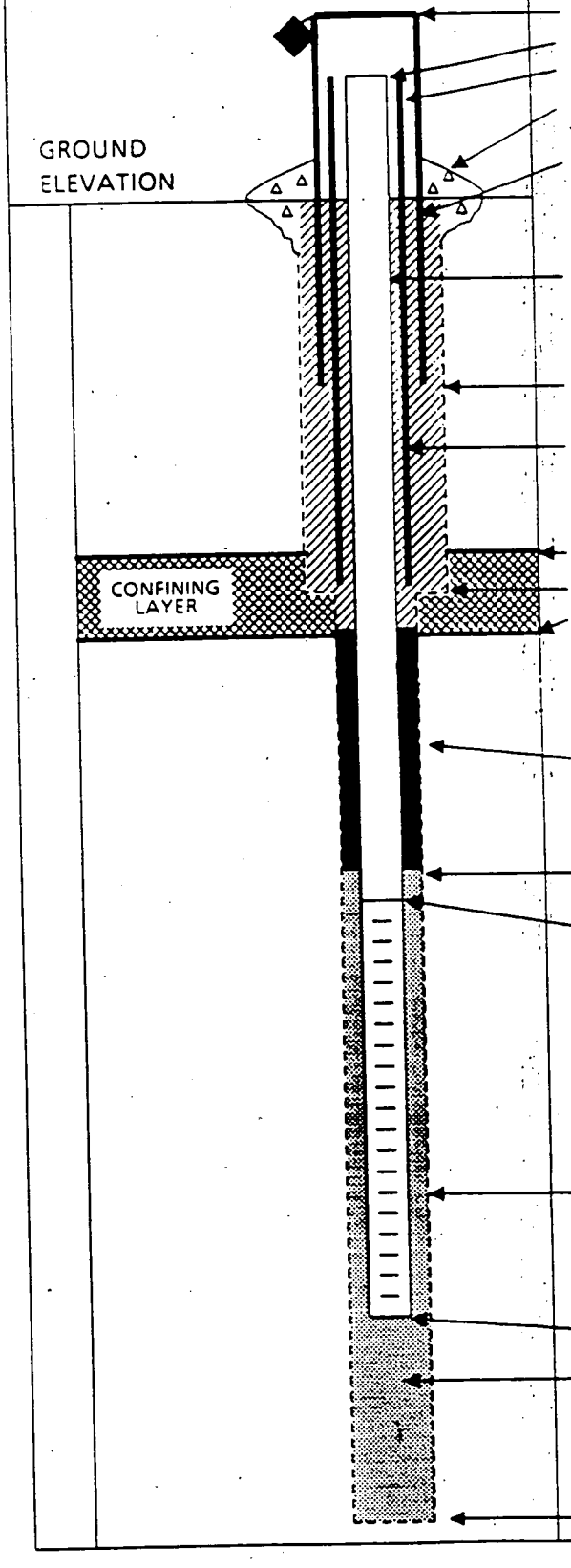
ACFILE: U370\GEOL\GBURDI.DWG

BORING NO.: _____

CONFINING LAYER
MONITORING WELL SHEET

PROJECT _____ LOCATION _____
PROJECT NO. _____ BORING _____
ELEVATION _____ DATE _____
FIELD GEOLOGIST _____

DRILLER _____
DRILLING METHOD _____
DEVELOPMENT METHOD _____



ELEVATION OF TOP OF SURFACE CASING : _____
ELEVATION OF TOP OF RISER PIPE: _____
ELEVATION TOP OF PERM. CASING: _____
TYPE OF SURFACE SEAL: _____

I.D. OF SURFACE CASING: _____
TYPE OF SURFACE CASING: _____

RISER PIPE I.D. _____
TYPE OF RISER PIPE: _____

BOREHOLE DIAMETER: _____

PERM. CASING I.D. _____
TYPE OF CASING & BACKFILL: _____

ELEVATION / DEPTH TOP CONFINING LAYER: _____
ELEVATION / DEPTH BOTTOM OF CASING: _____
ELEVATION / DEPTH BOT. CONFINING LAYER: _____ / _____

ELEVATION / DEPTH TOP OF SEAL: _____ / _____
TYPE OF SEAL: _____

DEPTH TOP OF SAND PACK: _____

ELEVATION/DEPTH TOP OF SCREEN: _____ / _____
TYPE OF SCREEN: _____

TYPE OF SAND PACK: _____

BOREHOLE DIA. BELOW CASING: _____

ELEVATION / DEPTH BOTTOM OF SCREEN: _____ / _____

ELEVATION / DEPTH BOTTOM OF SAND PACK: _____
TYPE OF BACKFILL BELOW OBSERVATION WELL: _____

ELEVATION / DEPTH OF HOLE: _____ / _____

BORING NO.: _____

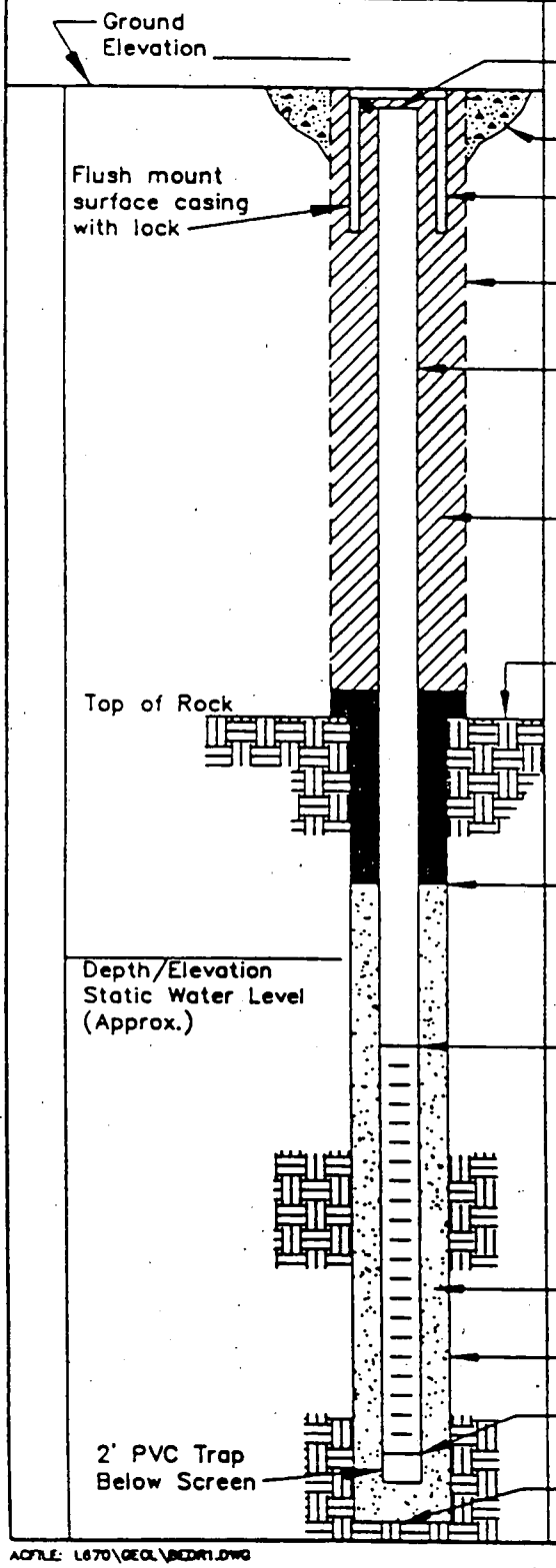
BEDROCK
MONITORING WELL SHEET
WELL INSTALLED IN BEDROCK

PROJECT: _____ LOCATION: _____ DRILLER: _____

PROJECT NO.: _____ BORING: _____ DRILLING METHOD: _____

ELEVATION: _____ DATE: _____ DEVELOPMENT METHOD: _____

FIELD GEOLOGIST: _____



ELEVATION TOP OF RISER: _____

TYPE OF SURFACE SEAL: _____

TYPE OF PROTECTIVE CASING: _____

I.D. OF PROTECTIVE CASING: _____

DIAMETER OF HOLE: _____

TYPE OF RISER PIPE: _____

RISER PIPE I.D.: _____

TYPE OF BACKFILL/SEAL: _____

_____

DEPTH/ELEVATION TOP OF BEDROCK: _____/_____

DEPTH/ELEVATION TOP OF SAND: _____/_____

DEPTH/ELEVATION TOP OF SCREEN: _____/_____

TYPE OF SCREEN: _____

SLOT SIZE x LENGTH: _____

TYPE OF SAND PACK: _____

DIAMETER OF HOLE IN BEDROCK: _____

DEPTH/ELEVATION BOTTOM OF SCREEN: _____/_____

DEPTH/ELEVATION BOTTOM OF SAND: _____/_____

DEPTH/ELEVATION BOTTOM OF HOLE: _____/_____

BACKFILL MATERIAL BELOW SAND: _____

ACFILE: L670\GEOL\BEDR1.DWG

Example IDW (drum) label

INVESTIGATION DERIVED WASTE

GENERATOR INFORMATION:

SITE _____ JOB NO. _____

LOCATION _____

DATE _____

DRUM# _____

CONTENTS _____

VOLUME _____

CONTACT _____

EMERGENCY PHONE NUMBER _____

TETRA TECH NUS
FIELD TASK MODIFICATION REQUEST FORM

Project/Installation Name _____ CTO & Project Number _____ Task Mod. Number _____

Modification To (e.g. Work Plan) _____ Site/Sample Location _____ Date _____

Activity Description: _____

Reason for Change: _____

Recommended Disposition: _____

Field Operations Leader (Signature) _____ Date _____

Approved Disposition:

Project/Task Order Manager (Signature) _____ Date _____

Distribution:

Program/Project File –
Project/Task Order Manager –
Field Operations Leader –

Other: _____

ATTACHMENT B

STANDARD OPERATING PROCEDURES

APPENDIX B

STANDARD OPERATING PROCEDURES

The field sampling techniques described in the Field Sampling Plan take precedence over the site-specific procedures. The information contained in Appendix B is considered supplementary to that described in the FSP.

SOP Number	Title
CTO 10-1	Inspection of Existing Monitoring Wells
CTO 10-2	Measurement of Water Levels in Monitoring Wells
CTO 10-3	Monitoring Well Purging and Stabilization
CTO 10-4	Monitoring Well Sampling
CTO 10-5	Surface Water Sampling
CTO 10-6	Sediment Sampling
CTO 10-7	Surface and Subsurface Soil Sampling
CTO 10-8	Drilling, Monitoring Well Installation and Well Development
CTO 10-9	Decontamination of Field Sampling Equipment
CTO 10-10	Sample Identification Nomenclature
CTO 10-11	Sample Custody and Documentation of Field Activities
CTO 10-12	Sample Preservation, Packaging, and Shipping
CTO 10-11	Field Documentation
CTO 10-12	Sample Handling
CTO 10-13	Use of Photoionization Detector
CTO 10-14	Borehole and Soil Sample Logging
CTO 10-15	Use of Water Quality Meter

STANDARD OPERATING PROCEDURE

CTO 10 SOP 1

INSPECTION OF EXISTING MONITORING WELLS

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish procedures for the inspection of existing monitoring wells prior to sampling.

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

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

The following equipment and field forms are required for inspection of existing monitoring wells.

Monitoring Well Inspection Form: A copy of the monitoring well inspection form can be found in Attachment A.

Bound Field Log Book
Well keys

3.0 INSPECTION PROCEDURES

3.1 Record the well identification (ID), date, and time on the Monitoring Well Inspection Form.

3.2 Record the condition of the well ID tag. Is the tag in place and legible?

3.3 Record the condition of the protective casing, caps, and lock. Has the casing, cap and/or lock been tampered with? Has the well been damaged in anyway or does it show signs of deterioration?

3.4 Record the condition of the concrete or gravel pad or collar. NSWC Crane wells will have either concrete pad, concrete collar, or gravel pad. Check the condition of the pad or collar and note

any changes. Are concrete pads or collar cracking or heaving? If a gravel pad is present, is there any erosion or plant growth in the pad area?

3.5 Record the condition of the cement seal surrounding the protective casing. Has the seal cracked or pulled away from the protective casing? Record any visible signs of deterioration in the area of the seal.

3.6 Record the presence of depressions and/or standing water around the casing or pad.

3.7 Unlock the well cap.

3.8 Record the condition of dedicated sampling equipment.

3.9 Inspect and record the condition of the PVC riser pipe and the surveyed reference point. The surveyed reference point is a V-notch on the top of the PVC riser pipe.

STANDARD OPERATING PROCEDURE

CTO 10 SOP 2

MEASUREMENT OF WATER LEVELS IN MONITORING WELLS

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish procedures for determining water levels in monitoring wells.

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

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

The following equipment and field forms are required for determining water levels in monitoring wells.

Ground Water Level Measurement Form: A copy of the Ground Water Level Measurement Form is included in Attachment A.

Bound Field Log Book

Photoionization detector (PID): The manual for the operation of the PID is found in the site-specific Health and Safety Plan (HASP).

Well key

Electronic water level indicator: The water level indicator must have a cable of sufficient length to reach the water surface and be capable of measurements of 0.01 feet.

Decontamination supplies: SOP 9 describes decontamination procedures including decontamination supplies.

3.0 WATER LEVEL MEASUREMENT PROCEDURES

3.1 Check the operation of the electronic water level indicator.

3.2 Record the well identification (ID), date, and time (using military time) on the Ground Water Level Measurement Form. A copy of this form can be found in Attachment A.

3.3 Unlock the well and remove the well cap.

3.4 Place the well cap on a clean piece of plastic.

3.5 Check the well for the presence of organic vapors in the 2-inch PVC riser pipe as follows:

1. Calibrate the PID in accordance with the calibration procedures described in SOP 13.

2. Insert the PID sample inlet straw approximately three inches into the riser pipe.

3. Record the PID reading on the Ground Water Level Measurement Form. If the reading is below concentrations specified in the site-specific HASP, proceed to step 3.6. If the reading is above the concentration specified in the HASP, measure the concentration in the breathing zone. If the concentration in the breathing zone is below the concentration specified in the HASP, proceed to Step 3.6. If the reading is above the specified concentration, allow the riser pipe to ventilate for ten minutes and repeat the measurement of breathing zone concentrations until the concentrations fall below the level specified in the HASP before proceeding to step 3.6.

3.6 Insert the water level meter probe. (The probe must be decontaminated before use according to the procedures in SOP 9).

3.7 Slowly lower the probe into the well riser pipe until an audible and/or visible signal is produced, indicating contact with the water surface.

3.8 Read the ground water level measurement from the top of the inner casing at the surveyed reference point to the nearest 0.01 foot.

3.9 Record the water level measurement on the Ground Water Level Measurement Form.

3.10 Wind the meter cable measuring tape back onto the spool.

3.11 Replace the well cap and lock.

3.12 Decontaminate the meter's probe following the procedures outlined in SOP 9.

3.13 Containerize any decontamination fluids and PPE in accordance with the procedures described in Section 2.19 of this approved Field Sampling Plan.

STANDARD OPERATING PROCEDURE

CTO 10 SOP 3

MONITORING WELL PURGING AND STABILIZATION

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish the procedure for well purging and stabilization utilizing low-flow techniques. Low-flow purging and stabilization techniques will be used for ground water sampling at the four Solid Waste Management Units (SWMUs): the McComish Gorge (SWMU 4), the Old Burn Pit (SWMU 5), the Pesticide Control Area (SWMU 9), and Rockeye (SWMU 10).

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

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

The following field forms and equipment are required for low-flow purging.

Low-Flow Purge Data Form: A copy of this form is included in Attachment A.

Ground Water Sample Log Form: A copy of this form is included in Attachment A.
Bound Field Log Book

Photoionization detector (PID): The manual for the operation of the PID is found in the Health and Safety Guidance Manual and in SOP 13.

Well key

Electronic water level indicator: The water level indicator must have a cable of sufficient length to reach the water surface and be capable of measurements of 0.01 feet. General instructions for operation of electronic water level indicators are supplied by the vendor and in CTO 10 SOP 2.

Multiple parameter water quality meter: This unit measures and displays field parameters measured in the field including pH, dissolved oxygen, turbidity, oxidation-reduction potential (ORP), temperature, and

specific conductance. The manual for operation and calibration of this unit will be supplied by the vendor and is also in CTO 10 SOP 15..

Flow-through cell adapter for water quality meter

Purge water containers: Plastic containers with lids.

Graduated cylinder and stopwatch: Used to calculate flow rate.

Decontamination supplies: SOP 9 describes required decontamination supplies.

Pump: Peristaltic requires battery, and silicone tubing and Teflon lined tubing. Bladder pump requires compressed nitrogen and electronic programmable controller.

3.0 PUMP SELECTION FOR PURGING AND SAMPLING MONITORING WELLS

Ground water monitoring wells will be purged and sampled using one of two pumping methods. Either a peristaltic pump or bladder pump will be used for all monitoring well purging and sampling. The method chosen will be based on the depth below ground surface (BGS) to water, and the recharge rate of the well. For a monitoring well having a depth to water equal to or greater than 20 feet BGS, a bladder pump will be used. For a monitoring well having a depth to water of less than 20 feet BGS and a recharge rate greater than 150 mL per minute, a peristaltic pump will be used. Prior to purging and sampling all monitoring wells will be developed, the recharge rate for each well will be determined during well development.

3.1 PERISTALTIC PUMP METHOD

Insert a new section of medical grade silicone tubing (approx. 18" in length) into the pump head, following the pump operation manual. Obtain the total depth of the well and screen length. Wear clean, disposable surgical gloves while handling the tubing. Measure the appropriate length of Teflon lined PE tubing and insert the tubing inlet (bottom of pump tubing) to the center of the saturated well screen. Insert the Teflon lined PE tubing into the silicone tubing. Proceed to section 4.0.

3.2 BLADDER PUMP METHOD

Obtain the total depth of the well and screen length. Calculate the length of tubing needed to position the inlet screen of the pump at the center of the saturated well screen. Wear clean, disposable surgical gloves while handling the pump assembly and tubing. Measure the appropriate length of Teflon lined PE pump tubing and attach it to the bladder pump, examine all fittings and connections for tightness.

Insert the pump into the PVC riser pipe of the well. While holding the tubing, slowly lower the pump, taking care not to kink the pump tubing. When the tubing is inserted to it's complete length, suspend the pump and tubing assembly on the top of the riser pipe using the attached well cap assembly. The manual for the operation of the controller will be supplied by the vendor. Proceed to Section 4.0.

Cylinder of compressed nitrogen with regulator: Compressed gas serves as the power source for the bladder pump.

Twelve-Volt Battery: A 12-Volt battery (car or NiCd) may serve as a power source for the peristaltic pump.

4.0 PROCEDURES FOR WELL PURGING

4.1 Prior to mobilizing to the site, clean, check for proper operation, and calibrate water quality meter as per manufacture requirements and SOP 15.

4.2 Follow steps 3.1 through 3.9 in SOP 2 to obtain a static water level measurement of the well to be purged. Record the information on the Ground Water Sample Log Form and the Low-Flow Purge Data Form. Leave the water level meter suspended in the well casing.

4.3 Calculate one well casing volume as follows:

1. Obtain the total depth of the well

2. Using the static water level determined in 3.2 and the total depth of the well, calculate the well casing volume using the following formula:

$$V = (0.163)(T)(r^2)$$

where:

V	=	Static casing volume of well in gallons.
T	=	Length of water table in feet (linear feet of water).
0.163	=	A constant conversion factor which compensates for the conversion of the casing radius from inches to feet, the conversion of cubic feet to gallons, and pi.
R	=	Inside radius of the well casing in inches

Note: For wells of 2-inch radius (4-inch diameter) the conversion factor is 0.652 gallons per foot of water column.

Bladder Pump only 4.4 and 5.5.

4.4 Connect the pump controller to the well pump air supply (at the well cap) by following the instructions in the pump control manual (a copy of the manual will be supplied by the vendor). The pump controller must be turned off when being connected.

4.5 Connect the nitrogen cylinder to the pump controller. The nitrogen cylinder valve must be closed and the regulator line pressure set at zero pounds per square inch (PSI) when being connected.

4.6 Following the instructions found in the water quality meter manual, connect the flow- through cell to the pump discharge line.

4.7 Place the discharge tubing from the flow-through cell to direct the purge water discharge into the graduated cylinder or purge-water container.

4.8 Following the instructions in the pump manual, start pumping water from the well.

4.9 Start with the initial pump rate set at approximately 0.1 liters/minute. Use the graduated cylinder and stopwatch to measure the pumping rate. Adjust pumping rates as necessary to prevent drawdown from exceeding 0.3 feet during purging. If no drawdown is noted, the pump rate may be increased (to a max of 0.4 liters/minute) to expedite the purging and sampling event. The

pump rate will be reduced if turbidity is greater than 10 NTUs. If ground water is drawn down below the pump intake or the top of the well screen (if the static water level is above the screen), purging will cease and the well will be allowed to recover before purging continues. Slow recovering wells will be identified and purged at the beginning of the workday. If possible, samples will be collected from these wells within the same 8-hour workday and no later than 24 hours after the start of purging.

The time to sample any given well will vary greatly due to the many variables associated with low flow purging and sampling i.e.:

- Stabilization of parameters
- Possible draw down
- Analytical requirements
- Varying QA sample requirements
- Variable pump rates

Normally, the time from the start of purging to the end of sampling will be between 1.5 to 4.0 hours.

4.10 Measure the well water level using the water level meter every five to ten minutes. Record the well water level on the Low-Flow Purge Data Form.

4.11 Record on the Low-Flow Purge Data Form every five to ten minutes the water quality parameters (pH, specific conductance, temperature, turbidity, ORP, and dissolved oxygen) measured by the water quality meter. Clean the flow through cell as needed during purging (e.g., when fluctuating turbidity readings are observed and confirmed by collection of a turbidity sample before the cell for comparison). If the cell needs to be cleaned during purging operations, continue pumping (allow the pump to discharge into a container) and disconnect the cell. Rinse the cell with distilled water. After cleaning is completed, reconnect the flow-through cell and continue purging. Document the cell cleaning on the Low-Flow Purge Data Form.

4.12 Measure the flow rate using a graduated cylinder. Remeasure the flow rate any time the pump rate is adjusted.

4.13 During purging, check for the presence of bubbles in the flow-through cell. The presence of bubbles would be an indication that connections are not tight. If bubbles are observed, check for loose connections.

4.14 Stabilization is achieved and sampling can begin when a minimum of one casing volume has been removed and three consecutive readings, taken at 5 to 10 minute intervals, are within the following limits:

pH ± 0.1 standard units
Specific conductance ± 3%
Temperature ± 3%
Turbidity less than 10 NTUs
Dissolved oxygen ± 10%

If the above conditions have not been met after the well has been purged for four hours, purging will be considered complete and sampling can begin.

STANDARD OPERATING PROCEDURE

CTO 10 SOP 4

MONITORING WELL SAMPLING

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish the procedure for monitoring well sampling. Low-flow sampling techniques will be used for ground water sampling at the four Solid Waste Management Units (SWMUs): the McComish Gorge (SWMU 4), the Old Burn Pit (SWMU 5), the Pesticide Control Area (SWMU 9), and Rockeye (SWMU 10).

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

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

The following field forms and equipment are required for low-flow sampling of monitoring wells.

Ground Water Sample Log Form: A copy of this form can be found in Attachment A.

Bound Field Log Book

Labeled sample containers: See SOP 10 for sample identification procedures.

Tag for each sample container

Peristaltic Pump or Bladder pump
See SOP 3 on purging for pump selection.

Electronic Programmable Controller, model 400: The programmable controller regulates the dedicated bladder pump. The manual for the operation of the controller will be supplied by the vendor.

Cylinder of compressed nitrogen with regulator: Compressed gas is the power source for the bladder pump.

Twelve-Volt Battery: A 12-volt battery (car or NiCd) may be used as a power source for the peristaltic pump.

Plastic storage bags

Shipping containers

3.0 MONITORING WELL SAMPLING PROCEDURES

3.1 Prior to sampling the well, the inspection procedures described in SOP 1, the water level measurements described in SOP 2, and the well purging procedures described in SOP 3 must be completed. Samples are identified by an alpha-numeric naming convention described in SOP 10. Initiate sampling when the well is stabilized in accordance with SOP 3.

3.2 Record the sample start time (using military time) on the Ground Water Sample Log Sheet.

3.3 With the pump continuing to run, disconnect the flow-through cell from the pump discharge tube and immediately start filling sample bottles directly from the pump discharge. Allow the pump discharge to flow gently down the inside of the container with minimal turbulence when filling sample containers. Avoid immersing the discharge tube into the sample as the sample container is being filled.

3.4 Cap each container immediately after filling.

3.5 Record the sample time on the Ground Water Sample Log Form, the sample tag and on the sample label. Additional sample documentation is discussed in SOP 11.

3.6 Secure the associated tag to each sample container.

3.7 Place the tagged sample container into a plastic storage bag and then into a cooler containing ice.

3.8 Repeat steps 3.3 through 3.7 for each sample container collected.

3.9 The pump rate should not be adjusted after sampling has commenced. If it becomes necessary to adjust the pump rate, document the change on the Ground Water Sample Log Form.

3.10 All samples will be collected into pre-preserved bottles (if required) supplied by an approved laboratory. Table 2-2 of this approved Field Sampling Plan includes information on preservation requirements. All samples will be collected in the following sequence (where applicable):

* Volatile organic compounds (VOCs)
Semivolatile organics (SVOCs)
Explosives
Total Metals
Pesticides/PCBs
Herbicides
TAL Inorganics (total)
Cyanide (total)
Dioxins/furans
TAL Inorganics (dissolved)
Cyanide (dissolved)

* When sampling with a peristaltic pump VOC's will be sampled last using the pipette (soda straw) method. The pipette VOC sampling method most often requires two people.

With the sample tubing full and the pump running on low (approx. 50 to 100 mL/min) remove the Teflon lined PE tubing from the silicone pump tubing and quickly place a gloved thumb over the end of the tubing. While holding and sealing the tubing end pull the pump tubing out of the well, this is accomplished by walking away from the well while the second person holds the tubing at the well head, using care to avoid contacting the ground with the tubing. When the end of the tubing has been removed from the well carefully hold it over an opened VOC vial, removing the thumb from the pump end of the tubing and gravity feed the sample into the vial (soda straw method). Reinsert the tubing into the well and pump until the tubing is full. Repeat as needed until all vials are full.

3.11 Sample containers for volatile constituents (VOCs) must be completely filled so that no headspace exists in the container.

3.12 Types of sample containers, sample volume, preservation requirements, and holding times are summarized in Table 2-2 of this Field Sampling Plan. All sample containers will be supplied by the laboratory, and the laboratory will pre-preserve all sample containers, where appropriate.

3.13 If the last turbidity measurement prior to the commencement of sampling showed turbidity to be greater than 10 Nephelometric Turbidity Units (NTUs), then filtered aliquots of ground water will be collected and analyzed for dissolved metals. Without turning off the pump, attach a disposable, inline, 0.45-um filter cartridge at the end of the discharge tube. Fill sample containers marked for "dissolved metals" so that the laboratory knows that these aliquots are distinct sample fractions and that the results should be reported as dissolved analytes.

3.14 Repeat steps 3.4 through 3.8 for the filtered sample containers.

3.15 After completion of sample collection: if using a peristaltic pump, pull tubing and properly dispose of tubing and filter following section 2.19 (IDW disposal) in the FSP; for bladder pump remove pump from well and decontaminate following the procedures in SOP 9. Replace the outer protective well cap and lock the well.

3.16 All equipment should be cleaned and packed into the sample vehicle, along with the sample cooler for transport.

STANDARD OPERATING PROCEDURE

CTO 10 SOP 5

SURFACE WATER SAMPLING

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish the procedure for surface water sampling. Surface water sampling will be collected at the four Solid Waste Management Units (SWMUs): the McComish Gorge (SWMU 4), the Old Burn Pit (SWMU 5), the Pesticide Control Area (SWMU 9), and Rockeye (SWMU 10).

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

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

The following field forms and equipment are required for surface water and spring sampling.

Surface Water Sample Log Form: A copy of this form is included in Attachment A.

Bound Field Log Book

Tags for each sample container

Multi-parameter water quality meter: The water quality meter is used for the measurement of dissolved oxygen, pH, specific conductance, temperature, turbidity, and oxidation-reduction potential. The procedures for the operation and calibration of this meter are provided in CTO 10 SOP 15.

Dedicated/disposable sample containers: Dedicated/disposable sample containers are used to fill sample containers and transport sample(s) to a pump for filtering if dissolved samples are required.

Labeled sample containers: See SOP 10 for sample identification procedures.

0.45 micron filter assembly: These are single-use filters used to filter samples. The filters are discarded after one use.

Peristatic pump + power source + tubing

Silicon tubing

Transfer bottles used during filtration

Plastic storage bags

Shipping containers

3.0 SURFACE WATER SAMPLING PROCEDURES

3.1 Sampling will start at the downstream location and proceed to the farthest upstream location. Reference figures are included in the FSP for approximate sample locations. The sampling sequence will be as follows:

3.2 Gently remove any leaves or twigs that have accumulated in the sample pool area

3.3 Estimate of the flow rate of the stream in gallons per minute (gpm) and note if base-flow (low-flow) or storm-flow (high-flow). This is an estimate only. Round the flow rate to the nearest five gallons and record this number on the Surface Water Sample Log Form.

3.4 Record the sample time (using military time) on the Surface Water Sample Log Form and sample container labels and sample tags. Complete sample documentation of field activities in accordance with CTO 10 SOPs 10 and 11.

3.5 If the sample can be obtained from the shore, begin sampling using a dedicated, clean, unpreserved, one-liter collection bottle supplied by the laboratory. VOC's are an exception to this method, VOC's will be direct fill and completely filled so that no headspace exists in the container. Hold the collection bottle at a 45-degree angle and lower it to approximately half the sample pool depth. With the mouth of the bottle facing upstream, fill the collection bottle with water, being careful not to disturb the sediment.

3.6 If the sample cannot be obtained from the shore, carefully step into the water downstream of the sample location. Make certain that any disturbed sediment clears from the water before sampling. Begin sampling using a dedicated, clean, unpreserved, one-liter collection bottle supplied by the laboratory. Obtain the sample upstream of your location. Hold the collection bottle at a 45-degree angle and lower it to approximately half the sample pool depth. With the mouth of the bottle facing upstream, fill the collection bottle with water, being careful not to disturb the sediment.

3.7 Transfer the contents of the collection bottle to the sample container and cap the sample container. Note, the unpreserved, one-liter collection bottle is needed for streams and surface water locations with low flow and/or shallow depths, that would prevent the complete filling of the sample container. Depending on site conditions, the sampler, may use either direct fill and/or a sample collection bottle (VOC are always direct fill).

3.9 Affix the sample label to the sample container and using a wire tie, secure the corresponding tag to the neck of the sample container.

3.10 Place the tagged sample container into a plastic storage bag and then place the plastic storage bag holding the sample container into a cooler containing ice.

3.11 Repeat steps 3.4 through 3.10 until all of the sample bottles have been filled.

3.12 All samples will be collected into pre-preserved bottles (if required for preservation) supplied by an approved laboratory. Table 2-2 of this approved Field Sampling Plan includes information on the preservative and bottle requirements. All samples will be collected in the following sequence (where applicable):

Volatile organic compounds (VOCs)
Semivolatile organics (SVOCs)
TAL inorganics (total)
Cyanide (total)
Pesticides/PCBs
Herbicides

Dioxins/furans

TAL inorganics (dissolved)

Cyanide (dissolved)

3.13 Sample containers for volatile constituents (VOCs) must be filled directly from the surface water body (using no transfer bottle) completely filled so that no headspace exists in the container.

3.14 Fill two 1-liter unpreserved polyethylene bottles. Use these bottles to transfer sample for field filtering. Set up a peristaltic pump (see vendor-supplied manual) for filtering of the dissolved metals (Appendix IX and miscellaenous) and dissolved cyanide samples. Using dedicated and disposable silicone tubing and a .45 micron filter, place the intake tubing from the pump into the transfer bottle with the filter attached to the discharge end and start the pump. Pre-rinse the filter with approximately 100-mL of sample water prior to filling the sample containers.

3.15 All samples will be collected into pre-preserved bottles (if required for preservation) supplied by an approved laboratory. Table 2-2 of this approved Field Sampling Plan includes information on preservative requirements.

3.16 Obtain measurements of dissolved oxygen, pH, specific conductance, temperature, turbidity, and oxidation-reduction potential using the multi-parameter water quality meter. Suspend the meter into the sample pool. After the meter has stabilized (approximately 1 to 2 minutes), record the readings on the Surface Water Sample Log Form.

3.18 Clean all equipment and load the equipment and the sample cooler in the sample vehicle for transport.

STANDARD OPERATING PROCEDURE

CTO 10 SOP 6

SEDIMENT SAMPLING

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish the procedure for sediment sampling. Sediment sampling will be collected the four Solid Waste Management Units (SWMUs): the McComish Gorge (SWMU 4), the Old Burn Pit (SWMU 5), the Pesticide Control Area (SWMU 9), and Rockeye (SWMU 10).

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

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

The following field forms and equipment are required for sediment sampling.

Sample Log Form: A copy of this form is included in Attachment A.

Bound Field Log Book

Tags for each sample container

Stainless steel and/or disposable plastic trowels

Survey Stakes and Flagging: Used to mark sampling locations after completion of sampling.

Labeled sample containers: See SOP 10 for sample identification procedures.

Plastic storage bags

Shipping containers

SEDIMENT SAMPLE LOCATION SELECTION

Sediment samples are usually collected at the same verticals at which water samples were collected. The shape, flow pattern, depth, and water circulation patterns must all be considered when selecting sediment sample locations. In streams, areas likely to have sediment accumulation (e.g., bends, behind boulders, quite shallow areas or very deep, low-velocity areas) shall be sampled while areas likely to show net erosion (e.g., high-velocity, turbulent areas) and suspension of fine solid materials, shall be avoided. In general bed sediments composed of fine-grained materials with lower porosity and greater surface area available for adsorption, are more desirable for sample selection. Bottom sediments (especially fined-grained materials) may act as a sink or reservoir for adsorbing heavy metals and organic contaminants (even if water column concentrations are below detection limits). Therefore, it is important to minimize the loss of low-density "fines" during the sampling process.

3.0 SEDIMENT SAMPLING PROCEDURES

3.1 Wearing clean disposable, surgical gloves and using a sampling trowel clear any accumulated vegetative mater from the sample area. Using the trowel to scoop the sediment into the labeled sample container, carefully decant any water that may have accumulated, from the sample container.

3.2 Record the sample time (using military time) on the Sediment Sample Log Form and sample container labels and tags.

3.3 Secure the tag to the neck of the sample container using a wire tie.

3.4 Place the tagged sample container into a plastic storage bag and then place the plastic storage bag holding the sample container into a cooler containing ice. Samples will be identified using procedures in SOP 10 and field activities documented in accordance with SOP 11.

3.5 Using a indelible marker write the sample ID on a survey stake, drive the stake into the ground at the sample location.

3.6 All samples will be collected into bottles supplied by an approved laboratory. Table 2-1 of this approved Field Sampling Plan includes information on the bottle requirements. All samples will be collected in the following sequence (where applicable):

Volatile organic compounds (VOCs)
Semivolatile organics (SVOCs)
TAL inorganics (total)
Cyanide (total)
Pesticides/PCBs
Herbicides
Dioxins/furans
TAL inorganics (dissolved)
Cyanide (dissolved)

3.7 Sample containers for volatile constituents (VOCs) must be completely filled so that no headspace exists in the container.

3.8 Clean all equipment and load the equipment and the sample cooler in the sample vehicle for transport.

STANDARD OPERATING PROCEDURE

CTO 10 SOP 7

SURFACE AND SUBSURFACE SOIL SAMPLING

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe the procedures for surface and subsurface soil sampling using direct push technology, split-barrel or hand auger for the Risk Assessment Work Plan at SWMU 4, McComish Gorge; SWMU 5, Old Burn Pit; SWMU 9, Pesticide Control/R-150 Tank Area; and SWMU 10, Rockeye at NSWC Crane. This procedure also describes the collection of samples for Volatile Organic analysis and the use of field screening to select the most appropriate subsurface soil interval for sampling.

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

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Writing utensil
Disposable Medical-Grade Gloves (i.e. latex, nitrile)
Boring Log
Sample Logsheets
Stainless-steel mixing bowls
Stainless-steel trowel or soup spoon
EnCore Handle and Sampler
Required sample containers with appropriate preservative: All sample containers for analysis by fix-based laboratories will be supplied and deemed certified clean by the laboratory.
Required Decontamination Materials
Bentonite Chips
Custody Seals
Chain of custody records
Required Personnel Protective Equipment (PPE)
A random number generator
Photoionization Detector (PID)

Wooden Stakes or Pin Flags

Sealable Polyethylene bags

Heavy-Duty Cooler

Ice

3.0 COLLECTING SOIL SAMPLES FOR VOLATILE ORGANIC COMPOUNDS (VOCs)

Soil samples collected for volatile organics will be obtained using a hermetically sealed sample vial such as an EnCore sampler and preserved in the laboratory (not in the field) with either methanol or sodium bisulfate dependent upon expected levels of contamination. The sample is collected by pushing the EnCore sampler directly into the soil core (before mixing in bowl), ensuring that the sampler is packed tight with soil, and leaving no headspace between cap and container. Four EnCore containers should be collected for each VOC sample. Using this type of sampling device eliminates the need for field preservation. Once the sample is collected, it should be kept at 4 deg C and shipped to the laboratory for preservation or extraction within 48 hours.

4.0 CONCENTRATION RANGE PRE-SCREENING

For this project, it is necessary to analyze volatile organic compounds in soil as low level (concentration range 0.5 to 200 ug/kg). Because low level preservation is known to react with highly alkaline soils and soils with high carbonate/calcium content, site soils must be pre-screened to determine if they are compatible with low level preservation (i.e., sodium bisulfate).

Pre-screening will be done by dividing each site into 500 meter quadrants and taking one surface soil sample (0-1 ft) approximately in the middle of each quadrant. The subcontracted laboratory will be asked to provide the appropriate number of sodium bisulfate pre-preserved VOA vials (according to SW-846 5035, one gram of sodium bisulfate in 5 mL of organic-free reagent grade water). At each sampling location, 5 g of surface soil (0-2') will be added to the preserved, uncapped VOA vial and closely observed for a reaction. A reaction will be identified as occurring if the temperature rises (noted by touch), or if bubbling or fizzing occurs (visual observation).

If pre-screening determines that site soils are not reactive with sodium bisulfate, samples will be collected using the Encore Sampler and shipped to the lab for preservation with sodium bisulfate in accordance with SW-846 5035.

If pre-screening indicates that the site soils react with sodium bisulfate, samples will be collected using the Encore Sampler and shipped to the lab for preservation. The lab shall preserve the reactive samples by placing 5 g of soil from the Encore Sampler in 5 mL of organic-free reagent grade water in a standard VOA vial. The vial will be capped, placed in a ziplock bag and stored in a freezer at -10 deg C until analysis. Analysis must occur within 14 days of preservation.

5.0 SURFACE SOIL COLLECTION

Field screening of surface soils is not required. Clear the area to be sampled of any surface debris (herbaceous vegetation, twigs, rocks, litter, etc.). Regardless of collection method, samples for organic analysis (VOC, SVOC, Herb/Pest/PCB/Dioxins, explosives) will be collected from the 1 to 2 foot interval. All other inorganic parameters for surface soil samples will be collected from the 0 to 1 foot interval. VOC containers are collected directly from the spoon, tube or auger without mixing. All other parameters will be collected after mixing of the interval.

6.0 SCREENING OF SUBSURFACE INTERVAL FOR SAMPLING

Field screening methods may be used to select the appropriate subsurface soil interval for sampling and laboratory analysis. The objective of screening is to select for laboratory analysis, the contaminated (elevated volatiles or staining) or most relevant subsurface soil interval (above the surficial aquifer) for use in the risk assessment. The maximum depth of a soil boring is 10 ft bgs or to the presence of saturated soil indicating the surficial aquifer. Since the surface interval extends from 0-2 feet bgs, a 1-foot soil interval must be selected from the bottom of the surface interval to the bottom of the soil boring (2-10 ft bgs).

Risk assessment requires identification of the most contaminated soil interval. Assuming that the presence of volatile organic contaminants is an indicator of other contaminants, a photoionization detector (PID) will be used to screen soil corings for the interval with the highest volatiles. Visual observation of soil discoloration or staining may also be used to select the contaminated soil interval. In the selection of soil intervals for sampling, elevated volatiles as measured by a PID, have priority over the visual observation of impacts.

If the most contaminated interval may not be identified, as above, then it is assumed that the most relevant subsurface interval for risk assessment is the one-ft interval above the uppermost (surficial) aquifer. Saturated conditions indicate the presence of a surficial aquifer and therefore without PID or

visual clues of contamination, the interval for sampling will be the interval above the uppermost aquifer. Standing water in an open borehole or saturated conditions in corings indicates a surficial aquifer. Measurements of volatiles with a PID or visual observations of impacts have priority over the use of saturated conditions to identify the interval for sampling.

In the absence of either elevated volatile organics, visual clues of impacts, or surficial aquifer, a random subsurface interval is pre-selected for representative sampling. If screening is negative above this randomly chosen interval, VOCs samples must be collected from this random interval before screening can resume on cores below this interval. If screening below this interval is negative, samples for other constituents may be collected from this random interval after mixing. If screening below this random interval indicates impacts (volatiles, staining, saturation), the random interval is ignored (samples discarded) and new samples should be collected from contaminated or relevant interval.

Since samples for VOC analysis must be collected soon after retrieval and corings from DPT/Drilling are retrieved in 4 ft sections, the outcome of screening in lower, as yet unretrieved intervals, may impact early decision made in upper levels. Therefore it may be necessary to collect extra VOC samples that will not be analyzed. Unused filled EnCore sample containers that will not be analyzed, will be emptied, washed and discarded as trash.

Screening criteria for selection of sample interval is prioritized in the following list:

1. Highest total VOC measurement by Photoionization Detector;
2. Visual Observation of Contamination including discoloration, staining, or others;
3. Interval above the uppermost surficial aquifer; and
4. Random interval.

The process for screening soil corings to select the most contaminated, relevant or representative subsurface interval is as follows:

- Prior to the start of the subsurface soil boring/probing, a random soil interval will be identified (2-3, 3-4, 4-5, 5-6, 6-7, 7-8, 8-9, 9-10). A roll of a die can be used. Samples will be collected from this random interval if no volatile organics are measured, no staining is observed, or no water table is detected

- Scan the length of the core interval for elevated volatile organics, visual signs of contamination, or saturated layers of soil. Field screening takes precedence over the random interval. If screening criteria are not identified, VOC samples must be collected from the random interval before proceeding to screen lower intervals of the core boring.

- Collect VOC samples from the selected interval with the following priority:

  - If elevated volatile organics are measured via the PID, collect the necessary VOC samples from this interval and continue to scan.

  - If visual signs of contamination (staining, etc.) are observed, but no volatiles, then collect the necessary VOC samples from the stained interval and continue to scan.

  - If a saturated layer of water is observed but no volatiles or staining, then collect VOCs from the first unsaturated one-ft interval above the saturated layer and stop.

  - If no elevated PID measurements, staining or groundwater are noted, collect the VOC sample from the random interval, and save the core for possible sampling. Continue to scan the core with the PID.

  - Continue this process, collecting VOC samples at suspect intervals until refusal, the water table or the bottom depth of 10' is reached.

- Composite and mix soils for other analytes from the interval with the highest volatile screening, the deepest interval with staining, or from the interval immediately above the uppermost water table. If no volatiles, staining, or saturation is observed, composite and mix soils from the random interval. (Note: Samples for all analytes including VOCs will be collected from the same interval.)

- Record the sample time on the Soil (and Sediment) Sample Log Sheet, the sample tag and on the sample label.

- Secure the associated tag to each sample container.

- Place the tagged sample in a plastic storage bag and then into a cooler containing ice. Package and ship samples according to SOP 12.

7.0 DIRECT PUSH TECHNOLOGY (DPT)

DPT refers to sampling tools and sensors that are driven directly into the ground without the use of conventional drilling equipment. DPT typically utilizes hydraulic pressure and/or percussion hammers to advance the sampling tools. A primary advantage of DPT over conventional drilling techniques is that DPT results in the generation of little or no drill cuttings .

7.1 SAMPLING EQUIPMENT

Additional equipment needed for conducting DPT probing for soil sampling includes, but is not limited to, the following:

- 4-foot X 1.5-inch diameter macro-core sampler
- Probe sampling adapters
- Roto-hammer with 1.5-inch bit
- Acetate liner for soil sampler
- Steel drive points
- Geoprobe AT-660 Series Large Bore Soil Sampler, or equivalent

7.2 DPT SAMPLING METHODOLOGY

There are several methods for the collection of soil samples using DPT probing equipment. The most common method is explained in the following section. Variations of the following method may be conducted upon approval of the Project Manager.

- Macro-core samplers fitted with detachable steel drive points are driven into the ground using hydraulic pressure. If there is concrete or pavement over a sampling location, a Roto-hammer is used to drill a minimum 1.5-inch diameter hole through the surface material.

- The sampler is advanced continuously in 4-ft intervals. No soil cuttings are generated because the soil is displaced within the formation.

- The sampler is retracted from the hole, and the 4-ft continuous sample is removed from the outer coring tube. The sample is contained within an acetate liner.

- Log the sample on the Boring Log Sheet. Note: the DPT macro-core sampler is 4' in length and sample length is 1' use a engineer's tape to measure for sample intervals.

- The acetate liner is cut lengthwise in order to field screen the sample with a PID, visually observe the sample for staining, assess moisture content, and if sampling criteria are met, mixing and transfer the sample to sample containers for laboratory analysis.

- Record the sample time on the Soil (and Sediment) Sample Log Sheet, the sample tag and on the sample label.

- Secure the associated tag to each sample container.

- Place the tagged sample in a plastic storage bag and then into a cooler containing ice. Package and ship samples according to SOP 12.

- If additional sample volume is required, push an additional boring adjacent to the first and composite/mix the same interval.

Once sampling has been completed, the hole is backfilled with bentonite chips or bentonite cement grout, depending upon project requirements. Asphalt or concrete patch is used to cap holes through paved or concrete areas. All holes will be finished smooth to existing grade.

8.0 SOIL SAMPLING USING A HAND AUGER

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), and a cross-handle. The hand auger can be used in a wide variety of soil conditions. It is limited in depth of boring by texture of soil, layers of rock, or collapse of borehole by saturated conditions.

8.1 HAND AUGERING EQUIPMENT

To accomplish soil sampling using a hand augering system, the following additional equipment is required:

- Complete hand auger assembly (including clips to attach auger bucket and handle to extension).

8.2 HAND AUGERING METHODOLOGY

To obtain soil samples using a hand auger, the following procedure shall be followed:

- Clear the area to be sampled of any surface debris (herbaceous vegetation, twigs, rocks, litter, etc.).
- Attach a properly decontaminated bucket bit to a clean extension rod and further attach the cross handle to the extension rod.
- Begin augering by turning the "T" handle in a clock-wise fashion, thus turning the auger bit until the bucket bit is advanced approximately 6 inches into the soil. Remove the bucket from the borehole, empty the contents and repeat, adding additional rod extensions as necessary to reach the desired depth.
- After reaching the desired depth, slowly and carefully withdraw the bucket from the borehole.
- Discard the top of core (approximately 1"), which represents any loose material collected by the bucket bit before penetrating the desired sample depth.
- Utilizing the hand trowel remove the sample material from bucket bit into a properly decontaminated stainless steel mixing bowl.
- Screen the auger interval for volatiles, staining, or saturation per procedure and collect surface or subsurface samples based on procedure.
- Log the recovered sample on the Boring Log sheet (provided in Att. A).
- Return the same bucket auger into the borehole and turn the auger, advancing the auger bit an additional 6 inches into the soil (totaling 1 foot).
- After reaching the desired depth, slowly and carefully withdraw the bucket from the borehole.

- Discard the top of core (approximately 1"), which represents any loose material collected by the bucket bit before penetrating the desired sample depth and repeat the field screening to identify the interval to be sampled.

- After the VOC samples have been collected, using a decontaminated stainless-steel trowel or soup spoon, thoroughly mix (homogenize) the sample material (which now contains a 1-foot interval of sample) in the mixing bowl and fill the appropriate sample bottle(s).

- If additional sample volume is required, auger adjacent to the initial boring and composite/mix soil from the same interval.

- Fill out a soil sample logsheet (found in Attachment A) and sample labels and tags (according to CTO 10 SOP 11) making sure that the appropriate fields are filled out completely and legibly and affix them to the sample bottle.

- Proceed with handling each sample container.

- Place the tagged sample container into a plastic storage bag and then into a cooler containing ice.

- Once sampling has been completed, the hole is backfilled with bentonite chips

9.0 SOIL SAMPLING WITH A HOLLOW STEM AUGER AND A SPLIT BARREL SAMPLER

A split-barrel (split spoon) sampler consists of a heavy stainless steel sampling tube that can be split into two equal halves to reveal the soil sample. Carbon steel split spoons cannot be used for soil sampling. A drive head is attached to the upper end of the tube and serves as a point of attachment for the drill rod. A removable tapered nosepiece/drive shoe attaches to the lower end of the tube and facilitates cutting. A basket-like sample retainer can be fitted to the lower end of the split tube to hold loose, dry soil samples in the tube when the sampler is removed from the drill hole. This split-barrel sampler is attached to a drill rod and forced into the ground by means of a 140-lb or larger casing driver.

9.1 HOLLOW STEM SAMPLING EQUIPMENT

The following additional equipment is used for obtaining a split-barrel sample:

- Drilling Equipment (provided by subcontractor)
- Stainless steel Split Barrel Samplers (OD 2", I.D. 1-3/8", either 20" or 26" long)
- Drive weight assembly, 140-lb weight, driving head and guide permitting free fall of 30".

9.2 SPLIT SPOON SAMPLING METHODOLOGY

The drilling subcontractor will usually provide the recovered spoon or barrel to the sampler and the following steps shall be used to obtain the collect the soil sample:

- Once the drive head and nosepiece is removed, open the sampler to reveal the soil sample. Immediately scan the sample core with the PID and visually for staining or saturation per procedure. Carefully separate the soil core, with a decontaminated stainless steel utensil at about 6-inch intervals while scanning the center of the core for elevated readings or staining. Record readings and observations.

- Select the sample interval per procedure.

- Collect the volatile sample from an undisturbed area of the interval (i.e., the center of the core) where scanning indicates layers of interest.

- Utilizing the hand trowel remove the sample material from the spoon or barrel into a properly decontaminated stainless steel mixing bowl. Mix thoroughly and collect samples for other analytes.

- Record the sample time on the Soil (and Sediment) Sample Log Sheet, the sample tag and on the sample label.

- Secure the associated tag to each sample container.

- Place the tagged sample in a plastic storage bag and then into a cooler containing ice. Package and ship samples according to SOP 12.

- If additional sample volume is required, auger an additional boring adjacent to the initial borehole and composite/mix the same interval. Do not collect soil for chemical analysis from the auger flights.

- Once sampling has been completed, the hole is backfilled with bentonite chips or bentonite cement grout, depending upon project requirements. Asphalt or concrete patch is used to cap holes through paved or concrete areas. All holes will be finished smooth to existing grade.

STANDARD OPERATING PROCEDURE

CTO 10 SOP 8

MONITORING WELL INSTALLATION AND WELL DEVELOPMENT

1.0 PURPOSE

This procedure provides general guidance and information pertaining to proper monitoring well design, installation, and development. The methods described herein are specific for monitoring well construction at SWMU 2 (Dye Burial Grounds), SWMU 4 (McComish Gorge), SWMU 5 (Old Burn Pit), SWMU 9 (Pesticide Control/R-150 Tank Area), and SWMU 10 (Rockeye). Guidelines by South Division, Naval Facilities Engineering Command, (South Div NavFac, 1997) should be consulted as should State of Indiana regulatory requirements in Article 16 Water Well Drillers of Chapter 310 of the Indiana Annotated Codes (310 IAC 16).

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

2.0 RESPONSIBILITIES

Driller - The driller provides adequate and operable equipment, sufficient quantities of materials, and an experienced and efficient labor force capable of performing all phases of proper monitoring well installation and construction. The driller may also be responsible for obtaining, in advance, any required permits for monitoring well installation and construction.

Field Geologist - The rig geologist supervises and documents well installation and construction performed by the driller, and insures that well construction is adequate to provide representative groundwater data from the monitored interval. Geotechnical engineers, field technicians, or other suitable trained personnel may also serve in this capacity.

Site Safety Officer – The Site Safety Officer is responsible for clearing the drill site for underground and overhead utilities or other potentially hazardous obstructions.

3.0 REQUIRED EQUIPMENT/ITEMS

The following list includes equipment and items required for monitoring well installation:

- Health and safety equipment as required by the Site Safety Officer.
- Well drilling and installation equipment with associated materials (typically supplied by the driller).
- Hydrogeologic equipment (weighted engineer's tape, water level indicator, retractable engineers rule, electronic calculator, clipboard, mirror and flashlight - for observing downhole activities, paint and ink marker for marking monitoring wells, sample jars, well installation forms, and a field notebook).

4.0 WELL DESIGN

The objectives for each monitoring well and its intended use are clearly defined in Tables 5-5, 6-5, 7-5, and 8-9. Summary of Objectives/Proposed Sampling for SWMUs 4, 5, 9, and 10, respectively in the Risk Assessment Work Plan. The objectives of monitoring well locations are to evaluate ground water quality of various locations in relation to their historical extent or to determine horizontal migration from surficial to deeper aquifers in geological strata of interest (paleo-channel).

Present siting of monitoring wells shall be confirmed after a preliminary estimation of the groundwater flow direction. In most cases, groundwater flow and potential well locations have been determined through the review of geologic data and the site terrain. In addition, data from existing monitoring wells in the area were used to determine the groundwater flow direction. If these methods fail, piezometers, which are relatively inexpensive to install, may have to be installed in a preliminary investigative phase to determine groundwater flow direction.

Well construction is tailored to the specific objective of the monitoring well. Specification of these items generally depends on the purpose of the monitoring system and the characteristics of the hydrogeologic system being monitored. The decision concerning the monitored interval and well depth is based on the following (and possibly other) information:

- Historical information on the construction of existing adjacent wells;
- Historical geologic logs describing the depth, thickness and uniformity of the water-bearing zone or strata of interest;

- The presence and location of contaminants encountered during drilling; and

- Whether the purpose of the installation is for evaluating the groundwater quality of the uppermost surficial aquifer or if a particular stratigraphic zone (Pennsylvanian, paleochannel, etc.) is being investigated.

In most situations depending on the purpose of the well and the site conditions, monitored intervals are 10 feet and will be installed with approximately 7 feet of the screen located below the water table. Shorter screen lengths (5 feet) are usually required where shallow surficial aquifers are being monitored. Bottoms of well screens should be placed a minimum of 6 inches but no more than 3 ft above the bottom of the drilled borehole.

All monitoring wells will be constructed of schedule-40, flush-joint threaded, 2-inch ID PVC riser pipe and flush joint threaded, factory slotted well screen with a threaded end cap. The well screens will be factory slotted to 0.010-inch size. Each section of well casing and screen shall be National Sanitation Foundation (NSF) approved. Well screens will be 10-feet long, but may be longer or shorter based on the subsurface conditions encountered. A PVC cap will be placed on the bottom and are also flush threaded. Thermoplastic pipe shall comply with ASTM F-480 (1981). Other means of joining casings using glue, gaskets, pop rivets or screws are not allowed.

The screen shall pass no more than 10 percent of the pack material, or in-situ aquifer material. The field geologist shall specify the combination of screen slot size and sand pack, which will be compatible with the water-bearing zone, to maximize groundwater inflow and minimize head losses and movement of fines into the wells.

The hollow-stem auger dry drilling method will be used to install most monitoring wells. The augers will have a 4.25 inch inside diameter and create a 9.5 inch borehole. The use of drilling fluids will not be permitted. Split-spoon samples will be collected in accordance with ASTM specification D1586-84. Split-spoon samplers will be of 2-inch or 3-inch diameter and 2-foot minimum length. Samples will typically be collected continuously to the water table or as determined by the field geologist. Every effort will be made to achieve maximum recovery of sample material during split-spoon sampling, including use of traps as needed.

Monitoring wells will be installed through the augers immediately upon completion of each well boring. A clean silica sand pack will be installed trough the augers as they are removed from the boring. Clean silica sand of U.S. Standard Sieve Size No. 20 to 40 will be used. The sand pack will be extended from 0.5 feet below the well screen to 2.0 feet above the top of the well screen. A minimum 2-foot thick bentonite pellet seal will be installed above the sand pack and allowed to hydrate as per the manufacturer's recommendations. Only 100-percent, certified pure, sodium bentonite will be used for well construction. The depths of backfill materials will be constantly monitored during well installation using a weighted stainless steel or fiberglass tape measure. The remaining annulus above the hydrated bentonite seal will be backfilled to the surface using a tremie pipe, with a 20:1 cement/bentonite grout. A maximum of 10 gallons of water per 94-pound bag of Type-1 cement will be used. The grout mixture should be blended in an above-ground rigid container or mixer to produce a thick lump-free mixture.

As required in the Navy Guidelines, a minimum 1-ft thick secondary filter pack will be used to prevent intrusion of the bentonite seal into the primary filter pack. Uniformly graded fine sand with 100% by weight passing the No. 30 U.S. Standard sieve, and less than 2% by weight passing the 200 U.S. Standard sieve should be used as a secondary filter pack.

Bentonite expands by absorbing water and provides a seal between the screened interval and the overlying portion of the annular space and formation. Cement-bentonite grout is placed on top of the bentonite pellets extending to the surface. The grout effectively seals the well and eliminates the possibility for surface infiltration reaching the screened interval. Grouting also replaces material removed during drilling and prevents hole collapse and subsidence around the well. A tremie pipe should be used to introduce grout from the bottom of the hole upward, to prevent bridging, and to provide a better seal. However, in shallow boreholes that don't collapse, it may be more practical to pour the grout from the surface without a tremie pipe.

When the well is completed and grouted to the surface, a protective steel surface casing is placed over the top of the well. The finished well casing shall extend at least 2 ft above the ground level and if located in a floodplain, must be at least 2 feet above the elevation of the regulatory flood or be equipped with a watertight cap. This casing will have a cap that can be locked to prevent vandalism. A vent hole shall be provided in the cap to allow venting of gases and maintain atmospheric pressure as water levels rise or fall in the well. The protective casing has a larger diameter than the well and is set into the wet cement grout over the well upon completion. In addition, one hole is drilled just above the cement collar through the protective casing which acts as a weep hole for the flow of water which may enter the annulus during well development, purging, or sampling.

4.1 MONITORING WELLS IN UNCONSOLIDATED SEDIMENTS

After the borehole is drilled to the desired depth, well installation can begin. The procedure for well installation will partially be dictated by the stability of the formation in which the well is being placed. In the case of hollow-stem auger drilling, the augers will act to stabilize the borehole during well installation.

Before the screen and riser pipe are lowered into the borehole, all pipe and screen sections should be measured with an engineer's rule to ensure proper placement. When measuring sections, the threads on one end of the pipe or screen must be excluded while measuring, since the pipe and screen sections are screwed flush together.

After the screen and riser pipe is lowered through the temporary casing, the sand pack can be installed. A weighted tape measure must be used during the installation procedure to carefully monitor installation progress. The sand is poured into the annulus between the riser pipe and temporary casing, as the casing is withdrawn. Sand should always be kept within the temporary casing during withdrawal in order to ensure an adequate sand pack. However, if too much sand is within the temporary casing (greater than 1 foot above the bottom of the casing) bridging between the temporary casing and riser pipe may occur.

After the sand pack (primary and secondary) is installed to the desired depth (at least 1 foot above the top of the screen), then the bentonite pellet seal (or equivalent) can be installed in the same manner as the sand pack. At least 1 to 3 feet of bentonite pellets should be installed above the sand pack.

The cement-bentonite grout is then mixed and either poured or tremied into the annulus as the temporary casing or augers are withdrawn. Finally, the protective casing can be installed.

4.2 CONFINING LAYER MONITORING WELLS

When drilling and installing a well in a confined aquifer, proper well installation techniques must be applied to avoid cross contamination between the unconfined and confined aquifer. Under most conditions, this can be accomplished by installing double-cased wells. This is accomplished by drilling a large-diameter boring through the upper aquifer, 1 to 3 feet into the underlying confining layer, and setting and pressure grouting or tremie grouting the outer casing into the confining layer. The grout material must fill the space between the native material and the outer casing. A smaller diameter boring is then continued through the confining layer for installation of the monitoring well as detailed for overburden

monitoring wells (with the exception of not using a temporary casing during installation). Sufficient time (determined by the rig geologist) must be allowed for setting of the grout prior to drilling through the confined layer.

4.3 BEDROCK MONITORING WELLS

When installing bedrock monitoring wells, a large diameter boring is drilled through the overburden and approximately 5 feet into the bedrock. A casing (typically Schedule 80 PVC) is installed and either pressure grouted or tremie grouted in place. After the grout has cured, a smaller diameter boring is continued through the bedrock to the desired depth. If the boring does not collapse, the well can be left open, and a screen is not necessary. If the boring collapses, then a screen is required and can be installed as detailed for overburden monitoring wells. However, if a screen is to be used, then the casing that is installed through the overburden and into the bedrock does not require grouting and can be installed temporarily until final well installation is completed.

4.4 DOCUMENTATION OF FIELD ACTIVITY

A critical part of monitoring well installation is recording of significant details and events in the site logbook, on field forms, and a field logbook. Details of borehole and soil sample logging are contained in SOP CTO10-14, and field documentation procedures are outlined in SOP CTO-11.

5.0 WELL DEVELOPMENT METHODS

The purpose of well development is to stabilize and increase the permeability of the gravel pack around the well screen, and to restore the permeability of the formation which may have been reduced by drilling operations. Wells are typically developed until all fine material and drilling water is removed from the well. Sequential measurements of pH, specific conductance, turbidity, and temperature taken during development yield information (stabilized values) that sufficient development is reached. Development should proceed until criteria are met as stated in Navy Guidelines.

A surge plunger (also called a surge block) is approximately the same diameter as the well casing and is used to agitate the water, causing it to move in and out of the screens. This movement of water pulls fine materials into the well, where they may be removed by any of several methods, and prevents bridging of sand particles in the gravel pack. There are two basic types of surge plungers; solid and valved surge plungers. In formations with low yields, a valved surge plunger may be preferred, as solid plungers tend

to force water out of the well at a greater rate than it will flow back in. Valved plungers are designed to produce a greater inflow than outflow of water during surging.

Development should proceed until the following criteria are met:

1. The well water is clear to the unaided eye AND
2. A minimum removal of five times the standing water volume in the well (to include the well screen and casing plus saturated borehole annulus, assuming 30% annular porosity) OR
3. When pH measurements remain constant within 0.1 Standard Units and specific conductance and temperature vary no more than plus or minus 3% for at least three consecutive readings. Turbidity should also show stabilization and ideally be below 10 Nephelometric Turbidity Units (NTUs).

If for any reason the above criteria cannot be met, the site geologist should document the event in writing and consult with the TOM regarding an alternate plan of action.

Well development must be completed at least 24 hours before well sampling. The intent of this hiatus is to provide time for the newly installed well and backfill materials to sufficiently equilibrate to their new environment and for that new environment to re-stabilize after the disturbance of drilling.

STANDARD OPERATING PROCEDURE

CTO 10 SOP 9

DECONTAMINATION OF FIELD SAMPLING EQUIPMENT

1.0 PURPOSE

The purpose of this procedure is to provide guidelines regarding the appropriate procedures to be followed when decontaminating drilling equipment, soil and sediment sampling equipment, surface water sampling equipment and monitoring well sampling equipment

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

2.0 GLOSSARY

Liquinox - A brand of phosphate-free laboratory-grade detergent.

Deionized Water - Deionized (analyte free) water is tap water that has been treated by passing through a standard deionizing resin column. Deionized water should contain no detectable heavy metals or other inorganic compounds at or above the analytical detection limits for the project.

Potable Water - Tap water used from any municipal water treatment system. Use of an untreated potable water supply is not an acceptable substitute for tap water.

Solvent - The solvent of choice is pesticide-grade Isopropanol. Solvents should not be used on PVC equipment or well construction materials.

3.0 RESPONSIBILITIES

Project Manager - Responsible for ensuring that all field activities are conducted in accordance with approved project plan(s) requirements.

Field Operations Leader (FOL) - Responsible for the onsite verification that all field activities are performed in compliance with approved Standard Operating Procedures, or as otherwise dictated by the approved project plan(s).

4.0 PROCEDURES

To ensure that analytical chemical results reflect actual contaminant concentrations present at sampling locations, the various drilling equipment, and chemical sampling and analytical equipment used to acquire the environmental sample must be properly decontaminated. Decontamination minimizes the potential for cross-contamination between sampling locations, and the transfer of contamination off site.

4.1 DRILLING EQUIPMENT

Prior to the initiation of a drilling program, all drilling equipment involved in field sampling activities shall be decontaminated by steam cleaning at a predetermined area. The steam cleaning procedure shall be performed using a high-pressure spray of heated potable water producing a pressurized stream of steam. This steam shall be sprayed directly onto all surfaces of the various equipment which might contact environmental samples. The decontamination procedure shall be performed until all equipment is free of all visible potential contamination (dirt, grease, oil, noticeable odors, etc.). In addition, this decontamination procedure shall be performed at the completion of each sampling and/or drilling location, including soil borings, installation of monitoring wells, test pits, etc. Such equipment shall include drilling rigs, backhoes, downhole tools, augers, well casings, and screens. Downhole equipment, however, must always be steam-cleaned between borings. Where PVC well casings are to be installed, decontamination is not required if the manufacturer provides these casings in factory-sealed, protective plastic sleeves (so long as the protective packaging is not compromised until immediately before use). Guidance to be used when decontaminating drilling equipment shall include:

As a general rule, any part of the drilling rig, which extends over the borehole, shall be steam cleaned.

All drilling rods, augers, and any other equipment, which will be introduced to the hole, shall be steam cleaned.

The drilling rig, all rods and augers, and any other potentially contaminated equipment shall be decontaminated between each well location to prevent cross contamination of potential hazardous substances.

Prior to leaving at the end of each work day and/or at the completion of the drilling program, drilling rigs and transport vehicles used onsite for personnel or equipment transfer shall be steam cleaned, as practicable. A drilling rig left at the drilling location does not need to be steam cleaned until it is finished drilling at that location.

4.2 DECONTAMINATION PAD CONSTRUCTION

The steam cleaning area shall be designed to contain decontamination wastes and waste waters and can be a lined excavated pit or a bermed concrete or asphalt pad. For the latter, a floor drain must be provided which is connected to a holding facility. A shallow aboveground tank may be used or a pumping system with discharge to a waste tank may be installed.

In certain cases such an elaborate decontamination pad is not possible. In such cases, a plastic lined gravel bed pad with a collection system may serve as an adequate decontamination area. Alternately, a lined sloped pad with a collection pump installed at the lower end may be permissible. The location of the steam cleaning area shall be onsite in order to minimize potential impacts at certain sites.

4.3 GROUND WATER SAMPLING EQUIPMENT

When aquiring environmental samples from monitoring wells at NSWC Crane, several types of sampling devices may be employed. The type of sampling equipment used, depending on well depth, water level, and/or cost will be a peristaltic pump, bladder pump, or bailer (stainless steel or Teflon).

4.3.1 Sampling Equipment

Before the initial sampling and after each successive sampling point, sampling equipment (augers, split spoons, bowls, soup spoons, bailers, etc.) must be decontaminated. The following steps are to be performed when sampling for organic and inorganic contaminants:

- Potable water rinse
- Liquinox detergent wash-Includes scrubbing of the equipment with a scrub brush (may be required if the sample point is heavily soiled with heavy or extremely viscous materials)
- Potable water rinse
- Deionized water rinse
- Pesticide-grade isopropanol (only when oily soil conditions are encountered)
- Copious Deionized water rinse
- Air dry

Only reagent grade or purer solvents are to be used for decontamination. When solvents are used, the sampling equipment must be thoroughly dry before using to acquire the next sample.

In general, specially purchased pre-cleaned disposable sampling equipment is not decontaminated (nor is an equipment rinsate blank collected) so long as the supplier has provided certification of cleanliness. If decontamination is performed on several pieces of equipment at once (i.e., in batches), equipment not immediately used may be completely wrapped in aluminum foil (shiny-side toward equipment) and stored for future use. When batch decontamination is performed, one equipment rinsate is generally collected from one of the pieces of equipment belonging to the batch before it is used for sampling.

4.3.2 Sampling Pumps

Sampling pumps are low volume (less than 0.5 gpm) pumps. These include peristaltic and bladder pumps. If these pumps are used for sampling from more than one sampling point, they must be decontaminated prior to initial use and after each use.

The following procedures shall be adhered to when decontaminating sampling pumps:

Bladder pumps- Each of the liquid factions are to be pumped through the system; the 10 percent nitric acid solution is omitted. The amount of pumping is dependent upon the size of the pump and the length of the intake and discharge tubing.

Peristaltic pumps- All contamination is confined to the tubing, therefore the tubing is discarded and replaced with new tubing.

4.4 OTHER SAMPLING EQUIPMENT

Field tools such as trowels and mixing bowls are to be decontaminated in the same manner as described in Section 4.3.1 of this SOP.

4.5 WATER LEVEL INDICATORS

Water level indicators that come into contact with groundwater must be decontaminated using the following steps:

Rinse with potable water
Rinse with deionized water

4.6 PROBES

Probes (e.g., pH or specific-ion electrodes, geophysical probes, or thermometers) which would come in direct contact with the sample, will be decontaminated using the procedures specified above unless manufacturer's instructions indicate otherwise (e.g., dissolved oxygen probes). Probes that contact a volume of groundwater not used for laboratory analyses can be rinsed with deionized water. For probes which make no direct contact, (e.g., OVA equipment) the probe is self-cleaning when exposure to uncontaminated air is allowed and the housing can be wiped clean with paper-towels or a cloth wetted with alcohol.

5.0 WASTE HANDLING

For the purposes of these procedures, contaminated materials are defined as any byproducts of field activities that are suspected or known to be contaminated with hazardous substances. These byproducts include such materials as decontamination solutions, purge water, soil cuttings, well-development fluids, and spill-contaminated materials. All of the above wastes will be handled following the procedures outlined in section 2.12 of the FSP.

As a general policy, it is wise to select investigation methods that minimize the generation of contaminated spoils and investigation derived wastes. Handling, decontaminating and disposing of potentially hazardous spoils and wastes can be dangerous and expensive. Until sample analysis is complete, it is assumed that all produced materials are suspected of contamination from hazardous chemicals and require containment.

STANDARD OPERATING PROCEDURE

CTO 10 SOP 10

SAMPLE IDENTIFICATION NOMENCLATURE AT NSWC CRANE

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 Surface Warfare Center Crane (NSWC). 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 data base sample numbers).
- Accommodation of all project-specific requirements.
- Accommodation of laboratory sample number length constraints.
- Ease of identification and direct link to site and year.

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

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Pen with indelible ink
Sample tags
Sample container labels

3.0 SAMPLE IDENTIFICATION NOMENCLATURE

3.1 Monitoring Sample

All monitoring samples collected at NSWC Crane will be properly labeled with a sample label affixed to the sample container and a tag tied around the neck of the container. Each sample will be assigned a unique sample tracking number. The sample tracking number will consist of a four or five segment alpha-

numeric code that identifies the sample's associated solid waste management (SWMU) or associated site, sample type, location, and, for aqueous samples where applicable, whether a sample is filtered and/ or the sample round number.

The alphanumeric coding to be used in the NSWC Crane sample system is explained in the diagram and the subsequent definitions:

NN	**AA**	**A or N 2 to 5-Characters**	**NN and/or A Aqueous only**	**NNNN Soils and Sediment only**
SWMU or Site Number	Sample Type	Location	Round Identifier and/or Filtered	Depth Interval

Character Type:

A = Alpha
N = Numeric

SWMU or Site Number:

Monitoring locations at the four sites. The site IDs of the four units are:

04 = McComish Gorge (MG) SWMU 4
05 = Old Burn Pit (OBP) SWMU 5
09 = Pesticide Control Area (PCA) SWMU 9
10 = Rockeye (RE) SWMU 10

Field sampling operations for the above SWMUs are currently in progress or are expected to take place. For future SWMUs or site numbers refer to the appropriate planning documents for the proper numbers.

Sample Type:

GW = Ground water sample
SD = Sediment sample
SW = Surface water sample
SB = Soil Boring sample
SS = Surface soil sample

Location:

The sample location code is the well number, the soil sample location sediment sample location, or the stream sample location (i.e., surface water, springs, or seeps. Existing well numbers are used when unique. New wells will be designated by a "T" for Tetra Tech NUS and, followed by a MW for permanent monitoring wells, TW for temporary wells, etc. and numbered sequentially, by SWMU, beginning with zero one (MWT01). Well clusters, two or more wells in close proximity, will be designated with the letter P followed by the number 2, 3, 4 etc. The number signifies the well's depth in relation to other wells in that cluster. This two-digit code will follow the well identification. Using well T02 as an example, of a three well cluster, the well identification will be as follows:

T02	=	The deepest well in the cluster.
T02P2	=	Intermediate well.
T02P3	=	Shallowest well in the cluster.

Note: To keep the sample identification nomenclature to a minimum numbers of characters and to avoid redundancy, MW (monitoring well) is used for text, figures and tables and replaced with GW (groundwater) in the sample identification, example MWT01 would be GWT01.

Round Identifier:

A two digit round identifier will be used to tract the number of aqueous samples (GW, SW, RW, etc.) taken from a particular aqueous sample location. The first sample collected from a location will be assigned round identifier 10, the second 02, etc. This applies to both existing and proposed monitoring wells and surface water locations.

Filtered:

Water samples that are field filtered (dissolved analysis) will be identified with an "F" in the last code section. No entry in this segment signifies an unfiltered (total) sample.

Depth Interval, Soil and Sediment only:

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

Depth (for soils, in feet bgs):

0002 = soil collected from 0 to 2 foot bgs

0204 = soil collected from 2 to 4 feet bgs

0810 = soil collected from 8 to 10 feet bgs, etc.

Depth (for sediments, in inches bgs):

0006 = sediment collected from 0 to 6 inches bgs

0612 = sediment collected from 6 to 12 inches bgs

3.1.1 Examples of Sample Nomenclature

The first ground water sample collected from existing monitoring well 01 at the McComish Gorge (SWMU 04) for a filtered sample would be designated as 04GW0101F.

The second ground water sample collected from existing monitoring well C20P2 at the McComish Gorge for an unfiltered sample would be designated as 04GWC20P202.

The first unfiltered ground water sample collected from new monitoring well MWT01 at the McComish Gorge would be designated as 04GWT0101.

The second surface water sample collected from drainage way point 01 at Rockeye (SWMU 10) for an unfiltered sample would be designated as 10SW0102.

The surface soil sample collected from soil boring 27 at the Old Burn Pit (SWMU 05) would be designated as 05SS270002.

The subsurface soil sample collected from the same soil boring at an interval of 4 to 5 feet bgs would be designated as 05SB270405.

A sediment sample collected at the McComish Gorge from 0 to 6 inches at drainage way location 14 would be designated as 04SD140006.

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

Field QA/QC samples are described in the approved Field Sampling Plan and QAPP. They will be designated using a different coding system. The QC code will consist of a three- to four-segment

alphanumeric code that identifies the sample QC type, the date the sample was collected, and the number of this type of QC collected on that date.

AA	NNNNNN	NN	F
QC Type	Date	Sequence Number (per day)	Filtered (aqueous only, if needed)

The QC types are identified as:

TB = Trip Blank
RB = Rinsate Blank (Equipment Blank)
FD = Field Duplicate
AB = Ambient Conditions Blank
SO = 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 Nomenclature

The first duplicate of the day for a filtered ground water sample obtained on June 3, 2000 would be designated as FD06030001F.

The third duplicate of the day taken of a subsurface soil sample collected on November 17, 2003 would be designated as FD11170303.

The first Trip Blank associated with samples collected on October 12, 2000 would be designated as TB10120001.

The only Rinsate Blank collected on November 17, 2001 would be designated as RB11170101.

STANDARD OPERATING PROCEDURE

CTO 10 SOP 11

SAMPLE CUSTODY AND DOCUMENTATION OF FIELD ACTIVITIES

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish the procedures for sample custody and documentation of field sampling and field analyses activities.

The Naval Surface Warfare Center (NSWC) Crane Environmental Protection Department must approve any deviations from this procedure.

2.0 FIELD FORMS LIST

The following log books, forms, labels, and tags are required.

Site Log Book
Field Log Book
Sample labels and tags
Chain-of-Custody
Custody seal
Boring Log
Monitoring Well Inspection Form
Water level Measurement Form
Low Flow Purge Data Form
Ground Water Sample Log Form
Surface Water Sample Log Form
Equipment Calibration Log Sheet
Soil Sample Log Sheet

3.0 PROCEDURES

This section describes custody and documentation procedures. All entries made into the log books, 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 shall be crossed out with a single strike mark, initialed, and dated.

3.1 SITE LOG BOOK

The site log book is a hardbound, paginated, controlled-distribution record book in which all major onsite activities are documented. At a minimum, the following activities/events shall be recorded (daily) in the site log book:

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

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

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

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

Information recorded daily in the site log book 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 log book must be signed and dated by the Field Operations Leader (FOL).

Upon completion of the fieldwork or when completely filled, the Site Log Book is stored in the NSWC Crane records repository.

3.2 FIELD LOG BOOKS

The Field Log Book is a separate dedicated notebook used by field personnel, as needed, to document the activities in the field. This notebook is hardbound and paginated.

Upon completion of the fieldwork or when completely filled, Field Log Books are stored in the NSWC Crane records repository.

3.3 SAMPLE LABEL AND TAG

Adhesive sample container labels must be completed and applied to every sample container. A second, identical adhesive sample label will be completed and affixed onto a tag that will be attached to the neck of the sample container. Once the laboratory receives the sample, the tag will be removed from the sample container and returned to the task manager. Sample tags will be stored in the NSWC Crane records repository.

3.4 CHAIN-OF-CUSTODY FORM

The Chain-of-Custody (COC) is a multi-part form that is initiated as samples are acquired and accompanies a sample (or group of samples) as they are transferred from person to person. Each COC is numbered. This form must be used for any samples collected for laboratory chemical analysis. The original (top) signed copy of the COC form shall be placed inside a large Ziploc-type 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 against the enclosed COC. Any problems are noted on the enclosed COC form (discrepancies between the sample labels, tags, COC form, etc.) and will be resolved through communication between the laboratory point-of-contact and the task manager. The COC form is signed and retained by the laboratory and becomes part of the sample's corresponding analytical data package.

Each COC is placed into a binder and stored in the NSWC Crane records repository. Attachment A contains an example COC.

3.5 CUSTODY SEAL

The Custody Seal is an adhesive-backed label. It is part of a chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field and sealed in coolers for transit to the laboratory. The Custody Seals are signed and dated by the samplers and affixed across the opening edges of each cooler (four seals per medium to larger coolers; two seals per small cooler)

containing environmental samples. The laboratory sample custodian will examine the Custody Seal for evidence of tampering and will notify the task manager if evidence of tampering is observed.

3.6 EQUIPMENT CALIBRATION LOG

The Equipment Calibration Log is used to document calibration of measuring equipment (e.g. multi-parameter water quality meter) 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.

Each calibration log is placed into a binder and stored in the NSWC Crane records repository. Attachment A contains an example Equipment Calibration Log sheet.

A preprinted, fill-in the blank type, field form will be used to document each field task i.e. drilling, surface water sampling, sediment sampling etc. An example of all field forms can be found in Attachment A.

3.7 BORING LOG SHEET

The Boring Log Sheet is used to document lithology encountered during advancement of the boring. This sheet is used in conjunction with the borehole advancement procedures outlined SOP CTO 10-8 and the lithologic documentation process outlined in SOP CTO10-14. Attachment A contains an example Boring Log Sheet.

3.8 SOIL SAMPLE LOG SHEET

The soil sample Log Sheet is used to document the samples taken from each boring. Attachment A contains an example Soil Sample Log Sheet.

STANDARD OPERATING PROCEDURE

CTO 10 SOP 12

SAMPLE PRESERVATION, PACKAGING, AND SHIPPING

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe the procedures for sample preservation, packaging, and shipping to be used in handling environmental samples obtained for chemical analysis at NSWC Crane.

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

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Shipping labels
Custody seals
Chain-of-custody (COC) forms
Sample containers with preservatives: All sample containers for analysis by fixed-base laboratories will be supplied and deemed certified clean by the laboratory.
Sample shipping containers (coolers): All sample shipping containers are supplied by the laboratory.
Packaging material: Bubble wrap, ZipLoc bags®, strapping tape, etc.
Temperature Blank

3.0 PROCEDURES FOR SAMPLE PRESERVATION, PACKAGING, AND SHIPPING

3.1 Tables 2-1 and 2-2 of this Field Sampling Plan (WP/FSP) establishes requirements for sample preservation. The laboratory provides sample containers that are certified clean for the analytical parameter for which the sample is to be analyzed. All samples will be held, stored, and shipped at 4°C ±2°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 the sample container is properly identified on the label and tag, the lid securely fastened, and the container sealed in a ZipLoc bag.

3.4 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. If the cooler is questionable for shipping, the cooler must be discarded.

3.6 Place the sample container into a shipping cooler in an upright position (all containers, except VOC's will be upright for shipment). Continue filling the cooler with samples and packing material until the cooler is full and the movement of the sample containers is limited.

3.7 Place a temperature blank in the cooler.

3.8 Fill the voids in between the bubble-out shipping bags with ice and continue filling the cooler with ice to the top, using a minimum of eight pounds of ice for a medium-size cooler.

3.9 Complete a Chain of custody form. List on the COC each sample bottle contained in the cooler. Include the air bill number on the COC. Use a ballpoint pen and make sure that all of the carbon forms are legible.

3.10 Place the original (top) signed copy of the COC form, inside a large ZipLoc bag. Tape the bag to the inside of the lid of the shipping cooler.

3.11 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 (a total of four signed custody seals must be used per cooler). Cover the custody seal with the last wrap of tape. This will provide a tamper evident custody seal system for the sample shipment.

3.12 Affix a shipping label to the top of the cooler containing all of the shipping information. Overnight (e.g. FedEx Priority Overnight) courier services will be used for all sample shipments. Include the air bill number on the COC.

3.13 All samples will be shipped to the laboratory no more than 72 hours after completion of sampling. Under no circumstances will sample holding times be exceeded for hold times (See Table2 2-1 and 2-2 of the WP/FSP).

3.14 Samples will be shipped to the following:

Laucks Testing Laboratories, Inc.
940 South Harney St.
Seattle, Washington 98108
Phone: 206-767-5060
Fax: 206-767-5063

STANDARD OPERATING PROCEDURE

CTO 10 SOP 13

USE OF PHOTOIONIZATION DETECTOR

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish procedures for the use, maintenance, and calibration of the photoionization detector (PID). The Photovac 2020 Photoionization Air Monitor will be used for the Risk Assessment investigation. The procedures for its use are discussed in detail in the following sections.

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

2.0 GLOSSARY

Electron volt (eV) - A unit of energy equal to the energy acquired by an electron when it passes through a potential difference of 1 volt in a vacuum. It is equal to $1.602192 \pm 0.000007 \times 10^{-19}$ volts.

Intrinsically Safe (I.S.) - Based on wiring, configuration, design, operation, gasketing, construction, this instrument may be employed within locations in which flammable gases and/or vapors may exist.

Ionization Potential (I.P.) - The energy required to remove an electron from a molecule yielding a positively charged ion and a negatively charged free electron. The instrument measures this energy level.

Photoionization Detector (PID) - Photoionization detector employed as general reference to air monitors of this type. PIDs detection method employs ultraviolet (UV) radiation as an energy source. As air and contaminant are drawn through the ionization chamber the UV light source causes the contaminant with ionization potentials equal to or less than the UV source to break into positive and negatively charge ions. The created ions are subjected to an electrostatic field. The voltage difference is measured in proportion to the calibration reference and the concentration of the contaminant.

Ultraviolet Radiation (UV) - Ultraviolet radiation is the energy source employed by the instrument to ionize collected sample gas streams. The UV lamp source is required to be equal to or greater than the

ionization potential of the substance drawn through the instrument in order to create separate ionized species.

3.0 REQUIRED EQUIPMENT

Pen

Equipment Calibration Form

4.0 PROCEDURES

4.1 PRINCIPLE OF OPERATION

The Photovac portable photoionizer detects the concentration of many organic (and a few inorganic). The basis for detection of this instrument is the ionization of components of captured gaseous streams. The incoming gas molecules are subjected to ultraviolet (UV) radiation, which is energetic enough to ionize many gaseous compounds. Molecules are transformed into charged-ion pairs, creating a current between two electrodes. Each molecule has a characteristic ionization potential, which is the energy required to remove an electron from the molecule, yielding a positively-charged ion and the free electron. The instrument measures this energy level.

This instrument measures the concentration of airborne photoionizable gases and vapors and automatically displays and records these concentrations. It does not distinguish between individual substances. Readings displayed represent the total concentration of all photoionizable chemicals present in the sample. This instrument is factory set to display concentration in units of ppm or mg/m^3. The meter display updates itself once per second.

2020 also performs short-term exposure limit (STEL), time-weighted average (TWA) and PEAK calculations. You can view any of these results, but only one mode may be viewed at a time.

2020 has 6 keys for alphanumeric entry and for accessing multiple functions. The keys are used to set up and calibrate 2020. They allow you to manipulate the concentration data in various ways.

All information entered with the keys and stored in 2020's memory is retained when the instrument is switched off. The clock and calendar continue to operate and do not need to be set each time 2020 is turned on.

4.1.1 Displays

The 2020 has a meter display for reporting detected concentration, and a display used to display status information and guide you through configuration options. All functions of the 2020 will be controlled or reported using one of these displays.

4.1.1.1 Meter Display

The meter display is a 4-digit display. It will always be used for reporting detected concentration. When the detector and pump are off, the meter display will be blank.

In order to accommodate the range of concentrations 2020 can detect, the meter reading will be reported using one of 2 resolutions. A resolution of 0.1 will be used for concentrations below 100 ppm, and a resolution of 1 will be used for concentrations above 100 ppm.

4.1.1.2 Status Display

The status display is a 2 line by 16 character display. The top line is used to display status information and prompts you for information. The bottom line is used for soft key names. Up to 3 names can be displayed for the 3 soft keys. If a name does not appear for a soft key, then the soft key has no associated function.

4.1.2 Keys

4.1.2.1 Fixed Keys

The three round keys below the soft keys each have a fixed function. The first key is the ON/OFF key, the middle key is the EXIT key, and the last key is the ENTER key.

The ON/OFF key is used to both turn power on to the 2020 as well as turn the power off. To turn on 2020, press the ON/OFF key. To turn the power off, press the ON/OFF key and hold it down for 2 seconds, and then release it. This is done to prevent accidental power off.

The EXIT key provides a way of returning to the default display. In the functional map, the soft keys allow you to advance and the EXIT key provides a way to go back. If you are at the initial entry of the menu, EXIT will return you to the default display.

The ENTER key has a context sensitive function. When you are operating or navigating through the function map, the ENTER key is used to exit the functions and return you to the default display. When entering data such as a name, number, date, or time, ENTER is used to confirm the entry.

4.1.2.2 Soft Keys

The three soft keys on 2020 are located directly below the status display. Each key has varying functions for configuring 2020, editing the data logger, and controlling the display. Since only three soft keys are available, each function is broken down into a path.

4.1.2.3 Entering Text With the Soft Keys

For all information that you must enter, the left, center, and right soft keys correspond to the up, down, and right arrow.

The up and down arrows are used to change the character highlighted by the cursor. The right arrow is used to advance the cursor to the next character on the right. When the cursor is advanced past the right most character, it wraps around to the first character again. To accept the changes, press the ENTER key. To ignore the change, press EXIT.

Formatting characters, such as the colon (:) in the time, the decimal (.) in a concentration, and the slash (/) in the date are skipped when advancing the cursor.

All inputs are an 8 character input, which is displayed on the right side of the top line of the status display. The prompt, describing the input, occupies the left half of the top line. The soft keys are defined on the bottom line of the status display.

4.2 DEFAULT DISPLAY

The meter display shows the detected concentration. The resolution of the display changes with the magnitude of the reading. A reading of 0 to 99.9 will be displayed with a resolution of 0.1 ppm or mg/m^3. A reading greater than 99.9 will be shown with a resolution of 1 ppm or mg/m^3. The meter will display concentrations up to 2000 ppm or 2(XX) mg/m^3.

The status display is used to display the instrument status, date, time, units, and active soft keys.

The default display provides the following information: instrument status, current detected concentration, time, date, and measurement units. The status display toggles between showing time and units and then the date.

When the display mode is MAX, the date and time correspond to the date and time the MAX concentration was recorded. In TWA mode, the time represents the number of hours and minutes during which the TWA has been accumulating. For PEAK and STEL monitoring, the date and time correspond to the current date and time.

4.3 MONITORING

4.3.1 Instrument Status

The instrument status is shown on the left of the first line of the status display and on the Table and Graph outputs. Each status has a priority assigned to it. If more than one status is in effect, then the status with the highest priority is displayed until the condition is corrected or until the option is turned off.

4.3.2 Alarms

While operating the instrument, any one of three alarm conditions can occur. To accurately identify the source of the alarm, each type of alarm has been given a unique status.

In addition to the status, 2020 also has an audible alarm and a visual alarm LED. To conserve power, the 2020 alternates between these two alarm indicators, rather than operating both concurrently. Different alarms are identified by the frequency at which the 2020 alternates as follows: PEAK alarm-5 times per second; STEL alarm-2.5 times per second; and TWA alarm-1.25 times per second.

The left soft key is used for acknowledging alarms, and is named "Ack." If no alarm exists, then the "Ack" key is not shown. To clear the alarm, press the "Ack" key. Once acknowledged, the alarm indicators are cleared. The alarm status will remain until the alarm condition clears.

2020 updates the peak concentration once every second. Following every update, the peak concentration is compared to the peak alarm level, and if exceeded, an alarm is triggered.

If 15 minute average exceeds the selected STEL, a STEL alarm is generated.

The TWA alarm is generated when the current average of concentration, since the TWA was last cleared, has exceeded the TWA exposure limit.

During calibration, all alarms are disabled. Once the calibration is complete the alarms are re-enabled.

4.4 STEL, TWA, MAX, AND PEAK OPERATION

The 2020's meter display can be configured to show one of four values: STEL, TWA, PEAK, and MAX.

4.4.1 Short-term Exposure Limit (STEL) Mode

The Short-term Exposure Limit (STEL) mode displays the concentration as a 15 minute moving average. 2020 maintains 15 samples, each representing a one-minute averaging interval.

Once every minute, the oldest of the 15 samples is replaced with a new one minute average. This moving average provides a 15-minute average of the last 15 minutes with a one-minute update rate. Since the average is calculated using 15 one-minute averages, the meter display will only update once every minute.

STEL is set to zero each time the instrument is turned on. Since STEL is a 15-minute moving average, there is no need to clear or reset the STEL.

STEL calculations are always being performed by 2020. You can display the results of the calculations by selecting STEL as the Display mode.

4.4.2 Time-weighted Average (TWA) Mode

The TWA accumulator sums concentrations every second until 8 hours of data have been combined. If this value exceeds the TWA alarm setting, a TWA alarm is generated. The TWA is not calculated using a moving average. Once 8 hours of data have been summed, the accumulation stops. In order to reset the TWA accumulator, press the "Clr" key.

This sum will only be complete after 8 hours, so the meter displays the current sum divided by 8 hours. While you are in TWA mode, the time on the status display will show the number of minutes and hours of data that TWA has accumulated. When this reaches 8 hours 2020 stops accumulating data and the TWA is complete.

TWA calculations are always being performed by 2020. You can display the results of the calculations by selecting TWA as the Display mode.

4.4.3 MAX Mode

The MAX mode displays the maximum signal, with the date and time that it was recorded. 2020 continues to log data according to the selected averaging interval, but only the maximum detected concentration is displayed on the meter display.

The right soft key is used to clear the meter when displaying MAX. The "Clr" key only affects the reading that the meter is displaying. For example, if you display the MAX reading, and you press "Clr," only the MAX value is cleared. The TWA is still accumulating in the background.

4.4.4 PEAK Mode

The PEAK mode displays the current detected concentration. The reading is updated once a second. In the background, the 2020 data logger is sampling the concentration and measuring minimum, maximum, and average concentrations for the selected averaging interval. At the end of every interval, one entry is placed in the data logger until the data logger is full. Typical application concerning the use of this instrument is operated in this mode. Operation within the other specialized modes are the responsibility of the SSO.

4.5 SET FUNCTIONS

Set functions are used to setup 2020. There are three functions which can be set on the 2020: Calibration, Pump and Clock.

4.5.1 Pump

The Pump function is used to control the pump. After selecting Set Pump, 2020 responds by displaying the new pump status.

The detector is also turned off when you turn the pump off. This prevents the detector from being damaged when there is no sample flowing through the detector.

When the pump and the detector are off, the meter display will be blank. Turn the pump and detector off when concentration measurements are not necessary, and 2020 will only be used for reviewing data or

generating reports. By operating the instrument with the pump and detector off when you do not need them, you will conserve the lives of the battery and ultraviolet (UV) lamp.

1. Press the ENTER key. The top line of the status display changes to "Select?". The bottom line displays 3 soft key names: "Set," "Log," and "Disp."

2. Press the soft key below "Set."

3. The names of the soft keys change to reflect the Set options. The display now shows 3 devices which can be set: "Clock," "Pump," and "Cal." Press the "Pump" key.

4. The 2020 turns the pump off. If the pump was off, pressing "Pump" will turn the pump on.

5. A message will be displayed to show you the status of the pump. 2020 reverts back to the previous menu after a few seconds.

6. To return to the default display, press the ENTER key.

4.5.2 Clock

The Clock function is used to set both the current date and time.

1. Press the ENTER key.

2. Press the "Set" key.

3. When the names of the soft keys change, press the "Clock" key.
   The up and down arrows are used to change the character underlined by the cursor. The right arrow is used to advance the cursor to the next character on the right. When the cursor is advanced past the right-most character, it wraps around to the first character again.
   Formatting characters, such as the colon (:) in the time and the slash (/) in the date are skipped when advancing the cursor.

4. Use the "arrow keys" to enter the correct time. The time is formatted as Hour:Minute:Second.

5. Press the ENTER key to confirm the time and move to the date option.

6. When setting the date, the 2020 prompts you for the current date formatted as Year/Month/Day. Use the "arrow keys" to enter the correct date.

7. Press the ENTER key to confirm the date and return to the Set options. You can wait for the display to timeout or press ENTER to return to the default display.

4.5.3 Calibration (Cal)

Cal allows you to setup and calibrate 2020. You have three options under the Cal function: "Zero," Span," and "Mem."

A calibration memory consists of a name, a response factor, and PEAK, TWA, and STEL alarm levels.

The "Zero" and "Span" keys are covered in detail in the manufacturer's operations manual for the instrument.

To edit the calibration memory, select "Mem" and then "Chng." The 2020 prompts you with two new soft keys: "User" and "Lib."

4.5.4 Library (Lib)

Library selections simplify Cal Memory programming, and provide standard response factors for approximately 70 applications. "Lib" allows you to select an entry from a pre-programmed library. The name, response factor, and three alarm levels are all set from the library. To select a library entry to program the selected Cal Memory:

1. Select "Set," "Cal," "Mem," "Chng," and "Lib."

2. Use the "Next" and "Prev" keys to scroll through the list. See the manufacturer's manual Appendix 8.7 for a list of the library entries.

4.6 PREPARING FOR FIELD OPERATION OF THE PHOTOVAC 2020

Turning 2020 On

1. Turn 2020 on by pressing the ON/OFF key.

2. 2020 will display the software version number. Wait for the 2020 to proceed to the default display.

3. Allow 10 minutes for the instrument to warm up and stabilize.

4. Press the Enter Key. The default display will provide 3 soft key selection "Set," "Log," and "Display."

5. Press "Set." From this option 3 other soft key selections will be offered: "Pump," "Clock," and "Cal."

6. Press "Cal." This will begin the calibration sequence. The first selection is to Zero the instrument.

7. Press Enter, zeroing will begin. (Note: When employing zero gas attach and activate zero gas supply at this time.)

8. The next selection offered will be Span. Press Enter at which time the concentration will be requested. The isobutylene calibration gas employed under general service will be marked on the side of the container. Use the soft keys to toggle into position and to log the concentration. Once the concentration is logged press "Enter." The direction or status display will indicate spanning. At this time hook up the span gas with a regulator to the Photovac 2020, and open it to supply enough flow to elevate the flow rate indicator to the green indicator line (1/8" from the rest position).

9. Once spanning is complete, the alarms which have been disabled during calibration will activate indicating that calibration is complete.

10. Document this calibration procedure using a Document of Calibration form (included in Appendix A).

This instrument is ready for general purpose application.

Calibration is to be performed daily or prior to each use in accordance with this section.

4.7 Maintenance and Calibration Schedule

Function	Frequency
Routine Calibration	Prior to each use
Factory Inspection and Calibration	Once a year, or when malfunctioning
Wipe Down the Outer Casing of the Unit	After each use
Clean UV Light Source	Every 24 hours of operation
Sample Inlet Filter	Change on a weekly basis or as required by level of use
Battery charging	After each use
Clean ionization chamber	Monthly

4.7.1 Cleaning the UV Light Source Window

1. Turn the FUNCTION switch to the OFF position. Use 2020 multi-tool and remove lamp housing cover.

2. Tilt the lamp housing with one hand over the opening, slide the lamp out of the housing.

3. The lamp window may now be cleaned with any of the following compounds using lens paper:
   a. 11.7 eV Lamp - Dry Aluminum Oxide Powder (3.0 micron powder)
   b. HPLC Grade Methanol - All other lamps

4. Following cleaning, reassemble by first sliding the lamp back into the lamp housing. Replace o-ring as necessary, reinstall lamp housing cover, tighten using 2020 multi-tool. (Do not over tighten).

5. Recalibrate as per Section 4.6.

4.7.2 Cleaning the Ionization Chamber

1. Turn the FUNCTION switch to the OFF position and remove the lamp housing cover and lamp as per Section 4.7.1.

2. Using a gentle jet of compressed air, gently blow out any dust or dirt.

3. Following cleaning, reassemble by first sliding the lamp back into the lamp housing. Replace o-ring as necessary, reinstall lamp housing cover, tighten using 2020 multi-tool. (Do not over tighten).

4. Recalibrate as per Section 4.6.

4.8 INSTRUMENT ADVANTAGES

The Photovac 2020 is easy to use in comparison to many other types of monitoring instrumentation. Its detection limit range is in the low parts-per-million range. Response time rapidly reaches 90 percent scale of the indicated concentration (less than 3 seconds for benzene). This instrument's automated performance covers multiple monitoring functions simultaneously, incorporating data logging capabilities.

4.9 LIMITATIONS OF THE PHOTOVAC 2020 PHOTOIONIZATION MONITOR

- Since the 2020 is a nonspecific total gas/vapor detector, it cannot be used to identify unknown chemicals; it can only quantitate them in relationship to a calibration standard (relative response ratio).

- For appropriate application of the 2020, ionization potentials of suspected contaminants must be known.

- Because the types of compounds that the 2020 can potentially detect are only a fraction of the chemicals possibly present at a hazardous waste site or incident, a background or zero reading on this instrument does not necessarily signify the absence of air contaminants.

- The 2020 instrument can monitor only certain vapors and gases in air. Many nonvolatile liquids, toxic solids, particulates, and other toxic gases and vapors cannot be detected.

- PID's are generally not specific. Their response to different compounds is relative to the calibration gas used. This is referred to as relative response ratio. Instrument readings may be higher or lower than the true concentration. This can be an especially serious problem when monitoring for total contaminant concentrations if several different compounds are being detected at once.

- The 2020 is a small, portable instrument which cannot be expected to yield results as accurately as laboratory instruments.

4.9.1 Variables Affecting Monitoring Data

Monitoring hazardous waste site environment can pose a significant challenge in assessing airborne concentrations and the potential threats to site personnel. Several variables may influence both dispersion and the instrument's ability to detect actual concentrations. Some of the variables which may impact these conditions are as follows:

- Temperature - changes in temperature or pressure will influence volatization, and effect airborne concentrations. Additionally, an increase or decrease in temperature ranges may have an adverse effect on the instrument's ability to detect airborne concentrations.

- Humidity - excessive levels of humidity may interfere with the accuracy of monitoring results.

- Rainfall - through increased barometric pressure and water may influence dispersion pathways effecting airborne emissions.

- Electromagnetic interference - high voltage sources, generators, other electrical equipment may interfere with the operation and accuracy of direct-reading monitoring instruments.

5.0 SHIPPING

The Photovac may be shipped as cargo or carried on as luggage providing there is no calibration gas cylinder accompanying the kit. When shipping or transporting the calibration gas, a Hazardous Airbill must be completed.

6.0 REFERENCES

Photovac 2020 Photoionization Monitor User's Manual, 1995.

STANDARD OPERATING PROCEDURE

CTO 10 SOP 14

BOREHOLE AND SOIL SAMPLE LOGGING

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe the standard procedures and technical guidance on borehole and sample logging at NSWC Crane.

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

2.0 FIELD FORMS AND EQUIPMENT

Knife
Ruler (marked in tenths and hundredths of feet)
Boring Log
Writing utensil
Munsell Soil Color Book

3.0 RESPONSIBILITIES

A field geologist/engineer is responsible for supervising all boring activities and assuring that each borehole is properly and completely

4.0 PROCEDURES FOR BOREHOLE AND SAMPLE LOGGING

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

4.1 USCS CLASSIFICATION

Soils are to be classified according to the Unified Soil Classification System (USCS). This method of classification is detailed in Figure 1 (Continued).

FIGURE 1

UNIFIED SOIL CLASSIFICATION (USCS)

FIELD IDENTIFICATIONPROCEDURES
(Excluding Particles Larger Than 3 Inches and Basing Fractions on Estimated Weights

COARSE-GRAINED SOILS More Than Half of Material is LARGER Than No. 200 Sieve Sizes			GROUP SYMBOL	TYPICAL NAMES
GRAVELS (50%(+)>1/4"Ø	CLEAN GRAVELS (Low % Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
		Predominantly one size or a range of sizes with some intermediate sizes missing.	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines.
	GRAVELS W/FINES (High % Fines)	Non-plastic fines (for identification procedures, see ML)	GM	Silty gravels, poorly graded gravel-sand-silt mixtures.
		Plastic fines (for identification procedures, see CL)	GC	Clayey gravels, poorly graded gravel-sand-clay mixtures.
SANDS 50%(+)<1/4"Ø	CLEAN SANDS (Low % Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	SW	Well graded sand, gravelly sands, little or no fines.
		Predominantly one size or a range of sizes with some intermediate sizes missing.	SP	Poorly graded sands, gravelly sands, little or no fines.
	SANDS W/FINES (High % Fines)	Non-plastic fines (for identification procedures, see MCL)	SM	Silty sands, poorly graded sand-silt mixtures.
		Plastic fines (for identification procedures, see CL)	SC	Clayey sands, poorly graded sand-clay mixtures.

FINE-GRAINED SOILS More Than Half of Material is SMALLER Than No. 200 Sieve Size	FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger Than 3 Inches and Basing Fractions on Estimated Weights) Identification Procedures on Fraction Smaller than No. 40 Sieve Size				GROUP SYMBOL	TYPICAL NAMES
		DAY STRENGTH (Crushing Characteristics)	QUATANCY (Reaction to Shaking)	TOUGHNESS (Consistency Near Plastic Limit)		
SILTS AND CLAYS Liquid Limit <50	None to Slight	Quick to Slow	None		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity.
	Medium to High	None to Very Slow	Medium		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
	Slight to Medium	Slow	Slight		OL	Organic silts and organic silt-clays of low plasticity.
SILTS AND CLAYS Liquid Limit >50	Slight to Medium	Slow to None	Slight to Medium		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
	High to Very High	None	High		CH	Inorganic clays of high plasticity, fat clays.
	Medium to High	None to Very Slow	Slight to Medium		OH	Organic clays of medium to high plasticity.
HIGHLY ORGANIC SOILS	Readily identified by color, odor, spongy feel and frequently by fibrous texture.				Pt	Peat and other organic soils

Boundary classifications: Soils possessing characteristics of two groups are designated by combining group symbols. For example, GW-GC, well graded gravel-sand mixture with clay binder.
All sieve sizes on this chart are U.S. Standard.

DENSITY OF GRANULAR SOILS	
DESIGNATION	STANDARD PENETRATION RESISTANCE-BLOWS/FOOT
Very Loose	0-4
Loose	5-10
Medium Loose	11-30
Dense	31-50
Very Dense	Over 50

CONSISTENCY OF COHESIVE SOILS			
CONSISTENCY	UNC COMPRESSIVE STRENGTH (TONS/SQ. FT.)	STANDARD PENETRATION RESISTANCE-BLOWS/FOOT	FIELD IDENTIFICATION METHODS
Very Soft	Less than 0.25	0 to 2	Easily penetrated several inches by fist
Soft	0.25 to 0.50	2 to 4	Easily penetrated several inches by thumb.
Medium Stiff	0.50 to 1.0	4 to 8	Can be penetrated several inches by thumb.
Stiff	1.0 to 2.0	8 to 15	Readily indented by thumb.
Very Stiff	2.0 to 4.0	15 to 30	Readily indented by thumbnail.
Hard	More than 4.0	Over 30	Indented with difficulty by thumbnail.

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 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 shall be divided into rock fragments, sand, or gravel. The terms sand and gravel 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 shall be used to indicate angular granular materials resulting from the breakup of rock. The sharp edges 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 shall be followed by a size designation such as "(1/4 inchΦ-1/2 inchΦ)" 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 shall 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." Since 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 shall 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" shall 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 noncohesive (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 Figure 2.

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 shall 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 shall be used in conjunction with it. The designations used to describe the consistency of cohesive soils are shown in Figure 2.

FIGURE 2

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

4.4 WEIGHT PERCENTAGES

In nature, soils are comprised 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 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 drilling job.

4.6 SUMMARY OF SOIL CLASSIFICATION

In summary, soils shall 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

4.7 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 shall 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

STANDARD OPERATING PROCEDURE

CTO 10 SOP 15

CALIBRATION AND CARE OF WATER QUALITY METER

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish the procedures for the calibration of the Water Quality Meter used to measure groundwater (purge and development) and surface water field parameters and for the documentation of that calibration and maintenance.

The Naval Surface Warfare Center (NSWC) Crane Environmental Protection Department must approve any deviations from this procedure.

2.0 FIELD FORMS AND EQUIPMENT LIST

The following log books, forms, equipment and supplies are required.

Site Log Book
Equipment Calibration Log Sheet
YSI Model 610-D and Sonde, multi parameter, water quality meter with flow through cell
Equipment manual
Calibration kit
Deionized water, paper towels, spray bottle etc.

3.0 PROCEDURES

This section describes the calibration procedure for the YSI Model 610-D and Sonde (YSI) the meter is supplied with an instruction manual. Sections of this manual are reproduced in this SOP the manual will be on-site and used as the calibration guidance document for the meter's calibration (page 29 section 2.6 starts the calibration procedure). This procedure will list requirements for frequency of calibration and checks to be performed on the meter.

The YSI Model 610-D and Sonde is a multi parameter, water quality meter that may be used to measure open water bodies (streams, ponds, springs etc.) with the probe guard installed. And, with the flow through cell attached gives the meter the ability to measure groundwater directly from the well, via the

pump discharge line prior to coming in contact with the atmosphere. The parameters measured by the YSI for this field effort is:

- Dissolved Oxygen
- Specific Conductance
- Temperature
- pH
- ORP
- Turbidity

3.1 DOCUMENTATION

Follow the procedure in SOP 11 for documentation of calibration an example of this form can be found in Appendix A.

3.2 CALIBRATION

All of the above parameters must be calibrated prior to the start of each field effort. After this initial calibration the YSI will be checked each day that it is used. If the check shows any out-of-spec readings, the parameters will be calibrated. Meter specifications can be found in the equipment manual, starting on page 248. Calibrations and checks as will be documented in the site logbook and on the equipment calibration form, an example of this form can be found in Attachment A. The name, lot number, and expiration date for all calibration, buffers and standards used will be recorded on the equipment calibration form. The meter's model, serial number and name of rental company will also be recorded on the equipment calibration form.

3.3 TIPS FOR GOOD CALIBRATION

- The DO calibration is a water-saturated air calibration. Make certain to loosen the calibration cup seal to allow pressure to equilibrate before calibrating.
- Make certain that sensors are completely submersed in solution and readings are stable when calibration values are entered.
- Use a small amount of calibration solution (previously used solution may be used, then discarded for this purpose) to pre-rinse the sonde.
- Fill a bucket with ambient temperature water to rinse the sonde between calibration solutions.
- Make sure to rinse and dry the probe between calibration solutions. This will reduce carry-over contamination and increase the accuracy of the calibration.

4.0 MAINTENANCE

The YSI will be rented for the duration of the brief field effort. Therefore, little field maintenance will be required. For any maintenance other than the routine, cleaning, calibrating or battery charging the YSI should be returned to the vender and a replacement sent to the job site.

4.1 METER STORAGE

For this field effort, the meter storage will be short term, i.e. over-night or between work shifts (4-day break). During these breaks the meter shall be placed on charge. And one half inch of tap or distilled water shall be placed in the meters calibration cup and the cup threaded onto the sonde. The key for short-term storage of probes is to use a minimal amount of water so that the calibration cup will remain at 100% humidity. The water level has to be low enough so that none of the probes are actually immersed. Proper storage of the sonde between usage will extend its life and, will also insure that the unit is ready for use as quickly as possible in the next application.

Multi parameter short term storage key points:

- Use enough water to provide humidity, but not enough to cover the probe surfaces.
- Make sure the storage vessel is sealed to minimize evaporation.
- Check periodically to make certain that water is still present.

4.2 PROBE CLEANING

Rinse probe thoroughly with potable water.
Wash in a mild solution of Liquinox and water wiping with paper towels and/or cotton swabs.
Rinse and soak in deionized water.
If stronger cleaning is required consult section 2.10 page 89 of the equipment manual.

Note: Reagents that are used to calibrate and check the YSI may be hazardous. Review Health and Safety Plan, Appendix A of the equipment manual and MSDS's, all of which are on file in the field trailer.

Health and Safety Plan
for
Risk Assessment
at
Solid Waste Management Units (SWMUs) 4, 5, 9, and 10

Naval Surface Warfare Center
Crane Division
Crane, Indiana

Southern Division
Naval Facilities Engineering Command
Contract No. N62467-94-D-0888
Contract Task Order 0010

August 2000

HEALTH AND SAFETY PLAN
FOR
RISK ASSESSMENT
AT
SOLID WASTE MANAGEMENT UNITS
(SWMUs) 4, 5, 9, AND 10

NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
Tetra Tech NUS, Inc.
661 Andersen Drive
Foster Plaza 7
Pittsburgh, Pennsylvania 15220

CONTRACT NO. N62467-94-D-0888
CONTRACT TASK ORDER 0010

August 2000

SUBMITTED BY:

KAREN SMECKER
TASK ORDER MANAGER
TETRA TECH NUS, INC.
PITTSBURGH, PENNSYLVANIA

APPROVED BY:

MATTHEW M. SOLTIS, CIH, CSP
CLEAN HEALTH & SAFETY MANAGER
TETRA TECH NUS, INC.
PITTSBURGH, PENNSYLVANIA

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1.0 INTRODUCTION

This Health and Safety Plan (HASP) has been developed to provide practices and procedures for Tetra Tech NUS, Inc. (TtNUS) and subcontractor personnel engaged in investigatory activities at Solid Waste Management Units (SWMUs) 4, 5, 9, and 10 at the Naval Surface Warfare Center Crane (NSWC Crane), located in Crane, Indiana. This HASP is to be used in conjunction with the TtNUS Health and Safety Guidance Manual. Both of these documents must be present at the site during the performance of all site activities. The Guidance Manual provides supporting information pertaining to the HASP as well as applicable TtNUS Standard Operating Procedures (SOPs). This HASP and the contents of the Guidance Manual were developed to comply with the requirements stipulated in 29 CFR 1910.120 (OSHA's Hazardous Waste Operations and Emergency Response Standard).

This HASP has been developed using the latest available information regarding known or suspected chemical contaminants and potential physical hazards associated with the proposed work at the site. The HASP will be modified if new information becomes available. All changes to the HASP will be made with the approval of the TtNUS Project Health and Safety Officer (PHSO) and the TtNUS CLEAN Health and Safety Manager (HSM). Requests for modifications to the HASP will be directed to the PHSO, who will determine if the changes are necessary. The PHSO will notify the Task Order Manager (TOM), who will notify all affected personnel of changes.

1.1 KEY PROJECT PERSONNEL AND ORGANIZATION

This section defines responsibility for site safety and health for TtNUS and subcontractor employees engaged in onsite activities. Personnel assigned to these positions will exercise the primary responsibility for all onsite health and safety. These persons will be the primary point of contact for any questions regarding the safety and health procedures and the selected control measures that are to be implemented for onsite activities.

- The TtNUS TOM is responsible for the overall direction of health and safety for this project.

- The PHSO is responsible for developing this HASP in accordance with applicable OSHA regulations. Specific responsibilities include:

  i. Providing information regarding site contaminants and physical hazards associated with the site.

ii. Establishing air monitoring and decontamination procedures.
iii. Assigning personal protective equipment based on task and potential hazards.
iv. Determining emergency response procedures and emergency contacts.
v. Stipulating training requirements and reviewing appropriate training and medical surveillance certificates.
vi. Providing standard work practices to minimize potential injuries and exposures associated with hazardous waste work.
vii. Modify this HASP, as it becomes necessary.

- The TtNUS Field Operations Leader (FOL) is responsible for implementation of the HASP with the assistance of an appointed SSO. The FOL manages field activities, executes the work plan, and enforces safety procedures as applicable to the work plan.

- The SSO supports site activities by advising the FOL on all aspects of health and safety on site. These duties may include:

  i. Coordinates all health and safety activities with the FOL.
  ii. Selects, applies, inspects, and maintains personal protective equipment.
  iii. Establishes work zones and control points in areas of operation.
  iv. Implements air monitoring program for onsite activities.
  v. Verifies training and medical clearance of onsite personnel status in relation to site activities.
  vi. Implements Hazard Communication, Respiratory Protection Programs, and other associated health and safety programs as they may apply to site activities.
  vii. Coordinates emergency services.
  viii. Provides site-specific training for all onsite personnel.
  ix. Investigates all accidents and injuries (see Attachment I - Illness/Injury Procedure and Report Form)
  x. Provides input to the PHSO regarding the need to modify, this HASP, or applicable health and safety associated documents as per site-specific requirements.

- Compliance with the requirements stipulated in this HASP is monitored by the SSO and coordinated through the TtNUS CLEAN HSM.

Note: In some cases one person may be designated responsibilities for more than one position. For example, at the NSWC, the FOL may also be responsible for SSO duties. This action will be performed only as credentials, experience, and availability permit.

1.2 SITE INFORMATION AND PERSONNEL ASSIGNMENTS

Site Name: Naval Surface Warfare Center
Address: 300 Highway 361
Crane, IN 47522-5001

Client Contact: Mr. Thomas Brent
Phone Number: (812) 854-6160

Alternate Contact: Ms. Chris Freeman
Phone Number: (812) 854-4423

Project Team:

Tetra Tech NUS Personnel:	Discipline/Tasks Assigned:	Phone No.
Karen Smecker	Task Order Manager	(412) 921-8893
Matthew M. Soltis, CIH, CSP	CLEAN Health and Safety Manager	(412) 921-8912
James K. Laffey	Project Health and Safety Officer	(412) 921-8678
TBD	FOL/SSO	
TBD	Field Technician	
Tom Patton	Equipment Manager	(412) 262-4583

Non-Tetra Tech NUS Personnel	Affiliation/Discipline/Tasks Assigned	
TBA	Analytical Laboratory	
TBA	Surveyor	
FedEx	Sample/Parcel Delivery	(800) 463-3339

Hazard Assessments for purposes of OSHA 29 CFR 1910.132 and HASP preparation conducted by:

James K. Laffey

2.0 EMERGENCY ACTION PLAN

2.1 INTRODUCTION

This section has been developed as part of a planning effort to direct and guide field personnel in the event of an emergency. All site activities (including responding to emergency incidents) will be coordinated with the client contact, Thomas Brent. In the event of an emergency which cannot be mitigated using onsite resources, personnel will evacuate to a safe place of refuge and the appropriate emergency response agencies will be notified. It has been determined that the majority of potential emergency situations would be better supported by outside emergency responders. Based on this determination, TtNUS and subcontractor personnel will not provide emergency response support beyond responding to easily-controlled, minor incidents. Workers who are ill or who have suffered a non-serious injury may be transported by site personnel to nearby medical facilities, provided that such transport does not aggravate or further endanger the welfare of the injured/ill person. The emergency response agencies listed in this plan are capable of providing the most effective response, and as such, will be designated as the primary responders. These agencies are located within a reasonable distance from the area of site operations, which ensures adequate emergency response time. NSWC contact Thomas Brent will be notified anytime outside response agencies are contacted. This Emergency Action Plan conforms to the requirements of 29 CFR 1910.38(a), as allowed in 29 CFR 1910.120(l)(1)(ii).

TtNUS will, through necessary services, provide the following emergency action measures:

- Incipient stage fire fighting support and prevention
- Incipient spill control and containment measures and prevention
- Removal of personnel from emergency situations
- Initial medical support for injuries or illnesses requiring basic first-aid
- Site control and security measures as necessary

2.2 PRE-EMERGENCY PLANNING

Through the initial hazard/risk assessment effort, emergencies resulting from chemical, physical, or fire hazards are the types of emergencies which could be encountered during site activities.

To minimize and eliminate the potential for these emergency situations, pre-emergency planning activities will include the following (which are the responsibility of the SSO and/or the FOL):

- Coordinating with local Emergency Response personnel to ensure that TtNUS emergency action activities are compatible with existing emergency response procedures. Base Fire Protection and Emergency Services will be notified of scheduled events and activities. This is most imperative in situations where their services may be required.

- Establishing and maintaining information at the project staging area (support zone) for easy access in the event of an emergency. This information will include the following:

  - Chemical Inventory (of chemicals used onsite), with Material Safety Data Sheets.
  - Onsite personnel medical records (Medical Data Sheets).
  - A log book identifying personnel onsite each day.
  - Hospital route maps with directions (these should also be placed in each site vehicle).
  - Emergency Notification - phone numbers.

The TtNUS FOL will be responsible for the following tasks:

- Identifying a chain of command for emergency action.

- Educating site workers to the hazards and control measures associated with planned activities at the site, and providing early recognition and prevention, where possible.

- Periodically performing practice drills to ensure site workers are familiar with incidental response measures.

- Providing the necessary equipment to safely accomplish identified tasks.

2.3 EMERGENCY RECOGNITION AND PREVENTION

2.3.1 Recognition

Emergency situations that may be encountered during site activities will generally be recognized by visual observation. To adequately recognize chemical exposures, site personnel must have a clear knowledge of signs and symptoms of exposure associated with site contaminants. This information is provided in Table 6-1. Tasks to be performed at the site, potential hazards associated with those tasks and the recommended control methods are discussed in detail in Sections 5.0 and 6.0. Additionally, early recognition of hazards will be supported by daily site surveys to eliminate any situation predisposed to an

emergency. The FOL and/or the SSO will be responsible for performing surveys of work areas prior to initiating site operations and periodically while operations are being conducted. Survey findings will be documented by the FOL and/or the SSO in the Site Health and Safety logbook, however, all site personnel will be responsible for reporting hazardous situations. Where potential hazards exist, TtNUS will initiate control measures to prevent adverse effects to human health and the environment.

The above actions will provide early recognition for potential emergency situations, and allow TtNUS to instigate necessary control measures. However, if the FOL and the SSO determine that control measures are not sufficient to eliminate the hazard, TtNUS will withdraw from the site and notify the appropriate response agencies listed in Table 2-1.

2.3.2 Prevention

TtNUS and subcontractor personnel will minimize the potential for emergencies by following the Health and Safety Guidance Manual and ensuring compliance with the HASP and applicable OSHA regulations. Daily site surveys of work areas, prior to the commencement of that day's activities, by the FOL and/or the SSO will also assist in prevention of illness/injuries when hazards are recognized early and control measures initiated.

2.4 EVACUATION ROUTES, PROCEDURES, AND PLACES OF REFUGE

An evacuation will be initiated whenever recommended hazard controls are insufficient to protect the health, safety or welfare of site workers. Specific examples of conditions that may initiate an evacuation include, but are not limited to the following: severe weather conditions; fire or explosion; monitoring instrumentation readings which indicate levels of contamination are greater than instituted action levels; and evidence of personnel overexposure to potential site contaminants.

In the event of an emergency requiring evacuation, all personnel will immediately stop activities and report to the designated safe place of refuge unless doing so would pose additional risks. When evacuation to the primary place of refuge is not possible, personnel will proceed to a designated alternate location and remain until further notification from the TtNUS FOL. Safe places of refuge will be identified prior to the commencement of site activities by the SSO and will be conveyed to personnel as part of the pre-activities training session. This information will be reiterated during daily safety meetings. Whenever possible, the safe place of refuge will also serve as the telephone communications point for that area. During an evacuation, personnel will remain at the refuge location until directed otherwise by the TtNUS FOL or the on-site Incident Commander of the Emergency Response Team. The FOL or the SSO will perform a

head count at this location to account for and to confirm the location of all site personnel. Emergency response personnel will be immediately notified of any unaccounted personnel. The SSO will document the names of all personnel onsite (on a daily basis) in the site Health and Safety Logbook. This information will be utilized to perform the head count in the event of an emergency.

Evacuation procedures will be discussed during the pre-activities training session, prior to the initiation of project tasks. Evacuation routes from the site and safe places of refuge are dependent upon the location at which work is being performed and the circumstances under which an evacuation is required. Additionally, site location and meteorological conditions (i.e., wind speed and direction) may dictate evacuation routes. As a result, assembly points will be selected and communicated to the workers relative to the site location where work is being performed. Evacuation should always take place in an upwind direction from the site.

2.5 DECONTAMINATION PROCEDURES / EMERGENCY MEDICAL TREATMENT

During any site evacuation, decontamination procedures will be performed only if doing so does not further jeopardize the welfare of site workers. Decontamination will not be performed if the incident warrants immediate evacuation. However, it is unlikely that an evacuation would occur which would require workers to evacuate the site without first performing the necessary decontamination procedures.

TtNUS personnel will perform removal of personnel from emergency situations and may provide initial medical support for injury/illnesses requiring only first-aid level support. Medical attention above that level will require assistance and support from the designated emergency response agencies. Attachment I provides the procedure to follow when reporting an injury/illness, and the form to be used for this purpose. **If the emergency involves personnel exposures to chemicals, follow the steps provided in Figure 2-1.**

FIGURE 2-1
EMERGENCY RESPONSE PROTOCOL

The purpose of this protocol is to provide guidance for the medical management of injury situations.

In the event of a personnel injury or accident:

- Rescue, when necessary, employing proper equipment and methods.
- Give attention to emergency health problems -- breathing, cardiac function, bleeding, and shock.
- Transfer the victim to the medical facility designated in this HASP by suitable and appropriate conveyance (i.e. ambulance for serious events)
- Obtain as much exposure history as possible (a Potential Exposure report is attached).
- If the injured person is a Tetra Tech NUS employee, call the medical facility and advise them that the patient(s) is/are being sent and that they can anticipate a call from the WorkCare physician. WorkCare will contact the medical facility and request specific testing which may be appropriate. WorkCare physicians will monitor the care of the victim. Site officers and personnel should not attempt to get this information, as this activity leads to confusion and misunderstanding.
- Call WorkCare at 1-800-455-6155 and enter Extension 109, being prepared to provide:
  - Any known information about the nature of the injury.
  - As much of the exposure history as was feasible to determine in the time allowed.
  - Name and phone number of the medical facility to which the victim(s) has/have been taken.
  - Name(s) of the involved Tetra Tech NUS, Inc. employee(s).
  - Name and phone number of an informed site officer who will be responsible for further investigations.
  - Fax appropriate information to WorkCare at (714) 456-2154.
- Contact Corporate Health and Safety Department (Matt Soltis) at 1-800-245-2730.

As data is gathered and the scenario becomes more clearly defined, this information should be forwarded to WorkCare.

WorkCare will compile the results of all data and provide a summary report of the incident. A copy of this report will be placed in each victim's medical file in addition to being distributed to appropriately designated company officials.

Each involved worker will receive a letter describing the incident but deleting any personal or individual comments. A personalized letter describing the individual findings/results will accompany this generalized summary. A copy of the personal letter will be filed in the continuing medical file maintained by WorkCare.

FIGURE 2-1 (continued)
POTENTIAL EXPOSURE REPORT

Name: _____ Date of Exposure: _____

Social Security No.: _____ Age: _____ Sex: _____

Client Contact: _____ Phone No.: _____

Company Name: _____

I. **Exposing Agent**
Name of Product or Chemicals (if known): _____
_____
Characteristics (if the name is not known)
Solid Liquid Gas Fume Mist Vapor

II. **Dose Determinants**
What was individual doing? _____
How long did individual work in area before signs/symptoms developed? _____
Was protective gear being used? If yes, what was the PPE? _____
Was there skin contact? _____
Was the exposing agent inhaled? _____
Were other persons exposed? If yes, did they experience symptoms? _____

III. **Signs and Symptoms** (check off appropriate symptoms)

Immediately With Exposure:

Burning of eyes, nose, or throat
Tearing
Headache
Cough
Shortness of Breath
Chest Tightness / Pressure
Nausea / Vomiting
Dizziness
Weakness

Delayed Symptoms:

Weakness
Nausea / Vomiting
Shortness of Breath
Cough
Loss of Appetite
Abdominal Pain
Headache
Numbness / Tingling

IV. **Present Status of Symptoms** (check off appropriate symptoms)

Burning of eyes, nose, or throat
Tearing
Headache
Cough
Shortness of Breath
Chest Tightness / Pressure
Cyanosis
Nausea / Vomiting
Dizziness
Weakness
Loss of Appetite
Abdominal Pain
Numbness / Tingling

Have symptoms: (please check off appropriate response and give duration of symptoms)
Improved: _____ Worsened: _____ Remained Unchanged: _____

V. **Treatment of Symptoms** (check off appropriate response)

None: _ Self-Medicated: _____ Physician Treated: _____

2.6 EMERGENCY ALERTING AND ACTION/RESPONSE PROCEDURES

TtNUS personnel will be working in close proximity to each other at NSWC. As a result, hand signals, voice commands, and line of site communication will be sufficient to alert site personnel of an emergency. When project tasks are performed simultaneously on different sites, vehicle horns will be used to communicate emergency situations.

If an emergency occurs on Base, the following procedures are to be initiated:

- Initiate an emergency notification by hand signals, voice commands, air horn, or two-way radios to the FOL/SSO. Describe to the FOL/SSO (who will serve as the Incident Coordinator) what has occurred and as many details as possible.

- Have your partner evacuate non-essential persons from the incident scene, engage initial response measures given the emergency type (i.e., spill response, fire extinguisher, first-aid)

In the event that site personnel cannot control the incident through offensive and defensive measures, the FOL/SSO will enact the emergency notification procedures to secure additional outside assistance in the following manner:

- On Base, call 854-3300 or 854-1333* and other appropriate emergency contacts (Table 2-1) and report the emergency. Give the emergency operator the location of the emergency, the type of emergency, the number of injured, and a brief description of what occurred. Stay on the phone and follow the instructions given by the operator. The operator will then notify and dispatch the proper emergency response agencies.

  ***NOTE:** On-base extensions 3300 and 1333 are the primary emergency phone numbers. From an NSWC Crane phone, on Base extensions must be preceded by "854". Off-base numbers can only be reached by dialing "990" or "991" first. Furthermore, all emergencies involving site activities should subsequently be reported to the Environmental Office (x6160).

Evacuate all Tetra Tech NUS and subcontractor personnel to the identified safe place of refuge. Conduct a head count of site personnel using the site logbook.

TABLE 2-1

EMERGENCY REFERENCES

NSWC CRANE, CRANE, INDIANA

AGENCY	TELEPHONE
Base Emergency Number (Fire Department, Base Security, Ambulance)	(812) 854-3300 or (812) 854-1333
Base Environmental Office	(812) 854-6160
Bedford Ambulance	(812) 279-6545
Bloomington Hospital (Bloomington, IN) Hospital, Bedford Medical Center (Bedford, IN)	(812) 336-9515 (812) 275-1200
Poison Control Center (Indiana Poison Center)	1-800-382-9097
Chemtrec	1-800-424-9300
National Response Center	1-800-424-8802
Base Contact, Thomas Brent	(812) 854-6160
Explosive Disposal Director, Walt Waggoner	(812) 854-1317
Contract Task Order Manager, Karen Smecker	(412) 921-8893
Tetra Tech NUS Office, Pittsburgh	1-800-245-2730 (412) 921-7090
Project Health and Safety Officer, James K. Laffey	(412) 921-8678
CLEAN Health and Safety Manager, Matthew M. Soltis, CIH, CSP	(412) 921-8912

NOTE: All emergency contacts to emergency services off base require the notification of NSWC Emergency Dispatch. Information to be provided will include the type and extent of the emergency and agencies notified.

2.7 PPE AND EMERGENCY EQUIPMENT

A first-aid kit, eye wash units (or bottles of disposable eyewash solution) and fire extinguishers (strategically placed) will be maintained onsite and shall be immediately available for use in the event of an emergency. This equipment will be located in the field office as well as in each site vehicle. At least one first aid kit supplied with equipment to protect against blood borne pathogens will also be available on site. Personnel identified within the field crew with blood borne pathogen and first-aid training will be the only personnel permitted to offer first-aid assistance.

2.8 EMERGENCY CONTACTS

Prior to initiating field activities, all personnel will be thoroughly briefed on the emergency procedures to be followed in the event of an accident. Table 2-1 provides a list of emergency contacts and their associated telephone numbers. This table must be posted where it is readily available to all site personnel. Facility maps should also be posted showing potential evacuation routes and designated meeting areas.

2.9 EMERGENCY ROUTE TO HOSPITAL

Directions to the Bloomington Hospital:

601 W. 2nd St.
P.O. Box 1149
Bloomington, IN 47402

Exit NSWC Crane on H-45 through the Bloomington Gate. Follow Highway 45 North to Bloomington at Highway 45 and Highway 37. Continue going straight over the overpass (Bloomfield Road). Follow Bloomfield Road North; this road turns into 2nd Street. Follow 2nd Street, hospital will be on the right (601 West 2nd Street)

Directions to Bedford Medical Center:*

2900 16th Street
Bedford, IN 47421

Exit the base on H-58, through the Bedford Gate. Head West on State Highway 158. State Highway 158 becomes 16th Street upon entering the City of Bedford. The medical center is on the right shortly after Plaza Drive.

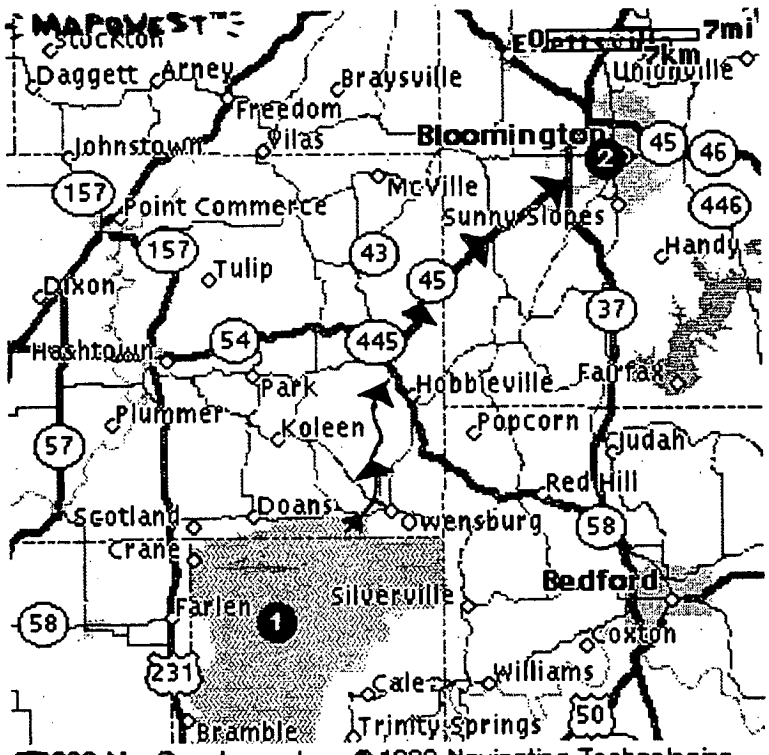
***NOTE:** The Bedford Gate is open only from 0600 - 0830 and 1500 - 1800 hours, whereas the Bloomington Gate is open 24 hours. A map indicating the travel route from the site to the hospitals will be inserted as Figure 2-2.

As soon as possible, Navy contact Thomas Brent must be informed of any incident or accident that requires medical attention.

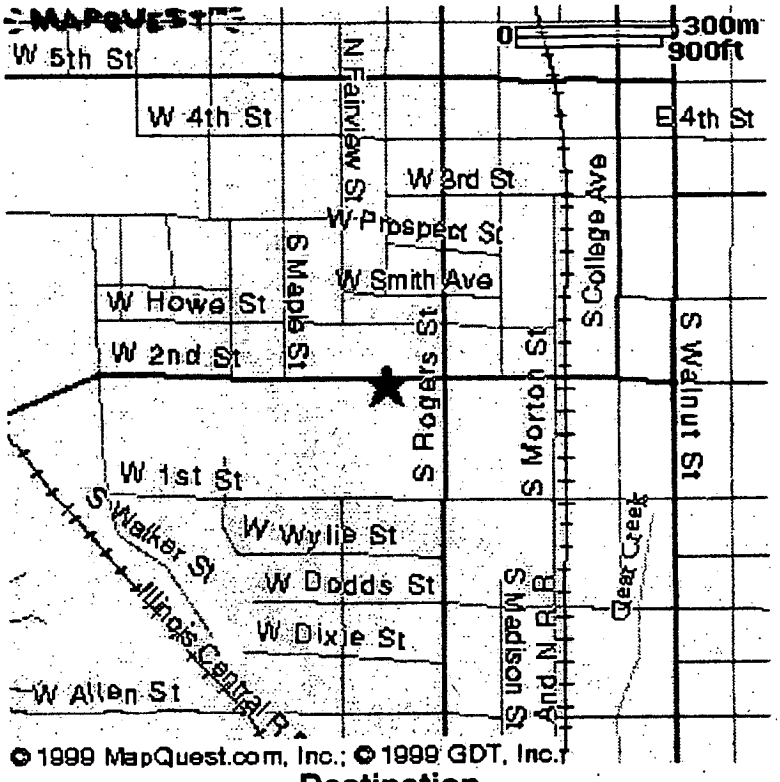
Any pertinent information regarding allergies to medications or other special conditions will be provided to medical services personnel. This information is listed on Medical Data Sheets filed onsite. If an exposure to hazardous materials has occurred, provide hazard information from Table 6-1 to medical service personnel.

Figure 2-2 Hospitals Route Map

Bloomington Hospital

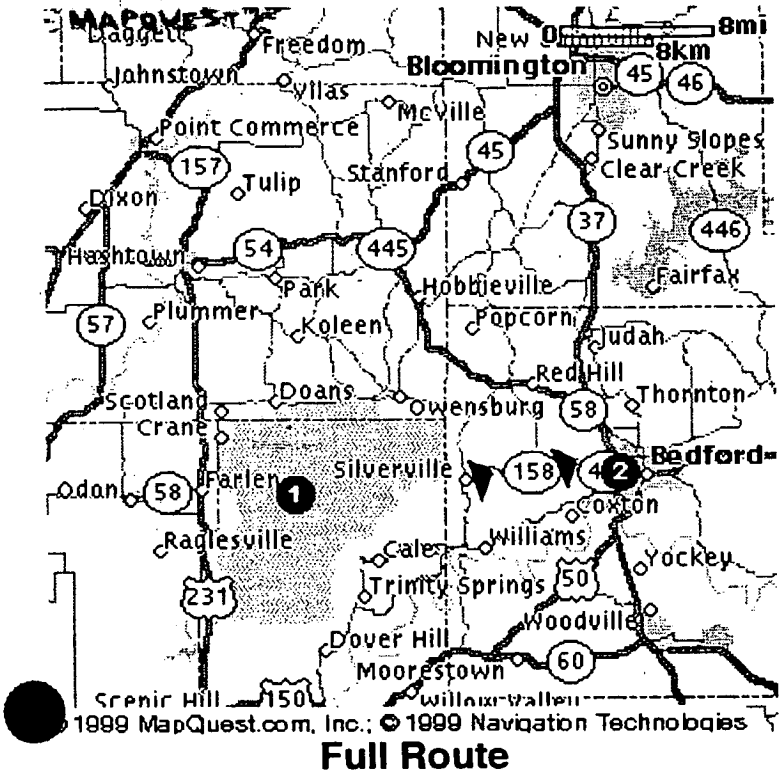


Full Route

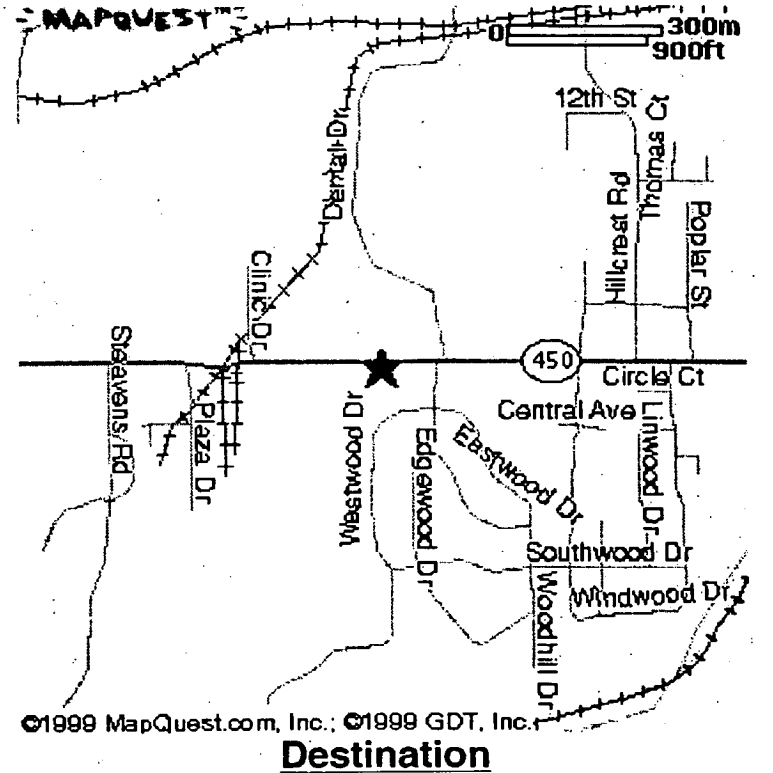


Destination

Bedford Medical Center



Full Route



Destination

3.0 SITE BACKGROUND

This section provides information pertaining to NSWC Crane and the specific sites that are to be investigated. This information will be revised if additional information becomes available or if additional sites are added to the scope of work.

3.1 SITE HISTORY

NSWC Crane is located in Crane, Indiana approximately 75 miles southwest of Indianapolis and 71 miles northwest of Louisville, Kentucky. The facility encompasses more than 100 square miles (64,463 acres) in Davies, Greene, Lawrence, and Martin Counties. It is located in a rural, sparsely populated area. The acreage surrounding the Base is either wooded or farmed land. The facility, originally called Naval Ammunition Depot (NAD), Burns City, was opened in 1941 to serve as an inland ammunition production and storage center. The Depot's name was changed to NAD, Crane in 1943. In 1975, the name was changed to Naval Weapons Support Center, Crane and in 1992, the name was again changed to Naval Surface Warfare Center, Crane. Today NSWC Crane's mission is to "provide quality and responsive engineering, technical and material support to the Fleet for combat subsystems, equipment and components, microelectronic technology, microwave components, electronic warfare, acoustic sensors tests, engineering pyrotechnics, small arms, electronic module test and system command." Under the Single Service Management Program, a segment of the Center's mission is to provide support (including environmental protection) to the Crane Army Ammunition Activity (CAAA). The Army is tasked with the production and renovation of conventional ammunition and related items, the performance of manufacturing, engineering, and product quality assurance to support production; and the storage, shipment, demilitarization, and disposal of conventional ammunition and related components. Because of the nature of the Army's operations, CAAA contributes significant financial support for the environmental program through an Inter-service Support Agreement.

3.2 SPECIFIC SITES TO BE INVESTIGATED

Four areas have been included in this investigation. These areas are addressed in the following subsections.

3.2.1 SWMU 4 – McComish Gorge

McComish Gorge is located in the northwest corner of NSWC Crane approximately 500 feet south of the Crane Gate, Gate No. 4. The site occupies approximately 5 acres. McComish Gorge is bounded on the north by Culpepper Branch Creek and on the east by Highway 140. The southern and western boundaries of the site have not been identified.

McComish Gorge was used as a dumpsite for an unknown period of time between 1942 and 1972. Undefined amounts and types of garbage and trash, such as construction debris, office trash, plaster filled warheads, and metal shavings, were buried in a gorge at the site. Reportedly, small arms ammunition may also have been buried at the site (USACE, September 1998). Currently, the site is inactive (i.e., not used for waste disposal activities) and has been revegetated. Prior sampling activities identified Volatile Organic Compounds (VOCs), Polychlorinated Biphenyls (PCBs), pesticides, and metals at the site.

3.2.2 SWMU 5 – Old Burn Pit

The Old Burn Pit (OBP) site is located in the northwest corner of the NSWC Crane facility in the northeast one fourth of Section 8, Township 5N, Range 4W of the Scotland, Indiana topographic quadrangle. It is located approximately 2000 feet east of the Crane Gate, Gate No. 4. The site occupies approximately 25 acres. The site is bounded on the west by Highway 5, on the south by the gravel lot south of the burn pit, and on the east by the power line running along the ridge above Lake Oberline. The northern boundary is undetermined.

OBP was used from 1942 to 1972. Undefined amounts of rubbish including wood, paper, construction material and industrial wastes were burned at the site. No explosive materials or waste were burned at the OBP. Residual ash and metal debris from the burning was buried in the gully to the north of the burn area. Currently, part of the site is used as a parking area for delivery trailers and the rest has been revegetated. Prior sampling activities identified VOCs, PCBs, pesticides, and metals at the site.

3.2.3 SWMU 9 – Pesticide Control/R-150 Tank Area

The Pesticide Control/R-150 Tank Area is located in the central portion of the NSWC Crane, approximately 5 miles northeast of the Burns City Gate No. 2. The site (including space between the three distinct area where site operation did not occur) occupies approximately 11 acres. Site operations were centered around the three areas (Building 55, Building 2189, and the R-150 Tank area) previously identified. The site is bounded on the east by Highway 45.

SWMU 9 is an inactive site composed of three distinct areas: Building 55, Building 2189, and the R-150 Tank area. Pesticide control activities occurred at Buildings 55 and 2189 (which are no longer present at the site). Waste solvents were stored at the R-150 Tank area; the tank has been removed from the site. The three areas are located near each other in a triangular configuration. Building 2189 is 1150 feet north of Building 55. The R-150 Tank area is approximately 800 feet southwest of Building 2189 and 700 feet northwest of Building 55.

Pesticides control activities, which were conducted at the site from 1950 to 1974, consisted of the storage and management of various types and quantities of pesticides and herbicides. The original Pesticide Control Building was Building 55. Around 1970, pesticide control operations were moved from Building 55 to Building 2189. Pesticide spray tanks and containers were reportedly rinsed in the vicinity of Building 2189 on the west side of the building. It is not known whether rinsing activities occurred outside Building 55.

Pesticides control operations ceased at the site around 1974. Buildings 55 and 2189 have since been demolished. Concrete pads are not apparent at the former building locations. Prior sampling activities identified VOCs, Semi-Volatile Organic Compounds (SVOCs), PCBs, pesticides, and metals at the site.

3.2.4 SWMU 10 – Rockeye

Rockeye is a 10-acre site located on a flattened ridge crest that separates Sulphur Creek and Boggs Creek in the north central portion of the base. It is located on Highway 45, approximately 2 miles south of North Gate No. 1. It began operations in the mid 1950's as a press-loading operation for 3-in. projectiles using Composition A-3 explosive (RDX and wax). In 1967-68, the facility was converted to a case-filling operation to produce the MK20 series antitank Rockeye cluster bomb. Rockeye is a production facility and not a storage, treatment, or disposal site. Prior sampling activities identified VOCs, PCBs, pesticides, explosives, and metals at the site.

4.0 SCOPE OF WORK

This section describes the project tasks that will be performed at NSWC. Additionally, each task has been evaluated and the associated hazards and recommended control measures are listed in Table 5-1 of this HASP. The planned activities involved in this effort are presented in detail in the Work Plan (WP) developed for the project. If new tasks are to be performed at the site, Table 5-1 and this section will be modified accordingly.

Field investigations to be performed by TtNUS are designed to collect field and laboratory data needed to evaluate the potential risks for human and ecological receptors at SWMUs 4, 5, 9, and 10. Specific tasks to be conducted include the following:

- Mobilization and demobilization
- Multi-media sampling, including:
  - Soil (surface)
  - Groundwater
  - Surface water
  - Sediment
  - Investigation derived waste (IDW)
- Soil borings (using hollow-stem augers and direct-push technologiy)
- Monitoring well installation, purging, and development
- Site surveys, including a geophysical survey at SWMU 4
- Decontamination of sampling and heavy equipment

For more detailed description of the associated tasks refer to the WP. If additional tasks are determined to be necessary, this HASP will need to be amended and a hazard evaluation of the additional tasks performed.

5.0 TASKS/HAZARDS/ASSOCIATED CONTROL MEASURES SUMMARIZATION

Table 5-1 of this section serves as the primary portion of the site-specific HASP which identifies the tasks that are to be performed as part of the scope of work. This table will be modified and incorporated into this document as new or additional tasks are performed at the site. The anticipated hazards, recommended control measures, air monitoring recommendations, required Personal Protective Equipment (PPE), and decontamination measures for each site task are discussed in detail. This table and the associated control measures shall be changed, if the scope of work, contaminants of concern, or other conditions change.

Through using the table, site personnel can determine which hazards are associated with each task and at each site, and what associated control measures are necessary to minimize potential exposure or injuries related to those hazards. The table also assists field team members in determining which PPE and decontamination procedures to use based on proper air monitoring techniques and site-specific conditions.

As discussed earlier, the Health and Safety Guidance Manual supports this table and HASP. The manual is designed to further explain supporting programs and elements for other site -specific aspects as required by regulatory requirements. The Guidance Manual should be referenced for additional information regarding air monitoring instrumentation, decontamination activities, emergency response, hazard assessments, hazard communication and hearing conservation programs, medical surveillance, PPE, respiratory protection, site control measures, standard work practices, and training requirements. Many of Tetra Tech NUS' SOPs are also provided in this Guidance Manual.

Safe Work Permits issued for all exclusion zone activities (See Section 10.10) will use elements defined in Table 5-1 as it's primary reference. The FOL and/or the SSO completing the Safe Work Permit will add additional site-specific information. In situations where the Safe Work Permit is more conservative than the direction provided in Table 5-1 the Safe Work Permit will be followed.

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TABLE 5-1
TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM FOR
NAVAL SURFACE WARFARE CENTER – CRANE DIVISION, CRANE INDIANA

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring	Personal Protective Equipment	Decontamination Procedures
Mobilization/ Demobilization	*Physical Hazards* 1) Lifting (strain/muscle pulls) 2) Pinches and compressions 3) Slip, trips, and falls 4) Heavy equipment hazards (rotating equipment, hydraulic lines, etc.) 5) Vehicular and foot traffic 6) Ambient temperature extremes (heat stress) *Natural hazards* 7) Insect/animal bites and stings (including fire ants and Eastern diamondback rattlesnakes) 8) Inclement weather	1) Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques. 2) Keep any machine guarding in place. Avoid moving parts. Use tools or equipment where necessary to avoid contacting pinch points. 3) Preview work locations for unstable/uneven terrain. 4) All equipment will be - Inspected in accordance with OSHA, and manufacturer's design. - Operated by knowledgeable operators, and knowledgeable ground crew. 5) Traffic and equipment considerations are to include the following: - Establish safe zones of approach (i.e. Boom + 3 feet). - Secure all loose articles to avoid possible entanglement. - All equipment shall be equipped with movement warning systems. - All activities are to be conducted consistent with the Base requirements. 6) Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding cold/heat stress concerns is provided in Section 4 of the TtNUS Health and Safety Guidance Manual. 7) Avoid potential nesting areas of biting/stinging insects and snakes. Use commercially available insect repellents. Wear appropriate clothing, including snake chaps where warranted. Tape ankle and wrists areas to prevent fire ants, ticks, chiggers, etc. from attaching themselves to your skin. Wear light colored clothing so that biting insects can be easily visible and be removed. Follow directions as specified in Section 6.3 and Attachment II concerning natural hazards. 8) Suspend or terminate operations until directed otherwise by SSO.	Not required	Level D - (Minimum Requirements) - Standard field attire (Sleeved shirt; long pants) - Safety shoes (Steel toe/shank) - *Safety glasses* - *Hardhat (when overhead hazards exists, or identified as a operation requirement)* - *Reflective vest for high traffic areas* - *Coveralls may be worn to protect exposed skin from insects, ticks, etc. Joints (ankles and wrists) should be taped.* - *Snake chaps shall be worn in areas of known or suspected snake infestation.* *(Items in italics are deemed optional as conditions or the FOL or SSO dictate.)*	Not required
Site surveys, including a geophysical survey at SWMU 4.	***Chemical hazards:*** **Exposure to potential site contaminants during these activities is unlikely given the nature of the work and the limited contact with potentially contaminated media.** ***Physical hazards:*** 1) Slip, trips, and falls ***Natural Hazards:*** 2) Insect/animal bites and stings (including fire ants and Eastern diamondback rattlesnakes) 3) Inclement weather	1) Preview work locations and site lines for uneven and unstable terrain. Clear necessary vegetation, establish temporary means for traversing hazardous terrain(i.e., rope ladders, etc.) 2) Avoid potential nesting areas of biting/stinging insects and snakes. Use commercially available insect repellents. Wear appropriate clothing, including snake chaps where warranted. Tape ankle and wrists areas to prevent fire ants, ticks, chiggers, etc. from attaching themselves to your skin. Wear light colored clothing so that biting insects can be easily visible and be removed. Follow directions as specified in Section 6.3 and Attachment II concerning natural hazards. 3) Suspend or terminate operations until directed otherwise by SSO.	No air monitoring is needed given the unlikelihood that volatile contaminants are present during surveying activities and the non-intrusive nature of the task. The potential for exposure to site contaminants during this activity is considered minimal. Minimize the generation of airborne dusts since most site contaminants are in the form of a particulate or may be bound to particulates.	These miscellaneous activities will be performed in Level D protection (unless otherwise indicated) consisting of the following: - Standard field dress including sleeved shirt and long pants - Steel-toe work boots or shoes - Safety glasses and hard hats (if working near machinery) - *Coveralls may also be worn to protect exposed skin from insects, ticks, etc. Joints (ankles and wrists) should be taped.* - *Snake chaps shall be worn in areas of known or suspected snake infestation.* *(Items in italics are deemed optional as conditions or the FOL or SSO dictate.)*	Personnel Decontamination - A structured decontamination is not required as the likelihood of encountering contaminated media is considered remote. Workers should inspect themselves and one another for the presence of fire ants, ticks, and other insects when exiting wooded areas, grassy fields, etc. This action will be employed to stop the transfer of these insects into vehicles, homes, and offices.

TABLE 5-1
TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM FOR
NAVAL SURFACE WARFARE CENTER – CRANE DIVISION, CRANE INDIANA

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring	Personal Protective Equipment	Decontamination Procedures
Multi-media sampling, including soil, surface water, groundwater, sediment, and IDW sampling.	*Chemical Hazards* 1) Primary contaminants include VOCs, SVOCs, (including general PAHs), metals, explosive compounds, PCBs, and pesticides. Specific contaminants by site are: SWMU 4 – VOCs, PCBs, pesticides, and metals. Small arms ammunition may also have been buried at the site. SWMU 5 - VOCs, PCBs, pesticides, and metals SWMU 9 - VOCs, SVOCs, PCBs, pesticides, and metals SWMU 10 - VOCs, PCBs, pesticides, explosives, and metals Specific compounds of concern are discussed in Section 6.1 and Table 6-1of the HASP. Table 6-1 provides more detailed information regarding the toxicological, chemical, and physical properties of these compounds. Note that many of these contaminants may be bound to particulates (dusts, soils, etc.) and contact with dusts should be avoided whenever possible. Many of these contaminants are non-volatile, and none of these contaminants are anticipated to be available in significant concentrations to present an inhalation hazard. 2) Transfer of contamination into clean areas *Physical hazards* 3) Noise in excess of 85 dBA 4) Lifting (strain/muscle pulls) 5) Pinches and compressions 6) Slip, trips, and falls 7) Ambient temperature extremes (heat stress) 8) Vehicular and foot traffic 9). Contact with explosives (SWMUs 4 and 10) *Natural hazards* 10) Insect/animal bites and stings (including fire ants and Eastern diamondback rattlesnakes) 11) Inclement weather	1) Use real-time monitoring instrumentation, action levels, and identified PPE to control exposures to potentially contaminated media (e.g. air, water, soils). Generation of dusts should be minimized. If airborne dusts are observed, area wetting methods may be used. If area wetting methods are not feasible, termination of activities may be used to minimize exposure to observed airborne dusts. 2) Decontaminate all equipment and supplies between sampling locations and prior to leaving the site. 3) When sampling at the drilling equipment use hearing protection. The use of hearing protection outside of 25 feet from the drilling equipment should be incorporated under the following condition: If you have to raise your voice to talk to someone who is within 2 feet of your location, hearing protection must be worn. 4) Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques. 5) Keep any machine guarding in place. Avoid moving parts. Use tools or equipment where necessary to avoid contacting pinch points. - A remote sampling device must be used to sample drill cuttings near rotating tools. The equipment operator shall shutdown machinery if the sampler is near moving machinery parts. 6) Preview work locations for unstable/uneven terrain. 7) Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding cold/heat stress concerns is provided in Section 4 of the TtNUS Health and Safety Guidance Manual. 8) Traffic and equipment considerations are to include the following: - Establish safe zones of approach (i.e. Boom + 3 feet). - Secure all loose articles to avoid possible entanglement. - All equipment shall be equipped with movement warning systems. - All activities are to be conducted consistent with the Base requirements. 9) All intrusive work at SWMUs 4 and 10 must be cleared by Base UXO Specialist or other responsible party. 10) Avoid potential nesting areas of biting/stinging insects and snakes. Use commercially available insect repellents. Wear appropriate clothing, including snake chaps where warranted. Tape ankle and wrists areas to prevent fire ants, ticks, chiggers, etc. from attaching themselves to your skin. Wear light colored clothing so that biting insects can be easily visible and be removed. Follow directions as specified in Section 6.3 and Attachment II concerning natural hazards. 11) Suspend or terminate operations until directed otherwise by SSO	**It is not anticipated that potential contaminant concentrations at outdoor sample locations will present an inhalation hazard.** Many anticipated site contaminants are non-volatile and are not expected to be present as an inhalation hazards. Nonetheless, a direct reading Photoionization Detector (PID) with an 11.7 eV lamp or Flameionization Detector (FID) will be used to screen samples and to detect the presence of any potential volatile organics. Source monitoring of the borehole will be conducted at regular intervals to be determined by the SSO. Positive sustained results at a source or downwind location(s) which may impact operations crew will require the following actions: - Monitor the breathing zone of at-risk and downwind employees. Any sustained readings (greater than 1 minute in duration) above background in the breathing zone of the at-risk employees requires site activities to be suspended and site personnel to retreat to an unaffected area. Work may only resume if airborne readings in worker breathing zone areas return to background levels. If elevated readings in worker breathing zone persist, the PHSO and HSM will be contacted to determine necessary actions and levels of protection. Site contaminants may adhere to or be part of airborne dusts or particulates generated during site activities. Generation of dusts should be minimized to avoid inhalation of contaminated dusts or particulates. Evaluation of dust concentrations will be performed by observing work conditions for visible dust clouds. Potential exposure to contaminated dust will be controlled using water suppression, by avoiding dust plumes, or evacuating the operation area until dust subsides.	Level D protection will be utilized for the initiation of all sampling activities. Level D - (Minimum Requirements) - Standard field attire (Sleeved shirt; long pants) - Safety shoes (steel toe/shank) - Safety glasses - Surgical style gloves (double-layered if necessary) - Reflective vest for high traffic areas - *Hardhat (when overhead hazards exists, or identified as a operation requirement)* - *Tyvek coveralls and disposable boot covers if surface contamination is present or if the potential exists for soiling work attire. Coveralls may also be worn to protect exposed skin from insects, ticks, etc. Joints (ankles and wrists) should be taped.* - *Snake chaps shall be worn in areas of known or suspected snake infestation.* *(Items in italics are deemed optional as conditions or the FOL or SSO dictate.)* **Note:** The Safe Work Permit(s) for this task (see Attachment IV) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task.	**Personnel Decontamination** will consist of a removal and disposal of non-reusable PPE (gloves, coveralls, etc., as applicable). The decon function will take place at an area adjacent to the site activities. This procedure will consist of: - Equipment drop - Outer coveralls, boot covers, and/or outer glove removal (as applicable) - Removal, segregation, and disposal of non-reusable PPE in bags/containers provided - Soap/water wash and rinse of reusable PPE (e.g., hardhat) if potentially contaminated - Wash hands and face, leave contamination reduction zone. In addition, workers should inspect themselves and one another for the presence of fire ants, ticks, and other insects when exiting wooded areas, grassy fields, etc. This action will be employed to stop the transfer of these insects into vehicles, homes, and offices.

TABLE 5-1
TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM FOR
NAVAL SURFACE WARFARE CENTER – CRANE DIVISION, CRANE INDIANA

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring	Personal Protective Equipment	Decontamination Procedures
Soil borings using hollow-stem augers and direct-push technology (e.g. Geoprobe). This task also includes monitoring well installation, development, and purging.	*Chemical Hazards* 1) Primary contaminants include VOCs, SVOCs, (including general PAHs), metals, explosive compounds, PCBs, and pesticides. Specific contaminants by site are: SWMU 4 – VOCs, PCBs, pesticides, and metals. Small arms ammunition may also have been buried at the site. SWMU 5 - VOCs, PCBs, pesticides, and metals SWMU 9 - VOCs, SVOCs, PCBs, pesticides, and metals SWMU 10 - VOCs, PCBs, pesticides, explosives, and metals Specific compounds of concern are discussed in Section 6.1 and Table 6-1of the HASP. Table 6-1 provides more detailed information regarding the toxicological, chemical, and physical properties of these compounds. Note that many of these contaminants may be bound to particulates (dusts, soils, etc.) and contact with dusts should be avoided whenever possible. Many of these contaminants are non-volatile, and none of these contaminants are anticipated to be available in significant concentrations to present an inhalation hazard. 2) Transfer of contamination into clean areas or onto persons *Physical hazards* 3) Heavy equipment hazards (pinch/compression points, rotating equipment, hydraulic lines, etc.) 4) Noise in excess of 85 dBA 5) Energized systems (contact with underground or overhead utilities) 6) Lifting (strain/muscle pulls) 7) Slip, trips, and falls 8) Vehicular and foot traffic 9) Ambient temperature extremes (heat stress) 10) Contact with explosives (SWMUs 4 and 10) *Natural hazards* 11) Insect/animal bites and stings (including fire ants and Eastern diamondback rattlesnakes) 12) Inclement weather	1) Use real-time monitoring instrumentation, action levels, and identified PPE to control exposures to potentially contaminated media (air, water, soils, etc.). Generation of dusts should be minimized. If airborne dusts are observed, area wetting methods may be used. If area wetting methods are not feasible, termination of activities may be used to minimize exposure to excessive airborne dusts. 2) Decontaminate all equipment and supplies between boreholes and prior to leaving the site. 3) All equipment to be used will be - Inspected in accordance with Federal safety and transportation guidelines, OSHA (1926.600,.601,.602), and manufacturers design and documented as such using Equipment Inspection Sheet (see Attachment III of this HASP). - Operated by knowledgeable operators and ground crew. - Repaired using only manufacturer approved parts and equipment In addition to the equipment considerations, the following standard operating procedures will be employed: - All personnel not directly supporting the drilling operation will remain at least 25 feet from the point of operation. - All loose clothing/protective equipment will be secured to avoid possible entanglement. - Hand signals will be established prior to the commencement of drilling activities. - A remote sampling device must be used to sample drill cuttings near rotating tools. - Work areas will be kept clear of clutter. - All personnel will be instructed in the location and operations of the emergency shut off device(s). This device will be tested initially (and then periodically) to insure its operational status. - Areas will be inspected prior to the movement of drilling equipment and support vehicles to eliminate any physical hazards. This will be the responsibility of the FOL and/or SSO. 4) Hearing protection will be used during all subsurface activities. 5) All utility clearances must be obtained, in writing, prior to subsurface activities (contact Thomas Brent). Prior to any subsurface investigations, the locations of all underground utilities must be identified and marked. 6) Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques. 7) Preview work locations for unstable/uneven terrain. 8) Traffic and equipment considerations are to include the following: - Establish safe zones of approach (i.e. Boom + 3 feet). - Secure all loose articles to avoid possible entanglement. - All equipment shall be equipped with movement warning systems. - All activities are to be conducted consistent with the Base requirements. 9) Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding heat stress concerns is provided in Section 4 of the TtNUS Health and Safety Guidance Manual. 10) All intrusive work at SWMUs 4 and 10 must be cleared by Base UXO Specialist or other responsible party. 11) Avoid potential nesting areas of biting/stinging insects and snakes. Use commercially available insect repellents. Wear appropriate clothing, including snake chaps where warranted. Tape ankle and wrists areas to prevent fire ants, ticks, chiggers, etc. from attaching themselves to your skin. Wear light colored clothing so that biting insects can be easily visible and be removed. Follow directions as specified in Section 6.3 and Attachment II concerning natural hazards. 12) Suspend or terminate operations until directed otherwise by SSO	**It is not anticipated that potential contaminant concentrations at outdoor sample locations will not present an inhalation hazard.** Many anticipated site contaminants are non-volatile and are not expected to be present as an inhalation hazards. Nonetheless, a direct reading Photoionization Detector (PID) with a lamp strength of more than 10.9 eV or Flameionization Detector (FID) will be used to screen samples and to detect the presence of any potential volatile organics. Source monitoring of the borehole will be conducted at regular intervals to be determined by the SSO. Positive sustained results at a source or downwind location(s) which may impact operations crew will require the following actions: - Monitor the breathing zone of at-risk and downwind employees. Any sustained readings (greater than 1 minute in duration) above background in the breathing zone of the at-risk employees requires site activities to be suspended and site personnel to retreat to an unaffected area. - Work may only resume if airborne readings in worker breathing zone area return to background levels. If elevated readings in worker breathing zone persist, the PHSO and HSM will be contacted to determine necessary actions and levels of protection. Site contaminants may adhere to or be part of airborne dusts or particulates generated during site activities. Generation of dusts should be minimized to avoid inhalation of contaminated dusts or particulates. Evaluation of dust concentrations will be performed by observing work conditions for visible dust clouds. Potential exposure to contaminated dust will be controlled using water suppression, by avoiding dust plumes, or evacuating the operation area until dust subsides. Where the utility clearance cannot be determined, subsurface activities shall proceed with extreme caution using hand digging to at least below frost-line depth (no less than 4 feet BGS). Also a magnetometer must be used for periodic down-hole surveys every 2 feet to a depth of at least 10 feet.	All subsurface operations are to be initiated in Level D protection. Level D protection constitutes the following minimum protection - Standard field attire (Sleeved shirt; long pants) - Safety shoes (Steel toe/shank) - Safety glasses - Nitrile gloves or leather gloves with surgical style inner gloves - Hardhat - Reflective vest for traffic areas - *Tyvek coveralls and disposable boot covers if surface contamination is present or if the potential exists for soiling work attire. Coveralls may also be worn to protect exposed skin from insects,ticks, etc. Joints (ankles and wrists) should be taped.* - *Snake chaps shall be worn in areas of known or suspected snake infestation.* - *Hearing protection during drilling or for other high noise areas as directed by the SSO.* *(Items in italics are deemed optional as conditions or the FOL or SSO dictate.)* **Note:** The Safe Work Permit(s) for this task (see Attachment IV) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task.	**Personnel Decontamination** - Will consist of a soap/water wash and rinse for reusable protective equipment (e.g., gloves). This function will take place at an area adjacent to the drilling operations bordering the support zone. This decontamination procedure for Level D protection will consist of - Equipment drop - Soap/water wash and rinse of reusable outer gloves, as applicable - Outer coveralls, boot covers, and/or outer glove removal - Removal, segregation, and disposal of non-reusable PPE in bags/containers provided - Wash hands and face, leave contamination reduction zone. In addition, workers should inspect themselves and one another for the presence of fire ants, ticks, and other insects when exiting wooded areas, grassy fields, etc. This action will be employed to stop the transfer of these insects into vehicles, homes, and offices.

TABLE 5-1
TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM FOR
NAVAL SURFACE WARFARE CENTER – CRANE DIVISION, CRANE INDIANA

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring	Personal Protective Equipment	Decontamination Procedures
Decontamination of Sampling and Heavy Equipment	*Chemical Hazards* 1) Primary contaminants include VOCs, SVOCs, (including general PAHs), metals, explosive compounds, PCBs, and pesticides. Specific contaminants by site are: SWMU 4 – VOCs, PCBs, pesticides, and metals SWMU 5 - VOCs, PCBs, pesticides, and metals SWMU 9 - VOCs, SVOCs, PCBs, pesticides, and metals SWMU 10 - VOCs, PCBs, pesticides, explosives, and metals Specific compounds of concern are discussed in Section 6.1 and Table 6-1of the HASP. Table 6-1 provides more detailed information regarding the toxicological, chemical, and physical properties of these compounds. Note that many of these contaminants may be bound to particulates (dusts, soils, etc.) and contact with dusts should be avoided whenever possible. Many of these contaminants are non-volatile, and none of these contaminants are anticipated to be available in significant concentrations to present an inhalation hazard. 2) Decontamination fluids - Liquinox (detergent), acetone or isopropanol *Physical Hazards* 3) Lifting (strain/muscle pulls) 4) Noise in excess of 85 dBA 5) Flying projectiles 6) Vehicular and foot traffic 7) Ambient temperature extremes (heat stress) 8) Slips, trips, and falls	1) and 2) Employ protective equipment to minimize contact with site contaminants and hazardous decontamination fluids. Obtain manufacturer's MSDS for any decontamination solvents used onsite. These must be used in well-ventilated areas such as outdoors. Use appropriate PPE as identified on MSDS. All chemicals used must be listed on the Chemical Inventory for the site, and site activities must be consistent with the Hazard Communication section of the Health and Safety Guidance Manual (Section 5). 3) Use multiple persons where necessary for lifting and handling sampling equipment for decontamination purposes. 4) Wear hearing protection when operating pressure washer. 5) Use eye and face protective equipment when operating pressure washer. All other personnel must be restricted from the area. 6) Traffic and equipment considerations are to include the following: - Establish safe zones of approach (i.e. Boom + 3 feet). - Secure all loose articles to avoid possible entanglement. - All equipment shall be equipped with movement warning systems. - All activities are to be conducted consistent with the Base requirements. 7) Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding cold/heat stress concerns is provided in Section 4 of the TtNUS Health and Safety Guidance Manual. 8) Preview work locations for unstable/uneven terrain.	Use visual observation, and real-time monitoring instrumentation to ensure all equipment has been properly cleaned of contamination and dried. After decon is completed, screen equipment with a PID/FID. If any elevated readings (i.e., above background) are observed, perform decon again and rescreen. Repeat until no elevated PID/FID readings are noted.	For Heavy Equipment This applies to high pressure soap/water, steam cleaning wash and rinse procedures. Level D Minimum requirements - - Standard field attire (Long sleeve shirt; long pants) - Safety shoes (Steel toe/shank) - Chemical resistant boot covers - Nitrile outer gloves - *PVC Rainsuits or PE or PVC coated Tyvek* - *Safety glasses underneath a splash shield* - *Hearing protection (plugs or muffs)* *Items in italics are at the discretion of the SSO.* For sampling equipment (trowels, MacroCore Samplers, bailers, etc.), the following PPE is required NOTE: Consult MSDS for PPE guidance. Otherwise, observe the following: Level D Minimum requirements - - Standard field attire (Long sleeve shirt; long pants) - Safety shoes (Steel toe/shank) - Nitrile outer gloves - Safety glasses	**Personnel Decontamination** will consist of a soap/water wash and rinse for reusable outer protective equipment (boots, gloves, PVC splash suits, as applicable). The decon function will take place at an area adjacent to the site activities. This procedure will consist of: - Equipment drop - Soap/water wash and rinse of outer boots and gloves, as applicable - Soap/water wash and rinse of the outer splash suit, as applicable - Disposable PPE will be removed and bagged. **Equipment Decontamination** - All heavy equipment decontamination will take place at a centralized decontamination pad utilizing steam or pressure washers. The drill rig will have the wheels and tires cleaned along with any loose debris removed, prior to transporting to the central decontamination area. All site vehicles will have restricted access to exclusion zones, and have their wheels/tires sprayed off as not to track mud onto the roadways servicing this installation. Roadways shall be cleared of any debris resulting from the onsite activity. **Sampling Equipment Decontamination** Sampling equipment will be decontaminated as per the requirements in the Sampling and Analysis Plan and/or Work Plan. MSDS for any decon solutions (Alconox, isopropanol, etc.) will be obtained and used to determine proper handling / disposal methods and protective measures (PPE, first-aid, etc.). All equipment used in the exclusion zone will require a complete decontamination between locations and prior to removal from the site. The FOL or the SSO will be responsible for evaluating equipment arriving onsite and leaving the site. No equipment will be authorized access or exit without this evaluation.

6.0 HAZARD ASSESSMENT

The following section provides information regarding the chemical, physical, and natural hazards anticipated to be present during the activities to be conducted. Table 6-1 provides information related to chemical constituents that have been identified by analysis or are suspected to be present at the site based on historical data. Specifically, toxicological information, exposure limits, symptoms of exposure, physical properties, and air monitoring and sampling data are discussed in the table.

6.1 CHEMICAL HAZARDS

The potential health hazards associated with NSWC include inhalation, ingestion, and dermal contact of various contaminants that may be present in surface soils, sediments, surface water, and groundwater. As the focus of this field investigation is to conduct additional sampling of various media, concentrations of the chemical hazards present are not fully determined. Based on historical uses for the site and prior sampling results, the types of contaminants anticipated include the following primary classes of contaminants (with specific compounds of interest where applicable):

- Volatile Organic Compounds (VOCs), including solvents and halogenated hydrocarbons. Specific compounds of concern include 1,2-Dichloroethylene, trichloroethylene, and propylene dichloride.
- Semi-Volatile Organic Compounds (SVOCs), including waste oils and general Polynuclear Aromatic Hydrocarbons (PAHs)
- Metals (specifically arsenic, chromium, and lead)
- Explosives and explosive compounds, specifically TNT and RDX at SWMU 10. Also, small arms explosives may have been buried at SWMU 4.
- Polychlorinated Biphenyls (PCBs)
- Pesticides (specifically 4,4'-DDT, Chlordane, and Aldrin)

None of these contaminants are anticipated to be available in significant concentrations to present an inhalation hazard. Further, occupational exposures to field crews via ingestion and skin contact are also not anticipated given the proposed site activities and previously detected very low concentrations of site contaminants. Table 6-1 provides information on these compounds and individual substances. Included is information on the toxicological, chemical, and physical properties of these substances. It is anticipated that the greatest potential for exposure to site contaminants is during intrusive activities (drilling, soil sampling, etc.). Exposure to these compounds is most likely to occur through ingestion and inhalation of contaminated soil or water, or hand-to-mouth contact during soil disturbance activities. For this reason, PPE and basic hygiene practices (washing face/hands before leaving site) will be extremely important.

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
NAVAL SURFACE WARFARE CENTER - CRANE DIVISION
CRANE, INDIANA

Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
General PAHs / Coal Tar Pitch Volatiles / Creosote / cresol (Fluoranthene, pyrene, benzo(a) anthracene, benzo(a) pyrene, benzo(f)fluoranthene, benzo(k)fluoranthene), etc.)	(CAS Numbers vary depending on specific compound)	PID: I.P. of 8.97 eV, relative response ratio unknown. FID: Response factor unknown but given the substances flammability, detection by FID can be anticipated.	Refer to NIOSH methods for each specfic compound for appropriate air sampilng protocols. Many PAHs can be sampled using NIOSH Method 5506 or 5515 - Teflon filter with support ring - High pressure liquid chromatography with UV detector. For cresol (a major constituent of creosote) by silica gel or xad-7 sorbent tube; Acetone desorption and analysis by gas chromatography - flame ionization detector or high-pressure liquid chromatography. (NIOSH Method #2001, or OSHA Method #32)	**General PAHs:** Most PAHs have no established exposure limits. Other Coal Tar Pitch Volatiles / PAHs such as chrysene and benzo(a)pyrene have an exposure limit of 0.2 mg/m³ (OSHA and ACGIH). 0.1 mg/m³ - (NIOSH) **Creosote / Cresol:** OSHA; ACGIH: 5 ppm NIOSH: 2.3 ppm IDLH: 80 mg/m³	Adequate - use a full-face air-purifying respirator with organic vapor / dust/mist cartridge up to 250 ppm. Cresol has an Odor Threshold of 0.00005-0.0079 ppm. **Recommended gloves:** Viton >96.00 hrs; butyl rubber >90.00 hrs; neoprene >4.50 hrs	Properties of various PAHs/Coal Tar Pitch Volatiles vary depending upon the specific compound. *For Creosote/Cresol:* **Boiling Pt:** 376-397°F; 191-203°C **Melting Pt:** 52-96°F; 10.9-35.5°C **Solubility:** Insoluble **Flash Pt:** 178°F; 81°C **LEL/LFL:** Not available **UEL/UFL:** Not available **Vapor Density:** 3.72 **Vapor Pressure:** 1 mmHg @ 100-127° F; 38-53°C **Specific Gravity:** 1.030-1.038 **Incompatibilities:** Nitric acid, oleum, chlorosulfonic acid, oxidizers **Appearance and Odor:** Yellowish or colorless, flammable, oily liquid (often brownish because of impurities or oxidation)	Regulated based on effects on respiratory tract and skin irritation Other effects may include eye irritiation and central nervous system, distrubances. Acute exposures may result in difficulty breathing, respiratory failure and skin and eye irritation and burns. Chronic exposure may damage the liver, kidneys, lungs and skin and cause photosensitivity. IARC, NTP, NIOSH, ACGIH, and the EPA list some PAHs such as benzo(a)pyrene as a potential carcinogen (ARC 2A, NTP-2, ACGIH TLV-A2, NIOSH-X, EPA-B2).
Waste Oils All information is based on mineral oil	N.E. 8012-95-1 for mineral oil	Varies between fractions however waste oils tend to be less volatile. The FID tends to handle the longer chained aliphatic hydrocarbons more efficiently than its PID counterpart and would be selected as the instrument of choice.	Sampling and analytical protocol shall be in accordance with NIOSH Method #5026 is the recommended method for mineral oil mist.	ACGIH; NIOSH: 5 mg/m³ (Oil mists); 10 mg/m³ STEL OSHA: 5 mg/m³ (Oil mists)	Non-volatile substance, therefore no respiratory protection is required. In an aerosol form dust and mist respirator would be considered acceptable for up to 500 mg/m³. **Recommended gloves:** Any glove suitable to prevent skin contact (Nitrile has been the one most widely used for the other substances, and will be acceptable).	**Boiling Pt:** 680°F; 360°C **Melting Pt:** Not available **Solubility:** Insoluble **Flash Pt:** 275-500°F; 135-260°C depends on the distillation fraction **LEL/LFL:** Not available **UEL/UFL:** Not available **Vapor Density:** Not available **Vapor Pressure:** <0.5 mmHg **Specific Gravity:** 0.90 **Incompatibilities:** None reported **Appearance and odor:** Colorless, oily, with an odor of burned lubricating oil.	Minor irritation to the eyes, skin, and respiratory system.

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
NAVAL SURFACE WARFARE CENTER, CRANE, INDIANA
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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Lead	7439-92-1	Particulate form - Unable to be detected by either PID or FID.	Air sample using a mixed cellulose ester filter; or HNO_3 or H_2O_2 desorption; or Atomic absorption detection. NIOSH Method #7082 or #7300.	OSHA: 0.05 mg/m³ ACGIH: 0.05 mg/m³ NIOSH: 0.10 mg/m³ IDLH: 100 mg/m³ as lead	The use of a air purifying, full-face respirator with high efficiency particulate air filter for up to 2.5 mg/m³. **Recommended gloves:** This is in the particulate form. Therefore any glove suitable to prevent skin contact (Nitrile has been the one most widely used for the other substances).	**Boiling Pt:** 3164°F; 1740°C **Melting Pt:** 621°F; 327°C **Solubility:** Insoluble **Flash Pt:** Not applicable (Airborne dust may burn or explode when exposed to heat, flame, or incompatible chemicals) **LEL/LFL:** Not applicable **UEL/UFL:** Not applicable **Vapor Density:** Not available **Vapor Pressure:** 0 mmHg **Specific Gravity:** 11.34 **Incompatibilities:** Strong oxidizers, peroxides, sodium acetylide, zirconium, and acids **Appearance and Odor:** Metal: A heavy ductile, soft gray solid.	Overexposure to this substance via ingestion or inhalation may result in metallic taste in the mouth, dry throat, thirst, Gastrointestinal disorders (burning stomach pain, nausea, vomiting, possible diarrhea sometimes bloody or black, accompanied by severe bouts of colic), CNS effects (muscular weakness, pain, cramps, headaches, insomnia, depression, partial paralysis possibly coma and death. Extended exposure may result in damage to the kidneys, gingival lead line, brain, and anemia.
Chromium Compounds	7440-47-3 (Element)	Not detectable by PID. Not detectable by FID.	Air sample using mixed cellulose - ester filter; acid desorption and analysis by atomic absorption. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #7024.	OSHA & NIOSH: (Chromium II, III) 0.5 mg/m³ (Chromium VI) 0.1 mg/m³ (Ceiling) ACGIH: 0.5 mg/m³ (Chromium II, III compounds), 0.05 mg/m³ (Chromium VI compounds) IDLH: 30 mg/m³ (Chromium VI compounds)	The use of a air purifying, full face-piece respirator with a high efficiency particulate filter for concentrations up to 0.1 mg/m³. **Recommended Gloves:** This is in particulate form. Therefore any glove suitable to prevent skin contact.	**Boiling Pt:** 4788°F; 2642°C **Melting Pt:** 3452°F; 1900°C **Solubility:** Insoluble **Flash Pt:** Not applicable (Airborne dust may burn or explode when exposed to heat, flame, or incompatible chemicals) **LEL/LFL:** Not applicable **UEL/UFL:** Not applicable **Vapor Density:** Not available **Vapor Pressure:** 0 mmHg **Specific Gravity:** 7.14 **Incompatibilities:** Strong oxidizers, peroxides, and alkalis **Appearance and Odor:** Appearance and odor vary depending upon the specific compound.	Health hazards are characterized normally through chronic exposure manifesting as histologic fibrosis of the lungs and ulceration of the nasal septum and skin. IARC, NTP and ACGIH list various chromium compounds as possessing carcinogenic properties.

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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Arsenic	7440-38-2	Particulate form - This substance is unable to be detected by PID/FID.	Air sample using a particulate filter; acid desorption; AAS detection. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #7900.	OSHA: Organic compounds 0.5 mg/m³ Inorganic compounds 0.01 mg/m³ NIOSH: (Ceiling) 0.002 mg/m³ ACGIH: 0.01 mg/m³ IDLH: 5 mg/m³ as arsenic	No identifiable warning properties to indicate presence and thereby detection. **Recommended APR Cartridge:** Suitable for dust and fume. Organic vapor acid gases with HEPA filter. This substance may be presented as a pesticide, therefore a cartridge suitable for pesticides (MSA-GMP). **Recommended Gloves:** This is in the particulate form. Therefore any glove suitable to prevent skin contact (Nitrile has been the one most widely used for the other substances).	**Boiling Pt:** sublimation @ 1134°F; 612°C **Melting Pt:** 1497°F; 814°C @ 36 atm **Solubility:** Insoluble in water;soluble in nitric acid **Flash Pt:** Nonflammable, however, airborne in the form of a dust this substance will support combustion **LEL/LFL:** Nonflammable **UEL/UFL:** Nonflammable **Vapor Density:** Not available **Vapor Pressure:** 1 mmHg @ 372°C (sublimes) **Specific Gravity:** 5.73 **Incompatibilities:** Oxidizers, halogens,zinc, lithium, azides, and acetylides **Appearance and odor:** Gray to black, brittle, crystalline, amorphous, odorless.	Overexposure to this substance through inhalation or ingestion may result in ulceration of the nasal septum, GI disturbances resulting in violent purging and vomiting, hoarse voice, sore throat, excessive salivation, peripheral neuropathy (numbness and burning sensations beginning at the extremities followed by motor weakness), respiratory irritation leading to possible pulmonary edema. Skin or eye contact may result in irritation, conjunctiva, dermatitis, and hyperpigmentation (darkening of the areas exposed) of the skin. This substance has been judged to be a Human carcinogen by NTP, and IARC.
Aroclor-1260 (Polychlorinated Biphenyl, PCB) It should be noted that this substance is representative of the more common isomers Aroclor - 1242, 1254, which may be encountered.	11096-82-5 53469-21-9 (42%) 11097-69-1 (54%)	Substance is not volatile (VP=0.00006 mmHg), I.P. is unknown however is anticipated to be elevated, therefore, PID is not anticipated to detect substance. Substance is non combustible and as a result will not be detected by FID.	Air sample using a particulate filter, Florisil sorbent tube with glass fiber filter; hexane desorption; gas chromatography-electron capture detector. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #5503 (PCBs).	OSHA; ACGIH: 0.5 mg/m³ (skin) NIOSH: 0.001 mg/m³ IDLH: 5 mg/m³	Inadequate - However due to the low volatility it is assumed unless agitated this substance does not present a volatile vapor or gas respiratory threat. For dusty conditions where this material may cling to particulates, use a HEPA filter. APRs are approved for escape only when concentrations exceed the exposure limits. Concentrations greater than the exposure limits require PAPR or supplied air respirators. **Recommended glove:** Butyl rubber >24 hrs; Neoprene rubber >24.00 hrs; Silver shield or Viton (for pure product).	**Boiling Pt:** distillation range 689- 734°F; 365-390° C **Melting Pt:** -2 to 50°F; -19 to 10°C **Solubility:** Insoluble **Flash Pt:** Not applicable **LEL/LFL:** Not applicable **UEL/UFL:** Not applicable Nonflammable liquid, however, exposure to fire results in black soot containing PCBs, dibenzofurans, & chlorinated dibenzo-p-dioxins **Vapor Density:** Not available **Vapor Pressure:** 0.00006 - 0.001 mmHg **Specific Gravity:** 1.566 @ 60°F; 15.5°C **Incompatibilities:** Strong oxidizers **Appearance and Odor:** Colorless to pale yellow, viscous liquid or solid (Aroclor 54 below 50°F) with a mild, hydrocarbon odor	This substance is irritating to the eyes and skin. Chronic effects of overexposure may include potential to cause liver damage, chloracne, and reproductive effects. Recognized as possessing carcinogenic properties by NIOSH, and NTP.

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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
2,4,6-Trinitrotoluene (TNT) Synonyms: Trinitrotoluene (dry)	118-96-7	PID: Ionization Potential - 10.59 eV, relative response ratio is unknown. FID: Relative response ratio is unknown it is estimated that the response will be slightly less than benzene (150%) or toluene (110%).	Air sample using a Tenax GC tube; Acetone desorption; GC/TEA detection. Sample and analytical protocol in accordance with OSHA Method #44.	OSHA: 1.5 mg/m³ (skin) ACGIH: 0.5 mg/m³ (skin) NIOSH: 0.5 mg/m³ (skin)	Rapid heating to 466°F; 240°C will cause detonation. Pale yellow crystals, subject to detonation by exposure to shock or temperatures exceeding 466° F; 240°C. Air purifying respirators recommended for escape purposes only. **Recommended Gloves:** Any glove which is impermeable to contact.	**Boiling Pt:** 466°F; 240°C **Melting Pt:** 176°F; 80C **Detonation Pt:** 464°F; 240°C **Solubility:** 0.01% at 75°F 25°C **Specific Gravity:** 1.65 **Vapor Density:** 7.8 **Vapor Pressure:** 0.057 mmHg @ 178° F; 81°C **Flash Pt:** Explodes 842°F; 450°C **LEL:** Not available **UEL:** Not available **Incompatibles:** Strong oxidizers, ammonia, combustible materials, and heat. **Appearance and odor:** Colorless to light yellow solid or crushed flakes.	**Routes of Exposure:** inhalation, absorption, ingestion, and skin & eye contact. The following symptoms may be experienced: Sneezing, coughing, sore throat, muscle pain, peripheral nerve sensitization, and irritation of the skin and mucous membranes. Chronic exposure may cause liver damage, jaundice, cyanosis, kidney damage, anemia, cataract, leukocytosis.
RDX Synonym: Cyclo-1,3,5-trimethylene-2,4,6-trinitramine; Cyclonite; Trimethylenetrini-tramine; T_4; RDX	121-82-4	No information found.	Air sampling use particulate filter; gravimetric detection. Sampling and analytical procedures shall be in accordance with NIOSH Method #0500 (Nuisance Dust, Total).	OSHA/NIOSH/ACGIH: 1.5 mg/m³ (skin); STEL 3 mg/m³ (skin)	Sensitive to friction, as stable as TNT, explosive when heated to 260°C; 126.6 °F Respiratory Protection: Can use air purifying respirator with an organic vapor cartridge for concentrations up to 75 mg/m³. Airborne concentrations above this level use an airline respirator or SCBA. **Recommended Gloves:** Impermeable gloves suitable to prevent skin contact. Nitrile gloves have been selected for most other applications.	**Boiling Pt:** Not available **Melting Pt:** Pure 399°F; 204.1°C Military grade ~10% HMX ~374°F; ~190°C **Freezing Pt:** Not available **Solubility:** Insoluble in water; soluble hot aniline, phenol, and nitric acid **Specific Gravity:** 1.2 **Vapor Pressure:** Not available **Flash Pt:** Heat (explosion in 5 seconds) 500°F; 260°C **LEL:** Not available **UEL:** Not available **Incompatibles:** Strong oxidizers, combustible materials, mercury fulminate, and heat **Appearance and odor:** Colorless to white crystalline powder, odorless	**Routes of exposure:** Inhalation, ingestion, skin and eye contact. Sign and symptoms of overexposure may include: headaches, dizziness, nausea, hyperactivity, convulsions, seizures, fatigue, irritability. These effects may be experienced quickly or several hours later. Topically irritating to skin and eyes.
Aldrin	309-00-2	PID: I.P. Unknown FID: FID will not detect this substance.	Sample using a glass fiber, binder free filter with a midget impinger. Analyze with Gas Chromatography - electrolytic conductivity detector in accordance with NIOSH Method #5502	OSHA: 0.25 mg/m³ NIOSH: 0.25 mg/m³ (skin) ACGIH: 0.25 mg/m³ (skin)	An air purifying respirator equipped with a combination filter for organic vapors, pesticides, and High Efficiency Particulate Air (HEPA) filter is acceptable. **Recommended glove:** Nitrile or neoprene gloves are adequate for protection against contact with the skin.	**Boiling Pt:** Decomposes **Melting Pt:** 219°F; 104°C **Solubility:** 0.003% **Flash Pt:** Not available **LEL/LFL:** Not available **UEL/UFL:** Not available **Vapor Density:** Not available **Vapor Pressure:** 0.00008 mmHg **Specific Gravity:** 1.60 **Incompatibilities:** Concentrated mineral acids, active metals, acid catalysts, acid oxidizing agents, phenol. **Appearance and Odor:** Colorless to dark-brown crystalline solid with a mild chemical odor.	Exposure to aldrin may result in the following symptoms: headache, dizziness, nausea, vomiting, tonic convulsions, myoclonic jerks of the limbs, malaise (vague feeling of discomfort), hematuria (blood in the urine), and coma. Aldrin also is known to have carcinogenic properties. Target organs include: Central Nervous System (CNS), liver, kidneys, and skin.

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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
DDT and the major metabolites; DDD and DDE.	50-29-3 72-54-8 72-55-9	Substance is not volatile, I.P. is unknown, detection by PID is unknown. Substance non-combustible, therefore a FID is anticipated to have reduced response to DDT.	Air sample using a binder free, glass fiber filter; isoctane desorption; gas chromatography-electron capture detector. Sampling and analytical protocol will proceed in accordance with NIOSH Method #3(S274).	OSHA; ACGIH: 1 mg/m³ NIOSH: 0.5 mg/m³	Adequate - Can use air purifying respirator with high efficiency particulate air filter (HEPA). **Recommended glove:** Nitrile acceptable for incidental contact.	**Boiling Pt:** 230°F; 110°C **Melting Pt:** 226°F; 108°C **Solubility:** Insoluble **Flash Pt:** 162-171°F; 72-77°C **LEL/LFL:** Not available **UEL/UFL:** Not available **Vapor Density:** Not available **Vapor Pressure:** Low **Specific Gravity:** 0.99 **Incompatibilities:** Strong oxidizers and alkalis **Appearance and Odor:** Colorless crystals or off-white powder with a slight aromatic odor	Large doses are followed by vomiting due to gastric irritation, diarrhea may follow. Numbness and parethesias of the lips tongue and face associated with malaise, headache, sorethroat, fatigue and weakness. Coarse tremors (usually first of the neck, head, and eyelids). This may be accompanied by confusion, apprehension, and depression. Convulsions may result and death may occur from respiratory failure. DDT is absorbed and retained in the fat of humans. Chronic exposure may result in damage to the liver, kidneys and Peripheral Nervous System. DDT is recognized as possessing carcinogenic properties by IARC and NTP.
Chlordane	57-74-9	Substance is not volatile (VP=.00001 mmHg) I.P. is unknown, therefore detection by PID is unknown. Substance is non-combustible, therefore a FID is not expected to have a response to chlordane.	Air sample using Chromosorb-102 sorbent tube with mixed cellulose-ester filter or a xad-2 sorbent tube with filter. Toluene desorption and analysis by gas chromatography-electron capture detector. Sampling and analytical protocol will proceed in accordance with NIOSH Method #5510 or OSHA Method #67.	OSHA; NIOSH; ACGIH: 0.5 mg/m³	Adequate - can use an air purifying respirator with an organic vapor & high efficiency air filter cartridges. **Recommended gloves:** PTFE Teflon for pure product. Nitrile acceptable for incidental contact.	**Boiling Pt:** 347°F; 175°C **Melting Pt:** Not available **Solubility:** Insoluble **Flash Pt:** Not available **LEL/LFL:** Not available **UEL/UFL:** Not available **Vapor Density:** Not available **Vapor Pressure:** 0.00001 mmHg **Specific Gravity:** 1.56 @ 60°F; 15.5° C **Incompatibilities:** Strong oxidizers and alkaline reagents **Appearance and Odor:** Amber-colored, viscous liquid with a pungent, chlorine like odor.	Earliest signs of overexposure manifest as hypersensitivity of the central nervous system characterized by hyperactive reflexes, muscle twitching, tremors, incoordination, ataxia, and clonic convulsions. Cycles of excitement and depression may be repeated over and over. Chronic health hazard information similar to those for DDT.
1,2-Dichloroethylene	540-59-0	PID: I.P. 9.65 eV, high response with PID and 10.2 eV lamp. FID: 50% response with FID.	Air sample using charcoal tube; and carbon disulfide desorption; Sampling and analytical protocol in accordance with OSHA Method #07; and NIOSH Method #1003.	OSHA; NIOSH; ACGIH: 200 ppm IDLH: 1000 ppm	Adequate- odor threshold 0.085-17 ppm. Use organic vapor/acid gas cartridges for exceedances above the TWA up to 1,000 ppm. >1,000 ppm should use pressure-demand supplied air respirator above exposure limits. **Recommended glove:** nitrile - 0.12 hrs; viton - 0.95 hrs	**Boiling Pt:** 117°F; 47°C **Melting Pt:** 7°F; -13.8°C **Solubility:** 0.4% **Flash Pt:** 36°F; 2.2°C **LEL/LFL:** 5.6% **UEL/UFL:** 12.8% **Vapor Density:** 2.0 **Vapor Pressure:** 180-260 mmHg **Specific Gravity:** 1.27 @ 90°F; 32°C **Incompatibilities:** Strong oxidizers, alkalis, potassium hydroxide, and copper. When heated to decomposition temperatures will emit toxic fumes of phosgene. **Appearance and Odor:** Colorless liquid with an acrid odor.	Overexposure may result in CNS depression with potential to cause sleepiness, hallucinations, distorted perceptions, and stupor (narcosis). Systemically, symptoms may result in nausea, vomiting, weakness, tremors, and cramps. May also irritate the eyes, skin, and mucous membranes. Chronic exposures may result in dermatitis, liver, kidney, and lung damage.

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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Trichloroethylene	79-01-6	PID: I.P. 9.45 eV, High response with PID and 10.2 eV lamp. FID: 70% Response with FID.	Air sample using charcoal tube; carbon disulfide desorption; Sampling and analytical protocol shall proceed in accordance with OSHA Method #07, or NIOSH Method #1022 or #1003.	OSHA: 50 ppm 200 ppm (Ceiling) ACGIH: 50 ppm 100 ppm STEL NIOSH: 25 ppm IDLH: 1000 ppm	Inadequate - Odor threshold 82 ppm. APRs with organic vapor/acid gas cartridges may be used for escape purposes. Exceedances over the exposure limits require the use of positive pressure-demand supplied air respirator. **Recommended gloves:** PV Alcohol unsupported >16.00 hrs; Silver shield >6.00 hrs; Teflon >24.00 hrs; or Viton >24.00 hrs; Nitrile (Useable time limit 0.5 hr, complete submersion for the nitrile selection)	**Boiling Pt:** 188°F; 86 7°C **Melting Pt:** -99°F; -73°C **Solubility:** 0.1% @ 77°F; 25°C **Flash Pt:** 90°F; 32°C **LEL/LFL:** 8% @ 77°F; 25°C **UEL/UFL:** 10.5 @ 77°F; 25°C **Vapor Density:** 4.53 **Vapor Pressure:** 100 mmHg @ 90°F; 32 °C **Specific Gravity:** 1.46 **Incompatibilities:** Strong caustics and alkalis, chemically active metals (barium, lithium, sodium, magnesium, titanium, and beryllium) **Appearance and Odor:** Colorless liquid with a chloroform type odor. Combustible liquid, however, burns with difficulty.	Central nervous system effects including euphoria, analgesia, anesthesia, paresthesia, headaches, tremors, vertigo, and somnolence. Damage to the liver, kidneys, heart, lungs, and skin have also been reported. Contact may result in irritation to the eyes, skin, and mucous membranes. Ingestion may result in GI disturbances including nausea, and vomiting NIOSH lists this substance a potential human carcinogen.
Propylene dichloride See also 1,2-Dichloropropane	78-87-5	PID: I.P. 10.87 eV, relative response ratio is unknown. FID: FID: Relative response ratio unknown, however, this substance is considered detectable.	Air sample using a charcoal tube (petroleum-based); acetone/cyclohexane desorption; GC/ECD detection in accordance with NIOSH Method #1013.	OSHA: 75 ppm ACGIH: 75 ppm, STEL 110 ppm NIOSH has not established anexposure limit.	Odor threshold - 50 ppm. An air purifying respirator equipped with organic vapor cartridges is acceptable for up to 400 ppm concentrations. For exposures greater than 400 ppm supplied air respirators are required. **Recommended glove:** Butyl, nitrile, or neoprene for brief (< 1 hr) and PVA or Viton for extended periods or contact with free product.	**Boiling Pt:** 206°F;96°C **Melting Pt:** -148°F;-100°C **Solubility:** Slight (0.3%) **Flash Pt:** 60°F; 15.6°C **LEL/LFL:** 3.4% **UEL/UFL:** 14.5% **Vapor Density:** 3.9 **Vapor Pressure:** 40 mmHg@68°F;20°C **Specific Gravity:** 1.16 @ 20°F; 4°C **Incompatibilities:** Strong oxidizing agents and strong acids. **Appearance and Odor:** Colorless liquid with a slight sweet chloroform odor.	Overexposure to this substance may result in irritation to the eyes, nose, and throat. Dermal contact is mildly irritating to human skin, and some skin absorption may occur from exposure to the liquid. Systemically, propylene dichloride is a narcotic and may cause dizziness and lightheadedness. Chronic effects may include kidney and liver dysfunction. This material is "Not classifiable as a human carcinogen (A4)" by the ACGIH.

6.2 PHYSICAL HAZARDS

The physical hazards that may be present during the performance of site activities are summarized below:

- Heavy equipment hazards (pinch/compression points, rotating equipment, etc.).
- Slips, trips, and falls
- Energized systems (contact with underground or overhead utilities)
- Lifting (strain/muscle pulls)
- Noise in excess of 85 decibels (dBA)
- Flying projectiles
- Ambient temperature extremes (heat stress)
- Pinches and compressions
- Vehicular and foot traffic
- Contact with explosives (considered a potential site hazard as there is a report that small arms ammunition may have been buried at SWMU 4 and explosives were detected in prior sampling at SWMU 10.)

These physical hazards are discussed in Table 5-1 as applicable to each site task. Further, many of these hazard are discussed in detail in Section 4.0 of the Health and Safety Guidance Manual. Specific discussions on some of these hazards are presented below.

6.2.1 Heavy Equipment Hazards (Pinch/compression points, rotating equipment, etc.)

Often the hazards associated with drilling operations are the most dangerous to be encountered during site activities. The SSO will thoroughly discuss safe drilling procedures during the pre-activities training session. All site personnel will sign the form in Figure 8-2 documenting that they received the training and understand the procedures. The following rules will apply to all drilling operations:

- Emergency stop devices (if applicable) will be tested daily to ensure that they are operational.

- Long handled shovels or equivalent shall be used to clear cuttings from the borehole and rotating equipment.

- The driller may not leave the controls when the augers are rotating.

6.2.2 Energized Systems (Contact with Underground or Overhead Utilities)

Underground utilities such as pressurized lines, water lines, telephone lines, buried utility lines, and high voltage power lines may be present throughout the facility. Clearance of underground and overhead utilities for each sample location will be coordinated with NSWC personnel. Additionally, drilling operations will be conducted at a safe distance (>20 feet) from overhead power lines. Whenever underground utilities are suspected to be close to subsurface sampling locations, the borehole will be advanced to a minimum of five (5) feet with a hand auger prior to drilling. As built drawings may also be utilized for additional clarification. In certain cases, Base personnel may need to deenergize electrical cables using facility lockout/tagout procedures to insure electrical hazards are eliminated.

6.2.3 Ambient Temperature Extremes

Overexposure to high ambient temperatures (heat stress) may exist during performance of this work depending on the project schedule. Extremely cold temperatures are not expected to be encountered due to project location. Work performed when ambient temperatures exceed 70°F may result in varying levels of heat stress (heat rash, heat cramps, heat exhaustion, and/or heat stroke) depending on variables such as wind speed, humidity, and percent sunshine, as well as physiological factors such as metabolic rate and skin moisture content. Additionally, work load and level of protective equipment will affect the degree of exposure. Site personnel will be encouraged to drink plenty of fluids to replace those lost through perspiration. Additional information such as Work-Rest Regimens and personnel monitoring may be found in Section 4.0 of the Health & Safety Guidance Manual. The SSO will recommend additional heat stress control measures as they are deemed necessary as per ACGIH guidelines.

6.3 NATURAL HAZARDS

Insect/animal bites and stings, poisonous plants, inclement weather, and other natural hazards must be considered given the location of activities to be conducted. In general, avoidance of areas of known infestation or nesting will be the preferred exposure control. Use of additional PPE with joints (ankles and wrists) taped, such as long pants tucked into boots or coveralls, is also recommended. Specific discussion on principle hazards of concern follows:

6.3.1 Insect/Animal Bites and Stings

Ticks, insect/animal bites, and stings are difficult to control given the climate and environmental setting of NSWC Crane. However, in an effort to minimize this hazard the following control measures will be enacted where possible.

- Commercially available bug sprays and repellents will be used whenever possible – TCLP Pesticides analytical screening includes chlordane, endrin, lindane, methoxychlor, toxathene and heptachlor. Commercially available repellants may be used providing these components are not part of this analyte listing. Products such as DEET should not be applied directly to the skin due to potential irritation. This product, when permitted for use, should be applied over clothing articles.

- Loose fitting light colored clothing with long sleeves, where possible should be worn. This will also aid in insect control by providing a barrier between the field person and the insects and to provide easy recognition of crawling insects against the lighter background. Pant legs should be secured to the work-boots using duct tape to prevent access by ticks. Mosquito nets are also recommended for use when commercially available repellents are not permitted.

- Clothing/limited body checks for ticks and other crawling insects should be conducted upon exiting heavily vegetated areas. Workers should perform a more detailed check of themselves when showering in the evening. Ticks prefer moist areas of the body (arm-pits, genitals, etc.) and will migrate to those locations.

- The FOL/SSO will preview all access routes and work areas in an effort to identify physical hazards including nesting areas in and around the work sites. These areas will be flagged and communicated to all site personnel.

- The FOL/SSO must determine if site personnel (through their Medical Data Sheets), suffer allergic reactions to bee and other insect stings and bites. When personnel are on-site who are predisposed to these conditions, the FOL/SSO will take the appropriate measures to secure physician directed antidotes.

Note to all personnel: It is imperative that any allergies be reported on the Medical Data Sheets and to the SSO.

Tick and Mosquito Transmitted Illnesses And Diseases

Ticks and mosquitoes have been identified in the transmission of diseases including Lyme's disease and malaria. Warm months (Spring through early Fall) are the most predominant time for this hazard. However, due to the climate and environmental setting of NSWC Crane, this hazard may occur year round. Information concerning transmitted Lyme's Disease including recognition, evaluation, tick removal, and control is provided in Attachment II of this HASP or Section 4.0 of the Health and Safety Guidance Manual.

Malaria may occur when a mosquito or other infected insect sucks blood from an infected person, and the insect becomes the carrier to infect other hosts. The parasite reproduces within the mosquito, and is then is passed on to another person through the biting action. Acute symptoms include chills accompanied by fever and general flu like symptoms. This generally terminates in a sweating stage. These symptoms may recur every 48 to 72 hours.

Conditions such as this should not be taken for granted and should be reported to the SSO immediately.

Snakes And Other Wild Animal Encounters

Indigenous animals including snakes (poisonous and non-poisonous varieties), raccoons, and other animals native to the region may have to be contended with. These animals may be encountered if work locations encroach on nesting or territories claimed by these animals.

To avoid the obvious hazards conveyed as part of a direct encounter, the following actions will be taken to minimize impact on the field crews and/or operations.

- FOL/SSO will preview access routes and work locations for nesting areas or signs of animal activities (tracks, foraging areas, etc.). All identified suspect areas will be communicated to the field crews. To the extent possible, suspected nesting/habitat areas are to be avoided. Otherwise, snake chaps will be required as a precaution.

6.3.2 Poisonous Plants

Various plants that can cause allergic reactions may be encountered during fieldwork. These include, but may not be limited to, poison ivy, poison oak, and poison sumac. Contact of field personnel with previous plants may occur when clearing vegetation for access to work areas, or through movement through these plants. An irritating, allergic reaction can occur when direct contact is achieved between the plant and the bare skin of a field person, or the plant and some piece of equipment or clothing article that then later

comes in contact with the bare skin of a field person. Oils are transferred from the plant to exposed skin, clothing, or piece of equipment. The degree of the irritating, allergic reaction can vary significantly from one person to the next.

Protective measures to control and minimize the effects of this hazard may include, but not limited to, the following:

- Identify plants for field personnel.

  - Poison Ivy - Characterized by climbing vines, three leaf configuration ovate to elliptical in shape, deep green leaves with a reddish tint, greenish flowers, and white berries.

  - Poison Sumac - Characterized as a tall bush of the sumac family bearing compound leaves (7-13 entire leaflets), branched from a central axis, drooping, with auxiliary clusters of white fruit.

    NOTE: These white fruits and berries may exist only during pubescent stages.

  - Poison oak - Characterized as similar to poison ivy consisting of a shrub, stems erect, 0.3 to 2.0 meters tall, leaflets consist of broad thick lobes coarsely serrated configuration, denser at the base, less so than the top.

- Protective measures may include wearing disposable garments such as Tyvek when clearing brush. These may be carefully removed and disposed of along with any oils accumulated from the plants.

- Personal Hygiene - The oils obtained from the plants will only elicit an allergic response when the person's bare skin layer is contacted. This can be aggravated through skin pores open when perspiring, or through breaks in the skin such as cuts, nicks, scratches, etc.. This can also be accomplished when using excessively hot water for cleaning the skin, which also causes pores to open. Prior to break time, lunchtime, etc. personnel should wash with cool water and soap to remove as much of the oils as possible. In heavily vegetated areas of these plants, additional measures including barrier creams and blocks may be used to prevent the oils from accessing and penetrating the skin.

All of these plants present an airborne sensitization hazard when burned. This is not to occur as part of this scope of work and therefore will not be addressed.

6.3.3 Inclement Weather

Project tasks under this Scope of Work will be performed outdoors and near water. As a result, inclement weather may be encountered. In the event that adverse weather conditions arise (electrical storms, hurricanes, etc.), the FOL and/or the SSO will be responsible for temporarily suspending or terminating activities until hazardous conditions no longer exist.

7.0 AIR MONITORING

Direct Reading Instruments (DRIs) will be used to screen source areas (sample locations, wells, etc.) and worker breathing zones for volatile and detectable site contaminants. Some of the anticipated site contaminants, however, are not volatile and are unable to be detected with the use of DRIs. Specifically, the PAHs, metals, and pesticides are unable to be detected due to their solid nature, low vapor pressure, and/or non-ionizing properties. Action levels are discussed in Table 5-1 as they may apply to a specific task or location. The use of personal protective equipment and the observance of the other control requirements presented in this HASP has been selected to minimize potential for personnel exposures to hazardous concentrations (known or unknown) of airborne contaminants. Additionally, the Health and Safety Guidance Manual, Section 1.0, contains detailed information regarding direct reading instrumentation, as well as general calibration procedures of various instruments.

7.1 INSTRUMENTS AND USE

Instruments will be used primarily to monitor source points and worker breathing zone areas, while observing instrument action levels. Action levels are discussed in Table 5-1 as they may apply to a specific task or location.

7.1.1 Photoionization Detector or Flame Ionization Detector

In order to accurately monitor for any substances which may present an exposure potential to site personnel, a Photoionization Detector (PID) using a lamp energy of 10.9 eV or higher will be used. This instrument will be used to monitor potential source areas and to screen the breathing zones of employees during site activities. The PID has been selected because it is capable of detecting the organic vapors of concern (NOTE: A Flame Ionization Detector [FID] may be used as an alternative to the PID, and may be preferable to use of a PID).

Prior to the commencement of any field activities, the background levels of the site must be determined and noted. Daily background readings will be taken away from any areas of potential contamination. These readings, any influencing conditions (i.e., weather, temperature, humidity) and site location must be documented in the field operations logbook or other site documentation (e.g., sample log sheet).

7.1.2 Hazard Monitoring Frequency

Table 5-1 presents the frequencies that hazard monitoring will be performed as well as the action levels which will initiate the use of elevated levels of protection. The SSO may decide to increases these

frequencies based on instrument responses and site observations. The frequency at which monitoring is performed will not be reduced without the prior consent of the PHSO or HSM.

7.2 INSTRUMENT MAINTENANCE AND CALIBRATION

Hazard monitoring instruments will be maintained and pre-field calibrated by the TtNUS Equipment Manager. Operational checks and field calibration will be performed on all instruments each day prior to their use. Field calibration will be performed on instruments according to manufacturer's recommendations (for example, the PID must be field calibrated daily and an additional field calibration must be performed at the end of each day to determine any significant instrument drift). These operational checks and calibration efforts will be performed in a manner that complies with the employees health and safety training, the manufacturer's recommendations, and with the applicable manufacturer standard operating procedure (copies of which can be found in the Health & Safety Guidance Manual which will be maintained on site for reference). All calibration efforts must be documented. Figure 7-1 is provided for documenting these calibration efforts. This information may instead be recorded in a field operations logbook, provided that all of the information specified in Figure 7-1 is recorded. This required information includes the following:

- Date calibration was performed
- Individual calibrating the instrument
- Instrument name, model, and serial number
- Any relevant instrument settings and resultant readings (before and after) calibration
- Identification of the calibration standard (lot no., source concentration, supplier)
- Any relevant comments or remarks

FIGURE 7-1

DOCUMENTATION OF FIELD CALIBRATION

SITE NAME: _____ PROJECT NO.: _____

Date of Calibration	Instrument Name and Model	Instrument I.D. Number	Person Performing Calibration	Instrument Settings		Instrument Readings		Calibration Standard (Lot Number)	Remarks/ Comments
				Pre-Calibration	Post-Calibration	Pre-Calibration	Post-Calibration		

8.0 TRAINING/MEDICAL SURVEILLANCE REQUIREMENTS

8.1 INTRODUCTORY/REFRESHER/SUPERVISORY TRAINING

This section is included to specify health and safety training and medical surveillance requirements for both TtNUS and subcontractor personnel participating in site activities.

8.1.1 Requirements for TtNUS Personnel

All TtNUS personnel must complete 40 hours of introductory hazardous waste site training prior to performing work at NSWC. Additionally, TtNUS personnel who have had introductory training more than 12 months prior to site work must have completed 8 hours of refresher training within the past 12 months before being cleared for site work. In addition, 8-hour supervisory training in accordance with 29 CFR 1910.120(e)(4) will be required for site supervisory personnel.

Documentation of TtNUS introductory, supervisory, and refresher training as well as site-specific training will be maintained at the project. Copies of certificates or other official documentation will be used to fulfill this requirement.

TtNUS will conduct a pre-activities training session prior to initiating site work. Additionally, a brief meeting will be held daily to discuss operations planned for that day. At the end of the workday, a short meeting will be held to discuss the operations completed and any problems encountered. This activity will be supported through the use of a Safe Work Permit System (See Section 10.10).

8.1.2 Requirements for Subcontractors

All TtNUS subcontractor personnel must have completed introductory hazardous waste site training or equivalent work experience as defined in OSHA Standard 29 CFR 1910.120(e) and 8 hours of refresher training meeting the requirements of 29 CFR 1910.120(e)(8) prior to performing field work at NSWC. TtNUS subcontractors must certify that each employee has had such training by sending TtNUS a letter, on company letterhead, containing the information in the example letter provided in Figure 8-1 and by providing copies of certificates for all subcontractor personnel participating in site activities.

FIGURE 8-1

TRAINING LETTER

The following statements must be typed on company letterhead, signed by an officer of the company and accompanied by copies of personnel training certificates:

LOGO
XYZ CORPORATION
555 E. 5th Street
Nowheresville, Kansas 55555

Month, day, year

Ms. Karen Smecker
Task Order Manager
Tetra Tech NUS, Inc.
661 Andersen Drive
Pittsburgh, Pennsylvania 15220

Subject: HAZWOPER Training for NSWC, Crane, Indiana

Dear Ms. Smecker:

As an officer of XYZ Corporation, I hereby state that I am aware of the potential hazardous nature of the subject project. I also understand that it is our responsibility to comply with all applicable occupational safety and health regulations, including those stipulated in Title 29 of the Code of Federal Regulations (CFR), Parts 1900 through 1910 and Part 1926.

I also understand that Title 29 CFR 1910.120, entitled "Hazardous Waste Operations and Emergency Response," requires an appropriate level of training for certain employees engaged in hazardous waste operations. In this regard, I hereby state that the following employees have had 40 hours of introductory hazardous waste site training or equivalent work experience as requested by 29 CFR 1910.120(e) and have had 8 hours of refresher training as applicable and as required by 29 CFR 1910.120(e)(8) and that site supervisory personnel have had training in accordance with 29 CFR 1910.120(e)(4).

LIST FULL NAMES OF EMPLOYEES AND THEIR SOCIAL SECURITY NUMBERS HERE.

Should you have any questions, please contact me at (555) 555-5555.

Sincerely,

(Name and Title of Company Officer)

8.2 SITE-SPECIFIC TRAINING

TtNUS will provide site-specific training to all site personnel who will perform work on this project. Site-specific training will also be provided to all personnel [U.S. Department of Defense (DOD), EPA, etc.] who may enter the site to perform functions that may or may not be directly related to site operations. Site-specific training will include:

- Names of designated personnel and alternates responsible for site safety and health
- Safety, health, and other hazards present on site
- Use of personal protective equipment
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure
- Contents of the Health and Safety Plan
- Emergency response procedures (evacuation and assembly points)
- Spill response procedures
- Review of the contents of relevant Material Safety Data Sheets

Site-specific documentation will be established through the use of Figure 8-2. All site personnel and visitors must sign this document upon receiving site-specific training.

8.3 MEDICAL SURVEILLANCE

8.3.1 Medical Surveillance Requirements for TtNUS Personnel

All TtNUS personnel participating in project field activities will have had a physical examination meeting the requirements of TtNUS's medical surveillance program and will be medically qualified to perform hazardous waste site work using respiratory protection

Documentation for medical clearances will be maintained in the TtNUS Pittsburgh office and made available, as necessary.

FIGURE 8-2

SITE-SPECIFIC TRAINING DOCUMENTATION

My signature below indicates that I am aware of the potential hazardous nature of performing remedial investigation activities at NSWC in Crane, Indiana, and that I have received site-specific training that included the elements presented below:

- Names of designated personnel and alternates responsible for site safety and health
- Safety, health, and other hazards present on site
- Use of personal protective equipment
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure
- Contents of the Health and Safety Plan
- Emergency response procedures (evacuation and assembly points)
- Spill response procedures
- Review of contents of relevant Material Safety Data Sheets
- Review of Safe Work Permits

My signature below indicates that I have been given the opportunity to ask questions and that all of my questions have been answered to my satisfaction, and that the dates of my training and medical surveillance indicated below are accurate.

Name (Printed and Signature)	Site-Specific Training Date	40-Hour Training (Date)	8-Hour Refresher Training (Date)	8-Hour Supervisory Training (Date)	Medical Exam

8.3.2 Medical Surveillance Requirements for Subcontractors

Subcontractors are required to obtain a certificate of their ability to perform hazardous waste site work and to wear respiratory protection. The "Subcontractor Medical Approval Form" provided in Figure 8-3 shall be used to satisfy this requirement, providing it is properly completed and signed by a licensed physician.

Subcontractors who have a company medical surveillance program meeting the requirements of paragraph (f) of OSHA 29 CFR 1910.120 can substitute "Subcontractor Medical Approval Form" with a letter, on company letterhead, containing all of the information in the example letter presented in Figure 8-4 of this HASP.

8.3.3 Requirements for All Field Personnel

Each field team member (including subcontractors) and visitors entering the exclusion zone(s) shall be required to complete and submit a copy of Medical Data Sheet presented in Section 7 of the Health and Safety Guidance Manual. This shall be provided to the SSO, prior to participating in site activities. The purpose of this document is to provide site personnel and emergency responders with additional information that may be necessary in order to administer medical attention.

8.4 SUBCONTRACTOR EXCEPTIONS

Subcontractors who will not enter the exclusion zone during intrusive operations, and whose activities involve no potential for exposure to site contaminants, will not be required to meet the requirements for training/medical surveillance other than those stated for site-specific training (see Section 8.2).

FIGURE 8-3
SUBCONTRACTOR MEDICAL APPROVAL FORM

For employees of _____
Company Name

Participant Name: _____ Date of Exam: _____

Part A

The above-named individual has:

1. Undergone a physical examination in accordance with OSHA Standard 29 CFR 1910.120. paragraph (f), and was found to be medically -

   ( ) qualified to perform work at the NSWC work site
   ( ) not qualified to perform work at the NSWC work site

and,

2. Undergone a physical examination in accordance with OSHA 29 CFR 1910.134(b)(10) and was found to be medically -

   ( ) qualified to wear respiratory protection
   ( ) not qualified to wear respiratory protection

My evaluation has been based on the following information, as provided to me by the employer.

( ) A copy of OSHA Standard 29 CFR 1910.120 and appendices.
( ) A description of the employee's duties as they relate to the employee's exposures.
( ) A list of known/suspected contaminants and their concentrations (if known).
( ) A description of any personal protective equipment used or to be used.
( ) Information from previous medical examinations of the employee that is not readily available to the examining physician.

Part B

I, _____, have examined _____
Physician's Name (print) Participant's Name (print)

and have determined the following information:

FIGURE 8-3
SUBCONTRACTOR MEDICAL APPROVAL FORM
PAGE TWO

1. Results of the medical examination and tests (excluding finding or diagnoses unrelated to occupational exposure):

_____
_____
_____

2. Any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health:

_____
_____
_____

3. Recommended limitations upon the employee's assigned work:

_____
_____
_____

I have informed this participant of the results of this medical examination and any medical conditions which require further examination of treatment.

Based on the information provided to me, and in view of the activities and hazard potentials involved at the NSWC work site, this participant

( ) may
( ) may not

perform his/her assigned task.

Physician's Signature _____

Address _____

Phone Number _____

NOTE: Copies of test results are maintained and available at:

_____
Address

FIGURE 8-4

MEDICAL SURVEILLANCE LETTER

The following statements must be typed on company letterhead and signed by an officer of the company:

LOGO
XYZ CORPORATION
555 E. 5th Street
Nowheresville, Kansas 55555

Month, day, year

Ms. Karen Smecker
Task Order Manager
Tetra Tech NUS, Inc.
661 Andersen Drive
Pittsburgh, Pennsylvania 15220

Subject: Medical Surveillance for NSWC, Crane, Indiana

Dear Ms. Smecker:

As an officer of XYZ Corporation, I hereby state that the persons listed below participate in a medical surveillance program meeting the requirements contained in paragraph (f) of Title 29 of the Code of Federal Regulations (CFR), Part 1910.120, entitled "Hazardous Waste Operations and Emergency Response: Final Rule." I further state that the persons listed below have had physical examinations under this program within the past 12 months and that they have been cleared, by a licensed physician, to perform hazardous waste site work and to wear positive- and negative-pressure respiratory protection. I also state that, to my knowledge, no person listed below has any medical restriction that would preclude him/her from working at the NSWC, Crane, Indiana site.

LIST FULL NAMES OF EMPLOYEES AND THEIR SOCIAL SECURITY NUMBERS HERE.

Should you have any questions, please contact me at (555) 555-5555.

Sincerely,

(Name and Title of Company Officer)

9.0 SPILL CONTAINMENT PROGRAM

9.1 SCOPE AND APPLICATION

It is anticipated that quantities of bulk potentially hazardous materials (greater than 55-gallons) may be handled during some of the site activities conducted as part of the scope of work (specifically Investigative-Derived Wastes [IDW]). It is not anticipated, however, that spillage of these materials would constitute a significant danger to human health or the environment. Further, it is possible that as the job progresses disposable PPE and other non-reusable items may be generated. As needed, 55 -gallon drums will be used to contain waste waters, IDW, and other unwanted items generated during investigatory activities. These drums will be labeled with the site name and address, the type of contents, and the date the container was filled as well as an identified contact person. Samples will be collected and analyzed to characterize the material and determine appropriate disposal measures. Once characterized they can be removed from the staging area and disposed of in accordance with Federal, State, and local regulations. Table 5-1 contains detailed information about handling IDW at NSWC.

9.2 POTENTIAL SPILL AREAS

Potential spill areas will be monitored in an ongoing attempt to prevent and control further potential contamination of the environment. Currently, there are various areas vulnerable to this hazard including the areas used for central staging and decontamination activities. Additionally, areas designated for handling, loading, and unloading of potentially contaminated soils, waters, and debris present limited potential for leaks or spills. It is anticipated that all IDW generated as a result of this scope of work will be containerized, labeled, and staged to await chemical analyses. The results of these analyses will determine appropriate disposal methods.

9.2.1 Site Drums/Containers

All drums/containers used for containing soils and liquids will be sealed, labeled, and staged within a centralized area awaiting shipment or disposal.

9.3 LEAK AND SPILL DETECTION

To establish an early detection of potential spills or leaks, periodic inspections by the SSO will be conducted during working hours to visually determine that containers are not leaking. If a leak is detected,

the first approach will be to transfer the container contents using a hand pump into a new container. Other provisions for the transfer of container contents will be made and appropriate emergency contacts will be notified, if necessary. In most instances, leaks will be collected and contained using absorbents such as Oil-dry, vermiculite, or sand, which will be stored at the staging area in a conspicuously marked drum. This material too, will be containerized for disposal pending analyses. All inspections will be documented in the Project Logbook.

9.4 PERSONNEL TRAINING AND SPILL PREVENTION

All personnel will be instructed on the procedures for spill prevention, containment, and collection of hazardous materials in the site-specific training. The FOL and/or the SSO will serve as the Spill Response Coordinator for this operation should the need arise.

9.5 SPILL PREVENTION AND CONTAINMENT EQUIPMENT

The following represents the types of equipment that may be maintained at the staging area for the purpose of supporting this Spill Prevention/Containment Program.

- Sand, clean fill, vermiculite, or other noncombustible absorbent (oil-dry);
- Drums (55-gallon U.S. DOT 17-E or 17-H)
- Shovels, rakes, and brooms
- Labels

9.6 SPILL CONTROL PLAN

This section describes the procedures the TtNUS field crewmembers will employ upon the detection of a spill or leak.

1) Notify the SSO or FOL immediately.

2) Employ the personnel protective equipment stored at the staging area. Take immediate actions to stop the leak or spill by plugging or patching the drum or raising the leak to the highest point. Spread the absorbent material in the area of the spill covering completely.

3) Transfer the material to a new container, collect and containerize the absorbent material. Label the new container appropriately. Await analyses for treatment or disposal options.

4) All spills will be recontainerized with 2-inches of top cover, and await test results for treatment or disposal options.

It is not anticipated that a spill will occur in which the field crews cannot handle. Should this occur; however, notification of appropriate emergency response agencies will be carried out by the FOL or SSO.

10.0 SITE CONTROL

This section outlines the means by which TtNUS will delineate work zones and use these work zones in conjunction with decontamination procedures to prevent the spread of contaminants into previously unaffected areas of the site. It is anticipated that a three-zone approach will be used during work at this site. This three zone approach will utilize an exclusion zone, a contamination reduction zone, and a support zone. It is also anticipated that this control measure will be used to control access to site work areas. Use of such controls will restrict the general public, minimize the potential for the spread of contaminants, and protect individuals who are not cleared to enter work areas.

10.1 EXCLUSION ZONE

The exclusion zone will be considered those areas of the site of known or suspected contamination. It is not anticipated that significant amounts of surface contamination are present in the proposed work areas of this site. It is anticipated that this will remain so until/unless contaminants are brought to the surface by intrusive activities, such as soil boring or sampling operations. Furthermore, once intrusive activities have been completed and surface contamination has been removed, the potential for exposure is again diminished and the area can then be reclassified as part of the contamination reduction zone. Therefore, the exclusion zones for this project will be limited to those areas of the site where active work is being performed plus a designated area surrounding the point of operation (see Table 5-1 for specific operation). When possible, exclusion zones will be delineated using barrier tape, cones and/or drive poles, and postings to inform site personnel.

10.1.1 <u>Exclusion Zone Clearance</u>

Prior to the initiation of site activities, utility locations will be identified by utility companies contacted through the NSWC Base Contact – Thomas Brent at (812) 854-6160. Additional utility surveys may be conducted by TtNUS through the use of available documentation provided by NSWC and/or local utility companies. The positions of identified utilities will be field located and staked to minimize the potential for damage during intrusive activities. Sample locations can be located to avoid buried utilities. In the event that a utility is struck during a subsurface investigative activity, the emergency numbers provided in Table 2-1 will be notified.

Access to work areas will be controlled by TtNUS personnel. No personnel will be permitted to enter site exclusion zones without site-specific training. Site visitors will be provided site-specific training and will be escorted by TtNUS personnel at all times (see section 10.4).

10.2 CONTAMINATION REDUCTION ZONE

The contamination reduction zone (CRZ) will be a buffer area between the exclusion zone and any area of the site where contamination is not suspected. The personnel and equipment decontamination will not take place in this area, but will take place at a central location established for this project. This area instead will serve as a focal point in supporting exclusion zone activities. When applicable, this area will be delineated using barrier tape, cones and/or drive poles, and postings to inform and direct facility personnel.

10.3 SUPPORT ZONE

The support zone for this project will include a staging area where site vehicles will be parked, equipment will be unloaded, and where food and drink containers will be maintained. In all cases, the support zones will be established at areas of the site where exposure to site contaminants would not be expected during normal working conditions or foreseeable emergencies.

10.4 SITE VISITORS

Site visitors for the purpose of this document are identified as representing the following groups of individuals:

- Personnel invited to observe or participate in operations by TtNUS
- Regulatory personnel (EPA, OSHA, etc.)
- NSWC personnel
- Other authorized visitors

All personnel working on this project are required to gain initial access to the site by coordinating with the TtNUS FOL or designee and following established site access procedures.

Upon gaining access to the site, all site visitors wishing to observe operations in progress will be escorted by a TtNUS representative (arranged for by the FOL) and shall be required to meet the minimum requirements discussed below:

- All site visitors will be routed to the FOL, who will sign them into the field logbook. Information to be recorded in the logbook will include the individual's name (proper identification required), the entity which they represent, and the purpose of the visit.

- All site visitors will be required to produce the necessary information supporting clearance to the site. This shall include information attesting to applicable training (40-hours of HAZWOPER training) and medical surveillance as stipulated in Section 8.0 of this document. In addition, to enter the site operational zones during planned activities, all visitors will be required to first go through site-specific training covering the topics stipulated in Section 8.2 of this HASP.

Once the site visitors have completed the above items, they will be permitted to enter the operational zone. All visitors are required to observe the protective equipment and site restrictions in effect at the site at the time of their visit. Any and all visitors not meeting the requirements stipulated in this plan will not be permitted to enter the site operational zones during planned activities. Any incidence of unauthorized site visitation will cause the termination of all onsite activities until the unauthorized visitor is removed from the premises. Removal of unauthorized visitors will be accomplished with support from the FOL, SSO or on-site security personnel.

10.5 SITE SECURITY

Site security will be accomplished using existing base security resources and procedures, supplemented by TtNUS or subcontractor personnel, if necessary. TtNUS will retain control over active operational areas. The first line of security will take place at the base boundaries restricting the general public. The second line of security will take place at the work site referring interested parties to the FOL. The FOL will serve as a focal point for site personnel, and will serve and the final line of security and the primary enforcement contact.

10.6 SITE MAPS

Once the areas of contamination, access routes, utilities, topography, and dispersion routes are determined, a site map will be generated and adjusted as site conditions change. These maps will show utility locations, potential points of contact with the public, roadways, and other significant characteristics that may impact site operations and safety. Site maps will be posted to illustrate up-to-date collection of contaminants and adjustment of zones and access points.

10.7 BUDDY SYSTEM

Personnel engaged in onsite activities will practice the "buddy system" to ensure the safety during this operation.

10.8 MATERIAL SAFETY DATA SHEET (MSDS) REQUIREMENTS

TtNUS and subcontractor personnel will provide MSDSs for all chemicals brought on site. The contents of these documents will be reviewed by the SSO with the user(s) of the chemical substances prior to any actual use or application of the substances on site. A chemical inventory of all chemicals used on site will be developed using Section 5.0 of the Health and Safety Guidance Manual. The MSDSs will then be maintained in a central location and will be available for anyone to review upon request.

10.9 COMMUNICATION

TtNUS personnel will be working in close proximity to each other at NSWC. As a result and since two way radio communication will not be available, hand signals, voice commands, and line of site will provide sufficient means of communication. When project tasks are performed simultaneously on different sites, vehicle horns will be used to communicate emergency situations per Section 2.6 of this HASP.

External communication will be accomplished by using provided telephones at the site. External communication will primarily be used for the purpose of resource and emergency resource communications.

10.10 SAFE WORK PERMITS

All exclusion zone work conducted in support of this project will be performed using Safe Work Permits to guide and direct field crews on a task by task basis. An example of the Safe Work Permit to be used is illustrated in Figure 10-1. Partially completed Permits for exclusion zone tasks are included as Attachment IV of this HASP. These work permits will be further supported by the daily meetings conducted during their generation. This effort will ensure all site-specific considerations and changing conditions are incorporated into the planning effort.

Use of these permits will provide the communication line for reviewing protective measures and hazards associated with each operation. This HASP will be used as the primary reference for selecting levels of protection and control measures. The work permit will take precedence over the HASP when more conservative measures are required based on specific site conditions.

The FOL and/or the SSO will be responsible for completing the safe work permit and issuing them to the appropriate parties. Site personnel at the end of each days activity will turn in the permit(s) used for that day to the SSO. All permits will be maintained as part of the permanent project files attesting to safety and health measures employed for a given task at a given time and place. Any problems encountered with the protective measures required should be documented on the permit and brought to the attention of the SSO.

FIGURE 10-1
SAFE WORK PERMIT

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope (To be filled in by person performing work)

I. Work limited to the following (description, area, equipment used): _____

_____

_____

II. Names: _____

_____

III. Onsite Inspection conducted Yes No Initials of Inspector _____ _____
TtNUS

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. Protective equipment required

Level D	Level B
Level C	Level A
Detailed on Reverse	

Respiratory equipment required

Full face APR	Escape Pack
Half face APR	SCBA
SKA-PAC SAR	Bottle Trailer
Skid Rig	None

Modifications/Exceptions: _____

_____

V.

Chemicals of Concern	Action Level(s)	Response Measures
_____	_____	_____
_____	_____	_____

VI. Additional Safety Equipment/Procedures

Hardhat	Yes	No	Hearing Protection	Yes	No
Safety Glasses	Yes	No	Safety belt/harness	Yes	No
Chemical/splash goggles	Yes	No	Radio	Yes	No
Splash Shield	Yes	No	Barricades	Yes	No
Splash suits/coveralls	Yes	No	Gloves (Type)	Yes	No
Steel toe/shank	Yes	No	Work/rest regimen	Yes	No
Workboots	Yes	No			

Modifications/Exceptions: _____

VII.

Procedure review with permit acceptors	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)			Emergency alarms		
Procedure for safe job completion			Evacuation routes		
Contractor tools/equipment inspected			Assembly points		

VIII. Equipment Preparation

	Yes	NA
Equipment drained/depressured		
Equipment purged/cleaned		
Isolation checklist completed		
Electrical lockout required/field switch tested		
Blinds/misalignments/blocks & bleeds in place		
Hazardous materials on walls/behind liners considered		

IX. Additional Permits required (Hot work, confined space entry, excavation etc.) Yes No

If yes, contact Health Science, Pittsburgh, PA Office

X. Special instructions, precautions: _____

_____

Permit Issued by: _____ Permit Accepted by: _____

Job Completed by: _____ Date: _____

11.0 CONFINED SPACE ENTRY

It is not anticipated, under the proposed scope of work, that confined space and permit-required confined space activities will be conducted. **Therefore, personnel under the provisions of this HASP are not allowed, under any circumstances, to enter confined spaces.** A confined space is defined as an area which has one or more of the following characteristics:

- Is large enough and so configured that an employee can bodily enter and perform assigned work.
- Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry).
- Is not designed for continuous employee occupancy.

A Permit-Required Confined Space is one that:

- Contains or has a potential to contain a hazardous atmosphere.
- Contains a material that has the potential to engulf an entrant.
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section.
- Contains any other recognized, serious, safety or health hazard.

For further information on confined space, consult the Health and Safety Guidance Manual or call the PHSO. If confined space operations are to be performed as part of the scope of work, detailed procedures and training requirements will have to be addressed.

12.0 MATERIALS AND DOCUMENTATION

when required.

- A complete copy of this HASP
- Health and Safety Guidance Manual
- Incident Reports
- Medical Data Sheets
- MSDSs for all chemicals brought onsite, including decon solutions, fuels, lime, sample preservatives, calibration gases, etc.
- A full-size OSHA Job Safety and Health Poster (posted in the site trailers)
- Training/Medical Surveillance Documentation Form (Blank)
- Emergency Reference Information (Section 2.0, extra copy for posting)

12.1 MATERIALS TO BE POSTED OR MAINTAINED AT THE SITE

The following documentation is to be posted or maintained at the site for quick reference purposes. In situations in which posting these documents is not feasible (such as no office trailer), these documents should be separated and immediately accessible.

Chemical Inventory Listing (posted) - This list represents all chemicals brought onsite, including decontamination solutions, sample preservations, fuel, etc. This list should be posted in a central area.

Material Safety Data Sheets (MSDSs) (maintained) - The MSDSs should also be in a central area accessible to all site personnel. These documents should match all the listings on the chemical inventory list for all substances used onsite. It is acceptable to have these documents within a central folder and the chemical inventory as the table of contents.

The OSHA Job Safety & Health Protection Poster (posted) - This poster, as directed by 29 CFR 1903.2 (a)(1), should be conspicuously posted in places where notices to employees are normally posted. Each FOL shall ensure that this poster is not defaced, altered, or covered by other material.

Site Clearance (maintained) - This list is found within the training section of the HASP (See Figure 8-2). This list identifies all site personnel, dates of training (including site-specific training), and medical surveillance. The lists indicates not only clearance but also status. If personnel do not meet these requirements, they do not enter the site while site personnel are engaged in activities.

Emergency Phone Numbers and Directions to the Hospital(s) (posted) - This list of numbers and directions will be maintained at all phone communications points and in each site vehicle.

Medical Data Sheets/Cards (maintained) - Medical Data Sheets will be completed by onsite personnel and filed in a central location. The Medical Data Sheet will accompany any injury or illness requiring medical attention to the medical facility. A copy of this sheet or a wallet card will be given to all personnel to carry at all times.

Hearing Conservation Standard (29 CFR 1910.95) (posted) - This standard will be posted any time hearing protection or other noise abatement procedures are used.

Personnel Monitoring (maintained) - All results generated through personnel sampling (levels of airborne toxins, noise levels, etc.) will be posted to inform individuals of the results of that effort.

Placards and Labels (maintained) - Where chemical inventories have been separated because of quantities and incompatibilities, these areas will be conspicuously marked using Department of Transportation (DOT) placards and acceptable (Hazard Communication 29 CFR 1910.1200(f)) labels.

The purpose, as stated above, is to allow site personnel quick access to this information. Variations concerning location and methods of presentation are acceptable as long as the objection is accomplished.

13.0 GLOSSARY

ACGIH	American Conference of Governmental Industrial Hygienists
APR	Air Purifying Respirators
AOC	Area of Concern
CFR	Code of Federal Regulations
CNS	Central Nervous System
CRZ	Contamination Reduction Zone
DOD	Department of Defense
DOT	Department of Transportation
EPA	Environmental Protection Agency
eV	electron Volts
FID	Flame Ionization Detector
FOL	Field Operations Leader
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	High Efficiency Particulate Air
LEL/O_2	Lower Explosive Limit/Oxygen
N/A	Not Available
NIOSH	National Institute Occupational Safety and Health
OSHA	Occupational Safety and Health Administration (U.S. Department of Labor)
PEL	Permissible Exposure Limit
PHSO	Project Health and Safety Officer
PID	Photo Ionization Detector
PPE	Personal Protective Equipment
PVC	Poly Vinyl Chloride
SAP	Sampling and Analysis Plan
SCBA	Self Contained Breathing Apparatus
SSO	Site Safety Officer
STEL	Short Term Exposure Limit
TOM	Task Order Manager
TPH	Total Petroleum Hydrocarbons
TWA	Time Weighted Average
UV	Ultraviolet
WP	Work Plan

ATTACHMENT I

INJURY/ILLNESS PROCEDURE AND REPORT FORM

CASE NO. _____

TETRA TECH NUS, INC.

INJURY/ILLNESS PROCEDURE
WORKER'S COMPENSATION PROGRAM

WHAT YOU SHOULD DO IF YOU ARE INJURED OR DEVELOP AN ILLNESS AS A RESULT OF YOUR EMPLOYMENT:

- If injury is minor, obtain appropriate first aid treatment.
- If injury or illness is severe or life threatening, obtain professional medical treatment at the nearest hospital emergency room.
- If incident involves a chemical exposure on a project work site, follow instructions in the Health & Safety Plan.
- Immediately report any injury or illness to your supervisor or office manager. In addition, you must contact your Human Resources representative, Marilyn Diethorn at (412) 921-8475, and the Corporate Health and Safety Manager, Matt Soltis at (412) 921-8912 within 24 hours. You will be required to complete an Injury/Illness Report (attached). You may also be required to participate in a more detailed investigation from the Health Sciences Department.
- If further medical treatment is needed, The Hartford Network Referral Unit will furnish a list of network providers customized to the location of the injured employee. These providers are to be used for treatment of Worker's Compensation injuries subject to the laws of the state in which you work. Please call Marilyn Diethorn at (412) 921-8475 for the number of the Referral Unit.

ADDITIONAL QUESTIONS REGARDING WORKER'S COMPENSATION:

Contact your local human resources representative, corporate health and safety coordinator, or Corporate Administration in Pasadena, California, at (626) 351-4664.

Worker's compensation is a state-mandated program that provides medical and disability benefits to employees who become disabled due to job related injury or illness. Tetra Tech, Inc. and its subsidiaries (Tetra Tech or Company) pay premiums on behalf of their employees. The type of injuries or illnesses covered and the amount of benefits paid are regulated by the state worker's compensation boards and vary from state to state. Corporate Administration in Pasadena is responsible for administering the Company's worker's compensation program. The following is a general explanation of worker's compensation provided in the event that you become injured or develop an illness as a result of your employment with Tetra Tech or any of its subsidiaries. Please be aware that the term used for worker's compensation varies from state to state.

WHO IS COVERED:

All employees of Tetra Tech, whether they are on a full-time, part-time or temporary status, working in an office or in the field, are entitled to worker's compensation benefits. All employees must follow the above injury/illness reporting procedures. Consultants, independent contractors, and employees of subcontractors are <u>not</u> covered by Tetra Tech's Worker's Compensation plan.

CASE NO. _____

WHAT IS COVERED:

If you are injured or develop an illness caused by your employment, worker's compensation benefits are available to you subject to the laws of the state you work in. Injuries do not have to be serious; even injuries treated by first aid practices are covered and must be reported. Please note that if you are working out-of-state and away from your home office, you are still eligible for worker's compensation benefits.

CASE NO. _____

TETRA TECH NUS, INC.
INJURY/ILLNESS PROCEDURE
WORKER'S COMPENSATION PROGRAM

To: Corporate Health and Safety Manager
Human Resource Administrator

Prepared by: _____

Position: _____

Project Name: _____

Office: _____

Project No. _____

Telephone: _____

Information Regarding Injured or Ill Employee:

Name: _____

Office: _____

Home address: _____

Gender: M ☐ F ☐ No. of dependents: _____

_____

Marital status: _____

Home telephone: _____

Date of birth: _____

Occupation (regular job title): _____

Social Security No.: _____

Department: _____

Date of Accident: _____ **Time of Accident:** _____

Location of Accident Was place of accident or exposure on employer's premises Yes ☐ No ☐

Street address: _____

City, state, and zip code: _____

County: _____

Narrative Description of How Accident Occurred: (Be specific. Explain what the employee was doing and how the accident occurred.)

TETRA TECH, INC.
INJURY/ILLNESS REPORT

Did employee die? Yes ☐ No ☐
Was employee performing regular job duties? Yes ☐ No ☐
Was safety equipment provided? Yes ☐ No ☐
Was safety equipment used? Yes ☐ No ☐
Note: Attach any police reports or related diagrams to this accident report.

Witness(es):

Name:

Address:

Telephone:

Describe the Illness or Injury and Part of Body Affected:

Name the Object or Substance which Directly Injured the Employee:

Medical Treatment Required:

☐ No ☐ Yes ☐ First Aid Only

Physician's Name: _____

Address: _____

Hospital or Office Name: _____

Address: _____

_____

Telephone No.: _____

Lost Work Days:

☐ No. of Lost Work Days _____

Last Date Worked _____

Time Employee Left Work _____

Date Employee Returned to Work _____

☐ No. of Restricted Work Days _____

☐ None

Corrective Action(s) Taken by Unit Reporting the Accident:

Corrective Action Still to be Taken (by whom and when):

Name of Tetra Tech employee the injury or illness was first reported to: _____

Date of Report: _____ Time of Report: _____

	Printed Name	Signature	Telephone No.	Date
Project or Office Manager				
Site Safety Coordinator				
Injured Employee				

To be completed by Human Resources:

Date of hire: Hire date in current job:

Wage information: $ _____ per _____ (hour, day, week, or month)

Position at time of hire:

Shift hours:

State in which employee was hired:

Status: ☐ Full-time ☐ Part-time Hours per week: _____ Days per week: _____

Temporary job end date:

To be completed during report to workers' compensation insurance carrier:

Date reported: Reported by:

TeleClaim phone number:

TeleClaim account number:

Location code:

Confirmation number:

Name of contact:

Field office of claims adjuster:

ATTACHMENT II

TICK CONTROL
AND
LYME DISEASE

TICK CONTROL
AND
LYME DISEASE

The occurrence of Lyme disease has become a worldwide problem since its identification in 1976. This disease is characteristically recognized as being transmitted by ticks, which may be encountered by field personnel while working at this site. As a result, this discussion has been included with this Health and Safety Plan to provide for adequate recognition, evaluation, and control efforts to minimize the occurrence and effects of this potential hazard.

The discovery of Lyme disease is credited to Dr. Allen Steere of Yale University Medical School, and is named after the community where it was (reportedly) first encountered, Lyme, Connecticut. This disease can be transmitted to man through the bite of ticks that are infected with a cork screw-shaped microbe (spirochete). The spread of this disease has been so rapid that in 1984 it surpassed Rocky Mountain Spotted fever as the most common tick-borne disease in the United States. In this country, most of the incidents of this disease have been recorded in the Northeast, and the tick species most commonly attributed with its spread is the deer tick.

Recognition

This hazard potential exists primarily in the spring and summer months, as these are the seasons that tick populations and activity flourish. In fact, 90 percent of the reported cases have occurred from early June through September. Also, this concern exists primarily in heavily vegetated areas. Therefore, recognition of these factors can aid in the awareness and control of this threat.

To aid in the recognition and identification of these insects, an example illustration of the tick species common to the region where this site is located has been included with this discussion. This species (the American Dog tick) is common in the eastern half of the United States, and typically exists in areas covered with grass or underbrush. These insects will attach themselves to animals (including man) that pass through the area and rub against them. After finding a host, the tick inserts its mouthparts and sucks blood until it is fully engorged. This requires a time period of three to twelve days, then the tick will drop off. In addition to Lyme disease concerns, this tick has also been identified as a transmitter of Rocky Mountain Spotted Fever, and the organisms of tularemia and possibly relapsing fever. The wounds left by tick bites can be painful, and can also have a paralyzing effect commonly referred to as tick paralysis.

The earliest symptom of the onset of this disease is the occurrence of an unusual red skin rash. This is commonly the first indication since it has been evidenced that many persons who have contracted this disease were, in fact, unaware that they had been bitten. This rash can appear at the site of the bite anywhere from several days to a few weeks after the bite. It typically starts as a small red spot, and then expands as the spirochetes expand from the bite location. Rash sizes can vary, but have been most commonly associated in a 2 to 3 inch diameter size range. This rash will fade (with or without treatment) after a few weeks. Close inspection is necessary to detect this symptom as the rashes are easy to miss because they're often very faint. Body sites where rashes frequently occur include the thigh areas, groin, and armpits. Also, it is not uncommon for a rash to develop in more than one place.

Other early symptoms include profound fatigue, a stiff neck, and flu-like symptoms such as headache, chills, fever, and muscle aches. Recognition of the onset of any of these symptoms is important since tick bites do not always produce a rash. If left untreated, the disease will progress to its second stage within weeks or months after the infection. This stage involves affects to the heart and nervous system. A common second stage symptom is a paralysis on one or both sides of the face. Others include severe headache, encephalitis, or meningitis. The third and final stage involves the development of chronic inflammatory arthritis, which can occur up to a year or more after the bite.

Evaluation

Evaluation of this hazard potential principally involves field personnel performing close self-inspections for the presence of ticks each time they leave the site. This should involve careful examination, especially of the individuals' heads. Personnel should be aware that when a tick attaches itself to its host, it inserts its entire head under the surface of the skin.

Control

Control of this threat involves several components. First, field personnel must be aware of the climate and area conditions which are commonly associated with being conducive to tick infestation. Second, when working in or walking through potential infested areas, personnel must ensure that they do not have exposed body parts (i.e. at least long sleeved shirts and long pants, particularly when protective coveralls are not worn). In heavily vegetated areas where infestation is likely, Tyvek coveralls will be required to minimize this hazard potential. Also, several commercial products have been demonstrated as being effective in repelling ticks. Examples include Permanone, Off!, and Cutter. These types of repellents will be used at the direction and discretion of the Tetra Tech NUS Health and Safety Officer, and only in accordance and observation of manufacturer's recommendations. In most instances, however, such repellents are typically applied to the outside surfaces of clothing (and not directly onto the skin), and should be applied also to shoe tops, socks, pants cuffs, and other areas most susceptible to ticks.

Tick Removal

In the event that a tick is discovered to be attached to a member of the field team, timely removal of the insect is critical to reducing the potential for contracting the disease. According to available information and research, there is apparently a grace period of at least a few hours from the time of the bite before the tick transmits the microbe (the spirochetes are not present in the mouth parts of the tick). However, the incident of a tick bite is frequently unnoticed, and the discovery of the tick may not occur until after this suspected grace period has already elapsed. Therefore, timely removal is very important. The preferred method of tick removal is to pull it out using tweezers or small forceps. In this method, the tick should be grasped as close to the mouth as possible, and then pulled steadily upward. Care must be exercised so as not to pull in a jerking motion as this can result in the head becoming detached. After the tick has been removed, disinfect the bite with rubbing alcohol or povidone iodine (Betadine). The tick must not be handled as the microbes can enter the body through any breaks in intact skin. The bite should be checked occasionally for at least a two-week period to see if a rash forms. If it does, medical attention must be promptly sought.

In order to provide for proper and timely response to the occurrence of a tick bite, the SSO will ensure that the site First Aid kit is properly equipped with medical forceps and rubbing alcohol, in addition to the standard kit contents. Also, an adequate supply of commercial insect (tick) repellents will be maintained on-site, and all personnel will be trained in its proper application and will be required to use it, at the direction of FOL.

ATTACHMENT III

EQUIPMENT INSPECTION CHECKLIST

EQUIPMENT INSPECTION

COMPANY:_____ **UNIT NO.**_____

FREQUENCY: Inspect daily, document prior to use and as repairs are needed.

Inspection Date: ____/____/____ Time: _____ Equipment Type:_____
(e.g., bulldozer)

	Good	Need Repair	N/A
Tires or tracks	❒	❒	❒
Hoses and belts	❒	❒	❒
Cab, mirrors, safety glass	❒	❒	❒
- Turn signals, lights, brake lights, etc. (front/rear) for equipment approved for highway use?	❒	❒	❒
- Is the equipment equipped with audible back-up alarms and back-up lights?	❒	❒	❒
Horn and gauges	❒	❒	❒
Brake condition (dynamic, park, etc.)	❒	❒	❒
Fire extinguisher (Type/Rating -_____)	❒	❒	❒
Fluid Levels:			
- Engine oil	❒	❒	❒
- Transmission fluid	❒	❒	❒
- Brake fluid	❒	❒	❒
- Cooling system fluid	❒	❒	❒
- Windshield wipers	❒	❒	❒
- Hydraulic oil	❒	❒	❒
Oil leak/lube	❒	❒	❒
Coupling devices and connectors	❒	❒	❒
Exhaust system	❒	❒	❒
Blade/boom/ripper condition	❒	❒	❒
Accessways: Frame, hand holds, ladders, walkways (non-slip surfaces), guardrails?	❒	❒	❒
Power cable and/or hoist cable	❒	❒	❒
Steering (standard and emergency)	❒	❒	❒

Safety Guards:

	Yes	No
– Around rotating apparatus (belts, pulleys, sprockets, spindles, drums, flywheels, chains) all points of operations protected from accidental contact?_____	❒	❒
– Hot pipes and surfaces exposed to accidental contact?_____	❒	❒
– All emergency shut offs have been identified and communicated to the field crew?_____	❒	❒
– Have emergency shutoffs been field tested? _____	❒	❒
– Results?_____	❒	❒
– Are any structural members bent, rusted, or otherwise show signs of damage?_____	❒	❒
– Are fueling cans used with this equipment approved type safety cans?_____	❒	❒

- Have the attachments designed for use (as per manufacturer's recommendation) with this equipment been inspected and are considered suitable for use?_____ ❒ ❒

Portable Power Tools:

- Tools and Equipment in Safe Condition?_____ ❒ ❒
- Saw blades, grinding wheels free from recognizable defects (grinding wheels have been sounded)? ❒ ❒
- Portable electric tools properly grounded?_____ ❒ ❒
- Damage to electrical power cords?_____ ❒ ❒
- Blade guards in place?_____ ❒ ❒
- Components adjusted as per manufacturers recommendation?_____ ❒ ❒

Cleanliness:

- Overall condition (is the decontamination performed prior to arrival on-site considered acceptable)?_____
- Where was this equipment used prior to its arrival on site?_____
- Site Contaminants of concern at the previous site?_____
- Inside debris (coffee cups, soda cans, tools and equipment) blocking free access to foot controls?_____

Operator Qualifications (as applicable for all heavy equipment):

- Does the operator have proper licensing where applicable, (e.g., CDL)?_____
- Does the operator, understand the equipments operating instructions?_____
- Is the operator experienced with this equipment? _____
- Does the operator have emotional and/or physical limitations which would prevent him/her from performing this task in a safe manner?_____
- Is the operator 21 years of age or more?_____

Identification:

- Is a tagging system available, for positive identification, for tools removed from service?___

Additional Inspection Required Prior to Use On-Site

	Yes	No
- Does equipment emit noise levels above 90 decibels?	❒	❒
- If so, has an 8-hour noise dosimetry test been performed?	❒	❒

- Results of noise dosimetry:_____
- Defects and repairs needed:_____
- General Safety Condition: _____
- Operator or mechanic signature:_____

Approved for Use: ❒ Yes ❒ No

_____
Site Safety Officer Signature

ATTACHMENT IV

SAFE WORK PERMITS

SAFE WORK PERMIT FOR MULTI-MEDIA SAMPLING

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope

I. Work limited to the following (description, area, equipment used): **Multi-media sampling including soil, groundwater, sediment, and surface water.**

II. Required Monitoring Instrument(s): PID (w/10.9 eV lamp) or FID for screening, although many site contaminants may not be detectable.

III. Field Crew: _____

IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector _____ _____
TtNUS

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. Protective equipment required
Level D ☒ Level B ☐
Level C ☐ Level A ☐
Detailed on Reverse

Respiratory equipment required

Full face APR	☐	Escape Pack	☐
Half face APR	☐	SCBA	☐
SKA-PAC SAR	☐	Bottle Trailer	☐
Skid Rig	☐	None	☒

Modifications/Exceptions: Minimum requirements include sleeved shirt and long pants, safety shoes, surgical style gloves, and safety glasses. Hard hats and hearing protection will be worn when working near operating equipment or when required by SSO. Coveralls and snake chaps will be worn near insect/snake areas.

V. Chemicals of Concern	Action Level(s)	Response Measures
Site contaminants include VOCs, SVOCs, metals pesticides, PCBs, & explosives	Any sustained reading above background in worker breathing zones.	Suspend site activities and report to an unaffected area.

VI. Additional Safety Equipment/Procedures

Hard-hat	☐ Yes	☐ No	Hearing Protection (Plugs/Muffs)	☐ Yes	☐ No
Safety Glasses	☐ Yes	☒ No	Safety belt/harness	☒ Yes	☒ No
Chemical/splash goggles	☐ Yes	☒ No	Radio	☐ Yes	☒ No
Splash Shield	☐ Yes	☒ No	Barricades	☐ Yes	☒ No
Splash suits/coveralls	☐ Yes	☒ No	Gloves (Type - Nitrile)	☒ Yes	☐ No
Steel toe Work shoes or boots	☒ Yes	☐ No	Work/rest regimen	☐ Yes	☒ No

Modifications/Exceptions: Reflective vests for high traffic areas. Tyvek coverall if there is a potential for soiling work cloths.

VII. Procedure review with permit acceptors

	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☐	☐	Emergency alarms	☐	☐
Procedure for safe job completion	☐	☐	Evacuation routes	☐	☐
Contractor tools/equipment/PPE inspected	☐	☐	Assembly points	☐	☐

VIII. Equipment Preparation

	Yes	NA
Equipment drained/depressurized	☐	☐
Equipment purged/cleaned	☐	☐
Isolation checklist completed	☐	☐
Electrical lockout required/field switch tested	☐	☐
Blinds/misalignments/blocks & bleeds in place	☐	☐
Hazardous materials on walls/behind liners considered	☐	☐

IX. Additional Permits required (Hot work, confined space entry, excavation etc.). ☐ Yes ☐ No
If yes, complete permit required or contact Health Sciences, Pittsburgh Office

X. Special instructions, precautions: Avoid areas of known or suspected insect/animal nesting or habitat.

Permit Issued by: _____ Permit Accepted by: _____

SAFE WORK PERMIT FOR SOIL BORINGS

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope

I. Work limited to the following (description, area, equipment used): **Soil borings using hollow stem augers and direct push technology. Installation, purging, and development of monitoring wells is included in this task.**

II. Required Monitoring Instruments: FID or PID (w/10.9 ev lamp) although site contaminants may not be be detectable.

III. Field Crew: _____

IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector _____ _____
TtNUS

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. Protective equipment required

Level D ☒ Level B ☐
Level C ☐ Level A ☐
Detailed on Reverse

Respiratory equipment required

Full face APR	☐	Escape Pack	☐
Half face APR	☐	SCBA	☐
SKA-PAC SAR	☐	Bottle Trailer	☐
Skid Rig	☐	None	☒

Modifications/Exceptions: Minimum requirements include sleeved shirt and long pants, safety shoes, safety glasses, hardhat, hearing protection, and nitrile gloves or leather gloves with surgical-style inner gloves.

V.

Chemicals of Concern	Action Level(s)	Response Measures
Potential site contaminants are VOCs, SVOCs, PAHs Pesticides, PCBs, and metals	Any sustained readings above background in worker breathing zones.	Suspend site activities and report to an unaffected area.

VI. Additional Safety Equipment/Procedures

Hard-hat	☒ Yes	☐ No	Hearing Protection (Plugs/Muffs)	☒ Yes	☐ No
Safety Glasses	☒ Yes	☐ No	Safety belt/harness	☐ Yes	☒ No
Chemical/splash goggles	☐ Yes	☒ No	Radio	☐ Yes	☒ No
Splash Shield	☐ Yes	☒ No	Barricades	☐ Yes	☒ No
Splash suits/coveralls	☐ Yes	☐ No	Gloves (Type - Nitrile)	☒ Yes	☐ No
Steel toe Work shoes or boots	☒ Yes	☐ No	Work/rest regimen	☐ Yes	☒ No

Modifications/Exceptions: Reflective vests for high traffic areas. Tyvek coverall and impermeable boots if there is a potential for soiling work clothes.

VII. Procedure review with permit acceptors

	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☐	☐	Emergency alarms	☐	☐
Procedure for safe job completion	☐	☐	Evacuation routes	☐	☐
Contractor tools/equipment/PPE inspected	☐	☐	Assembly points	☐	☐

VIII. Equipment Preparation

	Yes	NA
Equipment drained/depressurized	☐	☐
Equipment purged/cleaned	☐	☐
Isolation checklist completed	☐	☐
Electrical lockout required/field switch tested	☐	☐
Blinds/misalignments/blocks & bleeds in place	☐	☐
Hazardous materials on walls/behind liners considered	☐	☐

IX. Additional Permits required (Hot work, confined space entry, excavation etc.). ☐ Yes ☐ No
If yes, complete permit required or contact Health Sciences, Pittsburgh Office

X. Special instructions, precautions: Avoid areas of known or suspected insect/animal nesting or habitat.

Permit Issued by: _____ Permit Accepted by: _____

SAFE WORK PERMIT FOR SOIL BORING AT MCCOMISH GORGE SWMU - 4 NAVAL SURFACE WARFARE CENTER CRANE, INDIANA

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope

I. Work limited to the following (description, area, equipment used): Direct Push Technology within the disposal area at SWMU 4

II. Required Monitoring Instrument(s): PID (w/10.9 eV lamp) or FID for screening, although many site contaminants may not be detectable.

III. Field Crew: _____

IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector _____ _____
TtNUS

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. Protective equipment required

Level D ☒ Level B ☐
Level C ☐ Level A ☐
Detailed on Reverse

Respiratory equipment required

Full face APR	☐	Escape Pack	☐
Half face APR	☐	SCBA	☐
SAR	☐	Bottle Trailer	☐
Skid Rig	☐	None	☒

Modifications/Exceptions: Minimum requirements include sleeved shirt and long pants, safety shoes, safety glasses, hardhat, hearing protection, and nitrile gloves or leather gloves with surgical-style inner gloves.

V.

Chemicals of Concern	Action Level(s)	Response Measures
Site contaminants include VOCs, SVOCs, metals pesticides, PCBs, & explosives (small arms ammunition)	Any sustained reading above background in worker breathing zones. Any munition or suspicious material	Suspend site activities and report to an unaffected area or move to another location

VI. Additional Safety Equipment/Procedures

Hard-hat with full face shield.	☐ Yes	☐ No	Hearing Protection (Plugs/Muffs)	☒ Yes	☐ No
Safety Glasses	☒ Yes	☐ No	Safety belt/harness	☐ Yes	☒ No
Chemical/splash goggles.....	☐ Yes	☒ No	Radio	☐ Yes	☒ No
Splash Shield.....	☐ Yes	☒ No	Barricades	☒ Yes	☐ No
Splash suits/coveralls	☐ Yes	☐ No	Gloves (Type – Nitrile/Leather)	☒ Yes	☐ No
Steel toe Work shoes or boots	☒Yes	☐ No	Work/rest regimen	☐ Yes	☒ No

Modifications/Exceptions: Reflective vests for high traffic areas. Full face shield and leather gloves for worker initially opening the DPT sample tube and anyone in that immediate area.

VII. Procedure review with permit acceptors

	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☐	☒	Emergency alarms	☒	☐
Procedure for safe job completion	☒	☐	Evacuation routes	☒	☐
Contractor tools/equipment/PPE inspected	☒	☐	Assembly points	☒	☐

VIII. Equipment Preparation

	Yes	NA
Utility Locating and Excavation Clearance completed.....	☒	☐
Vehicle and Foot Traffic Routes Cleared and Established	☒	☐
Physical Hazards Barricaded and Isolated.....	☒	☐
Emergency Equipment Staged.....	☒	☐

IX. Additional Permits required (Hot work, confined space entry, excavation etc.). ..... ☒ Yes ☐ No
If yes, complete permit required or contact Health Sciences, Pittsburgh Office

X. Special instructions, precautions: The risk is from small arms propellant burn if the DPT passes through one of the munitions and is contaminated. When the sample tube is opened, the propellant may ignite. If any type of munition is observed stop all operations, evacuate the area and notify the PM.

Permit Issued by: _____ Permit Accepted by: _____

SAFE WORK PERMIT FOR SOIL BORING AT MCCOMISH GORGE SWMU - 4 NAVAL SURFACE WARFARE CENTER CRANE, INDIANA

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope

I. Work limited to the following (description, area, equipment used): Hollow Stem Augering within the disposal area at SWMU 4

II. Required Monitoring Instrument(s): PID (w/10.9 eV lamp) or FID for screening, although many site contaminants may not be detectable.

III. Field Crew: _____

IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector _____ _____
TtNUS

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. Protective equipment required

Level D ☒ Level B ☐
Level C ☐ Level A ☐
Detailed on Reverse

Respiratory equipment required

Full face APR	☐	Escape Pack	☐
Half face APR	☐	SCBA	☐
SAR	☐	Bottle Trailer	☐
Skid Rig	☐	None	☒

Modifications/Exceptions: Minimum requirements include Nomex coveralls, safety shoes, leather gloves, and safety glasses. Hard hats and hearing protection will be worn when working near operating equipment or when required by SSO. Nomex coveralls and full face shield a requirement.

V. Chemicals of Concern	Action Level(s)	Response Measures
Site contaminants include VOCs, SVOCs, metals pesticides, PCBs, & explosives (small arms ammunition)	Any sustained reading above background in worker breathing zones. Any munition or suspicious material	Suspend site activities and report to an unaffected area or move to another location

VI. Additional Safety Equipment/Procedures

Hard-hat with full face shield.	☒ Yes	☐ No	Hearing Protection (Plugs/Muffs)	☒ Yes	☐ No
Safety Glasses	☒ Yes	☐ No	Safety belt/harness	☐ Yes	☒ No
Chemical/splash goggles	☐ Yes	☒ No	Radio	☐ Yes	☒ No
Splash Shield	☐ Yes	☒ No	Barricades	☒ Yes	☐ No
Nomex coveralls	☒ Yes	☐ No	Gloves (Type – Nitrile/Leather)	☒ Yes	☐ No
Steel toe Work shoes or boots	☒ Yes	☐ No	Work/rest regimen	☐ Yes	☒ No

Modifications/Exceptions: Reflective vests for high traffic areas. Full face shield and Nomex coverall for any one in the immediate drilling area this includes the drillers and observer

VII. Procedure review with permit acceptors

	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☐	☒	Emergency alarms	☒	☐
Procedure for safe job completion	☒	☐	Evacuation routes	☒	☐
Contractor tools/equipment/PPE inspected	☒	☐	Assembly points	☒	☐

VIII. Equipment Preparation

	Yes	NA
Utility Locating and Excavation Clearance completed	☒	☐
Vehicle and Foot Traffic Routes Cleared and Established	☒	☐
Physical Hazards Barricaded and Isolated	☒	☐
Emergency Equipment Staged	☒	☐

IX. Additional Permits required (Hot work, confined space entry, excavation etc.). ☒ Yes ☐ No
If yes, complete permit required or contact Health Sciences, Pittsburgh Office

X. Special instructions, precautions: The risk is from small arms propellant burn if one of the munitions were broken open and the propellant ignited. The following procedure will be followed: 1) One person to observe cuttings from boring. 2) Advance boring slowly, lifting the auger to discharge cuttings onto the surface at the top of the hole. 3) If small arms ammo is observed,move to a new location. 4) If any other type of munition is observed stop all operations, evacuate the area and notify the PM.

Permit Issued by: _____ Permit Accepted by: _____

SAFE WORK PERMIT FOR MULTI-MEDIA SAMPLING
ROCKEYE AREA SWMU -10
NAVAL SURFACE WARFARE CENTER CRANE, INDIANA

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope

I. Work limited to the following (description, area, equipment used): Multi-media sampling

II. Required Monitoring Instrument(s): PID (w/10.9 eV lamp) or FID for screening, although many site contaminants may not be detectable.

III. Field Crew: _____

IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector _____ _____
TtNUS

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. Protective equipment required

Level D ☒ Level B ☐
Level C ☐ Level A ☐
Detailed on Reverse

Respiratory equipment required

Full face APR	☐	Escape Pack	☐
Half face APR	☐	SCBA	☐
SAR	☐	Bottle Trailer	☐
Skid Rig	☐	None	☒

Modifications/Exceptions: Minimum requirements include sleeved shirt and long pants, safety shoes, surgical style gloves, and safety glasses. Hard hats and hearing protection will be worn when working near operating equipment or when required by SSO. Coveralls and snake chaps will be worn near insect/snake areas.

V. Chemicals of Concern	Action Level(s)	Response Measures
Site contaminants include VOCs, SVOCs, metals pesticides, PCBs, & explosives	Any sustained reading above background in worker breathing zones.	Suspend site activities and report to an unaffected area.

VI. Additional Safety Equipment/Procedures

Hard-hat	☐ Yes	☒ No	Hearing Protection (Plugs/Muffs)	☐ Yes	☒ No
Safety Glasses	☒ Yes	☐ No	Safety belt/harness	☐ Yes	☒ No
Chemical/splash goggles	☐ Yes	☒ No	Radio	☐ Yes	☒ No
Splash Shield	☐ Yes	☒ No	Barricades	☐ Yes	☒ No
Splash suits/coveralls	☐ Yes	☒ No	Gloves (Type - Nitrile)	☒ Yes	☐ No
Steel toe Work shoes or boots	☒ Yes	☐ No	Work/rest regimen	☐ Yes	☒ No

Modifications/Exceptions: Reflective vests for high traffic areas. Tyvek coverall if there is a potential for soiling work cloths.

VII. Procedure review with permit acceptors

	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☒	☐	Emergency alarms	☒	☐
Procedure for safe job completion	☐	☒	Evacuation routes	☒	☐
Contractor tools/equipment/PPE inspected	☐	☒	Assembly points	☒	☐

VIII. Equipment Preparation

	Yes	NA
Utility Locating and Excavation Clearance completed	☐	☒
Vehicle and Foot Traffic Routes Cleared and Established	☒	☐
Physical Hazards Barricaded and Isolated	☒	☐
Emergency Equipment Staged	☒	☐

IX. Additional Permits required (Hot work, confined space entry, excavation etc.). ☐ Yes ☒ No
If yes, complete permit required or contact Health Sciences, Pittsburgh Office

X. Special instructions, precautions: Minimize the number of people in the working area. Use non-sparking sampling equipment. Add distilled water to soil to moisturize and desensitize explosive and residue. If large pieces of explosive are observed, do not sample. If crystals are observed, do not disturb or sample. Use field screening if it is determined that a large concentration of explosive is present (10% or greater by weight).

Permit Issued by: _____ Permit Accepted by: _____

APPENDIX C

QUALITY ASSURANCE PROJECT PLAN

Quality Assurance Project Plan
for
Risk Assessment
at
SWMUs 4, 5, 9, and 10

Naval Surface Warfare Center
Crane Division
Crane, Indiana

Southern Division
Naval Facilities Engineering Command
Contract Number N62467-94-D-0888
Contract Task Order 0010

August 2000

NOV 27 2000

QUALITY ASSURANCE PROJECT PLAN
FOR
RISK ASSESSMENT
AT
SWMUs 4, 5, 9, AND 10

NAVAL SURFACE WARFARE CENTER, CRANE DIVISION
CRANE, INDIANA

REVISION 1
AUGUST 2000

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
Tetra Tech NUS, Inc.
661 Andersen Drive
Foster Plaza 7
Pittsburgh, Pennsylvania 15220

CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0010

Date 8/28/00
KAREN M. SMECKER
TASK ORDER MANAGER
TETRA TECH NUS, INC.

Date 8/28/00
DEBBIE WROBLEWSKI
PROGRAM MANAGER
TETRA TECH NUS, INC.

Date 8/28/00
PAUL V. FRANK
QUALITY ASSURANCE MANAGER
TETRA TECH NUS, INC.

Date 10-27-00
ALLEN DEBUS
QUALITY ASSURANCE COORDINATOR
U.S. EPA REGION 5

Date 10/31/00
PETER RAMANAUSKAS
PERMITTING PROJECT MANAGER
U.S.EPA REGION 5

Date 11/16/00
TOM BRENT
SITE MANAGER
NSWC CRANE

Date 12/4/00
KATHY KREPS
LABORATORY DIRECTOR
LAUCKS TESTING LABORATORIES, INC.

Date 11/27/00
~~BELEN RUEDA~~ Patty L. Ragsdale
LABORATORY MANAGER
TRIANGLE LABORATORIES, INC.

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ACRONYMS/ABBREVIATIONS

AWQC	Ambient Water Quality Criteria
bgs	below ground surface
CEC	Cation Exchange Capacity
CLP	Contract Laboratory Program
COC	Chain of Custody
CTO	Contract Task Order
DOD	Department of Defense
DQL	Data Quality Level
DQLs	Data Quality Levels
DQO	Data Quality Objective
EC	Electron Capture
EDQL	Ecological Data Quality Level
FID	Flame Ionization Detector
FOL	Field Operations Leader
FSP	Field Sampling Plan
FTMR	Field Task Modification Request
GC/MS	Gas Chromatography/Mass Spectrometry
IAS	Initial Assessment Study
ICP/AES	Inductively Coupled Plasma/Atomic Emission Spectroscopy
ICP/MS	Inductively Coupled Plasma/Mass Spectrometry
IDEM	Indiana Department of Environmental Management
IDL	Instrument Detection Limit
LCS/LCSD	Laboratory Control Sample/Laboratory Control Sample Duplicate
LIMS	Laboratory Information Management System
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MSL	Mean Sea Level
NA	Not Applicable
NACIP	Navy Assessment and Control of Installation Pollutants
NEESA	Naval Energy and Environmental Support Agency
NFESC	Naval Facilities Engineering Service Center
NIST	National Institute of Standards and Technology

NSWC	Naval Surface Warfare Center
NTU	Nephelometric Turbidity Units
ORP/Eh	Oxidation-Reduction Potential
PAHs	Polynuclear Aromatic Hydrocarbons
PARCC	Precision, Accuracy, Representativeness, Comparability, Completeness
PCB	Polychlorinated Biphenyl
PE	Performance evaluation
PRGs	Preliminary Remediation Goals
QA	Quality Assurance
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAGS	Risk Assessment Guidance for Superfund
RBSL	Risk-Based Screening Level
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RL	Reporting Limit
RPD	Relative Percent Difference
SDG	Sample Delivery Group
SIM	Selective Ion Monitoring
SOP	Standard Operating Procedure
SRM	Standard Reference Material
SSL	Soil Screening Level
SVOC	Semivolatile Organic Compounds
SWMU	Solid Waste Management Unit
TPH	Total Petroleum Hydrocarbons
TOC	Total Organic Carbon
TOM	Task Order Manager
TSS	Total Suspended Solids
TtNUS	Tetra Tech NUS, Inc.
U.S. ACE	United States Army Corps of Engineer
U.S. EPA	United States Environmental Protection Agency
VOA	Volatile Organic Analyte
VOC	Volatile Organic Compound
WES	Waterways Experiment Station
%R	Percent Recovery

1.0 PROJECT DESCRIPTION

This project description for the Quality Assurance Project Plan (QAPP) outlines the overall scope of the field investigations to be performed in support of the human health and ecological risk assessments that are to be conducted for four Solid Waste Management Units (SWMUs). These SWMUs include: SWMU 4 - McComish Gorge, SWMU 5 - Old Burn Pit, SWMU 9 - Pesticide Control/R-150 Tank Area, and SWMU 10 - Rockeye.

In 1981 the Navy initiated the Navy Assessment and Control of Installation Pollutants (NACIP) Program. This included an investigation for designated sites at the facility. These investigations were known as the Initial Assessment Study (IAS). The Naval Energy and Environmental Support Agency (NEESA) completed the IAS in 1983 with assistance from the Ordnance Environmental Support Agency and the United States Army Corps of Engineers (USACE) Waterways Experiment Station (WES). The intent of the IAS was to identify and assess sites posing a potential threat to human health and the environment from past hazardous materials operations. Based on the conclusions from the IAS for these four SWMUs, it was determined that they did not represent an immediate human health and environmental threat. It was, however, recommended that further study be conducted at these four SWMUs to evaluate potential long-term impacts.

In 1989 Naval Surface Warfare Center (NSWC) Crane was given a final Resource Conservation and Recovery Act (RCRA) Part B Permit. The permit contained corrective action requirements to be performed at its SWMUs. In response to the IAS recommendations and the requirements of the permit, RCRA Facility Investigations (RFIs) were initiated for the four SWMUs. Phase I, II, and III RFIs have been performed at each SWMU.

Conclusions on the nature and extent of contamination for each SWMU were drawn from these studies. The objective of this field investigation is to obtain sufficient information to perform a human health and preliminary ecological risk assessment for SWMUs 4, 5, 9, and 10. Conclusions from the risk assessments will be used in a risk management evaluation to determine whether further activities (such as remediation, long-term monitoring, etc.) are warranted at these sites.

This QAPP presents the organization, objectives, planned activities, and specific Quality Assurance/Quality Control (QA/QC) procedures associated with sample collection and analysis for the field investigations. Specific protocols for sampling, sample handling and storage, chain-of-custody, and laboratory and field analyses are described. All QA/QC procedures are structured in accordance with

applicable United States Environmental Protection Agency (U.S. EPA), U.S. EPA Region 5 and Indiana Department of Environmental Management (IDEM) requirements, regulations, guidance, and technical standards.

This QAPP was prepared in accordance with U.S. EPA Region 5 QAPP Policy as presented in the "U.S. EPA Region 5 QAPP Instructions and Policy" (U.S. EPA , April 1998). The Naval Facilities Engineering Service Center (NFESC) guidance document titled "Navy Installation Restoration Laboratory Quality Assurance Guide (NFESC, February 1996) also was used in establishing the QA/QC requirements specified in this QAPP. U.S. EPA Region 5 Risk-Based Screening Levels (RBSLs) for human health and Ecological Data Quality Levels (EDQLs), as well as other health and ecological based criteria that were used in the development of this QAPP to outline facility-specific project objectives, required levels of analyte detection and intended data usage.

1.1 INTRODUCTION

This QAPP was developed in support of the field investigation for the following SWMUs located at NSWC Crane: SWMU 4 - McComish Gorge, SWMU 5 - Old Burn Pit, SWMU 9 - Pesticide Control/R-150 Tank Area, and SWMU 10 - Rockeye. The objectives of the field objectives of the investigation is to collect data for the conduct of site-specific human health and preliminary ecological risk assessments. This QAPP was prepared by Tetra Tech NUS, Inc. (TtNUS) on behalf of the United States Navy Southern Division Naval Facilities Engineering Command and NSWC Crane. This work was performed under Contract Number N62467-94-D-0888, Contract Task Order (CTO) Number 0010. A Work Plan, Field Sampling Plan (FSP), and Health and Safety Plan (TtNUS, April 1999) also have been prepared by TtNUS. These documents have been entirely incorporated into this QAPP through specific reference.

1.1.1 Overall Project Objectives

The purpose of the field investigation is to gather sufficient reliable information to conduct a baseline human health risk assessment and preliminary ecological risk assessment for each of the four SWMUs. The risk assessments will be conducted in accordance with the RCRA Corrective Action requirements identified in NSWC Crane's RCRA Part B Permit, U.S. EPA 's Risk Assessment Guidance for Superfund (RAGS) (U.S. EPA , December 1989), and other available risk assessment guidance. Details on the conduct of the human health and ecological risk assessments can be found in Sections 10.0 and 11.0, respectively, of the Work Plan.

The overall objective of the data collection is to develop representative exposure point concentrations for the defined human and ecological receptors in support of the risk assessments. Exposure point concentrations will be developed for those site-related constituents identified as potential chemicals of concern (i.e., chemicals reported at concentrations that exceed human health and/or ecological risk-based screening criteria) in the site media. The specific objectives associated with data collection activities for each SWMU are presented in Sections 5.0, 6.0, 7.0, and 8.0 of the Work Plan and tabulated on Tables 5-5, 6-5, 7-5, and 8-7 of the Work Plan.

1.1.2 Project Status/Phase

Tables 3-2, 3-5, 3-7, 3-10, 3-12, 3-15, 3-17, and 3-20 in the FSP presents the number of samples per medium per SWMU to be collected during the field investigation. In general, samples collected at SWMUs 4, 5, 9, and 10 will be analyzed for a full suite of Appendix IX parameters, unless historical data collected for the SWMUs were sufficient to allow for the reduction of analytical parameters. Deviations from the comprehensive analytical list are presented on the SWMU-specific objectives tables presented in the Work Plan (Tables 5-5, 6-5, 7-5 and 8-7). Explosives and dioxins/furans analyses will be completed for several of the SWMUs. A limited number of soil samples will be analyzed for cation exchange capacity (CEC), total organic carbon (TOC), and pH to determine soil physical parameters, their effect on constituent migration, and the potential for risks outside of SWMU boundaries. Also, surface water samples will be analyzed for total suspended solids (TSS), TOC and hardness to evaluate general water quality. Table 1-1 presents the comprehensive list of constituents for analysis.

1.1.3 QAPP Preparation Guidelines

As identified previously, this QAPP has been prepared in accordance with the "U.S. EPA Region 5 QAPP Instructions and Policy" (U.S. EPA , April 1998). Additional guidance regarding the generation of the QAPP was obtained during project scoping meetings. One of these meetings was a formal "pre-QAPP" meeting, which was held on March 27, 1996, at U.S. EPA Region 5 headquarters in Chicago, Illinois. Another "pre-QAPP" meeting was held on April 22, 1999. Representatives from the U.S. EPA Region 5, United States Navy Southern Division Naval Facilities Engineering Command, NSWC Crane, and TtNUS attended both of these meetings. A representative from IDEM was present at the March 27, 1996 meeting only.

1.2 SITE/FACILITY DESCRIPTION

A brief description of NSWC Crane with respect to SWMUs 4, 5, 9 and 10, geological setting, and associated features is presented in this section. Additional details can be found in Section 3.0 of the

TABLE 1-1

ANALYTICAL METHODS AND LIMITS OF DETECTION
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Parameter	CAS NUMBER	Aqueous Matrix			Solid Matrix			
		Laboratory MDL (ug/L)	Laboratory RL (ug/L)	Risk-Based Target Level(1) (ug/L)	Laboratory MDL (mg/kg)	Laboratory RL (mg/kg)	Risk-Based Soil Target Level(1) (mg/kg)	Risk-Based Sediment Target Level(1) (mg/kg)
EXPLOSIVES (SW-846 METHOD 8330)								
1,3,5-Trinitrobenzene	99-35-4	0.3	0.65	1100	0.22	0.5	1800	--
1,3-Dinitrobenzene	99-65-0	0.3	0.65	2.36	0.22	0.5	0.6547	0.000924
2,4,6-Trinitrotoluene (TNT)	118-96-7	0.44	0.65	2.2	0.13	0.5	16	--
2,4-Dinitrotoluene	121-14-2	0.44	0.65	1.2	0.136	0.5	0.00004	0.07513
2,6-Dinitrotoluene	606-20-2	0.44	0.65	1.2	0.13	0.5	0.00003	0.02062
2-Amino-4,6-dinitrotoluene	35572-78-2	0.18	0.65	2	0.072	0.5	--	--
2-Nitrotoluene	88-72-2	0.59	0.65	61	0.392	0.5	370	--
3-Nitrotoluene	99-08-1	0.59	0.65	61	0.392	0.5	370	--
4-Amino-2,6-dinitrotoluene	19406-51-0	0.26	0.65	--(2)	0.188	0.5	--	--
4-Nitrotoluene	99-99-0	0.59	0.65	61	0.392	0.5	370	--
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	0.31	0.61	0.61	0.253	0.5	4.4	--
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	479-45-8	0.51	0.65	360	0.19	0.5	610	--
Nitrobenzene	98-95-3	0.3	0.65	3.4	0.222	0.5	0.007	0.4876
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	0.38	0.65	1800	0.144	0.5	3100	--
Nitroglycerin	55-63-0	0.39	13	--	--(6)	--	--	--
Pentaerythritol tetranitrate (PETN)	78-11-5	0.38	26	--	--	1	--	--
APPENDIX IX METALS (SW-846 Method 6020 ICP/MS)								
Antimony	7440-36-0	0.082	1	6	0.008	0.5	0.1423	0.3
Arsenic	7440-38-2	0.1	1	0.045	0.028	0.5	0.39	0.0059
Barium	7440-39-3	0.022	1	2000	0.014	0.5	1.04	82
Beryllium	7440-41-7	0.048	1	4	0.008	0.5	0.1	--
Cadmium	7440-43-9	0.063	1	0.66	0.01	0.5	0.00222	0.4
Chromium (total)	7440-47-3	0.035	5	11	0.063	2.5	2	--
Cobalt	7440-48-4	0.02	3	5	0.019	1.5	0.14033	50
Copper	7440-50-8	0.038	2	5	0.015	1	2.96	16
Lead	7439-92-1	0.053	1	1.3	0.011	0.5	0.05373	31
Mercury (SW-846 Method 7470A/7471A)	7439-97-6	0.07	0.2	0.0013	0.03	0.1	0.073	0.1
Nickel	7440-02-0	0.063	5	29	0.031	2.5	7	16
Selenium	7782-49-2	0.35	1	5	0.055	1	0.02765	0.3
Silver	7440-22-4	0.014	3	1	0.002	1.5	2	0.5
Thallium	7440-28-0	0.0058	1	0.56	0.003	0.5	0.04	--
Tin	7440-31-5	0.023	10	73	--	5	7.62	45000
Vanadium	7440-62-2	0.031	2	19	0.011	2	1.59	300
Zinc	7440-66-6	0.38	10	58.9	0.098	5	6.62	120
MISCELLANEOUS METALS (SW-846 METHOD 6010B Trace) (3)								
Aluminum	7429-90-5	47	200	--	9.6	20	--	--
Calcium	7440-70-2	12	5000	--	2.3	500	--	--
Iron	7439-89-6	11	100	--	2.8	10	--	--
Magnesium	7439-95-4	18	5000	--	3.7	500	--	--
Manganese	7439-96-5	1.5	15	--	0.12	1.5	--	--
Potassium	7440-09-7	102	5000	--	19	500	--	--
Sodium	7440-23-5	80	5000	--	6.7	500	--	--

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Parameter	CAS NUMBER	Aqueous Matrix			Solid Matrix			
		Laboratory MDL (ug/L)	Laboratory RL (ug/L)	Risk-Based Target Level(1) (ug/L)	Laboratory MDL (mg/kg)	Laboratory RL (mg/kg)	Risk-Based Soil Target Level(1) (mg/kg)	Risk-Based Sediment Target Level(1) (mg/kg)
APPENDIX IX VOLATILE ORGANIC COMPOUNDS (SW-846 METHOD 8260B WITH 25mL PURGE - WATER, 5g PURGE - SOIL or 8015B WITH 10mL PURGE - WATER AND 5g PURGE - SOIL)								
1,1,1-Trichloroethane	71-55-6	0.1	1	88	0.0008	0.005	0.1	1.9
1,1,1,2-Tetrachloroethane	630-20-6	0.11	0.5	0.43	0.0006	0.005	0.050C	0.01089
1,1,2,2-Tetrachloroethane	79-34-5	0.18	0.5	0.055	0.0006	0.005	0.0002	0.02908
1,1,2-Trichloroethane	79-00-5	0.054	0.5	0.2	0.0007	0.005	0.0009	0.67351
1,2,3-Trichloropropane	96-18-4	0.11	1	0.0016	0.0018	0.005	0.0014	0.00835
1,1-Dichloroethane	75-34-3	0.11	1	47	0.0009	0.005	1	0.000575
1,1-Dichloroethene	75-35-4	0.14	0.5	0.046	0.0011	0.005	0.003	0.02327
1,2-Dibromo-3-chloropropane	96-12-8	0.17	1	0.048	0.0019	0.005	0.03518	0.01998
1,2-Dibromoethane	106-93-4	0.14	0.5	0.00076	0.0006	0.005	0.0069	0.01237
1,2-Dichloroethane	107-06-2	0.061	0.5	0.12	0.0009	0.005	0.001	0.05418
1,2-Dichloropropane	78-87-5	0.083	0.5	0.16	0.0007	0.005	0.001	0.35161
1,4-Dioxane (8015B)	123-91-1	100	100	6.1	0.025	0.5	2.05	0.00000543
2-Butanone	78-93-3	1	5	1900	0.0045	0.005	10	0.13696
2-Chloro-1,3-butadiene (chloroprene)	126-99-8	1	1	14	0.0009	0.005	0.0029	0.00106
2-Hexanone	591-78-6	0.81	5	1500	0.0023	0.005	12.6	1.01
4-Methyl-2-pentanone	108-10-1	0.38	5	160	0.0024	0.005	443	0.54437
Acetone	67-64-1	0.81	5	610	0.0046	0.005	0.8	0.45337
Acetonitrile (8015B)	75-05-8	18.1	40	79	0.0019	0.2	1.37	0.13905
Acrolein	107-02-8	2.3	10	0.042	0.013	0.05	0.00027	0.0000144
Acrylonitrile	107-13-1	0.66	3	0.039	0.008	0.05	0.02393	0.0000157
Allyl chloride (3-chloro-1-propene)	107-05-1	0.29	5	1800	0.0008	0.005	0.01338	0.000266
Benzene	71-43-2	0.093	0.5	0.41	0.0006	0.005	0.002	0.14157
Bromodichloromethane	75-27-4	0.093	0.5	0.18	0.0008	0.005	0.03	0.00113
Bromoform	75-25-2	0.12	1	8.5	0.0013	0.005	0.04	0.99627
Bromomethane	74-83-9	0.24	1	8.7	0.005	0.005	0.01	0.94674
Carbon disulfide	75-15-0	0.078	1	84.1	0.0008	0.005	0.09412	0.13397
Carbon tetrachloride	56-23-5	0.12	0.5	0.17	0.0009	0.005	0.003	0.03573
Chlorobenzene	108-90-7	0.12	1	10	0.0007	0.005	0.07	0.06194
Chloroethane	75-00-3	0.13	1	4.6	0.0018	0.005	3	58.6
Chloroform	67-66-3	0.054	0.5	0.16	0.0009	0.005	0.03	0.027
Chloromethane	74-87-3	0.18	1	1.5	0.0006	0.005	1.2	0.0000785
cis-1,2-Dichloroethene	156-59-2	0.1	1	61	0.0009	0.005	0.02	0.20894
cis-1,3-Dichloropropene	10061-01-5	0.057	0.5	0.081	0.0008	0.005	0.0002	0.00296
Dibromochloromethane	124-48-1	0.093	0.5	0.13	0.0007	0.005	0.02	0.02
Dibromomethane	74-95-3	0.11	1	61	0.0006	0.005	65	0.0000859
Dichlorodifluoromethane	75-71-8	0.14	1	390	0.0008	0.005	39.5	0.00133
Ethylbenzene	100-41-4	0.076	1	17.2	0.0007	0.005	0.7	0.0001
Ethyl methacrylate	97-63-2	0.21	1	550	0.0009	0.005	30	0.000602
Isobutanol (8015B)	78-83-1	0.32	40	1800	0.053	0.2	20.8	3.35
Methacrylonitrile	126-98-7	0.48	1	1	0.01	0.1	0.05705	0.0000297
Methylene chloride	75-09-2	0.22	1	4.3	0.0017	0.005	0.001	1.26
Methyl iodide	74-88-4	0.66	1	--	0.0017	0.005	--	--
Methyl methacrylate	80-62-6	0.28	1	1400	0.0015	0.005	984	0.16756

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Parameter	CAS NUMBER	Aqueous Matrix			Solid Matrix			
		Laboratory MDL (ug/L)	Laboratory RL (ug/L)	Risk-Based Target Level(1) (ug/L)	Laboratory MDL (mg/kg)	Laboratory RL (mg/kg)	Risk-Based Soil Target Level(1) (mg/kg)	Risk-Based Sediment Target Level(1) (mg/kg)
Propionitrile (8015B)	107-12-0	2	20	6080	0.01	0.7	0.04983	0.11466
Styrene	100-42-5	0.11	1	56	0.0006	0.005	0.2	0.44496
Tetrachloroethene	127-18-4	0.1	1	1.1	0.001	0.005	0.003	0.19583
Toluene	108-88-3	0.096	1	253	0.0006	0.005	0.6	52.5
trans-1,2-Dichloroethene	156-60-5	0.1	1	100	0.0007	0.005	0.03	0.20894
trans-1,3-Dichloropropene	10061-02-6	0.061	0.5	0.081	0.0008	0.005	0.0002	0.00296
trans-1,4-Dichloro-2-butene	764-41-0	3.1	0	0.0012	0.0016	0.005	--	0.00182
Trichloroethene	79-01-6	0.11	1	1.6	0.001	0.005	0.003	0.17956
Trichlorofluoromethane	75-69-4	0.12	1	1300	0.0021	0.005	16.4	0.00307
Vinyl acetate	108-05-4	0.63	5	248.03	0.0023	0.005	2.3	0.01295
Vinyl chloride	75-01-4	0.15	0.5	0.02	0.006	0.005	0.0007	0.002
Total Xylenes	1330-20-7	0.17	5	117	0.0018	0.005	9	1.88
APPENDIX IX SEMIVOLATILE ORGANIC COMPOUNDS (SW-846 METHOD 8270C OR 8270C - SELECTIVE ION MONITORING)								
1,2,4,5-Tetrachlorobenzene	95-94-3	3	10	11	0.092	0.33	2.02	18
1,2,4-Trichlorobenzene	120-82-1	1.231	5	69.2	0.1627	0.33	0.3	11.7
1,2-Dichlorobenzene	95-50-1	0.434	5	11	0.186	0.33	0.9	0.23132
1,3-Dichlorobenzene	541-73-1	0.342	5	5.5	0.1706	0.33	0.42	0.42
1,4-Dichlorobenzene	106-46-7	0.286	5	0.5	0.1823	0.33	0.1	1.45
1,4-Naphthoquinone	130-15-4	1	10	--	0.059	0.33	--	--
1,4-Phenylenediamine	106-50-3	25	25	6900	0.308	0.83	6.16	0.00000568
1-Naphthylamine	134-32-7	2	10	0.67	0.169	0.33	--	--
2,3,4,6-Tetrachlorophenol	58-90-2	5	10	14.06	0.096	0.33	0.19878	1.51
2,4,5-Trichlorophenol	95-95-4	0.753	25	3600	0.1736	0.83	14	0.08556
2,4,6-Trichlorophenol	88-06-2	0.858	5	2	0.1516	0.33	0.008	0.08484
2,4-Dichlorophenol	120-83-2	0.698	10	18	0.1773	0.33	0.05	0.13363
2,4-Dimethylphenol	105-67-9	1.909	10	100.17	0.1026	0.33	0.01	0.30453
2,4-Dinitrophenol	51-28-5	1.202	10	4.07	0.04052	0.83	0.01	0.00133
2,6-Dichlorophenol	87-65-0	3	10	--	0.104	0.33	1.17	0.00394
2-Acetylaminofluorene	53-96-3	1	10	534.97	0.073	0.33	0.59634	0.01532
2-Chloronaphthalene	91-58-7	0.6	2	0.396	0.153	0.33	0.01218	0.41723
2-Chlorophenol	95-57-8	0.853	3	8.8	0.1935	0.33	0.2	0.0117
2-Methylnaphthalene (SIM)	91-57-6	0.0191	0.2	329.55	0.000561	0.0066	3.24	0.0202
2-Methylphenol	95-48-7	1.03	10	1800	0.1916	0.33	0.8	0.000826
2-Naphthylamine	91-59-8	4	10	--	0.194	0.33	3.03	0.00174
2-Nitroaniline	88-74-4	0.993	2	2.1	0.1435	0.83	3.5	0.000222
2-Nitrophenol	88-75-5	0.913	10	13.5	0.1674	0.33	1.6	0.00777
2-Picoline	109-06-8	5	10	3790	0.25	0.33	9.9	0.75305
3,3'-Dichlorobenzidine	91-94-1	0.527	10	0.15	0.1395	0.33	0.0003	0.02822
3,3'-Dimethylbenzidine	119-93-7	8	50	0.0073	--	0.33	0.053	0.002
3-Methylcholanthrene	56-49-5	1	12	0.0891	0.384	0.33	0.07794	8190
3-Methylphenol(4)	108-39-4	5	10	1800	0.079	0.33	163	0.000808
4-Methylphenol(4)	106-44-5	0.96	10	180	0.2021	0.33	3.49	0.000845
3-Nitroaniline	99-09-2	0.634	25	--	0.1372	0.83	3.16	0.000222
4,6-Dinitro-2-methylphenol	534-52-1	0.872	10	2.3	0.109	0.83	0.14408	0.01038

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Parameter	CAS NUMBER	Aqueous Matrix			Solid Matrix			
		Laboratory MDL (ug/L)	Laboratory RL (ug/L)	Risk-Based Target Level(1) (ug/L)	Laboratory MDL (mg/kg)	Laboratory RL (mg/kg)	Risk-Based Soil Target Level(1) (mg/kg)	Risk-Based Sediment Target Level(1) (mg/kg)
4-Aminobiphenyl	92-67-1	1	10	--	0.135	0.33	0.00305	0.00566
4-Bromophenyl phenyl ether	101-55-3	0.65	2	1.5	0.1661	0.33	--	1.68
4-Chloro-3-methylphenol	59-50-7	0.559	10	20	0.1938	0.33	7.95	0.38818
4-Chloroaniline	106-47-8	1.094	10	150	0.07858	0.33	0.03	0.03
4-Chlorophenyl phenyl ether	7005-72-3	0.634	10	--	0.2104	0.33	--	0.14608
4-Nitroaniline	100-01-6	0.67	25	--	0.1128	0.33	21.9	0.000222
4-Nitrophenol	100-02-7	0.876	25	35	0.1257	0.33	5.12	0.00778
4-Nitroquinoline-1-oxide	56-57-5	19	25	--	0.783	0.33	0.12222	0.00124
5-Nitro-o-toluidine	99-55-8	2	15	2	0.086	0.33	8.73	0.000845
7,12-Dimethylbenz(a)anthracene	57-97-6	2	10	--	0.249	0.33	--	--
Acenaphthene (SIM)	83-32-9	0.077	0.2	9.9	0.000559	0.0066	29	0.00671
Acenaphthylene (SIM)	208-96-8	0.0108	0.2	370	0.000511	0.0066	682	0.00587
Acetophenone	98-86-2	2	20	0.042	0.052	0.33	0.49	0.246
Aniline	62-53-3	0.57	5	0.44	0.05256	0.33	0.05678	0.0000338
Aramite	140-57-8	2	10	2.7	0.043	0.33	19	0.00000111
Anthracene (SIM)	120-12-7	0.0175	0.2	0.029	0.000722	0.0066	51	0.0469
Benzo(a)anthracene (SIM)	56-55-3	0.0141	0.2	0.092	0.000791	0.0066	0.08	0.0317
Benzo(a)pyrene (SIM)	50-32-8	0.0153	0.2	0.0092	0.002627	0.0066	0.062	0.0319
Benzo(b)fluoranthene (SIM)	205-99-2	0.0157	0.2	0.092	0.001166	0.0066	0.2	10.4
Benzo(g,h,i)perylene (SIM)	191-24-2	0.0141	0.2	6.2	0.000723	0.0066	119	0.17
Benzo(k)fluoranthene (SIM)	207-08-9	0.0178	0.2	0.0056	0.000397	0.0066	2	0.24
Benzyl alcohol	100-51-6	1.473	10	281.24	0.1887	0.33	65.8	0.03394
Bis(2-chloroethoxy)methane	111-91-1	1.801	10	6400	0.1705	0.33	0.30209	0.34971
Bis(2-chloroethyl)ether	111-44-4	0.826	1	0.0098	0.1754	0.33	0.00002	0.21196
Bis(2-chloroisopropyl)ether	108-60-1	0.765	3	0.27	0.2238	0.33	0.027	--
Bis(2-ethylhexyl)phthalate	117-81-7	0.722	2	2.1	0.171	0.33	0.92594	0.182
Butyl benzyl phthalate	85-68-7	0.813	10	49	0.161	0.33	0.23889	4.19
Chlorobenzilate	510-15-6	1	5	0.25	0.051	0.33	1.8	0.86029
Chrysene (SIM)	218-01-9	0.0149	0.2	0.033	0.001023	0.0066	4.73	0.0571
Diallate	2303-16-4	1	10	1.1	0.046	0.33	0.45214	0.00151
Di-n-butyl phthalate	84-74-2	0.512	10	3	0.1911	0.33	0.14979	0.1105
Di-n-octyl phthalate	117-84-0	0.486	10	20	0.1961	0.33	709	40.6
Dibenzo(a,h)anthracene (SIM)	53-70-3	0.0119	0.2	0.0016	0.000792	0.0066	0.062	0.00622
Dibenzofuran	132-64-9	0.653	10	20	0.1824	0.33	290	1.52
Diethyl phthalate	84-66-2	0.599	2	3	0.2017	0.33	23	0.00804
Dimethoate	60-51-5	---	10	7.3	---	0.67	0.21802	0.19015
p-(Dimethylamino)azobenzene	60-11-7	1	10	--	0.024	0.33	--	--
a,a-Dimethylphenethylamine	122-09-8	13	25	37	0.153	0.83	61	--
Dimethyl phthalate	131-11-3	0.638	10	73	0.2083	0.33	734	0.02495
Diphenylamine(5)	122-39-4	3.6	10	412.51	---	0.33	1.01	0.0346
Disulfoton	296-04-4	---	15	0.0402	---	17	0.01988	0.32408
Ethyl methane sulfonate	62-50-0	2	10	--	0.059	0.33	--	--
Ethyl parathion	56-38-2	1	15	0.008	0.052	0.33	0.00034	0.00034
Famphur	52-85-7	---	10	--	---	0.67	0.0497	0.00178

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Parameter	CAS NUMBER	Aqueous Matrix			Solid Matrix			
		Laboratory MDL (ug/L)	Laboratory RL (ug/L)	Risk-Based Target Level(1) (ug/L)	Laboratory MDL (mg/kg)	Laboratory RL (mg/kg)	Risk-Based Soil Target Level(1) (mg/kg)	Risk-Based Sediment Target Level(1) (mg/kg)
Fluoranthene (SIM)	206-44-0	0.0141	0.2	8.1	0.000512	0.0066	122	0.1113
Fluorene (SIM)	86-73-7	0.0153	0.2	3.9	0.000723	0.0066	28	0.0212
Hexachlorobenzene	118-74-1	0.516	2	0.00024	0.1231	0.33	0.1	0.02
Hexachlorobutadiene	87-68-3	0.504	10	0.223	0.1394	0.33	0.03976	0.1
Hexachlorocyclopentadiene	77-47-4	0.129	10	50	0.05693	0.33	0.75537	0.90074
Hexachloroethane	67-72-1	0.445	2	4.8	0.1575	0.33	0.02	2.23
Hexachloropropene	1888-71-7	5	10	20	0.126	0.33	--	0.0002
Indeno(1,2,3-cd)pyrene (SIM)	193-39-5	0.0084	0.02	0.092	0.001023	0.0066	0.62	0.2
Isodrin	465-73-6	1	10	0.0309	0.057	0.33	0.00332	0.05516
Isophorone	78-59-1	0.766	10	71	0.148	0.33	0.03	0.4223
Isosafrole	120-58-1	1	10	--	0.058	0.33	9.94	0.00412
Kepone	143-50-0	1	25	0.0037	0.072	0.83	0.027	0.00331
Methapyrilene	91-80-5	16	25	--	0.215	0.83	2.78	0.0000144
Methyl methane sulfonate	66-27-3	2	25	--	0.172	0.83	--	--
Methyl parathion	298-00-0	1	10	9.1	0.058	0.33	0.000292	0.000755
n-Nitrosodi-n-butylamine	924-16-3	2	10	0.002	0.045	0.33	0.024	0.77204
n-Nitrosodiethylamine	55-18-5	2	10	0.00045	0.07	0.33	0.0032	0.0346
n-Nitrosodimethylamine	62-75-9	0.44	10	0.0013	0.151	0.33	0.0000321	0.000217
n-Nitrosodi-n-propylamine	621-64-7	0.938	2	0.0096	0.1753	0.33	0.000002	0.000002
n-Nitrosomethylethylamine	62-75-9	3.6	10	0.0031	0.125	0.33	0.00166	0.00000485
n-Nitrosomorpholine	59-89-2	1	10	--	0.063	0.33	0.07057	0.0000037
n-Nitrosopiperidine	100-75-4	1	10	--	0.073	0.33	0.00665	0.0000226
n-Nitrosopyrrolidine	930-55-2	2	10	0.032	0.073	0.33	0.01258	0.000000908
Naphthalene (SIM)	91-20-3	0.0141	0.2	6.2	0.000559	0.0066	0.09939	0.0346
Pentachlorobenzene	608-93-5	4	10	0.47	0.038	0.33	0.49695	1.26
Pentachloroethane	76-01-7	1.4	25	56.42	0.0016	0.33	10.7	0.68918
Pentachloronitrobenzene	82-68-8	1	10	0.26	0.059	0.83	1.9	1.9
Phenacetin	62-44-2	1	10	--	0.051	0.33	11.7	0.00225
Phenanthrene (SIM)	85-01-8	0.0191	0.2	2.1	0.000723	0.0066	45.7	0.0419
Phenol	108-95-2	1.022	10	100	0.1906	0.33	5	0.02726
Phorate	296-02-2	---	10	3.62	---	0.67	0.000496	0.000861
Pronamide	23950-58-5	1	10	160	0.047	0.33	0.0136	0.0016
Pyrene (SIM)	129-00-0	0.0168	0.2	0.3	0.001022	0.0066	78.5	0.053
Pyridine	110-86-1	2.078	10	37	0.221	0.33	1.03	0.10617
Safrole	94-59-7	1	10	40	0.078	0.33	0.40398	0.16486
Tetraethyl dithiopyrophosphate (Sulfotepp)	3689-24-5	---	10	13.9	---	0.67	0.59634	0.55998
Thionazin	297-97-2	---	100	--	---	0.67	0.79949	0.0000488
o-Toluidine	95-53-4	2	15	0.28	0.086	0.33	2	0.000199
O,O,O-Triethyl phosphorothioate	126-68-1	1	10	58.25	0.087	0.33	--	--
APPENDIX IX ORGANOCHLORINE PESTICIDES and PCBs (SW-846 METHOD 8081A and 8082)								
Aldrin	309-00-2	0.0089	0.01	0.004	0.00018	0.0017	0.00332	0.002
Alpha-BHC	319-84-6	0.0025	0.01	0.011	0.00014	0.0017	0.00003	0.006
Alpha-chlordane	5103-71-9	0.0026	0.03	0.00029	0.00024	0.0017	0.224	0.0045
Beta-BHC	319-85-7	0.0029	0.03	0.037	0.00031	0.0017	0.0001	0.005

TABLE 1-1

ANALYTICAL METHODS AND LIMITS OF DETECTION
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Parameter	CAS NUMBER	Aqueous Matrix			Solid Matrix			
		Laboratory MDL (ug/L)	Laboratory RL (ug/L)	Risk-Based Target Level(1) (ug/L)	Laboratory MDL (mg/kg)	Laboratory RL (mg/kg)	Risk-Based Soil Target Level(1) (mg/kg)	Risk-Based Sediment Target Level(1) (mg/kg)
4,4'-DDD	72-54-8	0.0042	0.05	0.0011	0.00029	0.0033	0.75815	0.00553
4,4'-DDE	72-55-9	0.0052	0.05	4.51E-09	0.00035	0.0033	0.59587	0.00142
4,4'-DDT	50-29-3	0.0057	0.05	0.001	0.00038	0.0033	0.0175	0.00119
Delta-BHC	319-86-8	0.0059	0.05	0.011	0.00016	0.0017	9.94	71.5
Dieldrin	60-57-1	0.0046	0.02	0.000026	0.00032	0.0033	0.0002	0.002
Endosulfan I	115-29-7	0.0027	0.05	0.003	0.00026	0.0017	0.11927	0.000175
Endosulfan II	33213-65-9	0.0062	0.05	0.003	0.00038	0.0033	0.11927	0.000104
Endosulfan sulfate	1031-07-8	0.0059	0.08	0.22	0.00049	0.0033	0.03578	0.0346
Endrin	72-20-8	0.0052	0.03	0.002	0.00021	0.0033	0.0101	0.00267
Endrin aldehyde	7421-93-4	0.0058	0.08	0.15	0.00044	0.0033	0.0105	3.2
Gamma-BHC (Lindane)	58-89-9	0.0024	0.05	0.01	0.00015	0.0017	0.0005	0.00094
Gamma-chlordane	12789-03-6	0.0021	0.03	0.00029	0.0002	0.0017	0.224	0.0045
Heptachlor	76-44-8	0.0078	0.03	0.00039	0.00016	0.0017	0.00598	0.0006
Heptachlor epoxide	1024-57-3	0.003	0.03	0.00048	0.0002	0.0017	0.03	0.0006
Methoxychlor	72-43-5	0.0312	0.17	0.005	0.0016	0.017	0.01988	0.00359
Toxaphene	8001-35-2	0.7	5	0.0002	0.0016	0.17	0.11927	0.000109
Aroclor-1016	12674-11-2	0.072	0.5	0.000029	0.0138	0.033	0.67971	0.0341
Aroclor-1221	11104-28-2	0.08	0.5	0.000029	0.0105	0.033	0.22	0.0341
Aroclor-1232	11141-16-5	0.21	0.5	0.000029	0.0122	0.033	0.22	0.0341
Aroclor-1242	53469-21-9	0.33	0.5	0.000029	0.0117	0.033	0.22	0.0341
Aroclor-1248	12672-29-6	0.061	0.5	0.000029	0.0162	0.033	0.22	0.0341
Aroclor-1254	11097-69-1	0.11	0.5	0.000029	0.0214	0.033	0.22	0.0341
Aroclor-1260	11096-82-5	0.041	0.5	0.000029	0.0065	0.033	0.22	0.0341
APPENDIX IX HERBICIDES (SW-846 METHOD 8151A)								
2,4-D	94-75-7	---	0.08	70	---	0.0027	0.02725	0.00579
2,4,5-T	93-76-5	---	0.04	360	---	0.0027	0.59634	58.7
2,4,5-TP (Silvex)	93-72-1	---	0.04	50	---	0.00133	0.1088	7.35
Dinoseb	88-85-7	---	0.08	0.39	---	0.0027	0.0218	0.01178
Hexachlorophene	70-30-4	---	0.1	0.228	---	0.0167	0.19878	231
Pentachlorophenol	87-86-5	---	0.02	0.56	---	0.00066	0.001	30.1
DIOXINS/FURANS (SW-846 METHOD 8290)								
2,3,7,8-Tetrachlorodibenzodioxin (2,3,7,8-TCDD)	1746-01-6	0.0000046	1E-5	4.50E-07	0.00000054	1.00E-06	3.90E-06	3.90E-06
1.2.3.7.8-Pentachlorodibenzodioxin (1,2,3,7,8-PeCDD)	40321-76-4	0.0000134	5E-5	4.50E-07	0.0000026	1.00E-06	3.90E-06	3.90E-06
1,2,3,6,7,8-Hexachlorodibenzodioxin (1,2,3,6,7,8-HxCDD)	67653-85-7	0.00000312	5E-5	4.50E-06	0.0000024	2.50E-06	3.90E-05	3.90E-05
1,2,3,4,7,8-Hexachlorodibenzodioxin (1,2,3,4,7,8-HxCDD)	39227-28-6	0.0000194	5E-5	4.50E-06	0.0000021	2.50E-06	3.90E-05	3.90E-05
1,2,3,7,8,9-Hexachlorodibenzodioxin (1,2,3,7,8,9-HxCDD)	72918-21-9	0.0000421	5E-5	4.50E-06	0.0000024	2.50E-06	3.90E-05	3.90E-05
1,2,3,4,6,7,8-Heptachlorodibenzodioxin (1,2,3,4,6,7,8-HpCDD)	67562-39-4	0.0000084	5E-5	4.50E-05	0.0000016	2.50E-06	3.90E-04	3.90E-04
1,2,3,4,6,7,8,9-Octachlorodibenzodioxin (OCDD)	3268-87-9	0.0000317	1E-4	4.50E-03	0.0000051	5.00E-06	3.90E-02	3.90E-02
2,3,7,8-Tetrachlorodibenzofuran (2,3,7,8-TCDF)	1746-01-6	0.0000047	1E-5	4.50E-06	0.0000062	1.00E-06	3.90E-05	3.90E-05
1.2.3.7.8-Pentachlorodibenzofuran (1,2,3,7,8-PeCDF)	57117-41-6	0.0000184	5E-5	9.00E-06	0.0000038	1.00E-06	7.80E-05	7.80E-05
2,3,4,7,8-Pentachlorodibenzofuran (2,3,4,7,8-PeCDF)	57117-31-4	0.0000337	5E-5	9.00E-07	0.000003	1.00E-06	7.80E-06	7.80E-06
1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-HxCDF)	57117-44-9	0.0000081	5E-5	4.50E-06	0.0000014	2.50E-06	3.90E-05	3.90E-05
1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-HxCDF)	19408-74-3	0.0000075	5E-5	4.50E-06	0.0000019	2.50E-06	3.90E-05	3.90E-05
1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-HxCDF)	70648-26-9	0.0000305	5E-5	4.50E-06	0.0000027	2.50E-06	3.90E-05	3.90E-05

TABLE 1-1

ANALYTICAL METHODS AND LIMITS OF DETECTION
NSWC CRANE, INDIANA
PAGE 7 OF 7

Parameter	CAS NUMBER	Aqueous Matrix			Solid Matrix			
		Laboratory MDL (ug/L)	Laboratory RL (ug/L)	Risk-Based Target Level(1) (ug/L)	Laboratory MDL (mg/kg)	Laboratory RL (mg/kg)	Risk-Based Soil Target Level(1) (mg/kg)	Risk-Based Sediment Target Level(1) (mg/kg)
2,3,4,6,7,8- Hexachlorodibenzofuran (2,3,4,6,7,8-HxCDF)	60851-34-5	0.0000901	5E-5	4.50E-06	0.0000014	2.50E-06	3.90E-05	3.90E-05
1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-HpCDF)	67562-39-4	0.0000108	5E-5	4.50E-05	0.0000031	2.50E-06	3.90E-04	3.90E-04
1,2,3,4,7,8,9- Heptachlorodibenzofuran (1,2,3,4,7,8,9-HpCDF)	55673-89-7	0.0000778	5E-5	4.50E-04	0.0000095	2.50E-06	3.90E-03	3.90E-03
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	39001-02-00	0.0000388	1E-4	4.50E-03	0.0000041	5.00E-06	3.90E-02	3.90E-02
Total Tetrachlorodibenzodioxin (Total TCDD)		NA	1E-5	4.50E-07			3.90E-06	3.90E-06
Total Pentachlorodibenzodioxin (Total PCDD)		NA	5E-5	4.50E-07			3.90E-06	3.90E-06
Total Hexachlorodibenzodioxin (Total HxCDD)		NA	5E-5	4.50E-06			3.90E-05	3.90E-05
Total Heptachlorodibenzodioxin (Total HpCDD)		NA	5E-5	4.50E-05			3.90E-04	3.90E-04
Total Tetrachlorodibenzofuran (Total TCDF)		NA	1E-5	4.50E-06			3.90E-05	3.90E-05
Total Pentachlorodibenzofuran (Total PCDF)		NA	5E-5	9.00E-06			7.80E-05	7.80E-05
Total Hexachlorodibenzofuran (Total HxCDF)		NA	5E-5	4.50E-06			3.90E-05	3.90E-05
Total Heptachlorodibenzofuran (Total HpCDF)		NA	5E-5	4.50E-05			3.90E-04	3.90E-04
MISCELLANEOUS PARAMETERS								
Cyanide (SW-846 Method 9012A)	74-90-8	0.74 (mg/L)	10(ug/L)	5.2(mg/L)	0.1	1	1.33	0.0001
Nitrate/Nitrite (EPA 353.2)	NA	2(ug/L)	10(ug/L)	10000 (nitrate)(ug/L)	ANR	ANR	--	--
Hardness (Standard Methods 2340B)	NA	---	1000(ug/L)	--	ANR	ANR	--	--
Total Suspended Soilds (EPA 160.1)	NA	---	2000(ug/L)	--	ANR	ANR	--	--
Total Organic Carbon (TOC) (EPA 415.1)	NA	350	1000	--	---	1000	--	--
pH (SW-846 Method 9045C)	NA	ANR	ANR	--	---	1(S.U.)	--	--
CEC (SW-846 Method 9081)	NA	ANR	ANR	--	---	6 meq/100g	--	--

MDL = method detection limit
RL = reporting limit
µg/L = micrograms per liter.
mg/kg = milligrams per kilogram.
mg/L = milligrams per liter.
NA = Not Applicable
ANR = Analysis Not Required

Shaded cells indicate laboratory MDLs that exceed a risk-based target level for the project.
Shaded cells indicate laboratory RLs that exceed a risk-based target level for the project.

1. Value is based on the lowest human health or ecological risk-based criteria as presented in Appendix C.
2. Risk-based target level is not provided because human and ecological risk-based criteria are not available for this parameter.
3. Thesse are not Appendix 9 metals. They are being analyzed for general water quality information.
   They are not to be included in the screening process; therefore, no criteria are listed.
4. 3-Methylphenol and 4-methylphenol coelute; therefore, one analytical result for 3-, 4-methylphenol will be reported.
5. N-Nitrosodiphenylamine is more toxic than diphenylamine.
   However, n-nitrosodiphenylamine rapidly degrades to diphenylamine.
   Therefore, only diphenylamine will be reported, but results for diphenylamine will be treated as n-nitrosodiphenylamine during risk assessment.
6. MDL and/or RL from the laboratory is not available.
7. These reporting limits are estimated only, as Laucks Testing Laboratory has not developed analysis on soils via this method for the analyte.

approved Work Plan (TtNUS, April 1999). Specific subsections and figures of the approved Work Plan, where detailed information can be found, are referenced, as appropriate.

1.2.1 Location

The NSWC Crane, Indiana, is a Naval facility located in southwestern Indiana. It is located 75 miles southwest of Indianapolis, Indiana and 71 miles northwest of Louisville, Kentucky (Figure 3-1 of the Work Plan). NSWC Crane covers approximately 62,463 acres (approximately 100 square miles) of the northern portion of Martin County and a small portion of neighboring Greene, Davies, and Lawrence Counties. Figure 3-2 in the attendant Work Plan depicts the location of the Facility as well as the specific locations of SWMUs 4, 5, 9 and 10.

SWMU 4, McComish Gorge is located in the northwest corner of the Facility. The site is approximately 500 feet south of the Crane Gate, Gate No. 4. McComish Gorge is located in the northeast one-fourth of Section 7, Township 5N, Range 4W of the Scotland, Indiana topographic quadrangle.

SWMU 5, Old Burn Pit is located in the northwest corner of the Facility. The area is approximately 2,000 feet east of the Crane Gate, Gate No. 4. The Old Burn Pit is located in the northeast one-fourth of Section 8, Township 5N, Range 4W of the Scotland, Indiana topographic quadrangle.

SWMU 9, Pesticide Control/R-150 Tank Area is located in the central portion of the Facility in the northwest one-fourth of Section 23, Township 5N, Range 4W of the Indiana Springs, Indiana topographic quadrangle.

SWMU 10, Rockeye is located on a flattened ridge crest that separates Sulphur Creek and Boggs Creek in the north central portion of the Facility. The site is approximately 2 miles south of North Gate No. 1. Rockeye lies in the southeast one-fourth of Section 5, Township 5N, Range 3W of the Koleen, Indiana topographic quadrangle.

1.2.2 Facility Size and Borders

NSWC Crane covers approximately 62,463 acres (approximately 100 square miles) in a rural, sparsely populated area. The acreage surrounding the Facility is primarily wooded or farmed land. The majority of NSWC Crane is covered by forest.

SWMU 4, McComish Gorge occupies approximately 5 acres in the northwest corner of the facility. The area is heavily vegetated. Figure 5-1 in the attendant Work Plan shows the site map for McComish Gorge.

SWMU 5, Old Burn Pit occupies approximately 25 acres. The former burn pit area is used as a parking area for delivery trucks. The remainder of the site is vegetated. Figure 6-1 in the attendant Work Plan presents the site map for the Old Burn Pit.

SWMU 9, Pesticide Control/R-150 Tank Area consists of three distinct areas: the former locations of Building 55, Building 2189, and an underground storage tank. The entire site (including space between the three distinct areas where historical operations did not occur) occupies approximately 11 acres. Several gravel parking lots are located at the site. Figure 7-1 in the attendant Work Plan presents the site map for the Pesticide Control/R-150 Tank Area.

SWMU 10 - Rockeye is a 10-acre site located on a flattened ridge crest that separates Sulphur Creek and Boggs Creek in the north central portion of the Facility. The site contains a variety of buildings and is vegetated around the perimeter and drainage ways. Buildings at Rockeye are located on Highways 491, 490, 489 and 161. Figure 8-1 in the attendant Work Plan presents the site map for Rockeye.

1.2.3 Natural and Manmade Features

Natural and manmade features for each SWMU are described in Sections 5.0 through 8.0 of the Work Plan. The primary natural stresses that created site features are from erosion and siltation. Manmade stresses that generated site features are from land clearing, logging and timber management, fires of manmade origin, and munitions-related stresses.

1.2.4 Topography

The topography at NSWC Crane consists of undulating terrain dissected by many small drainage ways. The elevation of the site ranges from 490 feet above mean sea level (MSL) at a southern drainage way to 860 feet MSL on a ridge in the west-central portion of the site. Several V-shaped drainage ways in the north progress to 2,000-foot-wide floodplains in the south and rise to approximately 150 to 200 feet to the ridgelines.

The following sections in the approved Work Plan present information on the local topography for each of the SWMUs: McComish Gorge (SWMU 4), Section 5.2.1; Old Burn Pit (SWMU 5), Section 6.2.1; Pesticide Control/R-150 Tank Area (SWMU 9), Section 7.2.1; and Rockeye (SWMU 10), Section 8.2.1.

1.2.5 Local Hydrology and Hydrogeology

Six creeks receive drainage in five separate drainage basins at NSWC Crane. The six creeks are: Furst Creek, Sulphur Creek, Little Sulphur Creek, Boggs Creek, Turkey Creek, and Seed Tick Creek. Surface drainage from NSWC Crane eventually empties into the east fork of the White River, south of the facility. Situated within Crane are Lake Greenwood and several ponds. Lake Greenwood is the main source of water at NSWC Crane and also is used for recreation. None of the surface water from the four SWMUs drains directly into Lake Greenwood. SWMU 4 and 5 drain into Furst Creek; SWMU 9 drains into Boggs Creek; and SWMU 10 drains into Sulphur Creek, Furst Creek, and Turkey Creek.

The following sections in the approved Work Plan present information on the local hydrology for each of the SWMUs: McComish Gorge (SWMU 4), Section 5.2.1; Old Burn Pit (SWMU 5), Section 6.2.1; Pesticide Control/R-150 Tank Area (SWMU 9), Section 7.2.1; and Rockeye (SWMU 10), Section 8.2.1.

Information on the hydrogeology of the site is located in Section 3.0 of the approved Work Plan. In general, aquifers beneath NSWC Crane are considered to be vertically separate from each other by interlayered shale beds that act as aquitards. Ground water recharge occurs where aquifer units outcrop. After entering an aquifer outcrop, ground water flows by gravity down the dip of the aquifer unit. The following sections in the approved Work Plan present information on the local hydrogeology for each SWMU: McComish Gorge (SWMU 4), Section 5.2.3; Old Burn Pit (SWMU 5), Section 6.2.3; Pesticide Control/R-150 Tank Area (SWMU 9), Section 7.2.3; and Rockeye (SWMU 10), Section 8.2.3.

The locations of each SWMU relative to Lake Greenwood coupled with local and regional ground water flow directions indicate that ground water from the four SWMUs does not discharge to Lake Greenwood, the principal water supply for NSWC Crane.

1.2.6 Surrounding Land Use

The area surrounding NSWC Crane is comprised of woodlands and small farms. The populace is served by the towns of Odon, Loogootee, and Bedford in Daviess, Martin and Lawrence counties, respectively. Details of the surrounding land use are provided in Section 3.0 of the Work Plan and in the human health risk assessment methodology section of the Work Plan, Section 10.0.

1.2.7 Ecological Communities and Habitats

Eighty percent of NSWC Crane's 63,000 acres is classified as Central Hardwoods Forest of the United States. Some old agricultural fields are in various stages of biological succession. Openings on dry upland sites contain almost pure strands of grasses with some clumps of woody plants. About 2 percent of the area has been planted with pines to stabilize the soil.

A great variety of habitats is present at NSWC Crane. Many forest animals need several habitats to complete their life cycles. At NSWC Crane, this variety is supplied by the many stages of forest succession, streams, ponds, Lake Greenwood, and grassy open spaces, all of which support a high diversity of animal species.

None of the local plant species present at NSWC Crane are known to be listed as threatened or endangered. No threatened or endangered aquatic, reptilian, amphibian, or avian species have been observed at the site. Only one mammalian species, the Indiana Bat, is listed as endangered by the Federal government and is a potential inhabitant at NSWC Crane. Details of the ecological setting are provided in the ecological risk assessment methodology section of the Work Plan, Section 11.0.

1.3 FACILITY HISTORY

This section contains a brief summary of the general history of NSWC Crane and SWMUs 4, 5, 9, and 10.

1.3.1 General History

The facility was opened in 1941 as the Naval Ammunition Depot, Burns City, to serve as an inland munitions production and storage center. The name was changed in 1975 to the Naval Weapons Support Center and in 1992 to Naval Surface Warfare Center (NSWC) Crane. The Department of Defense (DOD) ammunition procurement responsibilities were transferred to the Army in 1977. The Army has assumed ordnance production, storage, and related responsibilities under the single service management directive. All environmental activities on the installation, including permitting activities, remain the responsibility of the Navy.

1.3.1.1 SWMU 4 - McComish Gorge

McComish Gorge is a dumpsite that was used for an unknown period of time between 1942 and 1972. Rubbish and trash were disposed of at the site. Section 5.0 of the attendant Work Plan contains information regarding the history of McComish Gorge.

1.3.1.2 SWMU 5 - Old Burn Pit

From 1942 to 1972 rubbish and industrial wastes were burned at the Old Burn Pit. Ash from burning operations and metal debris were placed in the gully north of the burn pit area. Section 6.0 of the attendant Work Plan contains information regarding the history of the Old Burn Pit.

1.3.1.3 SWMU 9 - Pesticide Control/R-150 Tank Area

SWMU 9, Pesticide Control/R-150 Tank Area consists of the former location of two buildings (Buildings 55 and 2189) and an underground storage tank. Pesticide management operations (i.e., storage and rinsing activities) occurred at Buildings 55 and 2189. The underground storage tank was used for the storage of spent solvents. Section 7.0 of the attendant Work Plan contains information regarding the history of Pesticide Control/R-150 Tank Area.

1.3.1.4 SWMU 10 - Rockeye

Rockeye is a munitions production facility and not a storage, treatment, or disposal site. The site has been used as a press-loading facility for projectiles and as a case-filling facility for Rockeye cluster bombs. Section 8.0 of the attendant Work Plan contains information regarding the history of Rockeye.

1.3.2 Past Data Collection Activities

The first investigation conducted for SWMUs 4, 5, 9, and 10 was the IAS. The IAS began in April 1981 in response to the NACIP Program and was completed in May 1983 by NEESA with assistance from the Ordnance Environmental Support Agency and the USACE WES. The intent of the IAS was to identify and assess sites posing a potential threat to human health and the environment from past hazardous materials operations. These studies primarily addressed ground water quality. Although none of the sites investigated were determined to represent immediate human health and environmental threats, 14 of the sites included in the IAS were recommended for further study to evaluate potential long-term impacts. SWMUs 4, 5, 9, and 10 were among the 14 sites recommended for further investigation.

In 1989 NSWC Crane was given a final RCRA Part B Permit. The permit contained corrective action requirements to be conducted at its SWMUs. In response to the recommendation included in the IAS and the Corrective Action requirements in the Part B Permit, Phase II RFIs for the characterization of site soils were performed at the four SWMUs. Based on results of the RFI Phase II soils studies, Phase III ground water studies were conducted at SWMUs 4, 5, 9, and 10.

Details of the investigations previously conducted for each SWMU are provided in Sections 5.0 through 8.0 of the approved Work Plan. Tables 5-1, 6-1, 7-1 and 8-1 of the approved Work Plan present a summary of the historical investigations for each SWMU.

1.3.3 Current Status

Based on the reports and documents reviewed for SWMUs 4, 5, 9, and 10, it has been determined that there was a release of hazardous constituents to the environment from past site operations. Comparisons of the historical data with human health and ecological risk-based screening criteria suggest that the magnitude and persistence of these releases may pose an "unacceptable" risk to current and future potential receptors, who may come in contact with potentially contaminated site media.

The following sections present a summary of the evaluation of the historical data compared with current human health and ecological risk-based screening criteria. Based on this evaluation, the following detected chemicals of interest (target constituents) and source area release mechanisms have been used to focus the proposed field investigation. Details of the data evaluations and conclusions are presented in Sections 5.0 through 8.0 of the approved Work Plan.

1.3.3.1 SWMU 4 - McComish Gorge

McComish Gorge was used as a dumpsite from 1942 through 1972. Currently, the site is inactive and has been revegetated. Municipal garbage and industrial rubbish was disposed at this site. Additionally, small arms ammunition may have been buried at the site. Based on previous field investigations, inorganics, semivolatile organics compounds (SVOCs), and explosives have most likely been released to the surrounding soil. Releases of volatile organic compounds (VOCs), herbicides, and polychlorinated biphenyls (PCBs) have not occurred based on the soil data collected from the site. In ground water, various organics and inorganics were detected; however, it is anticipated that only the inorganics are a result of a release from past waste disposal activities.

The following constituents are detected chemicals of interest (i.e., chemicals reported at concentrations that exceed risk-based screening criteria) for soil and ground water at McComish Gorge:

- Soil: 2,4-Dinitrotoluene, 2,6-dinitrotoluene, N-nitrosodiphenylamine, 4,4'-DDT, and various inorganics

- Ground Water: Benzene, cis-1,3-dichloropropene, trans-1,3-dichloropropene, alpha-chlordane, gamma-BHC, heptachlor, toxaphene, Aroclor-1254, and various inorganics.

Because of the uncertainty associated with the historical analytical data, all constituents reported at concentrations that exceed risk-based screening criteria, except suspected blank contaminants, were included in the list of detected chemicals of interest for the site. This list was used to develop appropriate chemical categories to be included in the analytical program for the proposed field investigation.

Supporting details for the conclusions regarding detected chemicals of interest for McComish Gorge are presented in Section 5.4 of the attendant Work Plan. A summary of the proposed investigation for SWMU 4 is presented in Table 5-5 of the Work Plan.

1.3.3.2 SWMU 5 - Old Burn Pit

The Old Burn Pit was used from 1942 to 1972 to burn rubbish. No explosives were burned at the site. Since 1972 the site has been revegetated. Currently, the site is inactive and the former burn pit area is used as a parking area for delivery trucks. Previous investigations at the site indicate the potential release of halogenated VOCs, pesticides, and PCBs to the ground water. Both inorganics and SVOCs (i.e., polynuclear aromatic hydrocarbons [PAHs]) were found in the soil samples collected from the site.

The following constituents are detected chemicals of interest (i.e., chemicals reported at concentrations that exceed risk-based screening criteria) for soil and ground water at the Old Burn Pit:

- Soil: 1,1,2,2-Tetrachloroethane, chloroform, cis-1,2-dichloroethene, trichloroethene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-cd)pyrene, naphthalene, aldrin, 4,4'-DDT, dieldrin, endrin, and various inorganics

- Ground Water: 1,1-Dichloroethene, 1,2-dichloropropane, benzene, chloroform, cis-1,2-dichloroethene, trans-1,2-dichloroethene, trichloroethene, vinyl chloride, 2,4,5-TP, 4,4'-DDD, 4,4'-DDE, alpha-chlordane, Aroclor-1254, beta-BHC, ensdosulfan II, endrin, endrin aldehyde, gamma-chlordane, heptachlor, and various inorganics.

Because of the uncertainty associated with the historical analytical data, all constituents reported at concentrations in excess of risk-based screening criteria, except suspected blank contaminants, were included in the list of detected chemicals of interest for the site. This list was used to develop appropriate chemical categories to be included in the analytical program for the proposed field investigation.

Supporting details for the conclusions regarding detected chemicals of interest are presented in Section 6.4 of the attendant Work Plan. A summary of the proposed investigation for SWMU 5 is presented in Table 6-5 of the Work Plan.

1.3.3.3 SWMU 9 - Pesticide Control/R-150 Tank Area

The Pesticide Control/R-150 Tank Area consists of the former location of Buildings 55 and 2189 and an R-150 (underground storage) Tank. Storage and management of pesticides and herbicides, as well as rinsing of pesticide/herbicide applicators (e.g., sprayers) was conducted at Buildings 55 and 2189. These buildings have been demolished. Currently, only the concrete foundations from the two buildings exist. The R-150 Tank, which was used to store waste solvents, has also been removed from the site. During the excavation of the tank, contaminated soil surrounding the tank was taken offsite for disposal. Previous investigations at the site indicate the potential release of chlorinated VOCs, pesticides, PCBs, and inorganics to the ground water. PAHs, pesticides, herbicides, inorganics, and total petroleum hydrocarbons (TPH) were found in the soil samples collected from the site.

The following constituents are detected chemicals of interest (i.e., chemicals reported at concentrations that exceed risk-based screening criteria) for soil and ground water at the Pesticide Control/R-150 Tank Area:

- Soil: Anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, pyrene, 4,4'-DDT, aldrin, alpha-BHC, beta-BHC, dieldrin, dinoseb, disulfoton, endrin aldehyde, heptachlor, methoxychlor, methyl parathion, phorate, Aroclor-1242, Aroclor-1254, various inorganics, and TPH

- Ground Water: Benzene, cis-1,2-dichloropropene, trans-1,3-dichloropropene, 1,1,1-trichloroethene, 1,1,2,2-tetrachloroethane, 1,1-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethane, 1,2-dichloroethenes (cis- and trans-), tetrachloroethene, trichloroethene, vinyl chloride, 4,4'-DDD, 4,4'-DDT, alpha-chlordane, Aroclor-1254, beta-BHC, endosulfan II, heptachlor, and various inorganics.

Because of the uncertainty associated with the historical analytical data, all constituents reported at concentrations that exceed risk-based screening criteria, except suspected blank contaminants, were included in the list of detected chemicals of interest for the site. This list was used to develop appropriate chemical categories to be included in the analytical program for the proposed field investigation.

Supporting details for the conclusions regarding detected chemicals of interest are presented in Section 7.4 of the attendant Work Plan. A summary of the proposed investigation for SWMU 9 is presented in Table 7-5 of the Work Plan.

1.3.3.4 SWMU 10 - Rockeye

Rockeye is a production facility that was formerly a press-loading operation for 3-inch projectiles. The facility was later converted to a case-filling operation to produce Rockeye cluster bombs. A variety of explosive materials were used at the site. Previous investigations indicate that explosives and explosives-related chemicals were released to the soil and ground water. However, based on the conclusions of the previous site investigations, other organic and inorganic constituents detected at the site are not attributable to past site operations.

The following constituents are detected chemicals of interest (i.e., chemicals reported at concentrations that exceed risk-based screening criteria) for soil and ground water at Rockeye:

- Soil: N-nitrosodiphenylamine, aniline, dinitrotoluenes (2,4- and 2,6-), 2,4,6-trinitrotoluene, HMX, and RDX

- Ground Water: Dinitrotoluenes (2,4- and 2,6-), 2,4,6-trinitrotoluene, and RMX

Because of the uncertainty associated with the historical analytical data, all constituents reported at concentrations that exceed risk-based screening criteria, except suspected blank contaminants, were included in the list of detected chemicals of interest for the site. This list was used to develop appropriate chemical categories to be included in the analytical program for the proposed field investigation.

Supporting details for the conclusions regarding detected chemicals of interest are presented in Section 8.4 of the attendant Work Plan. A summary of the proposed investigation for SWMU 10 is presented in Table 8-7 of the Work Plan.

1.4 PROJECT OBJECTIVES

The development of the data quality objectives (DQOs) for the entire Contract Task Order (CTO) is presented in Section 4.0 of the attendant Work Plan. The specific investigative objectives for each SWMU are presented in Sections 5.5, 6.5, 7.5, and 8.5 of the Work Plan. A summary of analyses to be conducted per media per SWMU is presented on Table 1-2.

This section provides an explanation of the project objectives for the field and laboratory investigations for SWMUs 4, 5, 9, and 10. A summary of the specific objectives and associated tasks is presented in Section 1.4.1. Project target parameters and intended data uses are listed in Section 1.4.2. A review of the historical data and its impact on the DQOs is presented in Section 1.4.3.

1.4.1 Specific Objectives and Associated Tasks

For this project, it will be necessary to gather sufficient information to achieve the following general objectives:

- Refine the SWMU-specific conceptual risk model for potential human and ecological receptors exposed to site media under current and future land use;
- Refine the list of constituents of interest for each SWMU;
- Calculate representative SWMU-specific exposure point concentrations for the defined current/future human and ecological receptors; and
- Assess the overall risk to current/future human and ecological receptors based on the detected levels of constituents present in environmental media at each SWMU.

Specific DQOs for each SWMU are presented in Tables 5-5, 6-5, 7-5, and 8-7 of the attendant Work Plan.

To accomplish these goals, a confirmational level of analytical quality is needed. This provides the highest level of data quality necessary to address potential human and ecological risks. These analyses require full documentation of the chosen U.S. EPA , Standard Method, or U.S. EPA SW-846 analytical methods and sample preparation steps, data packages, and data validation sufficient to provide defensible data. QC must be sufficient to define the precision and accuracy of these procedures at every step.

TABLE 1-2

SUMMARY OF ANALYSIS PER MEDIA AND SWMU
NSWC CRANE, INDIANA

Site	Matrix	Chemical Category								
		Appendix IX VOCs	Appendix IX SVOCs	Appendix IX Pesticides/PCBs Herbicides	Appendix IX Dioxins/Furans	Energetics	Metals[1]	Cyanide	Nitrate/ Nitrite	Other Miscellaneous Parameters[2]
SWMU 4 - McComish Gorge	Soil	X	X	X			X	X		X
	Sediment	X	X	X			X	X		X
	Surface Water	X	X	X			X[3]	X[3]		X
	Ground Water	X	X	X			X	X		
SWMU 5 - Old Burn Pit	Soil	X	X	X	X		X	X		X
	Sediment	X	X	X	X		X	X		X
	Surface Water	X	X	X	X		X[3]	X[3]		X
	Ground Water	X	X	X	X		X	X		
SWMU 9 - Pesticide Control/ R-150 Tank Area	Soil	X	X	X			X			X
	Sediment	X	X	X			X			X
	Surface Water	X	X	X			X[3]			X
	Ground Water	X	X	X			X			
SWMU 10 - Rockeye	Soil		X			X	X	X		X
	Sediment					X	X	X		X
	Surface Water					X	X[3]	X[3]	X	X
	Ground Water	X				X	X	X	X	

CEC Cation exchange capacity

TSS Total suspended solids
TOC Total organic carbon

1. Metals include Appendix IX metals and the following miscellaneous metals: calcium, iron, manganese, magnesium, potassium, and sodium.
2. Miscellaneous parameters include the following: Surface water - TSS and hardness; Soil - pH, CEC, and TOC; and Sediment - TOC.
3. Analysis will be conducted for both total and dissolved sample matrices.

1.4.2 Project Target Parameters and Intended Data Uses

The list of target parameters for the project is included in Table 1-1. Field measurements and laboratory data will be obtained for SWMUs 4, 5, 9, and 10 to meet the project objectives outlined in the Work Plan (Tables 5-5, 6-5, 7-5, and 8-7). Laboratory data will be compared with human health and ecological risk-based criteria, with the ultimate objective of determining whether detected constituents are present in the SWMU-specific media at concentrations that may pose an adverse impact to human and ecological receptors. The list of specific risk-based criteria used and compared to the laboratory limits is presented in Appendix A of this QAPP. Historical data were used to identify detected parameters of interest for each SWMU. This list was used to develop the target parameters for the project.

1.4.2.1 Field Parameters

The field parameters to be collected at each SWMU are listed in Tables 5-5, 6-5, 7-5, and 8-7 of the approved Work Plan. The proposed field parameters include HNu readings for soil. Soils collected from a boring will be scanned for potential contamination. In general, collated surface and subsurface soil samples will be collected, to a maximum depth of 10 feet below ground surface (bgs). The top interval (i.e., surface soil; 0 to 2 feet bgs) will be analyzed for each boring. A subsurface soil interval associated with the highest HNu reading will also be selected for chemical analysis.

The following are field parameters for ground water: dissolved oxygen, pH, specific conductivity, temperature, turbidity, oxidation-reduction potential and water level measurements. This information will be used to ensure that well water is equivalent to formation water (i.e., ensure the integrity of the sample). Also, these data will provide general water quality information.

1.4.2.2 Laboratory Parameters

Table 1-1 provides a list of the laboratory parameters. This list of parameters includes the RCRA Appendix IX constituents, as well as explosives and some miscellaneous parameters. In general, the list of chosen analytical methods is composed of U.S. EPA SW-846 methods. Specific chemicals to be included in each analytical fraction, as well as identification of the analytical methods to be used, are presented in Table 1-1. Further information regarding analytical methods, including references, is provided in Section 7.0 of this QAPP.

Also included in Table 1-1 are the project-specific risk-based target levels and laboratory-specific method detection limits (MDLs; all parameters except metals), instrument detection limits (IDLs; metals only), and

reporting limits (RLs) for the target parameters and chosen analytical methods. The risk-based target criteria presented in Table 1-1 are based upon the lowest applicable current human health and ecological risk-based criteria. A tabular presentation of the human health and ecological risk-based criteria used as a basis for determining the target levels is provided in Appendix A of this QAPP. The following lists provide a summary of the types of risk-based target criteria used for this project:

Aqueous Matrix:

- Federal Maximum Contaminant Levels (MCLs)
- U.S. EPA Region 9 Preliminary Remediation Goals (PRGs) for Tap Water
- Federal Ambient Water Quality Criteria (AWQC) for Freshwater
- Indiana Department of Environmental Management (IDEM) Tier I Default Cleanup Level
- U.S. EPA Region 5 EDQLs for Surface Water

Solid Matrix:

- U.S. EPA Soil Screening Level (SSL) for Ingestion
- U.S. EPA SSL for Inhalation
- U.S. EPA SSL for Migration to Ground water
- U.S. EPA Region 9 PRGs for Residential Land Use
- IDEM Tier I Surface Soil Default Cleanup Level for Residential Land Use
- IDEM Tier I Subsurface Soil Default Clean Levels for Residential Land Use
- U.S. EPA Region 5 EDQLs for Soil
- U.S. EPA Region 5 EDQLs for Sediment

Based on the limitations of the best available analytical technology, RLs for some analytes could not reach the risk-based levels. Section 1.4.3 (Risk-Related Issues) presents the chemical-specific rationales as to the validity of using the technology-based RL, as well as the impact of the historical data on the selection of analytical methods and reporting limits.

1.4.3 Risk-Related Issues

TtNUS worked closely with the subcontracted analytical laboratory to select and optimize analytical methods in an effort to attain, to the greatest extent possible, laboratory RLs at concentrations less than or equal to the risk-based target levels. For example, as noted on Table 1-1, analysis for PAHs will be

performed using SW-846 Method 8270C with selective ion monitoring (SIM) to achieve lower RLs at concentrations less than respective target levels for PAHs. Other examples of steps taken to achieve lower RLs include the use of SW-846 Method 6020 (Inductively Coupled Plasma/Mass Spectrometry [ICP/MS]) in place of SW-846 Method 6010B (ICP/Atomic Emission Spectroscopy) for the Appendix IX metals and the use of a 25 mL sample volume for VOC analysis by SW-846 Method 8260B.

As noted above, based on the limitations of best available technology, RLs for some analytes still do not meet the associated risk-based target levels. These laboratory RLs are shaded in Table 1-1. The following paragraphs summarize the rationale for using the analytical methods established in this QAPP and presented in Table 1-1. The rationale for each matrix is presently separately. The comments noted in the general section apply to all environmental matrices.

GENERAL

The laboratory RLs for a limited number of dioxins and furans exceed the associated risk-based target levels. Dioxins/furans are included in the analytical program for only the Old Burn Pit. Analyses for these chemicals were included because low levels (i.e., levels less than the screening criteria) of PCBs were found and because burning activities occurred at the site. The combination of the presence of the Aroclor-1254 in the soil at the site and burning activities may indicate the potential for a release of dioxins/furans. Since dioxins/furans are relatively immobile in soil, they would not be expected to leach to ground water (U.S. EPA, February 1984); therefore, dioxins/furans are not expected to be present in site ground water. Dioxins/furans are not associated with explosives and burning did not occur at SWMUs 4, 9 and 10. Therefore, dioxins/furans are not expected to be present at these other SWMUs based on site history. The analytical method and RLs presented in Table 1-1 will be used for this project. The absence of dioxins/furans will be confirmed by the non-detection of these constituents at the RL listed in Table 1-1.

N-nitrosodiphenylamine is more toxic than diphenylamine to human and ecological receptors. N-nitrosodiphenylamine, however, rapidly degrades in the analytical system to diphenylamine (SW-846 Method 8270C). Consequently, only diphenylamine will be reported in the analytical data. The results of diphenylamine will be treated as N-nitrosodiphenylamine in the risk assessment. The uncertainty associated with N-nitrosodiphenylamine will be addressed in the risk assessment. N-nitrosodiphenylamine was identified as a detected chemical of interest for soil at SWMUs 4 and 10.

SOIL

In general, the lowest risk-based target criteria for soil are either the U.S. EPA Region 5 EDQL for soils or the U.S. EPA SSL for migration to ground water. The risk-based target criteria for direct contact with soil under residential land use are typically greater than the MDLs/RLs. The U.S. EPA Region 9 residential soil risk-based target criteria for the following constituents are less than the MDLs/RLs:

- 1,2,3-Trichloropropane
- 3,3'-Dimethylbenzidine
- Arsenic
- Bis(2-chloroethyl)ether
- Kepone
- N-nitrosodi-n-butylamine
- N-nitrosodiethylamine
- N-nitrosodimethyamine
- N-nitrosodi-n-propylamine
- N-nitrosomethylethylamine
- N-nitrosopyrrolidine
- Tetraethyl dithiopyrophosphate

As shown on Tables 5-1, 6-1, 7-1 and 8-1 in the Work Plan, these constituents were not identified as chemicals of interest for SWMUs 4, 5, 9, and 10 and would not be expected to be related to known historical practices at the sites. Various inorganics including arsenic were identified as constituents of concern for several of the SWMUs. Although the reporting limit (RL) for arsenic is greater than the screening criteria, the method detection limit (MDL) is an order of magnitude less. Therefore, results of arsenic below the RL but greater than the MDL may be used to evaluate arsenic. Therefore, these constituents will be analyzed via the proposed methods with MDLs/RLs that are slightly greater than the associated risk-based screening criteria. The absence of these constituents at these four SWMUs will be confirmed by the non-detection of these constituents at the RLs presented in Table 1-1.

As shown on Table 1-1, the soil matrix MDLs/RLs for seven inorganics (i.e., antimony, cadmium, cobalt, lead, mercury, selenium, and vanadium) exceed the associated ecological risk-based target levels, but are less than the human health risk-based target levels. (See Appendix A of this QAPP for human health and ecological risk-based screening criteria.) Although various inorganics were identified as constituents of concern at the SWMUs, the method and field QC blanks associated with the soil samples contained a

variety of inorganic constituents. Consequently, the presence of metals is suspect because of the potential for contamination introduced during sampling and analysis. Additionally, only one mammalian species listed as endangered by the Federal government is potentially present at NSWC Crane. This species is the Indiana bat. Most likely, the low-level risk targets for these constituents were developed for a more susceptible species, and the risk-based target levels for this species would be higher. Therefore, the analytical methods noted in Table 1-1 will be used to analyze for these constituents. The absence of these constituents will be confirmed by a nondetect at the RL listed in Table 1-1.

MDLs/RLs for dioxins and 34 other constituents exceed ecological soil screening criteria. As shown in Tables 5-1, 6-1, 7-1, and 8-1 of the Work Plan, only a limited number of organic constituents were identified as parameters of interest for SWMUs 4, 5, 9, and 10. Many of the constituents with MDLs/RLs greater than the ecological screening criteria are not identified as parameters of interest. Additionally, only one mammalian species listed as endangered by the Federal government is potentially present at NSWC Crane. This species is the Indiana bat. Most likely, the low-level risk targets for these constituents were developed for a more susceptible species, and the risk-based target levels for this species would be higher. Therefore, the analytical methods noted in Table 1-1 will be used to analyze for these constituents. The absence of these constituents will be confirmed by a nondetect at the RL listed in Table 1-1.

MDLs/RLs for 34 organic constituents exceed the soil to ground water risk-based target criteria which was the lowest risk-based screening criteria for soils The aqueous MDLs/RLs for 14 of these constituents are less than the lowest risk-based screening criteria for ground water, indicating that the analytical methods are sufficient to determine whether these chemicals are present at concentrations of concern in ground water. Therefore, if these constituents are chemicals of concern in subsurface soils, then this will be identified based on a review of the ground water data.

MDLs/RLs for the following 20 constituents are greater than the associated lowest ground water screening criteria:

- 1,4-Dichlorobenzene (Less than Federal MCL)
- 1,1,2,2-Tetrachloroethane
- cis-1,3-Dichloroproprene
- 2,4,6-Trichlorophenol
- 3,3'-Dichlorobenzidine
- Bis(2-chloroethyl)ether
- Dieldrin
- 1,1,2-Trichloroethane (Less than Federal MCL)
- 1,1-Dichloroethene (Less than Federal MCL)
- 1,2-Dichloroethane (Less than Federal MCL)
- 1,2-Dichloropropane (Less than Federal MCL)
- Benzene (Less than Federal MCL)
- Carbon tetrachloride (Less than Federal MCL)
- trans-1,3-Dichloropropene

- Hexachlorobenzene
- N-nitrosodi-n-propylamine
- Aldrin
- Vinyl chloride (Less than Federal MCL)
- 2,4-Dinitrophenol
- gamma-BHC (Lindane) (Less than Federal MCL)

These constituents were either not detected or detected infrequently during historical investigations and are not attributable to site activities. None of the aforementioned SVOCs were detected in the surface soil, subsurface soil, or ground water for SWMUs 4, 5, 9 and 10. Of the VOCs identified, methylene chloride was the only constituent found at all four sites in the soil. Although the soil to groundwater screening critiera for methylene chloride (i.e., the lowest value) is less than the RL, the lowest groundwater screening criteria is greater than the aqueous RL. A variety of the VOC constituents were found in groundwater. As shown on Table 1-1 and in Appendix A, most of these constituents have RLs within Federal MCLs. Based on the historical data and historical chemical usage, these constituents will be analyzed via the proposed methods with MDLs/RLs that are slightly greater than the associated lowest risk-based screening criteria. The absence of these constituents at these four SWMUs will be confirmed by the non-detection of these constituents at the RLs presented in Table 1-1.

SEDIMENT

As noted in Table 1-1, MDLs/RLs for a variety of constituents, including one inorganic, 18 VOCs, 70 SVOCs (including four constituents analyzed via SW 846 method 8330), four pesticides, and furans exceed the U.S. EPA Region 5 EDQLs for sediment. During the historical investigative studies, sediments were not sampled. As determined by the historical chemical usage, soil and ground water analytical results from the previous investigations and the fact that these constituents are not typically associated with site practices, many of these obscure Appendix IX constituents are not of concern for SWMUs 4, 5, 9, and 10. As noted in soils, only one mammalian species listed as endangered by the Federal government is potentially present at NSWC Crane. This species is the Indiana bat. Most likely, the low-level risk-based target criteria for these constituents were developed for a more susceptible species and the risk-based target criteria for these species would be higher. Therefore, the analytical methods noted on Table 1-1 will be used to analyzed for these constituents. The absence of these constituents will be confirmed by a nondetect at the RL listed in Table 1-1.

GROUND WATER/SURFACE WATER

MDLs/RLs for the inorganics were less than the Federal MCL human health screening criteria. Arsenic is the only constituent with a MDL/RL greater than the U.S. EPA Region 9 PRGs. Therefore, the aqueous MDLs/RLs for inorganics via SW-846 6020 are adequate to support regulatory decision-making purposes.

The MDL/RL for mercury is greater than the ecological screening criteria. Acrylonitrile and acrolein are the only VOCs that have a MDL/RL that exceeds the ecological screening criteria. The following SVOCs analyzed via SW-846 8270C have a MDL/RL that exceed the USEPA Region 5 ecological DQOs for surface water:

- 1-Naphythylamine
- 2-Chloronaphthalene
- 2-Chlorophenol
- 2,4-Dinitrophenol
- 2,4,6-Trichlorophenol
- 3-Methylcholanthrene
- 4,6-Dinitro-2-methyl phenol
- 4-Bromo phenyl phenyl ether
- Aniline
- Anthracene
- Aramite
- Benzo(a)pyrene
- Benzo(k)fluoranthene
- Chrysene
- Dibenzo(a,h)anthracene
- Diethyl phthalate
- Di-n-butyl phthalate
- Ethyl parathion
- Disulfoton
- Hexachlorobutadiene
- Hexachlorobenzene
- Isodrin
- Kepone
- Pentachlorobenzene
- Pentachloro phenol
- Phorate

MDLs/RLs for the following organochlorine pesticides analyzed via SW-846 8081A exceed the USEPA Region 5 ecological DQOs for surface water:

- alpha-Chlordane
- 4,4'-DDD
- 4,4'-DDE
- 4,4'-DDT
- Dieldrin
- Endosulfan I
- Endosulfan II
- Endrin
- gamma-BHC (Lindane)
- gamma-Chlordane
- Heptachlor
- Heptachlor expoxide
- Methoxychlor
- Toxaphene

PCBs analyzed via SW-846 8082 have a MDL/RL that exceeds the USEPA Region 5 ecological DQOs for surface water. As noted previously, only one mammalian species listed as endangered by the Federal government is potentially present at NSWC Crane. This species is the Indiana bat. Most likely, the low-level risk-based target criteria for these constituents were developed for more susceptible species and the risk-based target criteria for this species would be higher. Therefore, the analytical methods noted on Table 1-1 will be used to analyzed for these constituents. The absence of these constituents will be confirmed by a non-detect at the RL listed in Table 1-1.

MDLs/RLs for 13 VOCs (1,1,1,2-tetrachloroethane, 1,1,2,2-tetrachloroethane; 1,1-dichloroethene; 1,2-dichloroethane; 1,2,3-trichloropropane; 1,2-dibromo-3-chloropropane; 1,2-dibromoethane; acrolein; acrylonitrile, cis-1,3-dichloropropene; trans-1,3-dichloropropene; trans-1,4-dichloro-2-butene; and 1,4-dioxane), 28 SVOCs (1,4-dichlorobenzene; 3,3'-dichlorobenzidine; 3,3'-dimethylbenzidine; 5-nitro-o-toluidine; acetophenone; aramite; benzo(a)anthracene; benzo(b)fluoranthene; bis(2-chloroethyl)ether; bis(2-chloroisopropyl)ether; chlorobenzilate; diallate; dibenzo(a,h)anthracene; disulfoton; kepone; hexachlorobenzene; hexachlorobutadiene; Indeno(1,2,3-cd)pyrene; methyl parathion; n-nitrosodi-n-butylamine; n-nitrosodiethylamine; n-nitrosodimethylamine; n-nitrosodi-n-propylamine; n-nitrosomethylethylamine; n-nitrosopyrrolidine; o-toluidiene; pentachloronitrobenzene, and pentachlorophenol) and three organochlorine pesticides (aldrin, delta-BHC, and dieldrin) exceed the associated human health risk-based target levels. It should be noted that there were several constituents

that are not listed above whose MDLs/RLs exceed the U.S. EPA Region 9 PRGs, but were less than the Federal MCLs (e.g., PCBs, benzo(a)pyrene, and vinyl chloride). Regulatory decisions for these chemicals will be based on the Federal MCLs. As noted above, many of these constituents were not identified as parameters of interest based on the historical data. The absence of these constituents will be confirmed by a nondetect at the RL listed in Table 1-1.

Of the nine VOCs, 1,1,2,2-tetrachloroethane was detected in the ground water at SWMU 9 (detections ranging from 1 to 2 µg/L). Cis-1,3-dichloropropene was detected at SWMU 4 (1 ug/L) and 9 (1 µg/L). Trans-1,3-dichloropropene was found at SWMU 4 (2 µg/L). With the exception of dieldrin, none of the SVOCs or organochlorine pesticides were found in the ground water at SWMUs 4, 5, 9, and 10. Dieldrin was detected only in the Pennsylvanian aquifer in SWMU 10. It was detected three times out of 236 samples. In general, none of these constituents are associated with explosives nor are they expected to be present based on historical chemical use of the site. The absence of these constituents will be confirmed by non-detections at the MDLs/RLs listed in Table 1-1.

Several of the SVOCs noted in Table 1-1 (i.e., disulfoton, methyl parathion, ethyl parathion, famphur and phorate) are organophosphorus pesticides that also could be analyzed by SW-846 Method 8141A. Historically, these chemicals were not identified as parameters of interest. The RLs obtained using SW-846 Method 8270 are sufficient to meet the DQOs for this project. The RL for kepone greatly exceeds the associated screening criteria. Difficulties are associated with the analysis of this chemical. The subcontracted laboratory performed an MDL study for kepone using SW-846 Method 8081 in an attempt to obtain a lower RL. The results for kepone using this method were poor. In fact, SW-846 Method 8081 recommends using SW-846 Method 8270C for the analysis of kepone. As stated in Method 8081, kepone has poor chromatographic performance (i.e., tailing) and there is a significant change in the retention time between the environmental presence and the standard. Kepone is not expected to be present based on the site history. Therefore, it was determined that the RL for this analyte obtained using SW-846 Method 8270C is sufficient to meet the project objectives.

1.5 SAMPLE NETWORK DESIGN AND RATIONALE

Information regarding the sample network and design, as well as the rationale for the proposed sampling, is provided in this section. Since the details for the proposed field investigation are defined in the Work Plan, specific references to associated Work Plan sections are provided.

1.5.1 Sample Network by Task and Matrix

The proposed sample network for SWMUs 4, 5, 9, and 10 is described in Sections 5.0 through 8.0 of the Work Plan. Tables 5-5, 6-5, 7-5, and 8-7 of the Work Plan present summaries of the proposed samples for each SWMU per environmental matrix.

1.5.2 Site Maps of Sampling Locations

The following sections in the approved Work Plan present information on the sampling locations for each SWMU: McComish Gorge (SWMU 4), Section 5.5.2, Figure 5-8; Old Burn Pit (SWMU 5), Section 6.5.2, Figure 6-8; Pesticide Control/R-150 Tank Area (SWMU 9), Section 7.5.2, Figure 7-8; and Rockeye (SWMU 10), Section 8.5.2, Figure 8-10.

1.5.3 Rationale of Selected Sampling Locations

The following sections in the approved Work Plan present information on the rationale for the selection of sampling locations for each SWMU: McComish Gorge (SWMU 4), Section 5.5.2, Table 5-5; Old Burn Pit (SWMU 5), Section 6.5.2, Table 6-5; Pesticide Control/R-150 Tank (SWMU 9), Section 7.5.2, Table 7-5; and Rockeye (SWMU 10), Section 8.5.2, Table 8-7.

1.5.4 Sample Network Summary Table

Tables 3-1, 3-4, 3-6, 3-9, 3-11, 3-14, 3-16, and 3-19 in the attendant FSP presents a summary of the sample network.

1.6 PROJECT SCHEDULE

This section outlines the schedule for field investigation activities at NSWC Crane.

1.6.1 Anticipated Date of Project Mobilization

The earliest date on which samples are planned to be collected is October 16, 2000. Figure 1-1 presents the overall project schedule.

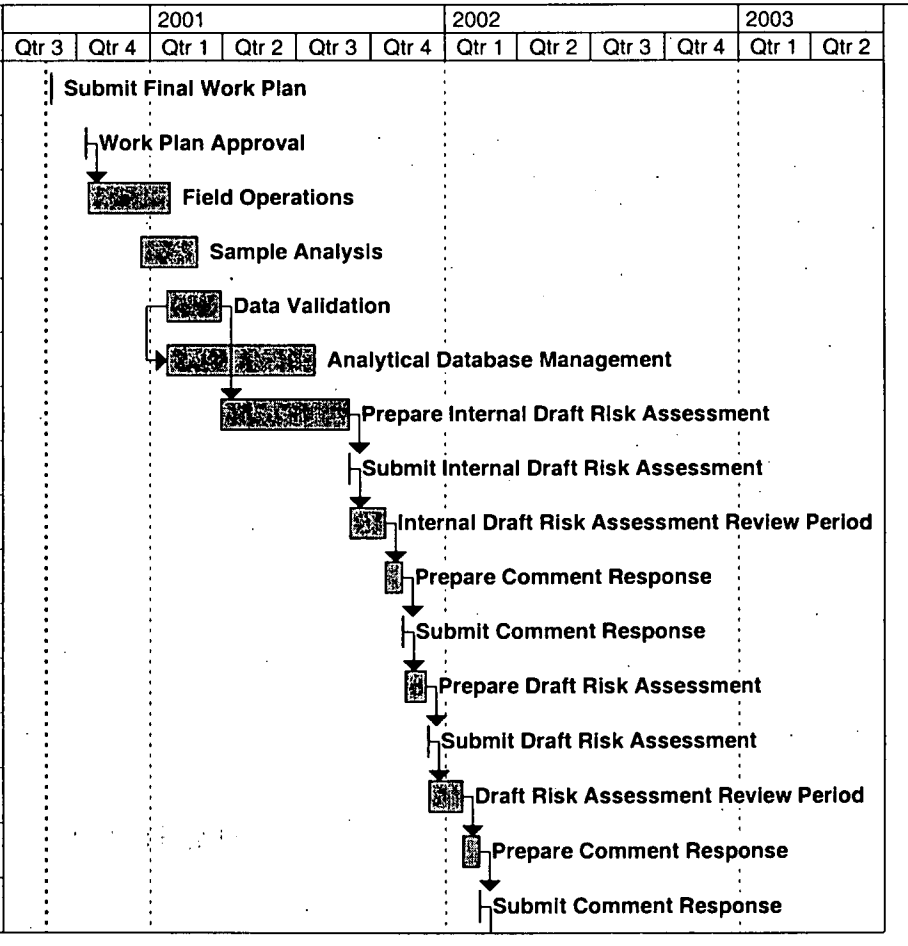
1.6.2 Task Bar Chart and Associated Timeframes

The dates of projected milestones are shown in Figure 1-1.

FIGURE 1-1

SCHEDULE
SWMUs 4, 5, 9, AND 10 RISK ASSESSMENT
NSWC CRANE, INDIANA

ID	Task Name	Duration	Start	Finish
1	Submit Final Work Plan	1 day	Thu 8/31/00	Thu 8/31/00
2	Work Plan Approval	1 day	Fri 10/13/00	Fri 10/13/00
3	Field Operations	74 days	Mon 10/16/00	Thu 1/25/01
4	Sample Analysis	50 days	Thu 12/21/00	Wed 2/28/01
5	Data Validation	49 days	Mon 1/22/01	Thu 3/29/01
6	Analytical Database Management	131 days	Mon 1/22/01	Mon 7/23/01
7	Prepare Internal Draft Risk Assessment	112 days	Fri 3/30/01	Mon 9/3/01
8	Submit Internal Draft Risk Assessment	1 day	Tue 9/4/01	Tue 9/4/01
9	Internal Draft Risk Assessment Review Period	32 days	Wed 9/5/01	Thu 10/18/01
10	Prepare Comment Response	15 days	Fri 10/19/01	Thu 11/8/01
11	Submit Comment Response	1 day	Fri 11/9/01	Fri 11/9/01
12	Prepare Draft Risk Assessment	20 days	Mon 11/12/01	Fri 12/7/01
13	Submit Draft Risk Assessment	1 day	Mon 12/10/01	Mon 12/10/01
14	Draft Risk Assessment Review Period	30 days	Tue 12/11/01	Mon 1/21/02
15	Prepare Comment Response	15 days	Tue 1/22/02	Mon 2/11/02
16	Submit Comment Response	1 day	Tue 2/12/02	Tue 2/12/02

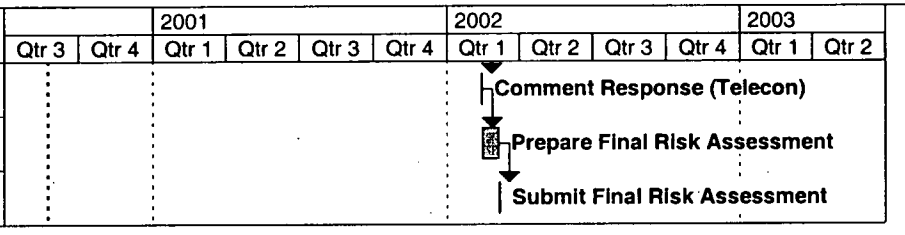


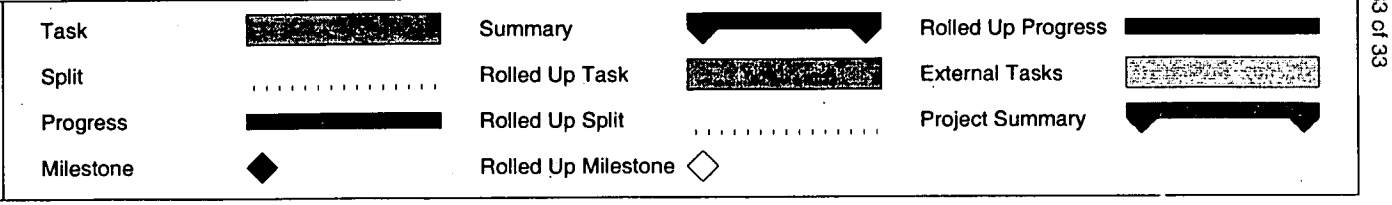
Task	Summary	Rolled Up Progress	
Split	Rolled Up Task	External Tasks	
Progress	Rolled Up Split	Project Summary	
Milestone	Rolled Up Milestone		

FIGURE 1-1

SCHEDULE
SWMUs 4, 5, 9, AND 10 RISK ASSESSMENT
NSWC CRANE, INDIANA

ID	Task Name	Duration	Start	Finish
17	Comment Response Resolution (Telecon)	1 day	Wed 2/13/02	Wed 2/13/02
18	Prepare Final Risk Assessment	15 days	Thu 2/14/02	Wed 3/6/02
19	Submit Final Risk Assessment	1 day	Thu 3/7/02	Thu 3/7/02





2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The project organization for the NSWC Crane field investigation for SWMUs 4, 5, 9, and 10 is provided in Section 2 of the approved Work Plan. A project organization chart is provided, and management, quality assurance, laboratory, and field responsibilities are presented.

3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The overall QA objective for this project is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting that will provide results that are technically sound and legally defensible in a court of law. Intended data uses are described in Section 1.4 of this QAPP and Section 4.0 of the Work Plan. Specific procedures for sampling, chain-of-custody, laboratory instrument calibration, laboratory analysis, reporting of data, internal QC, audits, preventive maintenance of field and laboratory equipment, and corrective action are described in other sections of this QAPP.

The PARCC parameters (precision, accuracy, representativeness, comparability, and completeness) are qualitative and/or quantitative statements regarding the quality characteristics of the data used to support project objectives and, ultimately environmental decisions. These parameters are presented in the remainder of this section. Specific routine procedures used to assess the quantitative parameters (precision, accuracy, and completeness) are provided in Section 12.0.

3.1 PRECISION

3.1.1 Definition

Precision is a measure of the amount of variability and bias inherent in a data set. Precision describes the reproducibility of measurements of the same parameter for samples under similar conditions. The equation for determining precision for this project is provided in Section 12.2.

3.1.2 Field Precision Objectives

Field duplicate precision monitors the consistency with which environmental samples were obtained and analyzed. In general, field duplicate results for aqueous and solid matrix samples are considered to be precise if the relative percent difference (RPD) is less than or equal to 30 percent. Field precision is assessed through the collection and measurement of field duplicates at a rate of 1 duplicate per 10 analytical samples per matrix.

3.1.3 Laboratory Precision Objectives

Precision for organic analyses will be measured via the RPDs for matrix spike/matrix spike duplicate (MS/MSD) samples. Laboratory precision QC samples will be analyzed with a minimum frequency of 5

percent (i.e., 1 QC sample per 20 environmental samples per matrix). Laboratory precision is measured via comparison of RPD values and precision control limits specified in the analytical method or by the laboratory's QA/QC program. In addition, precision for dioxin/furan analysis will be measured via the RPDs for laboratory control sample/laboratory control sample duplicates (LCS/LCSDs). Precision for inorganic analyses will be measured via RPDs for laboratory duplicates. Tables 3-1, 3-3, 3-5, 3-7, 3-9, 3-11, 3-13, 3-14, and 3-15 present precision control limits for MS/MSD, LCS/LCSD, and laboratory duplicate RPDs, as applicable, for each analytical fraction. (Tables 3-2, 3-4, 3-6, 3-8, 3-10, 3-12, and 3-16 present accuracy control limits, which are explained in Section 3.2.)

3.2 ACCURACY

3.2.1 Definition

Accuracy is the degree of agreement between an observed value and an accepted reference value. The equations for determining accuracy for this project are provided in Section 12.1.

3.2.2 Field Accuracy Objectives

Accuracy in the field is assessed through the use of rinsate and trip blanks and is ensured through adherence to all sample handling, preservation, and holding time requirements. Accuracy and precision requirements for field measurements (e.g., pH) are ensured through routine instrument calibration, as presented in Section 2.15.1 of the approved FSP.

3.2.3 Laboratory Accuracy Objectives

Accuracy in the laboratory is measured through the comparison of a spiked sample result with a known or calculated value and is expressed as a percent recovery (%R). Percent recoveries are derived from the analysis of known amounts of compounds spiked into deionized water (i.e., LCS analysis) or into actual samples (i.e., surrogate or MS analysis). LCS analysis, which may also be referred to as blank spike analysis, measures the accuracy of laboratory operations. Surrogate and MS analyses measure the accuracy of laboratory operations as affected by sample matrix. LCS and MS analyses are performed at

TABLE 3-1

QUALITY CONTROL LIMITS[1]
MATRIX SPIKE/MATRIX SPIKE DUPLICATE SAMPLES AND SURROGATE SPIKES
EXPLOSIVES ANALYSES
NSWC CRANE, INDIANA

Chemical	Solid Matrix		Aqueous Matrix	
	Accuracy (%R)	Precision (RPD)	Accuracy (%R)	Precision (RPD)
EXPLOSIVES BY SW-846 METHOD 8330				
1,3,5-Trinitrobenzene	65-152	50	44-142	30
1,3-Dinitrobenzene	65-135	50	32-122	30
2,4,6-Trinitrotoluene	65-138	50	59-114	30
2,4-Dinitrotoluene	65-135	50	42-110	30
2,6-Dinitrotoluene	65-139	50	38-106	30
HMX	64-137	50	10-96	30
2-Nitrotoluene	65-139	50	30-99	30
3-Nitrotoluene	50-144	50	28-105	30
4-Nitrotoluene	32-160	50	31-100	30
4-Amino-2,6-dinitrotoluene	68-139	50	58-117	30
2-Amino-4,6-dinitrotoluene	74-134	50	58-117	30
Tetryl	20-152	50	27-109	30
Nitrobenzene	25-144	50	31-99	30
RDX	65-142	50	47-125	30
Nitroglycerin	30-150[2]	50[2]	30-150[2]	50[2]
PETN	30-150[2]	50[2]	30-150[2]	50[2]
1,2-Dinitrobenzene (surrogate)	60-140	NA[3]	60-140	NA[3]

1 In-house QC limits provided by Laucks Testing Laboratories, Inc.
2 Laucks will perform the preparative extraction for these analytes in the same manner as the remaining analytes but will analyze for them using a 210 wavelength (similar to SW-846 Method 8332) rather than a wavelength of 254. Statistical QC limits will be developed when 20 data points are obtained. The default limits presented will be used until that time.
3 Not applicable.

TABLE 3-2

QUALITY CONTROL LIMITS[1]
LABORATORY CONTROL SAMPLES
EXPLOSIVES ANALYSES
NSWC CRANE, INDIANA

Chemical	Solid Matrix Accuracy (%R)	Aqueous Matrix Accuracy (%R)
EXPLOSIVES BY SW-846 METHOD 8330		
1,3,5-Trinitrobenzene	65-152	52-125
1,3-Dinitrobenzene	65-135	53-122
2,4,6-Trinitrotoluene	65-138	51-134
2,4-Dinitrotoluene	65-135	55-129
2,6-Dinitrotoluene	65-139	49-132
HMX	64-137	29-135
2-Nitrotoluene	65-139	41-140
3-Nitrotoluene	50-144	40-145
4-Nitrotoluene	32-160	39-142
4-Amino-2,6-dinitrotoluene	68-139	60-125
2-Amino-4,6-dinitrotoluene	74-134	61-125
Methyl-2,4,6-Trinitrophenylnitramine	20-152	33-138
Nitrobenzene	25-144	40-134
RDX	65-142	44-125
Nitroglycerin	30-150[2]	30-150[2]
PETN	30-150[2]	30-150[2]

1 In-house QC limits provided by Laucks Testing Laboratories, Inc.

2 Laucks will perform the preparative extraction for these analytes in the same manner as the remaining analytes but will analyze for them using a 210 wavelength (similar to SW-846 Method 8332) rather than a wavelength of 254. Statistical QC limits will be developed when 20 data points are obtained. The default limits presented will be used until that time.

TABLE 3-3

QUALITY CONTROL LIMITS[1]
MATRIX SPIKE AND LABORATORY DUPLICATE SAMPLES
METALS ANALYSES
NSWC CRANE, INDIANA

Chemical	Solid Matrix		Aqueous Matrix	
	Accuracy[2] (%R)	Precision[3] (RPD)	Accuracy[2] (%R)	Precision[3] (RPD)
APPENDIX IX METALS BY SW-846 METHOD 6020 (UNLESS OTHERWISE NOTED)				
Antimony	75-125	20	75-125	20
Arsenic	75-125	20	75-125	20
Barium	75-125	20	75-125	20
Beryllium	75-125	20	75-125	20
Cadmium	75-125	20	75-125	20
Chromium (total)	75-125	20	75-125	20
Cobalt	75-125	20	75-125	20
Copper	75-125	20	75-125	20
Lead	75-125	20	75-125	20
Mercury (SW-846 Method 7070A)	75-125	20	75-125	20
Nickel	75-125	20	75-125	20
Selenium	75-125	20	75-125	20
Silver	75-125	20	75-125	20
Thallium	75-125	20	75-125	20
Tin	75-125	30	75-125	30
Vanadium	75-125	20	75-125	20
Zinc	75-125	20	75-125	20
MISCELLANEOUS METALS BY SW-846 METHOD 6010B				
Aluminum	75-125	20	75-125	20
Calcium	75-125	20	75-125	20
Iron	75-125	20	75-125	20
Magnesium	75-125	20	75-125	20
Manganese	75-125	20	75-125	20
Potassium	75-125	20	75-125	20
Sodium	75-125	20	75-125	20

1 In-house QC limits provided by Laucks Testing Laboratories, Inc.
2 These acceptance limits apply to spikes that augment the native sample analyte concentration by at least 25 percent.
3 These acceptance limits apply to original and duplicate sample concentrations >5x RL. If one or both of the results is <5x RL, the acceptance criterion is ± RL. If one of the results is a non-detect, the reported %RPD will be 200%.

TABLE 3-4

QUALITY CONTROL LIMITS[1]
LABORATORY CONTROL SAMPLES
METALS ANALYSES
NSWC CRANE, INDIANA

Chemical	Solid Matrix Accuracy (%R)[2]	Aqueous Matrix Accuracy (%R)[2]
APPENDIX IX METALS BY SW-846 METHOD 6020 (UNLESS OTHERWISE NOTED)		
Antimony	75-125	75-125
Arsenic	80-120	80-120
Barium	80-120	80-120
Beryllium	80-120	80-120
Cadmium	80-120	80-120
Chromium (total)	80-120	80-120
Cobalt	80-120	80-120
Copper	80-120	80-120
Lead	80-120	80-120
Mercury (SW-846 Method 7470A)	80-120	80-120
Nickel	80-120	80-120
Selenium	80-120	80-120
Silver	75-125	75-125
Thallium	80-120	80-120
Tin	80-120	80-120
Vanadium	80-120	80-120
Zinc	80-120	80-120
MISCELLANEOUS METALS BY SW-846 METHOD 6010B		
Aluminum	80-120	80-120
Calcium	80-120	80-120
Iron	80-120	80-120
Magnesium	80-120	80-120
Manganese	80-120	80-120
Potassium	80-120	80-120
Sodium	80-120	80-120

1 In-house QC limits provided by Laucks Testing Laboratories, Inc.

2 As noted in the laboratory SOPs, the laboratory may use a purchased standard reference material (SRM) in place of a LCS. If a SRM is used, the acceptance limits provided by the supplier of the SRM may be used unless the SRM limits are wider than the acceptance limits provided in this table. If the SRM limits are wider, the laboratory must use the acceptance limits provided in this table.

TABLE 3-5

QUALITY CONTROL LIMITS[1]
MATRIX SPIKE/MATRIX SPIKE DUPLICATE SAMPLES AND SURROGATE SPIKES
VOLATILE ORGANIC COMPOUND ANALYSES
NSWC CRANE, INDIANA
PAGE 1 OF 2

Chemical	Solid Matrix		Aqueous Matrix	
	Accuracy (%R)	Precision (RPD)	Accuracy (%R)	Precision (RPD)
VOLATILE ORGANIC COMPOUNDS BY SW-846 METHOD 8260B				
1,1,1-Trichloroethane	65-135	30	75-125	20
1,1,2,2-Tetrachloroethane	64-135	30	74-125	20
1,1,2-Trichloroethane	65-135	30	75-127	20
1,1-Dichloroethane	62-135	30	72-125	20
1,1-Dichloroethene	65-135	30	59-145	20
1,2-Dichloroethane	58-137	30	68-127	20
1,2-Dichloropropane	60-135	30	70-125	20
2-Butanone	60-135	30	70-125	20
2-Hexanone	60-135	30	70-125	20
4-Methyl-2-pentanone	60-135	30	70-125	20
Acetone	60-135	30	70-125	20
Benzene	65-135	30	62-142	20
Bromodichloromethane	65-135	30	75-125	20
Bromoform	65-135	30	75-125	20
Bromomethane	62-135	30	72-175	20
Carbon disulfide	60-135	30	70-125	20
Carbon tetrachloride	52-135	30	62-125	20
Chlorobenzene	65-135	30	62-135	20
Chloroethane	55-135	30	65-125	20
Chloroform	64-135	30	74-125	20
Chloromethane	65-135	30	75-125	20
cis-1,2-Dichloroethene	65-135	30	75-125	20
trans-1,2-Dichloroethene	65-135	30	75-125	20
cis-1,3-Dichloropropene	64-135	30	74-125	20
trans-1,3-Dichloropropene	56-135	30	66-125	20
Dibromochloromethane	63-135	30	75-125	20
Ethylbenzene	65-135	30	75-125	20
Methylene chloride	65-135	30	75-125	20
Styrene	65-135	30	75-125	20
Tetrachloroethene	61-135	30	71-125	20
Toluene	64-135	30	59-139	20
Toluene-D8 (surrogate)	65-135	NA[2]	75-125	NA[2]
Trichloroethene	61-135	30	54-141	20
Vinyl chloride	36-144	30	46-134	20

TABLE 3-5

QUALITY CONTROL LIMITS[1]
MATRIX SPIKE/MATRIX SPIKE DUPLICATE SAMPLES AND SURROGATE SPIKES
VOLATILE ORGANIC COMPOUND ANALYSES
NSWC CRANE, INDIANA
PAGE 2 OF 2

Chemical	Solid Matrix		Aqueous Matrix	
	Accuracy (%R)	Precision (RPD)	Accuracy (%R)	Precision (RPD)
VOLATILE ORGANIC COMPOUNDS BY SW-846 METHOD 8260B (Continued)				
Xylenes (Total)	65-135	30	75-125	20
1,2-Dichloroethane-D4 (surrogate)	52-149	NA[2]	62-139	NA[2]
4-Bromofluorobenzene (surrogate)	65-135	NA[2]	75-125	NA[2]
ADDITIONAL VOLATILE ORGANIC COMPOUNDS BY SW-846 METHOD 8015B				
1,4-Dioxane	30-140[3]	50	30-140[3]	50
Acetonitrile	30-140[3]	50	57-126	20
Isobutyl alcohol	30-140[3]	50	63-130	18
Propionitrile	30-140[3]	50	73-124	15
4-Bromofluorobenzene (surrogate)	70-130	NA[2]	70-130	NA[2]

1 In-house QC limits provided by Laucks Testing Laboratories, Inc.
2 Not applicable.
3 Statistical QC limits will be developed once 20 data points are obtained. The default limits presented will be used until that time.

TABLE 3-6

QUALITY CONTROL LIMITS[1]
LABORATORY CONTROL SAMPLES
VOLATILE ORGANIC COMPOUND ANALYSES
NSWC CRANE, INDIANA

Chemical	Solid Matrix Accuracy (%R)	Aqueous Matrix Accuracy (%R)
VOLATILE ORGANIC COMPOUNDS BY SW-846 METHOD 8260B		
1,1-Dichloroethene	30-160	70-130
Benzene	63-141	70-130
Chlorobenzene	61-143	70-130
Trichloroethene	65-146	70-130
Toluene	62-148	70-130
ADDITIONAL VOLATILE ORGANIC COMPOUNDS BY SW-846 METHOD 8015B		
Acetonitrile	30-140[2]	65-133
Isobutyl alcohol	30-140[2]	68-131
Propionitrile	30-140[2]	77-121

1 In-house QC limits provided by Laucks Testing Laboratories, Inc.
2 Statistical QC limits will be developed when 20 data points are obtained. The default limits presented will be used until that time.

TABLE 3-7

QUALITY CONTROL LIMITS[1]
MATRIX SPIKE/MATRIX SPIKE DUPLICATE SAMPLES AND SURROGATE SPIKES
SEMIVOLATILE ORGANIC COMPOUND ANALYSES
NSWC CRANE, INDIANA
PAGE 1 OF 3

Chemical	Solid Matrix		Aqueous Matrix	
	Accuracy (%R)	Precision (RPD)	Accuracy (%R)	Precision (RPD)
SEMIVOLATILE ORGANIC COMPOUNDS BY SW-846 METHOD 8270C				
1,2,4-Trichlorobenzene	40-121	30	43-103	20
1,2-Dichlorobenzene	32-135	30	42-155	20
1,3-Dichlorobenzene	26-135	30	36-125	20
1,4-Dichlorobenzene	25-135	30	33-96	20
2-Chloronaphthalene	50-135	30	60-125	20
2-Chlorophenol	40-106	30	41-115	20
2-Methylphenol	25-135	30	25-125	20
2-Nitroaniline	40-135	30	50-125	20
2-Nitrophenol	34-135	30	44-125	20
2,4-Dichlorophenol	36-135	30	46-125	20
2,4-Dimethylphenol	35-149	30	45-139	20
2,4-Dinitrophenol	25-161	30	30-151	20
2,4,5-Trichlorophenol	25-175	30	25-175	20
2,4,6-Trichlorophenol	29-138	30	39-128	20
3-Nitroaniline	41-135	30	51-125	20
3,3'-Dichlorobenzidine	25-175	30	29-175	20
4-Bromophenyl phenyl ether	43-137	30	53-127	20
4-Chloroaniline	35-146	30	45-136	20
4-Chloro-3-methylphenol	55-120	22	49-121	20
4-Chlorophenyl phenyl ether	41-142	30	51-132	20
4-Methylphenol	25-135	30	33-125	20
4-Nitroaniline	30-153	30	40-143	20
4-Nitrophenol	23-143	37	38-134	20
4,6-Dinitro-2-methylphenol	25-144	30	26-134	20
Bis(2-chloroethoxy)methane	39-135	30	49-125	20
Bis(2-chloroethyl)ether	34-135	30	44-125	20
Bis(2-chloroisopropyl)ether	26-175	30	36-166	20
Bis(2-ethylhexyl)phthalate	25-139	30	33-129	20
Butyl benzyl phthalate	25-135	30	26-125	20
Di-n-butyl phthalate	25-136	30	34-126	20
Di-n-octyl phthalate	28-137	30	38-127	20
Dibenzofuran	42-135	30	52-125	20
Diethyl phthalate	27-135	30	37-125	20
Dimethyl phthalate	25-175	30	25-175	20
Hexachlorobenzene	36-143	30	46-133	20

TABLE 3-7

QUALITY CONTROL LIMITS[1]
MATRIX SPIKE/MATRIX SPIKE DUPLICATE SAMPLES AND SURROGATE SPIKES
SEMIVOLATILE ORGANIC COMPOUND ANALYSES
NSWC CRANE, INDIANA
PAGE 2 OF 3

Chemical	Solid Matrix		Aqueous Matrix	
	Accuracy (%R)	Precision (RPD)	Accuracy (%R)	Precision (RPD)
SEMIVOLATILE ORGANIC COMPOUNDS BY SW-846 METHOD 8270C (CONTINUED)				
Hexachlorobutadiene	25-135	30	25-125	20
Hexachlorocyclopentadiene	31-135	30	41-125	20
Hexachloroethane	25-163	30	25-153	20
Isophorone	25-175	30	26-175	20
n-Nitrosodi-n-propylamine	48-118	28	53-128	20
n-Nitrosodiphenylamine	25-135	30	27-125	20
Pentachlorophenol	20-159	43	60-131	20
Phenol	41-109	28	33-112	20
2,4,6-Tribromophenol (surrogate)	19-122	NA[2]	10-123	NA[2]
2-Fluorobiphenyl (surrogate)	32-99	NA[2]	45-88	NA[2]
2-Fluorophenol (surrogate)	25-108	NA[2]	21-100	NA[2]
Nitrobenzene-D5 (surrogate)	24-102	NA[2]	35-105	NA[2]
Phenol-D5 (surrogate)	24-112	NA[2]	10-94	NA[2]
Terphenyl-D14 (surrogate)	31-109	NA[2]	33-129	NA[2]
POLYNUCLEAR AROMATIC HYDROCARBONS BY SW-846 METHOD 8270C WITH SIM				
2-Methylnaphthalene	20-160[3]	30	20-160[3]	30
Acenaphthylene	20-160[3]	30	20-160[3]	30
Acenaphthene	20-160[3]	30	20-160[3]	30
Anthracene	20-160[3]	30	20-160[3]	30
Benzo(a)anthracene	20-160[3]	30	20-160[3]	30
Benzo(a)pyrene	20-160[3]	30	20-160[3]	30
Benzo(b)fluoranthene	20-160[3]	30	20-160[3]	30
Benzo(k)fluoranthene	20-160[3]	30	20-160[3]	30
Benzo(g,h,i)perylene	20-160[3]	30	20-160[3]	30
Chrysene	20-160[3]	30	20-160[3]	30
Dibenzo(a,h)anthracene	20-160[3]	30	20-160[3]	30
Fluoranthene	20-160[3]	30	20-160[3]	30
Fluorene	20-160[3]	30	20-160[3]	30
Indeno(1,2,3-c,d)pyrene	20-160[3]	30	20-160[3]	30
Naphthalene	20-160[3]	30	20-160[3]	30
Phenanthrene	20-160[3]	30	20-160[3]	30
Pyrene	20-160[3]	30	20-160[3]	30

TABLE 3-7

QUALITY CONTROL LIMITS[1]
MATRIX SPIKE/MATRIX SPIKE DUPLICATE SAMPLES AND SURROGATE SPIKES
SEMIVOLATILE ORGANIC COMPOUND ANALYSES
NSWC CRANE, INDIANA
PAGE 3 OF 3

Chemical	Solid Matrix		Aqueous Matrix	
	Accuracy (%R)	Precision (RPD)	Accuracy (%R)	Precision (RPD)
POLYNUCLEAR AROMATIC HYDROCARBONS BY SW-846 METHOD 8270C WITH SIM				
1-Fluoronaphthalene (surrogate)	20-160[3]	NA[2]	20-160[3]	NA[2]
Fluorene-D10 (surrogate)	20-160[3]	NA[2]	20-160[3]	NA[2]
Pyrene-D10 (surrogate)	20-160[3]	NA[2]	20-160[3]	NA[2]

1 In-house QC limits provided by Laucks Testing Laboratories, Inc.
2 Not applicable.
3 Statistical QC limits will be developed when 20 data points are obtained. The default limits presented will be used until that time.

TABLE 3-8

QUALITY CONTROL LIMITS[1]
LABORATORY CONTROL SAMPLES
SEMIVOLATILE ORGANIC COMPOUND ANALYSES
NSWC CRANE, INDIANA

Chemical	Solid Matrix Accuracy (%R)	Aqueous Matrix Accuracy (%R)
SEMIVOLATILE ORGANIC COMPOUNDS BY SW-846 METHOD 8270C		
1,2,4-Trichlorobenzene	40-121	44-110
1,4-Dichlorobenzene	34-107	20-108
2-Chlorophenol	40-106	31-126
4-Chloro-3-methylphenol	55-120	56-115
4-Nitrophenol	23-143	10-110
n-Nitrosodi-n-propylamine	48-118	50-127
Pentachlorophenol	20-159	30-123
Phenol	41-109	10-112
POLYNUCLEAR AROMATIC HYDROCARBONS BY SW-846 METHOD 8270C WITH SIM		
2-Methylnaphthalene	20-160[2]	20-160[2]
Acenaphthylene	20-160[2]	20-160[2]
Acenaphthene	20-160[2]	20-160[2]
Anthracene	20-160[2]	20-160[2]
Benzo(a)anthracene	20-160[2]	20-160[2]
Benzo(a)pyrene	20-160[2]	20-160[2]
Benzo(b)fluoranthene	20-160[2]	20-160[2]
Benzo(k)fluoranthene	20-160[2]	20-160[2]
Benzo(g,h,i)perylene	20-160[2]	20-160[2]
Chrysene	20-160[2]	20-160[2]
Dibenzo(a,h)anthracene	20-160[2]	20-160[2]
Fluoranthene	20-160[2]	20-160[2]
Fluorene	20-160[2]	20-160[2]
Indeno(1,2,3-c,d)pyrene	20-160[2]	20-160[2]
Naphthalene	20-160[2]	20-160[2]
Phenanthrene	20-160[2]	20-160[2]
Pyrene	20-160[2]	20-160[2]

1 In-house QC limits provided by Laucks Testing Laboratories, Inc.
2 Statistical QC limits will be developed when 20 data points are obtained. The default limits presented will be used until that time.

TABLE 3-9

QUALITY CONTROL LIMITS[1]
MATRIX SPIKE/MATRIX SPIKE DUPLICATE SAMPLES AND SURROGATE SPIKES
ORGANOCHLORINE PESTICIDE AND PCB ANALYSES
NSWC CRANE, INDIANA

Chemical	Solid Matrix		Aqueous Matrix	
	Accuracy (%R)	Precision (RPD)	Accuracy (%R)	Precision (RPD)
ORGANOCHLORINE PESTICIDES AND PCBs BY SW-846 METHOD 8081A/8082				
α-BHC	65-135	50	75-125	30
β-BHC	41-133	50	51-125	30
δ-BHC	65-136	50	75-126	30
γ-BHC (Lindane)	20-128	50	33-141	36
α-Chlordane	35-135	50	41-125	30
γ-Chlordane	35-135	50	41-125	30
4,4'-DDD	38-146	50	48-136	30
4,4'-DDE	35-149	50	45-139	30
4,4'-DDT	25-153	50	35-143	28
Aldrin	20-138	50	24-128	27
Dieldrin	32-142	50	40-135	23
Endosulfan I	39-153	50	49-143	30
Endosulfan II	65-169	50	75-159	30
Endosulfan sulfate	36-151	50	46-141	30
Endrin	33-144	50	44-140	34
Endrin aldehyde	65-160	50	75-150	30
Heptachlor	20-131	50	30-123	29
Heptachlor epoxide	43-144	50	53-134	30
Methoxychlor	63-152	50	73-142	30
Aroclor-1260	31-136	50	40-126	30
Decachlorobiphenyl (surrogate)	20-160	NA[2]	30-160	NA[2]
Tetrachloro-m-xylene (surrogate)	20-150	NA[2]	25-139	NA[2]

1 In-house QC limits provided by Laucks Testing Laboratories, Inc.
2 Not applicable.

TABLE 3-10

QUALITY CONTROL LIMITS[1]
LABORATORY CONTROL SAMPLES
ORGANOCHLORINE PESTICIDE AND PCB ANALYSES
NSWC CRANE, INDIANA

Chemical	Solid Matrix Accuracy (%R)	Aqueous Matrix Accuracy (%R)
ORGANOCHLORINE PESTICIDES AND PCBs BY SW-846 METHOD 8081A/8082		
γ-BHC (Lindane)	20-128	20-159
Aldrin	20-138	34-127
Heptachlor	20-131	29-122
Aroclor-1260	20-160	39-149

1 In-house QC limits provided by Laucks Testing Laboratories, Inc.

TABLE 3-11

QUALITY CONTROL LIMITS[1]
MATRIX SPIKE/MATRIX SPIKE DUPLICATE SAMPLES AND SURROGATE SPIKES
HERBICIDE ANALYSES
NSWC CRANE, INDIANA

Chemical	Solid Matrix		Aqueous Matrix	
	Accuracy (%R)	Precision (RPD)	Accuracy (%R)	Precision (RPD)
HERBICIDES BY SW-846 METHOD 8151A				
2,4-D	20-160	50	41-140	30
2,4,5-T	20-160	50	32-140	30
2,4,5-TP (Silvex)	20-160	50	45-140	30
Dinoseb	20-160	50	7-140	30
Hexachlorophene	20-160	50	20-160	50
2,6-Dichlorobenzoic acid (surrogate)	20-160	NA[2]	45-140	NA[2]
2,4-Dichlorophenylaceticacid (surrogate)	20-160	NA[2]	50-140	NA[2]

1 In-house QC limits provided by Laucks Testing Laboratories, Inc.
2 Not applicable.

TABLE 3-12

QUALITY CONTROL LIMITS[1]
LABORATORY CONTROL SAMPLES
HERBICIDE ANALYSES
NSWC CRANE, INDIANA

Chemical	Solid Matrix Accuracy (%R)	Aqueous Matrix Accuracy (%R)
HERBICIDES BY SW-846 METHOD 8151A		
2,4-D	20-160	38-140
2,4,5-TP (Silvex)	20-160	45-140
Hexachlorophene	20-160	20-160

1 In-house QC limits provided by Laucks Testing Laboratories, Inc.

TABLE 3-13

QUALITY CONTROL LIMITS[1]
MATRIX SPIKE/MATRIX SPIKE DUPLICATE SAMPLES
DIOXIN/FURAN ANALYSES
NSWC CRANE, INDIANA

Chemical	Solid Matrix		Aqueous Matrix	
	Accuracy[2] (%R)	Precision[3] (RPD)	Accuracy[2] (%R)	Precision[3] (RPD)
DIOXINS/FURANS BY SW-846 METHOD 8290				
2,3,7,8-TCDD	70-130	20	70-130	20
1,2,3,7,8-PeCDD	70-130	20	70-130	20
1,2,3,6,7,8-HxCDD	70-130	20	70-130	20
1,2,3,4,7,8-HxCDD	70-130	20	70-130	20
1,2,3,7,8,9-HxCDD	70-130	20	70-130	20
1,2,3,4,6,7,8-HpCDD	70-130	20	70-130	20
1,2,3,4,6,7,8,9-OCDD	70-130	20	70-130	20
2,3,7,8-TCDF	70-130	20	70-130	20
1,2,3,7,8-PeCDF	70-130	20	70-130	20
2,3,4,7,8-PeCDF	70-130	20	70-130	20
1,2,3,6,7,8-HxCDF	70-130	20	70-130	20
1,2,3,7,8,9-HxCDF	70-130	20	70-130	20
1,2,3,4,7,8-HxCDF	70-130	20	70-130	20
2,3,4,6,7,8-HxCDF	70-130	20	70-130	20
1,2,3,4,6,7,8-HpCDF	70-130	20	70-130	20
1,2,3,4,7,8,9-HpCDF	70-130	20	70-130	20
1,2,3,4,6,7,8,9-OCDF	70-130	20	70-130	20

1 In-house QC limits provided by Triangle Laboratories, Inc.
2 As specified in Section VIII.E.Z of SOP DAR182 (in Appendix B of the QAPP), recoveries or up to two analytes may be as high as 145% or as low as 60% as long as the associated RPDs meet criteria.
3 As specified in Section VIII.E.3 of SOP DHR182 (in Appendix B of the QAPP), RPDs for up to two analytes may be up to 35% as long as the associated percent recoveries meet criteria.

TABLE 3-14

QUALITY CONTROL LIMITS[1]
LABORATORY CONTROL SAMPLE/LABORATORY CONTROL SAMPLE DUPLICATES
DIOXIN/FURAN ANALYSES
NSWC CRANE, INDIANA

Chemical	Solid Matrix		Aqueous Matrix	
	Accuracy[2] (%R)	Precision[3] (RPD)	Accuracy[2] (%R)	Precision[3] (RPD)
DIOXINS/FURANS BY SW-846 METHOD 8290				
2,3,7,8-TCDD	70-130	20	70-130	20
1,2,3,7,8-PeCDD	70-130	20	70-130	20
1,2,3,6,7,8-HxCDD	70-130	20	70-130	20
1,2,3,4,7,8-HxCDD	70-130	20	70-130	20
1,2,3,7,8,9-HxCDD	70-130	20	70-130	20
1,2,3,4,6,7,8-HpCDD	70-130	20	70-130	20
1,2,3,4,6,7,8,9-OCDD	70-130	20	70-130	20
2,3,7,8-TCDF	70-130	20	70-130	20
1,2,3,7,8-PeCDF	70-130	20	70-130	20
2,3,4,7,8-PeCDF	70-130	20	70-130	20
1,2,3,6,7,8-HxCDF	70-130	20	70-130	20
1,2,3,7,8,9-HxCDF	70-130	20	70-130	20
1,2,3,4,7,8-HxCDF	70-130	20	70-130	20
2,3,4,6,7,8-HxCDF	70-130	20	70-130	20
1,2,3,4,6,7,8-HpCDF	70-130	20	70-130	20
1,2,3,4,7,8,9-HpCDF	70-130	20	70-130	20
1,2,3,4,6,7,8,9-OCDF	70-130	20	70-130	20

1 In-house QC limits provided by Triangle Laboratories, Inc.
2 As specified In Section VIII.E2 of SOP DHR182 (in Appendix B of the QAPP), recoveries for up to two analytes may be as high as 145% or as low as 60% as long as the associated RPDs meet criteria.
3 As specified in Section VIII.E.3 of SOP DHR182 (in Appendix B of the QAPP), RPDs for up to two analytes may be up to 35% as long as the associated percent recoveries meet criteria.

TABLE 3-15

QUALITY CONTROL LIMITS[1]
MATRIX SPIKE AND LABORATORY DUPLICATE SAMPLES
MISCELLANEOUS PARAMETERS
NSWC CRANE, INDIANA

Chemical	Solid Matrix		Aqueous Matrix	
	Accuracy (%R)	Precision (RPD)[5]	Accuracy (%R)	Precision (RPD)[5]
MISCELLANEOUS PARAMETERS				
Hardness (Standard Method 2340B)	ANR[2]	ANR	NA[3]	NA
Cyanide (SW-846 Method 9012A)	ANR	ANR	64-135	11
Nitrite/Nitrate (EPA 353.2)	ANR	ANR	68-122	10
Total Organic Carbon (EPA 415.1)	50-150	30	70-119	11
Total Suspended Solids (EPA 160.1)	ANR	ANR	NA	20
pH (SW-846 Method 9045C)	NA	10	ANR	ANR
CEC (SW-846 Method 9081)	TBD[4]	30	ANR	ANR

1 In-house QC limits provided by Laucks Testing Laboratories, Inc.
2 Analysis not required.
3 Not applicable.
4 To be determined.
5 These acceptance limits apply to original and duplicate sample concentrations >5x RL. If one or both of the results is <5x RL, the acceptance criterion is ± 5x RL. If one of the results is a non-detect, the reported percent RPD will be 200%.

TABLE 3-16

QUALITY CONTROL LIMITS[1]
LABORATORY CONTROL SAMPLES
MISCELLANEOUS PARAMETERS
NSWC CRANE, INDIANA

Chemical	Solid Matrix Accuracy (%R)[5]	Aqueous Matrix Accuracy (%R)[5]
MISCELLANEOUS PARAMETERS		
Hardness (Standard Method 2340B)	ANR[2]	NA[3]
Cyanide (SW-846 Method 9012A)	ANR	75-125
Nitrite/Nitrate (EPA 353.2)	ANR	86-114
Total Organic Carbon (EPA 415.1)	50-150	80-120
Total Suspended Solids (EPA 160.1)	ANR	NA
pH (SW-846 9045C)	NA	ANR
CEC (SW-846 9081)	TBD[4]	ANR

1 In-house QC limits provided by Laucks Testing Laboratories, Inc.
2 Analysis not required
3 Not applicable.
4 To be determined.
5 As noted in the laboratory SOPs, the laboratory may use a purchased standard reference material (SRM) in place of a LCS. If a SRM is used, the acceptance limits provided by the supplier of the SRM may be used unless the SRM limits are wider than the acceptance limits provided in this table. If the SRM limits are wider, the laboratory must use the acceptance limits provided as this table.

a frequency of 1 per 20 associated samples of like matrix. Surrogate spike analysis is performed for all organic chromatographic analyses with the exception of dioxin/furan analyses. Laboratory accuracy is assessed via comparison of calculated %R values with accuracy control limits specified in the analytical method or by the laboratory's QA/QC program.

Accuracy for organic analyses will be measured via the percent recoveries for surrogate spikes, MS/MSDs, and LCSs. Accuracy for inorganic analyses will be measured via percent recoveries for MSs and LCSs. Tables 3-1 through 3-16 present accuracy control limits for MS, surrogate spike, and LCS recoveries, as applicable, for each analytical fraction.

3.3 COMPLETENESS

3.3.1 Definition

Completeness is a measure of the amount of usable, valid, analytical data obtained, compared with the amount expected to be obtained. Completeness is typically expressed as a percentage. The equation for completeness is presented in Section 12.3.

The ideal objective for completeness is 100 percent (i.e., every sample planned to be collected is collected; every sample submitted for analysis yields valid data). However, samples can be rendered unusable during shipping or preparation (e.g., bottles broken or extracts accidentally destroyed); errors can be introduced during analysis (e.g., loss of instrument sensitivity, introduction of ambient laboratory contamination), or strong matrix effects can become apparent (e.g., extremely low MS recovery). These instances result in data that do not meet QC criteria. Completeness will be calculated for each chemical category (e.g., VOCs, SVOCs, metals, etc.) per media. If critical data points are lost, resampling and/or reanalysis may be required.

Validation will be performed for 100 percent of the laboratory data for this investigation based on the requirements of the analytical methods and this QAPP. To the extent practicable for SW-846 analyses, validation will be performed in accordance with the Region 5 SOPs for Validation of CLP (Contract Laboratory Program) Organic and Inorganic Data (U.S. EPA Region 5, 1993a, 1993b) and the U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic and Inorganic Data Review (U.S. EPA, 1994a, 1994b). Data rejected as a result of the validation process will be treated as unreliable, unusable data.

3.3.2 Field Completeness Objectives

Field completeness is a measure of the amount of valid field measurements obtained from all the field measurements taken in the project. Field completeness for this project is expected to be greater than 90 percent.

3.3.3 Laboratory Completeness Objectives

Laboratory completeness is a measure of the amount of valid laboratory measurements per matrix obtained from all the laboratory measurements per matrix taken in the project. Laboratory completeness for this project is expected to be greater than 95 percent.

3.4 REPRESENTATIVENESS

3.4.1 Definition

Representativeness is an expression of the degree to which the data accurately and precisely depict the actual characteristics of a population or environmental condition existing at an individual sampling point. Use of standardized sampling, handling, analytical, and reporting procedures ensures that the final data accurately represent actual site conditions.

3.4.2 Measures to Ensure Representativeness of Field Data

Representativeness depends on the proper design of the sampling program and will be satisfied by ensuring that the FSP is followed and that proper sampling techniques are used.

3.4.3 Measures to Ensure Representativeness of Lab Data

Representativeness in the laboratory is ensured by using the proper analytical procedures, meeting sample holding times, and analyzing and assessing field duplicate samples. The sampling network for the soil, sediment, surface water, and ground water monitoring program was designed to provide data representative of facility conditions. During development of this sampling network, consideration was given to past waste disposal practices, existing analytical data, physical setting and processes, and constraints inherent to the RCRA program. The rationale of the sampling network is presented in detail in Sections 5, 6, 7, and 8 of the attendant Work Plan.

3.5 COMPARABILITY

3.5.1 Definition

Comparability is defined as the confidence with which one data set can be compared with another (e.g., between sampling points; between sampling events). Comparability is achieved by using standardized sampling and analysis methods and data reporting formats (including use of consistent units of measure). Additionally, consideration is given to seasonal conditions and other environmental variations that could exist to influence analytical results.

3.5.2 Measures to Ensure Comparability of Field Data

Comparability depends on the proper design of the sampling program and will be satisfied by ensuring that the FSP is followed and that proper sampling techniques are used. It also depends on recording field measurements using consistent units. Units to be used for field measurements are further explained in Section 9.1.1.

3.5.3 Measures to Ensure Comparability of Lab Data

Planned analytical data will be comparable when similar sampling and analytical methods are used and documented. Results will be reported in units that ensure comparability with previous data. The units used for the laboratory measurements are further explained in Section 9.1.2 of this QAPP.

3.6 DECISION RULE

3.6.1 Definition

A decision rule is a statement that allows for a course of action or non-action to be taken, based on assumptions made to draw out and test its logical or empirical consequences.

3.6.2 Decision Rule Objectives

Decision levels, expressed as human health or ecological target decision levels, for each critical measurement parameter are specified in Table 1-1 of this QAPP. The decision rules and a flow chart of these rules are presented in Section 4.0 of the attendant Work Plan.

3.7 LEVEL OF QC EFFORT

Trip blank, rinsate blank, ambient blank, source water blank, field duplicate, method blank, laboratory duplicate, laboratory control, and MS samples will be analyzed to assess the quality of the data resulting from the field sampling and analytical programs. Internal QC samples (i.e., laboratory QC samples) are explained in Section 8.0 of this QAPP. External QC measures (i.e., field QC samples) consist of field duplicates, ambient blanks, trip blanks, source water blanks, and equipment rinsate blanks. Information gained from these analyses further characterizes the level of data quality obtained to support project goals. Each of these types of field QC samples undergo the same preservation, analysis, and reporting procedures as the related environmental samples. Each type of field QC sample is detailed below.

Field duplicates are two samples collected either: 1) independently at the same sampling location in the case of ground water and surface water or 2) as a single sample split into two portions in the case of soil or sediment. Field duplicates are collected and analyzed for chemical constituents to measure the precision of the sampling and analysis methods used. The general level of the QC effort will be one field duplicate for every 10 or fewer investigative samples per medium.

Trip blanks and ambient blanks will be submitted for analysis to provide the means to assess the quality of the data resulting from the FSP. Ambient blank samples are analyzed to check for interfering contaminants that could potentially be present in ambient air at the sampling site (e.g., volatile compounds or particulates). The parameter list for the ambient blank depends on the conditions at the site at the time of sampling. Ambient blanks will be collected at the sampling location by placing analyte-free water directly into the same types of containers, preserved and stored in the same manner as field samples. The need for collection of an ambient blank and the parameter list for the blank will be based on conditions at the time of sampling at the discretion of the Field Operations Leader (FOL). Section 2-7 of the attendant FSP details the basis for collection of an ambient blank.

Trip blanks pertain to VOCs only. Trip blanks are used to assess the potential for contamination of VOCs resulting from contaminant migration into sample bottles/jars during sample shipment and storage. Trip blanks are prepared by the laboratory using organic-free reagent water before the sampling event. They are shipped to the site with the sample containers and kept with the investigative samples throughout the sampling event. They are then packaged for shipment with other VOC environmental samples and sent to the laboratory for analysis. At no time after trip blank preparation are the trip blank sample containers opened before they reach the laboratory. One trip blank will be included in each sample shipping container that contains VOC samples.

Equipment rinstate blanks are used to assess the effectiveness of decontamination procedures. Equipment rinsate blanks are obtained under representative field conditions by collecting the rinse water generated by running analyte-free water through sample collection equipment after sampling and decontamination and then placing the rinse water in the appropriate sample container for analyses. One rinsate blank will be collected per each type of sampling equipment used (i.e., pump, etc.) per day that sampling is conducted. If pre-cleaned, dedicated, or disposable sampling equipment is used, one rinsate blank per lot per type of equipment used must be collected as a "batch blank." Rinsate blanks are analyzed for the same chemical constituents as the associated environmental samples.

The collection of source water blanks is anticipated because source water blanks are applicable if new monitoring wells are installed or if non-dedicated bailers/bladder pumps are used for sampling of existing monitoring wells. Source water blanks are obtained by sampling the analyte-free water and/or potable water source(s) used for decontamination of sampling equipment. Source water blanks are used to determine whether the analyte-free water or the potable water (used for steam cleaning) may be contributing to sample contamination. One source water blank will be collected for each source of water used for decontamination.

MSs are investigative samples analyzed to provide information about the effect of the sample matrix on the digestion and measurement methodology. All MSs for organic analyses are performed in duplicate and, as previously defined, are referred to as MS/MSD samples. One MS or MS/MSD sample will be collected/designated for every 20 or fewer investigative samples per medium. Extra sample volume must be collected for samples designated for MS/MSD analysis for VOCs and extractable organics. Specifically, two extra encore samplers for VOCs and two extra 1000-mL bottles for all other organic analyses are required. Specific details regarding extra sample volume required for MS/MSD samples are provided for each analytical fraction in Tables 2-1 and 2-2 of the FSP. MS/MSD samples are further explained in Section 8.0.

Tables 3-2, 3-5, 3-7, 3-10, 3-12, 3-15, 3-17, and 3-20 in the attendant FSP indicate the total number of QC samples to be collected on the basis of parameter, matrix, and SWMU. Specific locations for the collection of MS/MSD and duplicate samples are approximated on these tables. The order of sample collection cannot always be planned in advance due to the fact that the base is a working facility and access to certain areas may be restricted on some days. In order to maintain the proper frequency of QC sampling, the location of sampling must be somewhat flexible.

4.0 SAMPLING PROCEDURES

Field sampling procedures for the field investigations for SWMUs 4, 5, 9, and 10 are detailed in Section 2.0 of the FSP and in the following Standard Operating Procedures (SOPs):

SOP Number	Title
CTO 10-1	Inspection of Existing Monitoring Wells
CTO 10-2	Measurement of Water Levels in Monitoring Wells
CTO 10-3	Monitoring Well Purging and Stabilization
CTO 10-4	Monitoring Well Sampling
CTO 10-5	Surface Water Sampling
CTO 10-6	Sediment Sampling
CTO 10-7	Surface and Subsurface Soil Sampling
CTO 10-8	Drilling, Monitoring Well Installation and Well Development
CTO 10-9	Decontamination of Field Sampling Equipment
CTO 10-10	Sample Identification Nomenclature
CTO 10-11	Field Documentation
CTO 10-12	Sample Handling
CTO 10-13	Use of Photoinization Detector
CTO 10-14	Borehole and Soil Sample Logging
CTO 10-15	Use of Water Quality Meter

These SOPs are included in Attachment B the FSP.

5.0 CUSTODY PROCEDURES

Custody is one of several factors that is necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files. Final evidence files, including all originals of laboratory reports and purge files, are maintained under document control in a secure area. A sample or evidence file is under custody under any one of the following conditions:

- The item is in the actual physical possession of an authorized person.
- The item is in view of the person after being in his or her possession.
- The item was placed in a secure area to prevent tampering.
- The item is in a designated and identified secure area with access restricted to authorized personnel only.

The chain-of-custody (COC) report is a multi-part, standardized form used to summarize and document pertinent sample information, such as sample identification and type, matrix, date and time of collection, preservation, and requested analyses. Furthermore, through the sequential signatures of various sample custodians (e.g., sampler, airbill number, laboratory sample custodian), the COC report documents sample custody and tracking. Custody procedures apply to all environmental and associated field QC samples obtained as part of the data collection system.

5.1 FIELD CUSTODY PROCEDURES

The FOL (or designee) is responsible for the care and custody of the samples collected until they are relinquished to the laboratory or entrusted to a commercial overnight courier. COC reports are completed for each sample shipment. The reports are filled out in a legible manner, using waterproof ink, and are signed (and dated) by the sampler. Pertinent notes, such as whether the sample was field filtered, or whether the sample is suspected to be high in contaminant concentration, also are indicated on the COC report. Information similar to that contained in the COC report is provided on the sample label, which is securely attached to the sample bottle. In addition, sample tags will be affixed to the sample bottles and will be returned by the analytical laboratory for inclusion in the final evidence file. A temperature blank will be included in each cooler.

Full details regarding sample COC (including use of custody seals and sample shipment protocols) are contained in CTO 10 SOPs 11 and 12, which are provided in Attachment B of the FSP. CTO 10 SOP 11 presents maintenance of site logbooks, site notebooks, and other field records. Additionally, each of the various sampling SOPs incorporated into the FSP contains a section that addresses relevant sample documentation (i.e., completion of sample logsheets, etc.). All sample records are eventually docketed into the Administrative Record at NSWC Crane.

5.2 LABORATORY CUSTODY PROCEDURES

When samples are received by the subcontracted laboratory, the laboratory's sample custodian will examine each cooler's custody seals to verify that they are intact and that the integrity of the environmental samples has been maintained. The custodian will then open the cooler and measure its internal temperature by measuring the temperature of the temperature blank; as previously noted, a temperature blank will be included in each cooler. The temperature reading will be documented by each of the subcontracted laboratories in the comments column of the COC report. In addition, the temperature reading will be recorded by Laucks Testing Laboratories, Inc., on the Supplemental Sample Receipt Log, as further explained below, whereas the temperature reading will be documented by Triangle Laboratories, Inc., via the electronic laboratory information management system (LIMS). The sample custodian will then sign the COC report and examine the contents of the cooler. Sample container breakages or discrepancies between the COC report and sample label documentation will be recorded. With the exception of samples for VOC analysis, the pH of chemically preserved samples will be checked using Hydrion paper and recorded. (The pH of VOC samples will be checked and recorded after analysis to prevent loss of volatile compounds.) A Laucks Testing Laboratories, Inc., CLP Sample Receipt Log and Supplemental Sample Receipt Log, as shown in Appendix 3 of SOP LTL-4002 (Appendix B of this QAPP), will be completed by Laucks Testing Laboratories, Inc. As presented in Section B of SOP 5.01 (Appendix B of this QAPP), Triangle Laboratories, Inc., will record all sample shipment inspection observations directly into the LIMS. All problems or discrepancies noted during this process are to be promptly reported to the TtNUS Task Order Manager (TOM). Samples are then logged into the laboratory's LIMS. Other pertinent issues relating to sample custody, such as interlaboratory COC procedures and specific procedures for sample handling, storage, dispersement for analysis, and remnant disposal, are presented in the laboratory SOPs included in Appendix B of this QAPP.

5.3 FINAL EVIDENCE FILES

The Administrative Record at NSWC Crane will be the repository for all documents which constitute evidence relevant to sampling and analysis activities as described in this QAPP. NSWC Crane will be the custodian of the evidence file and will maintain the contents of these files, including all relevant records, reports, logs, field notebooks, pictures, subcontractor reports, and data reviews in a secure, limited access location and under custody of the NSWC Crane Site Manager. The control file will include at a minimum:

- Field logbooks
- Field data and data deliverables
- Photographs and negatives
- Drawings
- Laboratory data deliverables
- Data validation reports
- Data assessment reports
- Progress reports, QA reports, interim project reports, etc.
- All custody documentation (tags, forms, airbills, etc.).

Upon completion of the contract, all files associated with these field investigations will be maintained in the Administrative Record at NSWC Crane and will be available for inspection by the regulatory agencies.

6.0 CALIBRATION PROCEDURES AND FREQUENCY

All instrumentation used to perform chemical measurements must be properly calibrated to obtain valid and usable results. The requirement to properly calibrate instruments before use applies equally to field instruments as it does to fixed laboratory instruments. Field instrument calibration is presented in Section 6.1. Laboratory instrument calibration is outlined in Section 6.2.

6.1 FIELD INSTRUMENT CALIBRATION

Field instrument calibration is presented in Section 2.8 of the FSP.

6.2 LABORATORY INSTRUMENT CALIBRATION

Calibration procedures for a specific laboratory instrument will consist of initial calibration (generally three to five points), initial calibration verification (inorganic methods only), and continuing calibration verification. In all cases, an independently prepared standard (i.e., from a second source or a different lot number from the primary source) will be used as a calibration verification solution or as the LCS/MS spiking mix.

All standards used to calibrate analytical instruments must be obtained from the National Institute of Standards and Technology (NIST) or through a reliable commercial supplier with a proven record for quality standards. All commercially supplied standards will be traceable to NIST reference standards, where possible, and appropriate documentation will be obtained from the supplier. In cases where documentation is not available, the laboratory will analyze the standard and compare the results with U.S. EPA-known or previous NIST-traceable standard.

Calibration procedures, frequency requirements, acceptance criteria, and conditions that require recalibration are described for each analytical procedure in the applicable laboratory SOPs included in Appendix B of this QAPP.

7.0 ANALYTICAL AND MEASUREMENT PROCEDURES

With the exception of samples collected for dioxin/furan analysis, all samples collected as part of the NSWC Crane SWMU 4, 5, 9, and 10 investigations will be analyzed by Laucks Testing Laboratories, Inc., 940 South Harney Street, Seattle, Washington 98108; (206) 767-5060; FAX (206) 767-5063. Analysis for dioxins/furans will be performed by Triangle Laboratories, Inc., 801 Capitola Drive, Durham, NC 27713; (919) 544-5729; FAX (919) 544-5491. These laboratories have successfully completed the laboratory evaluation process required as part of the NFESC QA Program and described in the "Navy Installation Restoration Laboratory Quality Assurance Guide" (NFESC, February 1996).

Field measurements and analytical procedures are presented in detail in the remainder of this section.

7.1 FIELD MEASUREMENT PROCEDURES

Chemical/physical parameters to be measured using field instrumentation include temperature, specific conductance, pH, dissolved oxygen, oxidation reduction potential (ORP/Eh), turbidity, water level, and volatile organics (HNu). Measurement of field parameters is presented in Section 2.8 of the FSP. Calibration of field instruments is listed in Section 2.8.1 of the FSP.

7.2 LABORATORY ANALYTICAL AND MEASUREMENT PROCEDURES

Table 7-1 provides a summary of the laboratory analytical methods and associated laboratory SOPs to be used during the field investigation for SWMUs 4, 5, 9 and 10. Laboratory SOPs for these analyses are included in Appendix B of this QAPP.

For this project, it is necessary to analyze VOCs in soil as low level (concentration range 0.5 to 200 μg/kg). Because low level preservation is known to react with highly alkaline soils and soils with high carbonate/calcium content, site soils must be screened to determine whether they are compatible with low level preservation (i.e., sodium bisulfate).

Screening will be done by dividing each site into quadrants and taking one sample approximately in the middle of each quadrant. The subcontracted laboratory will be asked to provide the appropriate number of sodium bisulfate pre-preserved VOA vials (according to SW-846 5035, one gram of sodium bisulfate in 5 mL of organic-free reagent grade water). At each sampling location, 5 g of soil will be added to the pre-

preserved, uncapped VOA vial and closely observed for a reaction. A reaction will be identified as occurring if the temperature rises (noted by touch), or if bubbling or fizzing occurs (visual observation).

If screening determines that site soils are not reactive with sodium bisulfate, samples will be collected using the EnCore Sampler and shipped to the lab for preservation with sodium bisulfate in accordance with SW-846 5035.

If screening indicates that the site soils react with sodium bisulfate, samples will be collected using the EnCore Sampler and shipped to the lab for preservation. The lab shall preserve the reactive samples by placing 5 g of soil from the EnCore Sampler in 5 mL of organic-free reagent grade water in a standard VOA vial. Preservation must occur within 48 hours of sample collection. The vial will be capped, placed in a ziplock bag, and stored in a freezer at –10°C until analysis. Analysis must occur within 14 days of preservation or seven days if samples are frozen.

7.2.1 List of Project Target Compounds and Detection Limits

A complete list of the target compounds/analytes; project-specific risk-based target levels; and laboratory-specific MDLs (all parameters except metals), IDLs (metals only), and RLs is provided on Table 1-1. The MDLs shown have been experimentally determined using the procedures described in Section 6.3 of Laucks Testing Laboratories, Inc., SOP LTL-1011 and in Triangle Laboratories, Inc., SOP CQA125, which are included in Appendix B of this QAPP. These procedures are based on the method provided in 40 CFR Part 136 Appendix B (FR Vol. 49, No. 209, pages 198-199). The IDLs provided for metals have been experimentally determined as described in Section 6.2.6 of Laucks Testing Laboratories, Inc., SOP LTL-1011. This procedure is based on the procedure for IDL determination as specified in the U.S. EPA CLP (ILM04.0; U.S. EPA, 1995). All environmental data will be reported to the analyte's laboratory-specific RL. An analyte's RL is based on the associated MDL/IDL with adjustments made to ensure that the precision and accuracy requirements of the method are attainable. RLs will be adjusted on a sample-by-sample basis, as necessary, based on dilutions, sample volume and for soil and sediment samples percent moisture.

7.2.2 List of Associated Quality Control Samples

In addition to the field QC samples (field duplicates, trip blanks, rinsate blanks, etc.) presented in Section 3.0 of this QAPP, laboratory QC samples, including method blanks, preparation blanks, LCSs, etc., will be analyzed. Laboratory QC samples are detailed in Section 8.0 of this QAPP. The analytical SOPs included in Appendix B of this QAPP address minimum QC requirements for each associated analytical method.

TABLE 7-1

**SUMMARY OF ORGANIC AND INORGANIC ANALYTICAL PROCEDURES
SOLID AND AQUEOUS SAMPLES
NSWC CRANE, INDIANA
PAGE 1 OF 3**

Analytical Parameter	Preparation Method	Analytical Method	Preparation/Analytical SOP(s) [1]
Explosives	SW-846[2] 8330	SW-846 8330	Aqueous LTL-3077 Solid LTL-3161 Analytical LTL-8330
Appendix IX Metals (except mercury) - total	Aqueous SW-846 3010A or SW-846 3015 Solid SW-846 3050B or SW-846 3051	SW-846 6020	Aqueous LTL-7009 or LTL-7010 Solid LTL-7012 or LTL-7015 Analytical LTL-7202
Appendix IX Metals (except mercury) - dissolved	---[3]	SW-846 6020	LTL-7202
Miscellaneous Metals - total	Aqueous SW-846 3010A or SW-846 3015 Solid SW-846 3050B or SW-846 3051	SW-846 6010B	Aqueous LTL-7009 or LTL-7010 Solid LTL-7012 or LTL-7015 Analytical LTL-7105
Miscellaneous Metals - dissolved	---[3]	SW-846 6010B	LTL-7105
Mercury - total & dissolved	SW-846 7470A/ 7471A	SW-846 7470A/ 7471A	LTL-7501
Appendix IX Volatile Organic Compounds	Aqueous SW-846 5030B Solid SW-846 5035	SW-846 8260B (with 25 mL purge)	LTL-8265 (low-level option)
1,4-Dioxane, Acetonitrile, Isobutyl alcohol, and Propionitrile	Aqueous SW-846 5030B Solid SW-846 5035	SW-846 8015B	LTL-8019
Appendix IX Semivolatile Organic Compounds	Aqueous SW-846 3520C Solid SW-846 3550B	SW-846 8270C	Aqueous LTL-3000 Solid LTL-3100 Analytical LTL-8276

TABLE 7-1

**SUMMARY OF ORGANIC AND INORGANIC ANALYTICAL PROCEDURES
SOLID AND AQUEOUS SAMPLES
NSWC CRANE, INDIANA
PAGE 2 OF 3**

Analytical Parameter	Preparation Method	Analytical Method	Preparation/Analytical SOP(s) [1]
Polynuclear Aromatic Hydrocarbons	Aqueous SW-846 3520C Solid SW-846 3550B	SW-846 8270C with SIM	Aqueous LTL-3000 Solid LTL-3100 Analytical LTL-8277
Appendix IX Organochlorine Pesticides and PCBs	Aqueous SW-846 3510C Solid SW-846 3550B	SW-846 8081A and 8082	Aqueous LTL-3202 Solid LTL-3302 Analytical LTL-8084
Appendix IX Herbicides	Aqueous SW-846 8151A Solid SW-846 8151A	SW-846 8151A	Aqueous LTL-3510 Solid LTL-3011 Analytical LTL-8151
Dioxins/Furans	Aqueous SW-846 8290 Solid SW-846 8290	SW-846 8290	Aqueous DSP-161 Solid DSP-105 Analytical DHR-182
Hardness (Surface Water only)	---[3]	Standard Method[5] 2340B	SM-2340B
Nitrite/Nitrate	---[3]	EPA 353.2	LTL-9125
Cyanide	---[3]	SW-846 9012A	LTL-9104
Total Organic Carbon (Aqueous and Solid)	---[3]	EPA[4] 415.1	LTL-9115
Total Suspended Solids (Aqueous Only)	---[3]	EPA[4] 160.1	LTL-9202
pH (Solid Only)	---[3]	SW-846 9045C	LTL-9113
CEC (Solid Only)	---[3]	SW-846 9081	LTL-6006

TABLE 7-1

SUMMARY OF ORGANIC AND INORGANIC ANALYTICAL PROCEDURES
SOLID AND AQUEOUS SAMPLES
NSWC CRANE, INDIANA
PAGE 3 OF 3

1 Laboratory SOPs are included in Appendix A of this QAPP.
2 U.S. EPA, 1986a. Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods. SW-846, 3rd Ed. and subsequent updates.
3 No preparation method is required for this parameter.
4 U.S. EPA, 1983. Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020.
5 Standard Methods for the Examination of Water and Wastewater 19th Edition. American Public Health Association. Washington, DC 1995.

8.0 INTERNAL QUALITY CONTROL CHECKS

Field-related QC checks are presented in Section 3.0 of this QAPP and in Section 2.7 of the FSP. This section provides additional information regarding internal QC checks for the field and the laboratory.

8.1 FIELD QUALITY CONTROL CHECKS

Internal QC procedures for pH, specific conductance, temperature, dissolved oxygen, ORP/Eh, turbidity, and HNu will include calibrating the instruments as described in Section 2.8.1 of the FSP and in the SOPs provided in Attachment B of the FSP. Assessment of field sampling precision and bias will be made by collection of field duplicates and rinsate blanks for laboratory analysis. Collection of field QC samples will be in accordance with the procedures provided in Section 2.7 of the FSP at the frequencies indicated in Tables 3-2, 3-5, 3-7, 3-10, 3-12, 3-15, 3-17 and 3-20 of the FSP.

8.2 LABORATORY QUALITY CONTROL CHECKS

The identified subcontract laboratories have QC programs that ensure the reliability and validity of the analyses performed at the laboratories. Each laboratory maintains a QA Plan that describes the policies, organization, objectives, QC activities, and specific QA functions used by the laboratory. All analytical procedures are documented in writing as SOPs. Each analytical SOP specifies minimum QC requirements for the procedure. As previously noted, SOPs for all analyses to be performed during the field investigations for SWMUs 4, 5, 9, and 10 are included in Appendix B of this QAPP. Table 7-1 provides a list of the SOPs associated with each analytical procedure. In addition, the laboratories maintain SOPs regarding general laboratory QA procedures. Several of these SOPs, as applicable, are also included in Appendix B of this QAPP. The Table of Contents included in Appendix B of this QAPP provides a list of SOP titles and associated SOP numbers for all SOPs contained in the appendix.

Several internal laboratory QC checks are briefly highlighted in the remainder of this section. Additional QC requirements that are specific to the NFESC QA Program, and therefore requirements for this project, are specified, as applicable, for each QC check.

Laboratory method blanks are prepared and analyzed in accordance with the analytical method used to determine whether contaminants originating from laboratory sources have been introduced and have affected environmental sample analyses. Method blanks for analytical methods that include preparative extraction or digestion procedures also are called preparation blanks. A method blank for inorganic

aqueous and solid sample analysis generally consists of an aliquot of analyte-free water that is subjected to the same preparation and analysis procedures as the environmental samples undergoing analysis. The aqueous matrix results are normalized to a fictitious soil sample and presented on a dry weight basis assuming 100% solids. For the organic aqueous method blank sample, analysis generally consists of an aliquot of analyte-free water that is subjected to the same preparation and analysis procedures as the environmental samples undergoing analysis. The organic solid matrix method blank is an aliquot of sand (or in some cases sodium sulfate) that is subjected to the same preparation and analysis as the environmental samples. The solid method blank results are presented on a dry weight basis assuming 100% solids. Criteria for method blanks and corrective actions for noncompliant results are described in each of the SOPs for determinative analysis in Appendix B of this QAPP. Under no circumstances are laboratory method blank contaminant values subtracted from environmental sample analysis results.

Matrix spike analysis for organic fraction analyses will be performed in duplicate (i.e., MS/MSD analysis) with a frequency of 1 per 20 environmental samples per matrix as a measure of laboratory precision. For inorganic analyses, MS and laboratory duplicate analysis will be performed for every 20 environmental samples per matrix. Laboratory duplicates are prepared by obtaining two sample aliquots from the same sample container and analyzing each portion following the same analytical procedures. For volatile and extractable organic MSD analyses, a sample aliquot from a separate sample container is used for analysis. As detailed in Section 3.6 of the QAPP, the field crew will provide extra volumes of sample matrices designated for laboratory QC analyses, as required.

Based on NFESC requirements, MS samples should contain all targeted analytes of interest. However, because of the extensive list of compounds included on the Appendix IX list for volatile, semivolatile, and pesticide/PCB organic compounds and the overlapping retention times of some of these compounds, it is not feasible to spike and analyze for the full list of Appendix IX compounds in the MS/MSD samples. Therefore, MS/MSD samples for these fractions will be spiked with a representative list of these chemicals. Tables specifying matrix spiking compounds per analytical method and associated statistical laboratory control limits to be used for these field investigations are provided in Section 3.

If the MS recovery is not within applicable control limits, the laboratory will assess the batch to determine whether the spike results are attributable to a matrix effect or are the result of other problems in the analytical process. Based on NFESC requirements, if all the batch QC elements that are not affected by the sample matrix are in control (e.g., method blank, LCS, calibration checks) and if no evidence indicates that spiking was not properly performed, the poor spike recovery may be attributed to matrix effects. In this case, the failed MS will be addressed in the case narrative, but re-preparation and re-analysis are not

required. If any of the batch QC elements that are not affected by the sample matrix are out of control, or if any evidence indicated that spiking may have been improperly performed, the MS and/or MSD sample will be re-processed through the entire analytical sequence unless insufficient sample is available. Details of noncompliant MS/MSD and laboratory duplicate results will be included in the SDG narrative.

Surrogates are organic compounds (typically brominated, fluorinated, or isotopically labeled) which are similar in nature to the compounds of concern and are not likely to be present in environmental media. Surrogates are spiked into each sample, standard, and method blank before analysis, and, with the exception of dioxin/furan analysis, are used in organic chromatographic analysis procedures as a check of method effectiveness. Surrogate recoveries will be evaluated against the laboratory-derived statistical control limits presented in Section 3.0. Corrective actions for noncompliant surrogate recoveries are presented in the relevant determinative SOPs included in Appendix B of this QAPP. Details of noncompliant surrogate recoveries will be included in the SDG narrative.

Laboratory control samples or blank spike samples serve to monitor the overall performance of each step during the analysis, including the sample preparation. LCSs must be included in each preparation or analytical batch of 20 samples or less and must be analyzed using the same sample preparations, analytical methods, and QA/QC procedures as those used for the samples. Based on the requirements of the NFESC QA Program, LCSs for wet chemistry and metals analyses must contain all analytes of interest, whereas LCSs for multiple-analyte organic methods must contain at least two targeted analytes from each major class of compounds subject to analysis. (For example, a semivolatile organic LCS must contain at least six analytes, including two basic, two neutral, and two acidic compounds.) The complete target analyte list of explosives will be included in the LCSs associated with explosives analysis. The complete target analyte list of PAHs and dioxins/furans will also be included in the LCSs for these analyses. The spiking lists for volatile, semivolatile, pesticide/PCB, and herbicides analyses will contain analytes that represent each of the various classes of analytes on the target analyte list. LCS results will be evaluated against the control limits statistically established by the laboratory. Tables specifying LCS spiking compounds per analytical method and associated statistical laboratory control limits to be used for the field investigations for SWMUs 4, 5, 9, and 10 are provided in Section 3.0.

Based on NFESC QA Program requirements, if recovery of a LCS falls outside the control limits, the laboratory will reject the data for the analytical batch and take corrective action. The associated samples, extracts, or digestates may be reanalyzed a single time, and if the LCS recoveries meet acceptance criteria, the data will be reported. If LCS analyte recovery is still outside the acceptance limits, the associated samples in the preparation batch will be reprocessed if sufficient sample is available and

holding times have not elapsed. If repreparation or reanalysis is not possible, the SDG narrative will include details of the failed LCS.

Internal standard performance criteria ensure that gas chromatography/mass spectrometry (GC/MS) analysis sensitivity and response are stable during every analytical run. Internal standard area counts for samples and blanks must not vary by more than a factor of two (- 50% to + 100%) from the associated 12-hour calibration standard. The retention time of the internal standards in samples and blanks must not vary by more than ±30 seconds from the retention time of the associated 12-hour calibration standard.

Additional internal laboratory QC checks include mass tuning for GC/MS analysis, second-column confirmation for GC analysis, and endrin/DDT degradation checks for pesticide analysis. Specific QC requirements for each of these QC checks are provided in the applicable SOPs included in Appendix B of this QAPP.

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

This section describes the procedures to be used for data reduction, validation, and reporting for the field investigations for SWMUs 4, 5, 9, and 10 for NSWC Crane. Data generated during the course of the field investigations will be maintained in hard copy form in the Administrative Record at NSWC Crane.

9.1 DATA REDUCTION

Data reduction will be completed for both field measurements and laboratory-generated analytical data. Field data reduction will be relatively limited versus the degree of laboratory data reduction required for the project. Reduction of both field data and laboratory data are presented in the remainder of this section.

9.1.1 Field Data Reduction

Field data will be generated through onsite water quality testing for general indicator parameters, including pH, specific conductance, turbidity, dissolved oxygen, ORP/Eh, and temperature and for onsite soil VOC screening (HNu). Only direct-read instrumentation will be used in the field. Field measurements will be recorded on sample logsheets immediately after measurements are taken. No calculations will be necessary to reduce these data. If an error is made in the field records, the error will be legibly crossed out (single-line strikeout), initialed and dated by the field member, and corrected in a space adjacent to the original (erroneous) entry. Further information regarding field documentation is provided in CTO 10 SOP 11, which is included in Attachment B of the FSP. The field measurements will later be encoded into the NSWC Crane database. Field data will be entered in the electronic database manually, and the entries will be verified by an independent reviewer to ensure that no transcription errors occurred. Field measurements will be recorded and reported in the following units:

- pH - standard units (S.U.)
- Temperature - degrees Celsius
- Specific conductance - microSiemens per centimeter (mS/cm)
- Turbidity - nephelometric turbidity units (NTU)
- Dissolved oxygen - milligrams per liter (mg/L)
- ORP/Eh - millivolts (mV)
- Water level - feet (ft)
- HNu – microgram per cubic meter ($\mu g/m^3$)

9.1.2 Laboratory Data Reduction

Data reduction will be completed by the subcontracted laboratories in accordance with the method-specific laboratory SOPs included in Appendix B of this QAPP. In addition, SOP LTL-1018 (provided in Appendix B of this QAPP) presents the procedures used by Laucks Testing Laboratories, Inc., for review and approval of data.

It should be noted that the possibility of coelution exists for some of the explosive compounds. The list of explosive compounds that coelute may vary over time as new columns are installed or as column affinities change over time. The use of a liquid phase as an eluent for high-performance liquid chromatography (HPLC) provides a likely chance for chemical changes to occur in the column substrate and/or active sites.

SW-846 Method 8330 specifies that quantitation for explosive compounds be performed using primary column. However, if the peaks for two compounds are observed to coelute on the primary column but the peaks for these same two compounds do not coelute on the confirmation column, results for these compounds will be quantitated and reported from the confirmation column. The laboratory will document this in the case narrative.

If two compounds coelute on the confirmation column but the same two compounds do not coelute on the primary column, two scenarios could result. Quantitation will be performed using the primary column but the same two compounds do not coelute on the primary column, two scenarios could result. Therefore, if only one of the coeluting compounds is detected on the primary column [and not the compound(s) it coelutes with], coelution on the confirmation column has no impact. The only potential for uncertainty is in the unlikely case that more than one of the coeluting compounds is detected on the primary column and a peak is also present in the expected retention time window on the confirmation column. In this case, it would not be possible to confirm which compound(s) were actually present. Therefore, as a conservative measure, both compounds will be assumed to be present, and both will be quantitated and reported from the primary column. If this occurs, the results for these compounds will be reported by the laboratory with a "Z" flag to indicate coelution has occurred on the confirmation column and that quantitative confirmation is not possible.

Laboratory analytical data will be reported using standard concentration units to ensure comparability with previous analytical results. Solid matrix samples will be reported on a dry weight basis. Reporting units for the various classes of chemicals under consideration are as follows:

- Explosives - micrograms per liter (µg/L); micrograms per kilograms (µg/kg)

- Metals - µg/L; µg/kg
- Volatile organic compounds - µg/L; µg/kg
- Semivolatile organic compounds - µg/L; µg/kg
- Organochlorine pesticides/PCBs - µg/L; µg/kg
- Organophosphorus pesticides - µg/L; µg/kg
- Herbicides - µg/L; µg/kg
- Dioxins/furans - picograms per liter (pg/L); µg/kg
- Cyanide - mg/L; mg/kg
- Nitrate/Nitrite - mg/L
- TOC - mg/L; mg/kg
- TSS – mg/L
- pH – standard units (S.U.)
- CEC – milliequivalent per 100 grams (meq/100g)

9.2 DATA VALIDATION

Validation of field measurements and laboratory analytical data are presented in this section. Validation of field data will be limited to real time "reality" checks, whereas laboratory analytical data will be validated in accordance with current U.S. EPA guidance. Validation of field measurements is listed in Section 9.2.1. Validation of laboratory analytical data is explained in Section 9.2.2.

9.2.1 Procedures Used to Evaluate Field Data

Field measurements will not be subjected to a formal data validation process. However, field technicians will ensure that the equipment used for field measurement is performing accurately via compliance with the applicable SOPs provided in the FSP. As described in Section 9.1.1, all field data entered into the electronic database will be independently reviewed for transcription errors.

9.2.2 Procedures Used to Validate Laboratory Data

One hundred percent of the laboratory analytical data will be subjected to data validation to ensure that the data are of evidentiary quality. Validation of analytical data will be completed by the TtNUS Environmental Chemistry/Toxicology Department located in TtNUS's Pittsburgh office. Final review and approval of validation deliverables will be completed by the Department's Data Validation Coordinator.

Data validators will review the chemical analytical data packages submitted by the laboratory. Analytical results will be validated versus the applicable analytical methods, the SOPs included in Appendix B of this

QAPP, and the requirements of this QAPP. Validation of these data including the use of qualifying flags will conform to the Region 5 Standard Operating Procedures for Validation of CLP Organic and Inorganic Data (U.S. EPA Region 5, 1993a, 1993b) and the National Functional Guidelines for Organic and Inorganic Data Review (U.S. EPA, 1994a, 1994b) to the greatest extent practicable for non-CLP data. The data validator will generate a report describing data limitations, that will be reviewed internally by the Data Validation Coordinator before submittal to the TOM.

As presented in Section 9.1.2 of the QAPP, the potential for coelution exists for some explosive compounds. Section 9.1.2 indicated that if more than one of the coeluting compounds is detected on the primary column and a peak is also present in the expected retention time window on the confirmation column, as a conservative measure, both compounds will be quantitated and reported by the laboratory from the primary column. If this occurs, the results for these compounds will be qualified as presumptively present at an estimated concentration ("JN") during data validation.

9.3 DATA REPORTING

This section presents data reporting requirements for field and laboratory analytical data. Section 9.3.1 explains field measurement data handling and reporting. Section 9.3.2 details laboratory data handling and reporting.

9.3.1 Field Data Reporting

Field data will be reported in the units presented in Section 9.1.1. Documentation of field activities is described in CTO10 SOP 11, which is included in Attachment B of the FSP. Validation of field measurements will be conducted in the field by the Field Geologists/Technicians. Field measurements will be transferred from the sample logsheets to the electronic database manually and will be reviewed for accuracy by the TtNUS Data Management/EGIS Lead for the project.

All records regarding field measurements (i.e., field logbooks, sampling logbooks, and sample logsheets) will be placed in the Tetra Tech NUS central files upon completion of the field effort. Entry of these results in the database will require removal of these records from the files. Outcards will be used to document the removal of any such documentation from the files (date, person, subject matter). After database entry is complete, all records will be copied for placement in TtNUS central files; all original records will be sent to NSWC Crane for inclusion in the final evidence files, as described in Section 5.3.

9.3.2 Laboratory Data Reporting

Data reported by each laboratory for all analytical fractions will be in a CLP-type reporting format. All pertinent QC data including raw data and summary forms for blanks, standards analysis, calibration information, etc., will be provided for all analyses. Case narratives will be provided for each Sample Delivery Group (SDG). SOP LTL-4201 (Appendix B of this QAPP) provides further details regarding the information that will be included in CLP-type packages produced by Laucks Testing Laboratories, Inc.

Data will be handled electronically pursuant to the electronic deliverable requirements specified in TtNUS's Basic Ordering Agreement with analytical laboratories. This agreement requires the analytical laboratories to provide data in both hardcopy and electronic form. The database will include pertinent sampling information such as sample number, sampling date, and general location. Sample-specific quantitation limits will be reported for nondetected analytes. Units will be clearly summarized in the database and will conform to those identified in Section 9.1.2. The original electronic diskettes and data validation reports for the NSWC Crane field investigations for SWMUs 4, 5, 9, and 10 will be maintained in the Administrative Record at NSWC Crane; copies will be maintained in Tetra Tech NUS central files. SOP CT-05 lists database management and QA and is included in Appendix B of this QAPP.

Validation of the laboratory data will be completed by TtNUS chemists using the hard copy data. The TtNUS Data Validation Coordinator will be responsible for organizing this effort and reviewing data validation memoranda. Upon completing data validation activities, the validation qualifiers will be entered in the electronic database and will be reviewed for accuracy. During this review process, the electronic database printout will be compared with the hard copy data to ensure that the hard copy data and electronic data are consistent. The Data Validation Coordinator will ensure that the validation qualifiers are transferred to the electronic database. Data validation and incorporation of data qualifiers into the electronic database must be completed before statistical evaluation of the data.

10.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits will be performed periodically to ensure that work is being implemented in accordance with the approved project plans and in an overall satisfactory manner. Some examples of pertinent audits are as follows:

- The FOL will supervise and check daily that the field measurements are made accurately, equipment is thoroughly decontaminated, samples are collected and handled properly, and fieldwork is documented accurately and neatly.

- The TOM will maintain contact with the FOL and Data Validation Coordinator to ensure that management of the acquired data proceeds in an organized and expeditious manner. Validation and incorporation of validation results into the electronic database must be completed before statistical evaluation of the data.

- Details regarding additional audit responsibilities, frequency, and procedures are detailed in the remainder of this section. Field performance and system audits are presented in Section 10.1. Laboratory performance and system audits are explained in Section 10.2.

10.1 FIELD PERFORMANCE AND SYSTEM AUDITS

This section presents the responsibilities, frequencies, and procedures associated with internal and external field performance and system audits.

10.1.1 Internal Field Audits

10.1.1.1 Internal Field Audit Responsibilities

In addition to the daily checks performed by the FOL, an independent performance and system audit of field activities may be conducted by the TtNUS Quality Assurance Manager (QAM) or designee. Such audits are scheduled as part of the NSWC Crane RCRA environmental investigation program, which includes this and other environmental projects, with individual projects being selected for audit by the QAM without the involvement of the TOM. If a formal field audit is conducted for this study, the QAM (or designee) will be responsible for ensuring that sample collection, handling, and shipping protocols, as well

as equipment decontamination and field documentation procedures, are being performed in accordance with the approved project plans and SOPs.

10.1.1.2 Internal Field Audit Frequency

Internal field audits will be conducted at the beginning of the field program. These audits allow for identification and correction of problems early in the program.

10.1.1.3 Internal Field Audit Procedures

The field audit will be conducted in accordance with the following procedures:

- Before the audit, the auditor will prepare a detailed checklist to be used as an auditing guide. An example audit checklist is provided in Appendix C of this QAPP.
- Upon arrival at the audit location, the auditor shall conduct a pre-audit meeting with the responsible management of the organization or project to be reviewed.
- Field audits will include a review of required project documentation (logbooks, sample log sheets, etc.) and field operations (ground water and soil sampling, sample handling, etc.) to evaluate completeness and compliance with applicable SOPs.
- The audit checklist will be used to record observations including any noted nonconformances.
- A formal post-audit debriefing will be conducted, and potential immediate corrective actions will be discussed.
- The auditor will generate a formal audit report that will address corrective actions. This report will be provided by the auditor to the TOM.
- The TOM will ensure that all corrective actions are addressed and will provide written verification of corrective action implementation to the auditor.
- The auditor will manage corrective action verification and audit closure.

- The following audit records will be maintained by the QAM:

  - Audit checklists
  - Audit reports
  - Response evaluations
  - Verification of corrective actions
  - Follow-up checklists and audit reports

10.1.2 External Field Audits

10.1.2.1 External Field Audit Responsibilities

External field audits may be conducted by the IDEM, U.S. EPA Region 5, or both.

10.1.2.2 External Field Audit Frequency

External field audits may be conducted at any time during field activities at the discretion of the IDEM and U.S. EPA Region 5. If an audit is to be conducted, scheduling should be coordinated through the QAM to ensure that personnel and equipment are available as necessary. Personnel being audited may or may not be informed of the impending audit at the discretion and request of the auditing body.

10.1.2.3 Overview of the External Field Audit Process

External audit procedures are at the discretion of U.S. EPA Region 5 and the IDEM.

10.2 LABORATORY PERFORMANCE AND SYSTEMS AUDITS

This section presents the responsibilities, frequencies, and procedures associated with internal and external laboratory performance and system audits.

10.2.1 Internal Laboratory Audits

10.2.1.1 Internal Laboratory Audit Responsibilities

The QA/QC Officer or appropriate designee of each of the subcontracted laboratories performs routine internal audits of the laboratory. Internal laboratory audits also are conducted by the U.S. Navy. Tetra Tech NUS holds no responsibility for such audits. Performance and system audits of laboratories are

coordinated through the NFESC by an independent QA contractor. It is the responsibility of the NFESC and its contractor to ensure that the subcontracted laboratories comply with good laboratory practices and the general requirements of all analytical services provided by the laboratory.

10.2.1.2 Internal Laboratory Audit Frequency

At a minimum, Laucks Testing Laboratories, Inc. conducts internal system audits of each laboratory analytical department on an annual basis. Internal audits are performed bi-annually at Laucks Testing Laboratories, Inc. if no external audits are conducted. In addition, each laboratory department at Laucks Testing Laboratories, Inc., analyzes blind performance evaluation samples as described in SOP LTL-1009 (Appendix B of this QAPP). Data audits also are performed by the Laucks Testing Laboratory QA/QC Officer at least once per year for each analytical area.

Each laboratory section is audited at least once per quarter at Triangle Laboratories, Inc. As described in SOP 2.02 (Appendix B of this QAPP), these audits may consist of traceability audits, phase inspections, data audits, and/or documentation inspections.

Internal laboratory performance and system audits are completed by the U.S. Navy for each contracted laboratory on an 18-month schedule.

10.2.1.3 Internal Laboratory Audit Procedures

Internal systems audits are conducted to detect any problems in sample flow, analytical procedures, or documentation and to ensure adherence to laboratory SOPs. Laucks Testing Laboratories, Inc.'s, internal audit procedures are described in SOP LTL-1017 (Appendix B of this QAPP). Triangle Laboratories, Inc.'s, internal audit procedures are described in SOP 2.02 (Appendix B of this QAPP).

Internal U.S. Navy laboratory audit procedures, as performed by a Navy contractor, include a pre-screening process that requires review of the laboratory's QA manual, analysis of performance evaluation (PE) samples, generation of data deliverables for the PE samples, an onsite technical systems audit of the laboratory, and satisfactory resolution of all deficiencies and findings.

10.2.2 External Laboratory Audits

10.2.2.1 External Laboratory Audit Responsibilities

External audits may be performed by the IDEM and U.S. EPA Region 5 at their discretion. U.S. EPA Region 5 has recently audited Laucks Testing Laboratories, Inc. for another related NSWC Crane project, and the outcome was favorable. Each laboratory also is involved in external audits and performance evaluation studies throughout the year, as required, to maintain certifications and/or approvals by other regulatory agencies or programs.

10.2.2.2 External Laboratory Audit Frequency

An external laboratory audit may be conducted by U.S. EPA Region 5 or IDEM prior to or during sampling and analysis activities.

10.2.2.3 Overview of the External Laboratory Audit Process

External audit procedures are at the discretion of U.S. EPA Region 5 and the IDEM. External laboratory audits may include (but are not limited to) review of laboratory analytical procedures, laboratory onsite audits, and/or submission of performance evaluation (PE) samples to the laboratory for analysis.

11.0 PREVENTIVE MAINTENANCE PROCEDURES

Measuring equipment used in environmental monitoring or analysis for the NSWC Crane field investigation for SWMUs 4, 5, 9, and 10 will be maintained in accordance with the manufacturer's operation and maintenance manuals. Equipment and instruments will be calibrated in accordance with the procedures and at the frequency presented in Section 6.0 (Calibration Procedures and Frequency). Preventive maintenance for field and laboratory equipment are detailed in the remainder of this section.

11.1 FIELD EQUIPMENT PREVENTIVE MAINTENANCE

Preventive maintenance of field equipment is presented in Section 2.15.2 of the attendant FSP. The TtNUS FOL will be responsible for ensuring that equipment is operating properly before use and that routine maintenance is performed and documented. Any problems encountered while operating the instrument will be recorded in the field logbook, including a description of the symptoms and corrective actions taken. If problems with the equipment are detected and service is required, the equipment will be logged, tagged, and segregated from equipment in proper working order. Use of the instrument will not be resumed until the problem is resolved.

11.2 LABORATORY INSTRUMENT PREVENTIVE MAINTENANCE

Proper maintenance of laboratory instruments and equipment is essential to ensuring their readiness when needed. Dependent on manufacturer's recommendations, maintenance intervals are established for each instrument. All instruments will be labeled with a model number and serial number, and a maintenance logbook will be maintained for each instrument. Personnel will be alert to the maintenance status of the equipment they are using at all times. Table 11-1 provides a summary of preventive maintenance procedures performed by Laucks Testing Laboratories, Inc. and Triangle Laboratories, Inc. for key analytical instruments and equipment.

The use of manufacturer-recommended grades or better of supporting supplies and reagents is also a form of preventive maintenance. For example, gases used in the various gas chromatographs and metals instruments are of sufficient grade to minimize fouling of the instrument. The routine use of septa, chromatographic columns, and other supporting supplies from reputable manufacturers will assist in averting unnecessary periods of instrument downtime. An inventory of critical spare parts will also be maintained by the laboratory to minimize instrument downtime.

TABLE 11-1

PREVENTIVE MAINTENANCE FOR ANALYTICAL INSTRUMENTS
NSWC CRANE, INDIANA
PAGE 1 OF 4

Instrument	Laboratory[1]	Preventive Maintenance	Maintenance Frequency
GC/MS - Volatiles	LTL	Change pump oil.	Yearly.
		Clean and rinse transfer lines, trim front end of column, rinse 6-port valve, clean or replace sample lines, replace trap, replace column, clean source, replace fittings, change sample block on autosampler, replace filaments.	As needed.
GC/MS - Semivolatiles	LTL	Change injection port liner and septum, clip 5-10 cm from front of pre-column, ramp GC oven twice to 310 C.	Daily or as needed.
		Clean source, install new guard column, clean or replace tubing, replace bottom seal in injection port, replace o-ring in injection port.	As needed.
HRGC/VG HRMS - Dioxins/ Furans	Triangle Lab	Inspect vacuum system pressures, inspect helium tank pressures and change if less than 300 psi.	Daily.
		Change injection port liner and septum.	As needed.
		Inspect water filters and change if necessary.	Monthly.
		Bake AutoSpec flight tube.	Bi-monthly.
		Clean ion source, change reservoir septum.	Quarterly or as needed.
		Clean source slit, clean or replace split line, inspect focus 2 assembly and clean if necessary, bake out 70 style HRMS, replace rotary pump oil, check diffusion pump oil and add if needed.	Bi-annually or as needed.
		Change oxygen trap.	Annually.
		Full preventive maintenance visit by an engineer.	As needed.

TABLE 11-1

PREVENTIVE MAINTENANCE FOR ANALYTICAL INSTRUMENTS
NSWC CRANE, INDIANA
PAGE 2 OF 4

Instrument	Laboratory[1]	Preventive Maintenance	Maintenance Frequency
GC - Volatiles by purge and trap (i.e., 1,4-dioxane, acetonitrile, isobutyl alcohol, propionitrile)	LTL	Change carrier and make-up gas filters.	As needed.
		Change trap, clean flame ionization detector (FID) jet, trim column.	As needed.
GC – Organo-chlorine and organo-phosphorus pesticides/ PCBs, herbicides	LTL	Swab electron capture (EC) detectors for radioactivity.	Semi-annually.
		Change O_2 traps on gas lines.	Approx. semi-annually.
		Clean autosampler syringe.	Approx. monthly.
		Change injection port liner and septum.	Approx. every 100 injections.
		Bake system, flush injection port, clip guard column, change analytical column, change carrier hydrocarbon trap.	As needed.
HPLC	LTL	Change filter frit in mixer.	As needed (when pressure builds).
		Change column pre-filter.	As needed (2-3 months).
		Rinse water pump with methanol, filter water, sonicate water intake filter frit.	Approximately weekly.
		Change pump seals.	As needed

TABLE 11-1

PREVENTIVE MAINTENANCE FOR ANALYTICAL INSTRUMENTS
NSWC CRANE, INDIANA
PAGE 3 OF 4

Instrument	Laboratory[1]	Preventive Maintenance	Maintenance Frequency
ICP/MS	LTL	Clean or change air filters, change pump oil.	Semi-annually.
		Clean torch, replace nebulizer tips, replace pump tubing, replace injector, change cones.	As needed.
		Check mass calibration.	Every 2 weeks.
		Check sensitivity.	Daily.
ICP/AES	LTL	Service Intercooler.	Annually.
		Rinse and clean nebulizer cap and spray chamber.	Monthly or as needed.
		Clean torch, vacuum filters.	Bi-monthly.
		Profile instrument, examine autosampler tubing and replace as needed.	Daily.
		Empty rinse container, fill rinse water reservoir.	As needed
Mercury Analyzer	LTL	Check and replace pump tubing, check and replace membrane, check and clean windows.	As needed.
Spectro-photometer	LTL	Clean sample compartment and entrance windows.	Semi-annually.
		Check wavelength calibration.	Annually.
Ion Chromato-graph	LTL	Replace pump seals.	Annually.
		Lubricate analytical pump motor.	Semi-annually.
		Check chromatography module and all gas lines for leaks.	Every run.
		Clean conductivity detector cell electrodes, check cell calibration.	Monthly.
		Replace bed supports, clean columns, clean AMMS (membrane suppresser), replace autosampler pipette tip.	As needed.

TABLE 11-1

PREVENTIVE MAINTENANCE FOR ANALYTICAL INSTRUMENTS
NSWC CRANE, INDIANA
PAGE 4 OF 4

Instrument	Laboratory[1]	Preventive Maintenance	Maintenance Frequency
Lachat Ion Analyzer	LTL	Lubricate pump. Replace pump tubing. Change cadmium column.	Semi-annually. As needed (~ 1 to 2 months) As needed.
TOC Analyzer	LTL	Change pump tubing. Change other tubing, change furnace tubes, change LiOH tube, change tin trap, adjust optical balance, change septum, change permeation dryer tubing. Change IR filter screen, change gas tubing.	Each run. As needed. Check monthly; replace as needed.
Refrigerators	LTL Triangle Lab	Monitor temperature.	Daily.

1. LTL – Laucks Testing Laboratories, Inc.
   Triangle Lab – Triangle Laboratories, Inc.

12.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

The purpose of this section is to indicate the methods by which it will be ensured that the data collected for this investigation coincides with the project DQOs and input requirements as specified in Section 4.0 of the attendant Work Plan. The data assessment will be conducted to evaluate analytical data quality via compliance with the QC objectives listed in Tables 3-1 through 3-16 of Section 3.0. Additionally, the data will be reviewed for indications of interferences to results caused by sample matrices, cross contamination during sampling, cross contamination in the laboratory, and sample preservation and storage anomalies. Compliance with the completeness objectives for field and laboratory data/measurements will be calculated by hand (field measurements) and electronically via a database subroutine (laboratory data). Equations to be used for the precision, accuracy, and completeness assessment are outlined Sections 12.1, 12.2 and 12.3. Section 12.4 presents additional data quality considerations that will be evaluated after completion of data validation.

12.1 ACCURACY ASSESSMENT

As presented in Section 8.2, to ensure the accuracy of the analytical procedures, a minimum of 1 of every 20 samples per matrix will be spiked with a known amount of the analyte(s) to be evaluated. The spiked sample is then analyzed. The increase in concentration of the analyte observed in the spiked sample, due to the addition of a known quantity of the analyte, compared with the reported value of the analyte in the unspiked sample determines the %R. Control charts are plotted by the laboratory for each commonly analyzed compound and kept on matrix- and analyte-specific bases. The %R for a spiked sample is calculated by using the following formula:

$$\%R = \frac{\text{Amount in Spiked Sample} - \text{Amount in Sample}}{\text{Known Amount Added}} \times 100$$

Percent recovery for LCS and surrogate compound results is determined according to the following equation:

$$\%R = \frac{\text{Experimental Concentration}}{\text{Known Amount Added}} \times 100$$

12.2 PRECISION ASSESSMENT

As presented in Section 8.2, laboratory duplicate samples (for inorganic analyses) and MSD samples (for organic analyses) will be prepared and analyzed at a minimum frequency of 1 per every 20 environmental samples per matrix. As described in Section 3.6, field duplicate samples also will be collected at a minimum frequency of one per 10 environmental samples per matrix. The RPD between the sample (or spike) and duplicate (or duplicate spike) is calculated by using the following formula:

$$\text{RPD} = \frac{\text{Amount in Sample 1} - \text{Amount in Sample 2}}{0.5(\text{Amount in Sample 1} + \text{Amount in Sample 2})} \times 100$$

12.3 COMPLETENESS ASSESSMENT

As defined in Section 3.3, completeness is the ratio of the number of valid sample results to the total number of samples per medium. Following the completion of the analytical testing and data validation, the percent completeness will be calculated using the following equation:

$$\text{Completeness} = \frac{(\text{number of valid measurements})}{(\text{number of measurements planned})} \times 100$$

12.4 DATA ASSESSMENT

The field and laboratory data collected during the investigation for each SWMU will be used to determine whether the level of the constituents present at the site poses an adverse human health or ecological impact. The QC results associated with each analytical parameter for each matrix will be compared with the objectives presented in Sections 3.1 though 3.5 of this QAPP. Only data generated in association with QC results meeting these objectives and deemed usable by data validation will be considered usable for quantitative purposes.

In addition, the data obtained will be both qualitatively and quantitatively assessed on a project-wide, matrix-specific, parameter-specific, and SWMU-specific basis. The results of this assessment will be presented in the data usability assessment performed for the SWMU. Examples of issues to be considered in this assessment are as follows:

- Deviations, if any, from the field sampling SOPs
- Deviations, if any, from the laboratory analytical SOPs

- Deviations, if any, from the FSP
- Deviations, if any, from the data validation procedures
- Identification and explanation of elevated reporting limits
- Identification of unusable data (i.e., data qualified as "R")

13.0 CORRECTIVE ACTION

Under the TtNUS QA/QC program, it is required that any and all personnel noting conditions adverse to quality report these conditions immediately to the TOM and QAM. These parties, in turn, are charged with performing root-cause analyses and implementing appropriate corrective action in a timely manner. It is ultimately the responsibility of the QAM to document all findings and corrective actions taken and to monitor the effectiveness of the corrective measures performed.

13.1 FIELD CORRECTIVE ACTION

Field nonconformances or conditions adverse to quality must be identified and corrected as quickly as possible so that work integrity or quality of product is not compromised. The need for corrective action may arise based on deviations from project plans and procedures, adverse field conditions, or other unforeseen circumstances. Corrective action needs may become apparent during the performance of daily work tasks or as a consequence of internal or external field audits.

Corrective action may include resampling and may involve amending previously approved field procedures. Minor modifications to field activities, such as the collection of additional samples, will be initiated at the discretion of the FOL, subject to onsite approval by NSWC Crane Environmental Protection Department. Major modifications, such as the elimination of a sampling point, must be approved and documented via a Field Task Modification Request (FTMR). Approval of the corrective action will be obtained by the U.S. Navy (in conjunction with U.S. EPA Region 5 and IDEM). The FOL is responsible for initiating FTMRs; a FTMR will be prepared for all deviations from the project plan documents, as applicable. An example of a FTMR is provided as Figure 13-1. Copies of all FTMRs will be maintained with the onsite project planning documents and will be placed in the final evidence file.

13.2 LABORATORY CORRECTIVE ACTION

In general, laboratory corrective actions are warranted whenever an out-of-control event or potential out-of-control event is noted. The specific corrective action taken depends on the specific analysis and the nature of the event. Generally, the following occurrences alert laboratory personnel that corrective action may be necessary:

- QC data are outside established warning or control limits.
- Method blank analyses yield concentrations of target analytes exceeding acceptable levels.

FIGURE 13-1

FIELD TASK MODIFICATION REQUEST FORM

Client Identification Project Number FTMR Number

To _____ Location _____ Date _____

Description:

_____
_____
_____
_____

Reason for Change:

_____
_____
_____
_____

Recommended Disposition:

_____
_____
_____
_____

_____
Field Operations Leader (Signature, if applicable) Date

Disposition:

_____
_____
_____
_____

_____
Task Order Manager (Signature, if required) Date

_____
Distribution:
Program Manager
Quality Assurance Officer
Task Order Manager
Field Operations Leader

Others as required _____
_____
_____
_____

- Undesirable trends are detected in spike %Rs or in duplicate RPDs.
- There is an unexplained change in compound detection capability.
- Inquiries concerning data quality are received.
- Deficiencies are detected by laboratory QA staff audits or from PE sample test results.

Any corrective action taken above the analyst level that cannot be performed immediately at the instrument will be documented. Corrective actions are typically documented for out-of-control situations on a Corrective Action Form or an Out-of-Control Event Form. Copies of the forms used by Laucks Testing Laboratories, Inc. are included as Appendices 1 and 3 of SOP LTL-1008, which is in Appendix B of this QAPP. Further details describing the system used by Laucks Testing Laboratories, Inc. to identify, document, and resolve out-of-control events is provided in SOP LTL-1008. Further detail describing the system used by Triangle Laboratories, Inc. to identify, document, and resolve out-of-control events is provided in SOP 2.04.

13.3 CORRECTIVE ACTION DURING DATA VALIDATION AND DATA ASSESSMENT

The need for corrective action may become apparent during data validation, interpretation, or presentation activities. The performance of rework (i.e., resampling or reanalysis), the institution of a change in work procedures, or the provision of additional/refresher training are possible corrective actions relevant to data evaluation activities. The TOM will be responsible for approving the implementation of corrective action.

14.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

QA reports to management will be provided in various formats during the course of the NSWC field investigation for SWMUs 4, 5, 9, and 10. Data validation letters will be prepared on an SDG-specific basis and will summarize QA issues for the subcontracted laboratory data. In addition, daily reports via telephone summarizing accomplishments and QA/QC issues during the field investigation will be made by the FOL to the TOM. Monthly progress reports will be prepared by the TOM. QA reports will also be prepared by the subcontracted analytical laboratories if QC limits are updated during the field investigation or if significant plan deviations result from unanticipated circumstances.

14.1 CONTENTS OF PROJECT QUALITY ASSURANCE REPORTS

The data validation reports will address all major and minor laboratory noncompliances as well as noted sample matrix effects. In the event that major problems occur with an analytical laboratory (e.g., repeated or extreme holding time exceedances or calibration noncompliances, etc.), the Data Validation Coordinator will notify the TOM, QAM, Technical Program Manager, Deputy Program Manager, and Laboratory Services Coordinator. Such notifications (if necessary) are typically provided via internal memoranda and are placed in the project file. These reports contain a summary of the noncompliance, a synopsis of the impact on individual projects, and recommendations regarding corrective action and compensational adjustments. Corrective actions for major noncompliances are initiated at the program level.

The FOL will provide the TOM with daily reports via telephone during the course of the sampling event. These reports will explain accomplishments, deviations from the FSP, upcoming activities, and a QA summary. The TOM provides a monthly progress report to the Navy that addresses the project budget, schedule, accomplishments, planned activities, and QA/QC issues and intended corrective actions.

The subcontracted analytical laboratories will provide a QA report to TtNUS if QC limits for parameters associated with the NSWC Crane field investigation for SWMUs 4, 5, 9 and 10 are updated or if significant plan deviations result from unanticipated circumstances. Since MDLs/IDLs/RLs, as applicable, will be included in the analytical data packages for NSWC Crane samples, it is not necessary for the laboratories to include updated MDLs/IDLs/RLs in their QA reports unless the updates result in RLs that exceed risk-based target levels.

14.2 FREQUENCY OF QUALITY ASSURANCE REPORTS

The following frequencies will apply to QA reports for the NSWC Crane field investigation for SWMUs 4, 5, 9, and 10: (1) data validation QA reports - contingent on SDG delivery data; (2) field progress reports - daily during the course of the sampling event; (3) monthly progress reports - monthly; and (4) laboratory QA reports - as required based on QC limit updates or the occurrence of plan deviations resulting from unanticipated circumstances.

14.3 INDIVIDUALS RECEIVING/REVIEWING QUALITY ASSURANCE REPORTS

Data validation QA reports are provided to the TOM for inclusion in the project files. In the event that major problems are observed for a given laboratory, the Technical Program Manager, Deputy Program Manager, QAM, TOM, and Laboratory Services Coordinator are provided with copies of the QA report. Daily field progress reports via telephone are provided to the TOM. Monthly progress reports are provided to the U.S. Navy. Laboratory QA reports are provided to the TOM; these reports will be forwarded to U.S. EPA Region 5 only if QC updates result in RLs that exceed risk-based target levels or if QC limits for key parameters (e.g., explosives, metals, or other analytes that are associated with the site based on site history) degrade significantly or if any significant plan deviations result from unanticipated circumstances. Copies of any cited QA reports will be provided to the U.S. EPA Region 5 immediately on request.

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APPENDIX A

COMPARISON OF MDL/IDL/RL TO ALL SCREENING CRITERIA

TABLE C-1
TABULAR PRESENTATION OF RBSLs FOR RBTL SELECTION
NSWC CRANE, CRANE, INDIANA

PARAMETER	CAS	Aqueous Matrix Laboratory MDL (ug/L)	Aqueous Matrix Laboratory RL (ug/L)	REGION 5 ECO DQLs SURFACE WATER (ug/L)	Footnote	FEDERAL MCLs (ug/L)	Footnote	FEDERAL AWQCs FRESHWATER ACUTE (ug/L)	Footnote	FEDERAL AWQCs FRESHWATER CHRONIC (ug/L)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL GW CLOSURE LEVELS (ug/L)	IDEM TIER 1 DEFAULT INDUSTRIAL GW CLOSURE LEVELS (ug/L)	Footnote	Footnote	REGION 9 TAP WATER PRGs (ug/L)	Footnote
DIOXINS/FURANS																	
1,2,3,4,6,7,8-HPCDD	35822-46-9	8.40E-06	5.00E-05													4.50E-05	
1,2,3,4,6,7,8-HPCDF	67562-39-4	1.08E-05	5.00E-05													4.50E-05	
1,2,3,4,7,8,9-HPCDF	55673-89-7	7.78E-05	5.00E-05													4.50E-04	
1,2,3,4,7,8-HXCDD	39227-28-6	1.94E-05	5.00E-05													4.50E-06	
1,2,3,4,7,8-HXCDF	70648-26-9	3.05E-05	5.00E-05													4.50E-06	
1,2,3,6,7,8-HXCDD	57653-85-7	3.12E-06	5.00E-05													4.50E-06	
1,2,3,6,7,8-HXCDF	57117-44-9	8.10E-06	5.00E-05													4.50E-06	
1,2,3,7,8,9-HXCDD	19408-74-3	4.21E-05	5.00E-05													4.50E-06	C
1,2,3,7,8,9-HXCDF	72918-21-9	7.50E-06	5.00E-05													4.50E-06	
1,2,3,7,8-PECDD	40321-76-4	1.34E-05	5.00E-05													4.50E-07	
1,2,3,7,8-PECDF	57117-41-6	1.84E-05	5.00E-05													9.00E-06	
2,3,4,6,7,8-HXCDF	60851-34-5	9.01E-05	5.00E-05													4.50E-06	
2,3,4,7,8-PECDF	57117-31-4	3.37E-05	5.00E-05													9.00E-07	
2,3,7,8-TCDD	1746-01-6	4.60E-06	1.00E-05			0.00003										4.50E-07	C
2,3,7,8-TCDF	51207-31-9	4.70E-06	1.00E-05													4.50E-06	
1,2,3,4,6,7,8,9-OCDD	3268-87-9	3.17E-05	1.00E-04													4.50E-03	
1,2,3,4,6,7,8,9-OCDF	39001-02-0	3.88E-05	1.00E-04													4.50E-03	
EXPLOSIVES (SW-846 METHOD 8330)																	
1,3,5-Trinitrobenzene	99-35-4	0.3	0.65											N	N	1100	N
1,3-Dinitrobenzene	99-65-0	0.3	0.65	2.36										N	N	3.6	N
2,4,6-Trinitrotoluene (TNT)	118-96-7	0.44	0.65											C	C	2.2	C
2,4-Dinitrotoluene	121-14-2	0.44	0.65	230								1.2 C (15)	4.2 C (15)	N	N	73	N
2,6-Dinitrotoluene	606-20-2	0.44	0.65	42								1.2 C (15)	4.2 C (15)	N	N	36	N
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	0.38	0.65											N	N	1800	N
2-Nitrotoluene	88-72-2	0.59	0.65													61	
3-Nitrotoluene	99-08-1	0.59	0.65											N	sat	61	N
4-Nitrotoluene	99-99-0	0.59	0.65											N	sat	61	N
4-Amino-2,6-dinitrotoluene	19406-51-0	0.26	0.65														
2-Amino-4,6-dinitrotoluene	35572-78-2	0.18	0.65														
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	479-45-8	0.51	0.65											N	N	360	N
Nitrobenzene	98-95-3	0.3	0.65	740								4.3	51	N	N	3.4	N
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	0.31	0.61											C	C	0.61	C
Nitroglycerin	55-63-0	0.39	13														
Pentaerythritol tetranitrate (PETN)	78-11-5	0.38	26														
APPENDIX IX METALS (SW-846 Method 6020 ICP/MS)														0	0		
Antimony	7440-36-0	0.082	1	31		6						6	41	N	N	15	N
Arsenic	7440-38-2	0.1	1	53		50		340		150		50 C	50 C	C	C	0.045	C
Barium	7440-39-3	0.022	1	5000		2000						2000 C	7200	N	max	2600	N
Beryllium	7440-41-7	0.048	1	7.6		4						4 C	4 C	N	C	73	N
Cadmium	7440-43-9	0.063	1	0.66		5		4.3	1	2.2	1	5	51	N	N	18	N
Chromium (total)	7440-47-3	0.035	5	42		100		16	10	11	10	100	510	C	C	110 (10)	N
Cobalt	7440-48-4	0.02	3	5										N	max	2200	N
Copper	7440-50-8	0.038	2	5		1300	2,3	13	1	9	1	1300	3800	N	N	1400	N
Lead	7439-92-1	0.053	1	1.3		15	2	65	1	2.5	1	15	42	N	N		
Mercury (SW-846 Method 7470A/7471A)	7439-97-6	0.07	0.2	0.0013		2		1.4		0.77		2	31			11	N
Nickel	7440-02-0	0.063	5	29		100	4	470	1	52	1	100	2000	N	N	730	N
Selenium	7782-49-2	0.35	1	5		50				5		50	510	N	N	180	N
Silver	7440-22-4	0.014	3	1		100	7	3.4	1			180	510	N	N	180	N
Thallium	7440-28-0	0.0058	1	0.56		2						2	9			2.9 (11)	
Tin	7440-31-5	0.023	10	73										N	max	22000	N
Vanadium	7440-62-2	0.031	2	19										N	N	260	N
Zinc	7440-66-6	0.38	10	58.9		5000	7	120	1	120	1	11000	31000	N	max	11000	N
MISCELLANEOUS METALS (SW-846 METHOD 6010B Trace)																	
Aluminum	7429-90-5	47	200			50-200	1	750		87				N	max	36000	N

TABLE C-1
TABULAR PRESENTATION OF RBSLs FOR RBTL SELECTION
NSWC CRANE, CRANE, INDIANA

PARAMETER	CAS	Aqueous Matrix Laboratory MDL (ug/L)	Aqueous Matrix Laboratory RL (ug/L)	REGION 5 ECO DQLs SURFACE WATER (ug/L)	Footnote	FEDERAL MCLs (ug/L)	Footnote	FEDERAL AWQCs FRESHWATER ACUTE (ug/L)	Footnote	FEDERAL AWQCs FRESHWATER CHRONIC (ug/L)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL GW CLOSURE LEVELS (ug/L)	IDEM TIER 1 DEFAULT INDUSTRIAL GW CLOSURE LEVELS (ug/L)	Footnote	Footnote	REGION 9 TAP WATER PRGs (ug/L)	Footnote
Calcium	7440-70-2	12	5000														
Iron	7439-89-6	11	100			300	1			1000				N	max	11000	N
Magnesium	7439-95-4	18	5000														
Manganese	7439-96-5	1.5	15			50	1							N	N	880	N
Potassium	7440-09-7	102	5000														
Sodium	7440-23-5	80	5000														
APPENDIX IX VOLATILE ORGANIC COMPOUNDS (SW-846 METHOD 8260B WITH 25mL PURGE - WATER, 5g PURGE - SOIL or 8015B WITH 10mL PURGE - WATER AND 5g PURGE - SOIL)																	
1,1,1,2-Tetrachloroethane	630-20-6	0.11	0.5	90.25								6.9 C	110 C	C	C	0.43	C
1,1,1-Trichloroethane	71-55-6	0.1	1	88		200						200	9200	N	sat	790	N
1,1,2,2-Tetrachloroethane	79-34-5	0.18	0.5	13								0.9 C	14 C	C	C	0.055	C
1,1,2-Trichloroethane	79-00-5	0.054	0.5	650		5						5 C	50 C	C	C	0.2	C
1,1-Dichloroethane	75-34-3	0.11	1	47								990	10000	N	N	810	N
1,1-Dichloroethene	75-35-4	0.14	0.5	78		7						7 C	7 C	C	C	0.046	C
1,2,3-Trichloropropane	96-18-4	0.11	1	12.11										C	C	0.0016	C
1,2-Dibromo-3-chloropropane	96-12-8	0.17	1	11.2		0.2								C	C	0.048	C
1,2-Dibromoethane	106-93-4	0.14	0.5	22.5		0.05								C	C	0.00076	C
1,2-Dichloroethane	107-06-2	0.061	0.5	190		5						5 C	31 C	C	C	0.12	C
1,2-Dichloropropane	78-87-5	0.083	0.5	380		5						5 C	42 C	C	C	0.16	C
1,4-Dioxane	123-91-1	100	100													6.1	C
2-Butanone	78-93-3	1	5	7100								2500	61000	N	N	1900	N
2-Chloro-1,3-butadiene (chloroprene)	126-99-8	1	1											N	N	14	N
2-Hexanone	591-78-6	0.81	5	1710												1500 (13)	
4-Methyl-2-pentanone	108-10-1	0.38	5	3680										N	N	160	N
Acetone	67-64-1	0.81	5	78000								770	10000	N	N	610	N
Acetonitrile	75-05-8	18.1	40													79	N
Acrolein	107-02-8	2.3	10	0.205								0.056	2000	N	N	0.042	N
Acrylonitrile	107-13-1	0.66	3	0.89										C	C	0.039	C
Allyl chloride (3-chloro-1-propene)	107-05-1	0.29	5											N	N	1800	N
Benzene	71-43-2	0.093	0.5	114		5						5 C	99 C	C	C	0.41	C
Bromodichloromethane	75-27-4	0.093	0.5			80	9					100 C	100 C	C	C	0.18	C
Bromoform	75-25-2	0.12	1	466		80	9					100 C	360 C	C	C	8.5	C
Bromomethane	74-83-9	0.24	1									11	140	N	N	8.7	N
Carbon disulfide	75-15-0	0.078	1	84.1								1300	10000	N	sat	1000	N
Carbon tetrachloride	56-23-5	0.12	0.3	5.9		5						5 C	22 C	C	C	0.17	C
Chlorobenzene	108-90-7	0.12	1	10		100						100	2000	N	N	110	N
Chloroethane	75-00-3	0.13	1	230000										C	C	4.6	C

TABLE C-1
TABULAR PRESENTATION OF RBSLs FOR RBTL SELECTION
NSWC CRANE, CRANE, INDIANA

PARAMETER	CAS	Aqueous Matrix Laboratory MDL (ug/L)	Aqueous Matrix Laboratory RL (ug/L)	REGION 5 ECO DQLs SURFACE WATER (ug/L)	Footnote	FEDERAL MCLs (ug/L)	Footnote	FEDERAL AWQCs FRESHWATER ACUTE (ug/L)	Footnote	FEDERAL AWQCs FRESHWATER CHRONIC (ug/L)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL GW CLOSURE LEVELS (ug/L)	IDEM TIER 1 DEFAULT INDUSTRIAL GW CLOSURE LEVELS (ug/L)	Footnote	Footnote	REGION 9 TAP WATER PRGs (ug/L)	Footnote
Chloroform	67-66-3	0.054	0.3	79		80	9					100 C	470 C	C	C	0.16	C
Chloromethane	74-87-3	0.18	1											C	C	1.5	C
cis-1,2-Dichloroethene	156-59-2	0.1	1	310	5	70						70	1000	N	N	61	N
cis-1,3-Dichloropropene	10061-01-5	0.057	0.3	7.9								1.3 C (12)	16 C (12)	C	C	0.081 (12)	C
Dibromochloromethane	124-48-1	0.093	0.5	6400		80	9							C	C	0.13	C
Dibromomethane	74-95-3	0.11	1											N	N	61	N
Dichlorodifluoromethane	75-71-8	0.14	1											N	N	390	N
Ethyl methacrylate	97-63-2	0.21	1											sat	sat	550	N
Ethylbenzene	100-41-4	0.076	1	17.2		700						700	10000	sat	sat	1300	N
Isobutyl alcohol	78-83-1	0.32	40													1800	N
Methacrylonitrile	126-98-7	0.48	1											N	N	1	N
Methyl iodide	74-88-4	0.66	1														
Methyl methacrylate	80-62-6	0.28	1	2800										N	sat	1400	N
Methylene chloride	75-09-2	0.22	1	430		5						5 C	380 C	C	C	4.3	C
Proprionitrile	107-12-0	2	20	6080													
Styrene	100-42-5	0.11	1	56		100						100	20000	sat	sat	1600	N
Tetrachloroethene	127-18-4	0.1	1	8.9		5						5 C	55 C	C	C	1.1	C
Toluene	108-88-3	0.096	1	253		1000						1000	20000	sat	sat	720	N
Total Xylenes	1330-20-7	0.17	5	117		10000						10000	180000	sat	sat	1400	N
trans-1,2-Dichloroethene	156-60-5	0.1	1	310		100						100	2000	N	N	120	N
trans-1,3-Dichloropropene	10061-02-6	0.061	0.5	7.9								1.3 C (12)	16 C (12)	C	C	0.081 (12)	C
trans-1,4-Dichloro-2-butene	110-57-6	5	10													0.0012 (2)	
Trichloroethene	79-01-6	0.11	1	75		5						5 C	260 C	C	C	1.6	C
Trichlorofluoromethane	75-69-4	0.12	1											N	sat	1300	N
Vinyl acetate	108-05-4	0.63	5	248.03								550	100000	N	N	410	N
Vinyl chloride	75-01-4	0.15	0.5	9.2		2						2 C	2 C	C	C	0.02	C
APPENDIX IX SEMIVOLATILE ORGANIC COMPOUNDS (SW-846 METHOD 8270C; 8270C SIM OR 8310, BASED ON LABORATORY CAPABILITIES, WHERE NOTED)														0	0		
1,2,4,5-Tetrachlorobenzene	95-94-3	3	10	26.24										N	N	11	N
1,2,4-Trichlorobenzene	120-82-1	1.231	5	69.2		70						70	1000	N	sat	190	N
1,2-Dichlorobenzene	95-50-1	0.434	5	11		600						600	9200	sat	sat	370	N
1,3-Dichlorobenzene	541-73-1	0.342	5	87								22	3100	N	N	5.5	N
1,4-Dichlorobenzene	106-46-7	0.286	2	43		75						75 C	120 C	C	C	0.5	C
1,4-Naphthoquinone	130-15-4	1	10														
1,4-Phenylenediamine	106-50-3	25	25											N	max	6900	N
1-Naphthylamine	134-32-7	2	10	0.67													
2,3,4,6-Tetrachlorophenol	58-90-2	5	10	14.06										N	N	1100	N
2,4,5-Trichlorophenol	95-95-4	0.753	25									3600	10000	N	N	3600	N
2,4,6-Trichlorophenol	88-06-2	0.858	3	2								77 C	26 C	C	C	6.1	C
2,4-Dichlorophenol	120-83-2	0.698	10	18								110	310	N	N	110	N
2,4-Dimethylphenol	105-67-9	1.909	10	100.17								730	2000	N	N	730	N
2,4-Dinitrophenol	51-28-5	1.202	10	4.07								73	200	N	N	73	N
2,6-Dichlorophenol	87-65-0	3	10														
2-Acetylaminofluorene	53-96-3	1	10	534.97													
2-Chloronaphthalene	91-58-7	0.6	2	0.396										N	N	490	N
2-Chlorophenol	95-57-8	0.853	3	8.8								38	510	N	N	30	N
2-Methylnaphthalene (by SIM)	91-57-6	0.0191	0.2	329.55													
2-Methylphenol	95-48-7	1.03	10									1800	5100	N	N	1800	N
2-Naphthylamine	91-59-8	4	10														
2-Nitroaniline	88-74-4	0.993	2											N	N	2.1	N
2-Nitrophenol	88-75-5	0.913	10	13.5												290 (14)	N
2-Picoline	109-06-8	5	10	3790													
3,3'-Dichlorobenzidine	91-94-1	0.527	10	99.75								1.9 C	6.4 C	C	C	0.15	C
3,3'-Dimethylbenzidine	119-93-7	8	50											C	C	0.0073	C
3-Methylcholanthrene	56-49-5	1	12	0.0891													
3-Methylphenol	108-39-4	5	10											N	N	1800	N
3-Nitroaniline	99-09-2	0.634	25														

TABLE C-1
TABULAR PRESENTATION OF RBSLs FOR RBTL SELECTION
NSWC CRANE, CRANE, INDIANA

PARAMETER	CAS	Aqueous Matrix Laboratory MDL (ug/L)	Aqueous Matrix Laboratory RL (ug/L)	REGION 5 ECO DQLs SURFACE WATER (ug/L)	Footnote	FEDERAL MCLs (ug/L)	Footnote	FEDERAL AWQCs FRESHWATER ACUTE (ug/L)	Footnote	FEDERAL AWQCs FRESHWATER CHRONIC (ug/L)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL GW CLOSURE LEVELS (ug/L)	IDEM TIER 1 DEFAULT INDUSTRIAL GW CLOSURE LEVELS (ug/L)	Footnote	Footnote	REGION 9 TAP WATER PRGs (ug/L)	Footnote
4,6-Dinitro-2-methylphenol	534-52-1	0.872	10	2.3													
4-Aminobiphenyl	92-67-1	1	10														
4-Bromophenyl phenyl ether	101-55-3	0.65	2	1.5													
4-Chloro-3-methylphenol	59-50-7	0.559	10	20													
4-Chloroaniline	106-47-8	1.094	10	231.97								150	410	N	N	150	N
4-Chlorophenyl phenyl ether	7005-72-3	0.634	10														
4-Methylphenol	106-44-5	0.96	10											N	N	180	N
4-Nitroaniline	100-01-6	0.67	25														
4-Nitrophenol	100-02-7	0.876	25	35										N	N	290	N
4-Nitroquinoline-1-oxide	56-57-5	19	25														
5-Nitro-o-toluidine	99-55-8	2	16											C	C	2	C
7,12-Dimethylbenz(a)anthracene	57-97-6	2	10														
a,a-Dimethylphenethylamine	122-09-8	13	25	300.16										N	N	37	N
Acenaphthene (by SIM)	83-32-9	0.077	0.2	9.9								460	4200	N	N	370	N
Acenaphthylene (by SIM)	208-96-8	0.0108	0.2	4840								460 (19)	460 (19)			370 (19)	N
Acetophenone	98-86-2	2	20	687.89										N	N	0.042	N
Aniline	62-53-3	0.57	5	0.44										C	C	12	C
Anthracene (by SIM)	120-12-7	0.0175	0.2	0.029								43	43	N	max	1800	N
Aramite	140-57-8	2	10	3.09										C	C	2.7	C
Benzo(a)anthracene (by SIM)	56-55-3	0.0141	0.2	0.839								1.2 C	3.9 C	C	C	0.092	C
Benzo(a)pyrene (by SIM)	50-32-8	0.0153	0.2	0.014		0.2						0.2 C	0.39 C	C	C	0.0092	C
Benzo(b)fluoranthene (by SIM)	205-99-2	0.0157	0.2	9.07								1.2 C	1.5 C	C	C	0.092	C
Benzo(g,h,i)perylene (by SIM)	191-24-2	0.0141	0.2	7.64								8.3 (20)	8.3 (20)			6.2 (20)	N
Benzo(k)fluoranthene (by SIM)	207-08-9	0.0178	0.2	0.0056								0.8 C	0.8 C	C	C	0.92	C
Benzyl alcohol	100-51-6	1.473	10	281.24										N	max	11000	N
Bis(2-chloroethoxy)methane	111-91-1	1.801	10	6400													
Bis(2-chloroethyl)ether	111-44-4	0.826	1	1140								0.15 C	2.6 C	C	C	0.0098	C
Bis(2-chloroisopropyl)ether	39638-32-9	0.0000194	5E-5											C	C	0.27	C
Bis(2-ethylhexyl)phthalate	117-81-7	0.722	2	2.1		6						6 C	200 C	C	C	4.8	C
Butyl benzyl phthalate	85-68-7	0.813	10	49								2700	2700	N	max	7300	N
Chlorobenzilate	510-15-6	1	5	7.16										C	C	0.25	C
Chrysene (by SIM)	218-01-9	0.0149	0.2	0.033								1.6 C	1.6 C	C	C	9.2	C
Diallate	2303-16-4	1	10	29										C	C	1.1	C
Dibenzo(a,h)anthracene (by SIM)	53-70-3	0.0119	0.2	0.0016								0.12 C	0.39 C	C	C	0.0092	C
Dibenzofuran	132-64-9	0.653	10	20										N	N	24	N
Diethyl phthalate	84-66-2	0.599	2	3								29000	82000	N	max	29000	N
Dimethyl phthalate	131-11-3	0.638	10	73										max	max	360000	N
Dimethoate	60-51-5	---	10	41.2												7.3	
Di-n-butyl phthalate	84-74-2	0.512	10	3								3600	10000	N	N	3600	N
Di-n-octyl phthalate	117-84-0	0.486	10	30								20	20	N	sat	730	N
Diphenylamine	122-39-4	3.6	10	412.51										N	N	910	N
Disulfoton	296-04-4	---	16														
Ethyl methane sulfonate	62-50-0	2	10														
Ethyl parathion	56-38-2	1	15	0.008				0.065		0.013				N	N	220	N
Famphur	52-85-7	---	10														
Fluoranthene (by SIM)	206-44-0	0.0141	0.2	8.1								210	210	N	N	1500	N
Fluorene (by SIM)	86-73-7	0.0153	0.2	3.9								310	2000	N	N	240	N
Hexachlorobenzene	118-74-1	0.516	2	0.00024		1						1 C	1.8 C	C	C	0.042	C
Hexachlorobutadiene	87-68-3	0.504	1	0.223								7.3	20	C	C	0.86	C
Hexachlorocyclopentadiene	77-47-4	0.129	10	77.04		50						50	720	N	N	260	N
Hexachloroethane	67-72-1	0.445	2	30.5								36	100	C	C	4.8	C
Hexachloropropene	1888-71-7	5	10	20													
Indeno(1,2,3-cd)pyrene (by SIM)	193-39-5	0.0084	0.2	4.31								0.022 C	0.022 C	C	C	0.092	C
Isodrin	465-73-6	1	10	0.0309													
Isophorone	78-59-1	0.766	10	900								900 C	3000 C	C	C	71	C

TABLE C-1
TABULAR PRESENTATION OF RBSLs FOR RBTL SELECTION
NSWC CRANE, CRANE, INDIANA

PARAMETER	CAS	Aqueous Matrix Laboratory MDL (ug/L)	Aqueous Matrix Laboratory RL (ug/L)	REGION 5 ECO DQLs SURFACE WATER (ug/L)	Footnote	FEDERAL MCLs (ug/L)	Footnote	FEDERAL AWQCs FRESHWATER ACUTE (ug/L)	Footnote	FEDERAL AWQCs FRESHWATER CHRONIC (ug/L)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL GW CLOSURE LEVELS (ug/L)	IDEM TIER 1 DEFAULT INDUSTRIAL GW CLOSURE LEVELS (ug/L)	Footnote	Footnote	REGION 9 TAP WATER PRGs (ug/L)	Footnote
Isosafrole	120-58-1	1	10											C	C	0.0037	C
Kepone	143-50-0	1	25	0.132													
Methapyrilene	91-80-5	16	25														
Methyl methane sulfonate	66-27-3	2	25											N	N	9.1	N
Methyl parathion	298-00-0	1	10									8.3	2000	N	N	6.2	N
Naphthalene (by SIM)	91-20-3	0.0141	0.2	44										C	C	0.00045	C
n-Nitrosodiethylamine	55-18-5	2	10	767.94										C	C	0.0013	C
n-Nitrosodimethylamine	62-75-9	3.6	10											C	C	0.002	C
n-Nitrosodi-n-butylamine	924-16-3	2	10	1000								0.12 C	0.41 C	C	C	0.0096	C
n-Nitrosodi-n-propylamine	621-64-7	0.938	2											C	C	0.0031	C
n-Nitrosomethylethylamine	10595-95-6	1.909	10														
n-Nitrosomorpholine	59-89-2	1	10														
n-Nitrosopiperidine	100-75-4	1	10											C	C	0.032	C
n-Nitrosopyrrolidine	930-55-2	2	10														
O,O,O-Triethyl phosphorothioate	126-68-1	1	10	58.25										C	C	0.28	C
o-Toluidine	95-53-4	2	15														
p-(Dimethylamino)azobenzene	60-11-7	1	10											N	N	29	N
Pentachlorobenzene	608-93-5	4	10	0.47													
Pentachloroethane	76-01-7	1.4	25	56.42										C	C	0.26	C
Pentachloronitrobenzene	82-68-8	1	10	50													
Phenacetin	62-44-2	1	10									8.3 (20)	2000 (20)			6.2 (20)	N
Phenanthrene (by SIM)	85-01-8	0.0191	0.2	2.1								22000	61000	N	max	22000	N
Phenol	108-95-2	1.022	10	100												7.3	
Phorate	296-02-2	---	10	3.62										N	N	2700	N
Pronamide	23950-58-5	1	10	160								140	140	N	N	180	N
Pyrene (by SIM)	129-00-0	0.0168	0.2	0.3										N	N	37	N
Pyridine	110-86-1	2.078	10	2380													
Safrole	94-59-7	1	10	40												18	
Tetraethyl dithiopyrophosphate (Sulfotepp)	3689-24-5	---	10	13.9													
Thionazin	297-97-2	---	100														
APPENDIX IX ORGANOCHLORINE PESTICIDES and PCBs (SW-846 METHOD 8081A and 8082)																	
4,4'-DDD	72-54-8	0.0042	0.05	0.0011								3.6 C	12 C	C	C	0.28	C
4,4'-DDE	72-55-9	0.0052	0.05	4.51E-09								2.5 C	8.4 C	C	C	0.2	C
4,4'-DDT	50-29-3	0.0057	0.05	0.001				1.1		0.001		2.5 C	8.4 C	C	C	0.2	C
Aldrin	309-00-2	0.0089	0.01	0.0309				3				0.05 C	0.17 C	C	C	0.004	C
Alpha-BHC	319-84-6	0.0025	0.01	12.38								0.14 C	0.45 C	C	C	0.011	C
Alpha-chlordane	5103-71-9	0.0026	0.03	0.00029	6	2	6	2.4	6	0.0043	6	2 C (6)	8.2 C (6)	C	C	0.19 (6)	C
Aroclor-1016	12674-11-2	0.072	0.5	0.000029	8	0.5	8			0.014	8	0.5 C (8)	1.4 C (8)	N	C	0.96	C
Aroclor-1221	11104-28-2	0.08	0.5	0.000029	8	0.5	8			0.014	8	0.5 C (8)	1.4 C (8)	C	C	0.034	C
Aroclor-1232	11141-16-5	0.21	0.5	0.000029	8	0.5	8			0.014	8	0.5 C (8)	1.4 C (8)	C	C	0.034	C
Aroclor-1242	53469-21-9	0.33	0.5	0.000029	8	0.5	8			0.014	8	0.5 C (8)	1.4 C (8)	C	C	0.034	C
Aroclor-1248	12672-29-6	0.061	0.5	0.000029	8	0.5	8			0.014	8	0.5 C (8)	1.4 C (8)	C	C	0.034	C
Aroclor-1254	11097-69-1	0.11	0.5	0.000029	8	0.5	8			0.014	8	0.5 C (8)	1.4 C (8)	C	C	0.034	C
Aroclor-1260	11096-82-5	0.041	0.5	0.000029	8	0.5	8			0.014	8	0.5 C (8)	1.4 C (8)	C	C	0.034	C
Beta-BHC	319-85-7	0.0029	0.03	0.495								0.47 C	1.6 C	C	C	0.037	C
Delta-BHC	319-86-8	0.0059	0.05	666.67								0.14 C (17)	0.45 C (17)			0.011 (17)	
Dieldrin	60-57-1	0.0046	0.02	0.000026				0.24		0.056		0.053 C	0.18 C	C	C	0.0042	C
Endosulfan I	959-98-8	0.753	25	0.003				0.22		0.056		0.22 C (16)	0.51 C (16)			220	NC
Endosulfan II	33213-65-9	0.0062	0.05	0.003				0.22		0.056		0.22 C (16)	0.51 C (16)			220	NC
Endosulfan sulfate	1031-07-8	0.0059	0.08	2.22								0.22 C (16)	0.51 C (16)			220	NC
Endrin	72-20-8	0.0052	0.06	0.002		2		0.086		0.036		2	31	N	N	11	N
Endrin aldehyde	7421-93-4	0.0058	0.08	0.15								2 (18)	31 (18)			11	N
Gamma-BHC (Lindane)	58-89-9	0.0024	0.05	0.01		0.2		0.95				0.2 C	2.2 C	C	C	0.052	C
Gamma-chlordane	12789-03-6	0.0021	0.03	0.00029	6	2	6	2.4	6	0.0043	6	2 C (6)	8.2 C (6)	C	C	0.19 (6)	C
Heptachlor	76-44-8	0.0078	0.03	0.00039		0.4		0.52		0.0038		0.4 C	0.64 C	C	C	0.015	C

TABLE C-1
TABULAR PRESENTATION OF RBSLs FOR RBTL SELECTION
NSWC CRANE, CRANE, INDIANA

PARAMETER	CAS	Aqueous Matrix Laboratory MDL (ug/L)	Aqueous Matrix Laboratory RL (ug/L)	REGION 5 ECO DQLs SURFACE WATER (ug/L)	Footnote	FEDERAL MCLs (ug/L)	Footnote	FEDERAL AWQCs FRESHWATER ACUTE (ug/L)	Footnote	FEDERAL AWQCs FRESHWATER CHRONIC (ug/L)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL GW CLOSURE LEVELS (ug/L)	IDEM TIER 1 DEFAULT INDUSTRIAL GW CLOSURE LEVELS (ug/L)	Footnote	Footnote	REGION 9 TAP WATER PRGs (ug/L)	Footnote
Heptachlor epoxide	1024-57-3	0.003	0.03	0.00048		0.2		0.52		0.0038		0.2 C	3.2 C	C	C	0.0074	C
Methoxychlor	72-43-5	0.0312	0.12	0.005		40				0.03		40	45	N	N	180	N
Toxaphene	8001-35-2	0.7	3	0.0002		3		0.73		0.0002		3 C	3 C	C	C	0.061	C
APPENDIX IX HERBICIDES (SW-846 METHOD 8151A)																	
2,4-D	94-75-7	---	0.08			70								N	N	360	N
2,4,5-T	93-76-5	---	0.04	686.33										N	N	360	N
2,4,5-TP (Silvex)	93-72-1	---	0.04	326.64		50								N	N	290	N
Dinoseb	88-85-7	---	0.08	0.39		7								N	N	37	N
Hexachlorophene	70-30-4	---	0.1	0.228										N	N	11	N
Pentachlorophenol	87-86-5	---	0.02	5.23		1		19		15		1 C	24 C	C	C	0.56	C
MISCELLANEOUS PARAMETERS																	
Cyanide (SW-846 Method 9012A)	74-90-8	0.74 (mg/L)	10 (mg/L)	5.2	21	200				5.2	21					730	21
CEC (SW-846 Method 9081)	NA (23)	ANR (22)	ANR														
Hardness (standard Methods 2340B)	NA	---	1000(ug/L)														
Nitrate	14797-55-8	2(ug/L)	10(ug/L)			10000										10000	N
Nitrite	14797-65-0	2(ug/L)	10(ug/L)			1000										1000	N
pH (SW-846 9045C)	NA	ANR	ANR			6.5-8.5	7			6.5-9							
Total Organic Carbon (TOC) (EPA 415.1)	NA	350	1000														
Total Suspended Solids (EPA 160.1)	NA	---	2000(ug/L)														

Footnotes:

1 Criteria are hardness dependent.
2 Action level.
3 Secondary MCL for copper is 1,000 ug/L.
4 Value is being remanded.
5 trans-1,2-Dichloroethene.
6 Chlordane.
7 Secondary MCL, based on aesthetic drinking water qualities (i.e., color, odor, taste, etc.).
8 Total for all Aroclor congeners.
9 1994 Proposed rule for Disinfectants and Disinfection By-Products: Total for all trihalomethanes combined cannot exceed 80 ug/L.
10 Hexavalent chromium.
11 Thallium carbonate.
12 1,3-Dichloropropene.
13 EPA Region 3 RBC presented.
14 Value for 4-nitrophenol presented.
15 Dinitrotoluene mixture.
16 Endosulfan.
17 Value for alpha-BHC presented.
18 Value for endrin presented.
19 Value for acenahpthene presented.
20 Value for naphthalene presented.
21 Free Cyanide
22 ANR - Analysis not Required
23 NA - Not Applicable

TABLE C-2

TABULAR PRESENTATION OF SOIL AND SEDIMENT RBSLs FOR RBTL SELECTION
NSWC CRANE, CRANE,
INDIANA

PARAMETER	CAS	Solid Matrix Laboratory MDL (mg/kg)	Solid Matrix Laboratory RL (mg/kg)	EPA GENERIC SSLs INGESTION (mg/kg)	Footnote	EPA GENERIC SSLs INHALATION (mg/kg)	Footnote	EPA GENERIC SSLs MIGRATION TO GW (mg/kg) DAF = 1	Footnote	REGION 5 ECO DQLs SOIL (mg/kg)	Footnote	REGION 5 ECO DQLs SEDIMENT (mg/kg)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL SOIL CLOSURE LEVELS (mg/kg)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL SOIL DIRECT CONTACT (mg/kg)	Footnote	REGION 9 SOIL PRGs FOR RESIDENTIAL LAND USE (mg/kg)	REGION 9 SOIL PRGs FOR INDUSTRIAL LAND USE (mg/kg)
DIOXINS/FURANS																			
1,2,3,4,6,7,8-HPCDD	35822-46-9	1.60E-06	2.50E-06															3.90E-04	
1,2,3,4,6,7,8-HPCDF	67562-39-4	3.10E-06	2.50E-06															3.90E-04	
1,2,3,4,7,8,9-HPCDF	55673-89-7	9.50E-06	2.50E-06															3.90E-03	
1,2,3,4,7,8-HXCDD	39227-28-6	2.10E-06	2.50E-06															3.90E-05	
1,2,3,4,7,8-HXCDF	70648-26-9	2.70E-06	2.50E-06															3.90E-05	
1,2,3,6,7,8-HXCDD	57653-85-7	2.40E-06	2.50E-06															3.90E-05	
1,2,3,6,7,8-HXCDF	57117-44-9	1.40E-06	2.50E-06															3.90E-05	0.00040
1,2,3,7,8,9-HXCDD	19408-74-3	2.40E-06	2.50E-06															3.90E-05	
1,2,3,7,8,9-HXCDF	72918-21-9	1.90E-06	2.50E-06															3.90E-06	
1,2,3,7,8-PECDD	40321-76-4	2.60E-06	1.00E-06															7.80E-05	
1,2,3,7,8-PECDF	57117-41-6	3.80E-06	1.00E-06															3.90E-05	
2,3,4,6,7,8-HXCDF	60851-34-5	1.40E-06	2.50E-06															7.80E-06	
2,3,4,7,8-PECDF	57117-31-4	3.00E-06	1.00E-06															3.90E-06	0.000027
2,3,7,8-TCDD	1746-01-6	5.40E-07	1.00E-06															3.90E-05	
2,3,7,8-TCDF	51207-31-9	6.20E-06	1.00E-06															3.90E-02	
1,2,3,4,6,7,8,9-OCDD	3268-87-9	5.10E-06	5.00E-06															3.90E-02	
1,2,3,4,6,7,8,9-OCDF	39001-02-0	4.10E-06	5.00E-06																
EXPLOSIVES (SW-846 METHOD 8330)																			
1,3,5-Trinitrobenzene	99-35-4	0.22	0.5															1800	26000
1,3-Dinitrobenzene	99-65-0	0.22	0.5							0.6547		0.000924						6.1	88
2,4,6-Trinitrotoluene (TNT)	118-96-7	0.13	0.5															16	82
2,4-Dinitrotoluene	121-14-2	0.136	0.5	0.9				0.00004		1.28		0.07513		0.0085 (1)	C		C	120	1800
2,6-Dinitrotoluene	606-20-2	0.13	0.5	0.9				0.00003		0.03283		0.02062						61	880
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	0.144	0.5															3100	44000
2-Nitrotoluene	88-72-2	0.392	0.5															370	1000
3-Nitrotoluene	99-08-1	0.392	0.5															370	1000
4-Nitrotoluene	99-99-0	0.392	0.5															370	1000
4-Amino-2,6-dinitrotoluene	19406-51-0	0.188	0.5																
2-Amino-4,6-dinitrotoluene	35572-78-2	0.072	0.5																
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	479-45-8	0.19	0.5															610	8800
Nitrobenzene	98-95-3	0.222	0.5	39		92		0.007		1.31		0.4876		0.028		91		20	110
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	0.253	0.5															4.4	22
Nitroglycerin	55-63-0	---	---																
Pentaerythritol tetranitrate (PETN)	78-11-5	---	1																
APPENDIX IX METALS (SW-846 Method 6020 ICP/MS)																			
Antimony	7440-36-0	0.008	0.5	31				0.3		0.1423				5.4		138		31	820
Arsenic	7440-38-2	0.028	0.5	0.4		750		1		5.7		0.0059		3.9	C	3.9	C	0.39	2.7
Barium	7440-39-3	0.014	0.5	5500		690000		82		1.04				1600		24000		5400	100000
Beryllium	7440-41-7	0.008	0.5	0.1		1300		3		1.06				1.9	C	1.9	C	150	2200
Cadmium	7440-43-9	0.01	0.5	78		1800		0.4		0.00222		0.596		7.5		12		3	810
Chromium (total)	7440-47-3	0.063	2.5	390	4	270	4	2	4					36		470		210	450
Cobalt	7440-48-4	0.019	1.5							0.14033		50						4700	100000
Copper	7440-50-8	0.015	1							2.96		16		580		13000		2900	76000
Lead	7439-92-1	0.011	0.5	400	14					0.05973		31		81		350		400	1000
Mercury (SW-846 Method 7470A/7471A)	7439-97-6	0.03	0.1	23		10		0.1		0.073		0.174		2.1		55			
Nickel	7440-02-0	0.031	2.5	1600		13000		7		13.6		16		130		6900		1600	41000
Selenium	7782-49-2	0.055	1	390				0.3		0.02765				5.2		1700		390	10000
Silver	7440-22-4	0.002	1.5	390				2		4.04		0.5		31		1700		390	10000
Thallium	7440-28-0	0.003	0.5					0.04		0.05692				2.9		31		6.3 (16)	160 (16)
Tin	7440-31-5	---	5							7.62								47000	100000
Vanadium	7440-62-2	0.011	2	550				300		1.59								550	14000
Zinc	7440-66-6	0.098	5	23000				620		6.62		120		10000		104000		23000	100000
MISCELLANEOUS METALS (SW-846 METHOD 6010B Trace)																			
Aluminum	7429-90-5	9.6	20															76000	100000
Calcium	7440-70-2	2.3	500																
Iron	7439-89-6	2.8	10															23000	100000
Magnesium	7439-95-4	3.7	500																
Manganese	7439-96-5	0.12	1.5															1800	32000
Potassium	7440-09-7	19	500																
Sodium	7440-23-5	6.7	500																
APPENDIX IX VOLATILE ORGANIC COMPOUNDS (SW-846 METHOD 8260B WITH 25mL PURGE - WATER, 5g PURGE - SOIL or 8015B WITH 10mL PURGE - WATER AND 5g PURGE - SOIL)																			
1,1,1,2-Tetrachloroethane	630-20-6	0.0006	0.005							225		0.01089		0.05	C	39	C	3	7
1,1,1-Trichloroethane	71-55-6	0.0008	0.005			1200		0.1		29.8		0.24685		1.9		2400		770	1400
1,1,2,2-Tetrachloroethane	79-34-5	0.0006	0.005	3		0.6		0.0002		0.12722		0.02908		0.007	C	5.4	C	0.38	0.9
1,1,2-Trichloroethane	79-00-5	0.0007	0.005	11		1		0.0009		28.6		0.67351		0.03	C	10	C	0.84	1.9
1,1-Dichloroethane	75-34-3	0.0009	0.005	7800		1300		1		20.1		0.000575		5.6		1400		590	2100
1,1-Dichloroethene	75-35-4	0.0011	0.005	1		0.07		0.003		8.27		0.02327		0.058	C	0.73	C	0.054	0.12
1,2,3-Trichloropropane	96-18-4	0.0018	0.005							3.36		0.00835						0.0014	0.0031
1,2-Dibromo-3-chloropropane	96-12-8	0.0019	0.005							0.03518		0.01998						0.45	4
1,2-Dibromoethane	106-93-4	0.0008	0.005							1.23		0.01237						0.0069	0.048
1,2-Dichloroethane	107-06-2	0.0009	0.005	7		0.4		0.001		21.2		0.05418		0.024	C	4	C	0.35	0.76
1,2-Dichloropropane	78-87-5	0.0007	0.005	9		15		0.001		32.7		0.35181		0.03	C	5	C	0.35	0.77
1,4-Dioxane	123-91-1	0.025	0.5							2.05		0.000005-43						44	220

TABLE C-2

TABULAR PRESENTATION OF SOIL AND SEDIMENT RBSLs FOR RBTL SELECTION
NSWC CRANE, CRANE,
INDIANA

PARAMETER	CAS	Solid Matrix Laboratory MDL (mg/kg)	Solid Matrix Laboratory RL (mg/kg)	EPA GENERIC SSLs INGESTION (mg/kg)	Footnote	EPA GENERIC SSLs INHALATION (mg/kg)	Footnote	EPA GENERIC SSLs MIGRATION TO GW (mg/kg) DAF = 1	Footnote	REGION 5 ECO DQLs SOIL (mg/kg)	Footnote	REGION 5 ECO DQLs SEDIMENT (mg/kg)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL SOIL CLOSURE LEVELS (mg/kg)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL SOIL DIRECT CONTACT (mg/kg)	Footnote	REGION 9 SOIL PRGs FOR RESIDENTIAL LAND USE (mg/kg)	REGION 9 SOIL PRGs FOR INDUSTRIAL LAND USE (mg/kg)
2-Butanone	78-93-3	0.0045	0.005							89.6		0.13696		10		20000		7300	28000
2-Chloro-1,3-butadiene (chloroprene)	126-99-8	0.0009	0.005							0.0029		0.00106						3.6	12
2-Hexanone	591-78-6	0.0023	0.005							12.6		1.01						3100 (6)	62,000 (6)
4-Methyl-2-pentanone	108-10-1	0.0024	0.005							443		0.54437						790	2900
Acetone	67-64-1	0.0046	0.005	7800		100000		0.8		2.5		0.45337		3.1		4200		1600	6200
Acetonitrile	75-05-8	0.0019	0.2							1.37		0.13905						270	1700
Acrolein	107-02-8	0.013	0.05							5.27		0.0000144		0.00027		0.28		0.1	0.34
Acrylonitrile	107-13-1	0.008	0.05							0.02393		0.0000157						0.21	0.51
Allyl chloride (3-chloro-1-propene)	107-05-1	0.0008	0.005							0.01338		0.000266						3000	43000
Benzene	71-43-2	0.0006	0.005	22		0.8		0.002		0.25462		0.14157		0.34	C	9	C	0.67	1.5
Bromodichloromethane	75-27-4	0.0008	0.005	10		3000		0.03		0.53978		0.00113		0.63	C	11	C	1	2.4
Bromoform	75-25-2	0.0013	0.005	81		53		0.04		15.9		0.99627		0.75	C	290	C	62	310
Bromomethane	74-83-9	0.005	0.005	110		10		0.01		0.23516		0.94674		0.052		11		3.9	13
Carbon disulfide	75-15-0	0.0008	0.005	7800		720		2		0.09412		0.13397		10		990		360	720
Carbon tetrachloride	56-23-5	0.0009	0.005	5		0.3		0.003		2.98		0.03573		0.066	C	3.6	C	0.24	0.53
Chlorobenzene	108-90-7	0.0007	0.005	1600		130		0.07		13.1		0.06194		1.3		150		1	540
Chloroethane	75-00-3	0.0018	0.005									58.6						3	6.5
Chloroform	67-66-3	0.0009	0.005	100		0.3		0.03		1.19		0.027		0.59	C	3.3	C	0.24	0.52
Chloromethane	74-87-3	0.0006	0.005							10.4		0.0000785						1.2	2.7
cis-1,2-Dichloroethene	156-59-2	0.0009	0.005	780		1200		0.02		0.78373	5	0.20894	5	0.4		119		43	150
cis-1,3-Dichloropropene	10061-01-5	0.0008	0.005	4	11	0.1	11	0.0002	11	0.39786		0.00296		0.0091 (11)	C		C	0.082 (11)	0.18 (11)
Dibromochloromethane	124-48-1	0.0007	0.005	8		1300		0.02		2.05		0.26761						1.1	2.7
Dibromomethane	74-95-3	0.0006	0.005							65		0.0000859						87	240
Dichlorodifluoromethane	75-71-8	0.0008	0.005							39.5		0.00133						94	310
Ethyl methacrylate	97-63-2	0.0009	0.005							30		0.000602						140	140
Ethylbenzene	100-41-4	0.0007	0.005	7800		400		0.7		5.18		0.0001		13		5000		230	230
Isobutyl alcohol	78-83-1	0.053	0.2							20.8		3.35						13000	40000
Methacrylonitrile	126-98-7	0.01	0.1							0.05705		0.0000297						2.1	8.8
Methyl iodide	74-88-4	0.0017	0.005																
Methyl methacrylate	80-62-6	0.0015	0.005							984		0.16756						2200	2700
Methylene chloride	75-09-2	0.0017	0.005	85		13		0.001		4.05		1.26		0.023	C	120	C	8.9	21
Propionitrile	107-12-0	0.01	0.1							0.04983		0.11486							
Styrene	100-42-5	0.0006	0.005	16000		1500		0.2		4.69		0.44496		3.5		12000		1	1700
Tetrachloroethene	127-18-4	0.001	0.005	12		11		0.003		9.92		0.19583		0.058	C	50	C	5.7	19
Toluene	108-88-3	0.0006	0.005	16000		650		0.8		5.45		52.5		12		1800		520	520
Total Xylenes	1330-20-7	0.0018	0.005	160000		410	17	9	17	10		1.88		190		5300		210	210
trans-1,2-Dichloroethene	156-60-5	0.0007	0.005	1600		3100		0.03		0.78373		0.20894		0.68		190		63	210
trans-1,3-Dichloropropene	10061-02-6	0.0008	0.005	4	11	0.1	11	0.0002	11	0.39786		0.00296		0.0091 (11)	C		C	0.082 (11)	0.18 (11)
trans-1,4-Dichloro-2-butene	110-57-6	0.25	0.33									0.00182						0.0079 (9)	0.018 (9)
Trichloroethene	79-01-6	0.001	0.005	58		5		0.003		12.4		0.17956		0.057	C	48	C	2.8	6.1
Trichlorofluoromethane	75-69-4	0.0021	0.005							16.4		0.00307						390	2000
Vinyl acetate	108-05-4	0.0023	0.005	78000		1000		8		12.7		0.01295		2.3		1200		430	1400
Vinyl chloride	75-01-4	0.006	0.005	0.3		0.03		0.0007		0.64614		0.002		0.013	C	0.31	C	0.022	0.049
APPENDIX IX SEMIVOLATILE ORGANIC COMPOUNDS (SW-846 METHOD 8270C; 8270C SIM OR 8310, BASED ON LABORATORY CAPABILITIES, WHERE NOTED)																			
1,2,4,5-Tetrachlorobenzene	95-94-3	0.092	0.33							2.02		20.9						18	260
1,2,4-Trichlorobenzene	120-82-1	0.1627	0.33	780		3200		0.3		11.1		11.7		5.3		1800		6	3000
1,2-Dichlorobenzene	95-50-1	0.186	0.33	7000		560		0.9		2.96		0.23132		17		3000		370	370
1,3-Dichlorobenzene	541-73-1	0.1706	0.33							37.7		3.01		0.42		114		13	52
1,4-Dichlorobenzene	106-46-7	0.1823	0.33	27				0.1		0.54559		1.45		2.2	C	42	C	3	8.1
1,4-Naphthoquinone	130-15-4	0.059	0.33																
1,4-Phenylenediamine	106-50-3	0.308	0.83							6.16		0.00000568						12000	100000
1-Naphthylamine	134-32-7	0.169	0.33																
2,3,4,6-Tetrachlorophenol	58-90-2	0.096	0.33							0.19878		1.51						1800	26000
2,4,5-Trichlorophenol	95-95-4	0.1736	0.83	7800				14		14.1		0.08556		250		18000		6100	88000
2,4,6-Trichlorophenol	88-06-2	0.1516	0.33	58		200		0.008		9.94		0.08484		1.5	C	390	C	44	220
2,4-Dichlorophenol	120-83-2	0.1773	0.33	230				0.05		87.5		0.13363		1.1		550		1	2600
2,4-Dimethylphenol	105-67-9	0.1026	0.33	1600				0.4		0.01		0.30453		9		3600		1	18000
2,4-Dinitrophenol	51-28-5	0.04052	0.83	160				0.01		0.06086		0.00133		0.29		360		120	1800
2,6-Dichlorophenol	87-65-0	0.104	0.33							1.17		0.00394							
2-Acetylaminofluorene	53-96-3	0.073	0.33							0.59634		0.01532							
2-Chloronaphthalene	91-58-7	0.153	0.33							0.01218		0.41723						4900	27000
2-Chlorophenol	95-57-8	0.1935	0.33	390		53000		0.2		0.24266		0.0117		0.75		380		6	240
2-Methylnaphthalene (by SIM)	91-57-6	0.000561	0.0066							3.24		0.0202							
2-Methylphenol	95-48-7	0.1916	0.33	3900				0.8		40.4		0.000826		14		7600		3100	44000
2-Naphthylamine	91-59-8	0.194	0.33							3.03		0.00174							
2-Nitroaniline	88-74-4	0.1435	0.83							74.1		0.000222						3.5	50
2-Nitrophenol	88-75-5	0.1674	0.33							1.6		0.00777						490 (10)	7000 (10)
2-Picoline	109-06-8	0.25	0.33							9.9		0.75305							
3,3'-Dichlorobenzidine	91-94-1	0.1395	0.33	1				0.0003		0.64636		0.02822		0.062	C	9.5	C	1.1	5.5
3,3'-Dimethylbenzidine	119-93-7	--	0.33							0.1042		0.002						0.053	0.27
3-Methylcholanthrene	56-49-5	0.384	0.33							0.07794		8190							
3-Methylphenol	108-39-4	0.079	0.33							163		0.000808						3100	44000
3-Nitroaniline	99-09-2	0.1372	0.83							3.16		0.000222							
4,6-Dinitro-2-methylphenol	534-52-1	0.109	0.83							0.13408		0.01038							

TABLE C-2

TABULAR PRESENTATION OF SOIL AND SEDIMENT RBSLs FOR RBTL SELECTION
NSWC CRANE, CRANE,
INDIANA

PARAMETER	CAS	Solid Matrix Laboratory MDL (mg/kg)	Solid Matrix Laboratory RL (mg/kg)	EPA GENERIC SSLs INGESTION (mg/kg)	Footnote	EPA GENERIC SSLs INHALATION (mg/kg)	Footnote	EPA GENERIC SSLs MIGRATION TO GW (mg/kg) DAF = 1	Footnote	REGION 5 ECO DQLs SOIL (mg/kg)	Footnote	REGION 5 ECO DQLs SEDIMENT (mg/kg)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL SOIL CLOSURE LEVELS (mg/kg)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL SOIL DIRECT CONTACT (mg/kg)	Footnote	REGION 9 SOIL PRGs FOR RESIDENTIAL LAND USE (mg/kg)	REGION 9 SOIL PRGs FOR INDUSTRIAL LAND USE (mg/kg)
4-Aminobiphenyl	92-67-1	0.135	0.33							0.00305		0.00566							
4-Bromophenyl phenyl ether	101-55-3	0.1661	0.33									1.68							
4-Chloro-3-methylphenol	59-50-7	0.1938	0.33							7.95		0.38818							
4-Chloroaniline	106-47-8	0.07858	0.33	310				0.03		1.1		0.14608		0.97		730		240	3500
4-Chlorophenyl phenyl ether	7005-72-3	0.2104	0.33									0.656112							
4-Methylphenol	106-44-5	0.2021	0.33							3.49		0.000845						310	4400
4-Nitroaniline	100-01-6	0.1128	0.83							21.9		0.000222							
4-Nitrophenol	100-02-7	0.1257	0.83							5.12		0.00778						490	7000
4-Nitroquinoline-1-oxide	56-57-5	0.783	0.83							0.12222		0.00124							
5-Nitro-o-toluidine	99-55-8	0.086	0.33							8.73		0.000845						15	75
7,12-Dimethylbenz(a)anthracene	57-97-6	0.249	0.33																
a,a-Dimethylphenethylamine	122-09-8	0.153	0.83															61	880
Acenaphthene (by SIM)	83-32-9	0.000559	0.0066	4700				29		682		0.00671		130		9500		3700	38000
Acenaphthylene (by SIM)	208-96-8	0.000511	0.0066							682		0.00587		130 (12)				3700 (12)	38000 (12)
Acetophenone	98-86-2	0.052	0.33							300		0.246						0.49	1.6
Aniline	62-53-3	0.05256	0.33							0.05678		0.0000338						85	430
Anthracene (by SIM)	120-12-7	0.000722	0.0066	23000				590		1480		0.0469		51		47000		22000	100000
Aramite	140-57-8	0.043	0.83							166		0.00000111						19	99
Benzo(a)anthracene (by SIM)	56-55-3	0.000791	0.0066	0.9				0.08		5.21		0.0317		5	C	5	C	0.62	2.9
Benzo(a)pyrene (by SIM)	50-32-8	0.002627	0.0066	0.09				0.4		1.52		0.0319		0.5	C	0.5	C	0.062	0.29
Benzo(b)fluoranthene (by SIM)	205-99-2	0.001166	0.0066	0.9				0.2		59.8		10.4		5	C	5	C	0.62	2.9
Benzo(g,h,i)perylene (by SIM)	191-24-2	0.000723	0.0066							119		0.17		0.7 (15)				56 (15)	190 (15)
Benzo(k)fluoranthene (by SIM)	207-08-9	0.000397	0.0066	9				2		1480		0.24		39	C	50	C	6.2	29
Benzyl alcohol	100-51-6	0.1887	0.33							65.8		0.03394						18000	100000
Bis(2-chloroethoxy)methane	111-91-1	0.1705	0.33							0.30209		0.34971							
Bis(2-chloroethyl)ether	111-44-4	0.1754	0.33	0.6		0.2		0.00002		23.7		0.21196		0.0007	C	1.6	C	0.21	0.62
Bis(2-chloroisopropyl)ether	39638-32-9	0.2238	0.33											0.027	C			2.5	7.4
Bis(2-ethylhexyl)phthalate	117-81-7	0.171	0.33	46		31000		180		0.92594		0.182		300	C	300	C	35	180
Butyl benzyl phthalate	85-68-7	0.161	0.33	16000		930		810		0.23889		4.19		930		36000		12000	100000
Chlorobenzilate	510-15-6	0.051	0.33							5.05		0.86029						1.8	9.1
Chrysene (by SIM)	218-01-9	0.001023	0.0066	88				8		4.73		0.0571		26	C	500	C	62	290
Dialate	2303-16-4	0.046	0.33							0.45214		0.00151						8	40
Dibenzo(a,h)anthracene (by SIM)	53-70-3	0.000792	0.0066	0.09				0.08		18.4		0.00622		0.5	C	0.5	C	0.062	0.29
Dibenzofuran	132-64-9	0.1824	0.33									1.52						290	5100
Diethyl phthalate	84-66-2	0.2017	0.33	63000		2000		23		24.8		0.00804		450		150000		49000	100000
Dimethoate	60-51-5	---	0.67							0.21802		0.19015						12	180
Dimethyl phthalate	131-11-3	0.2083	0.33							734		0.02495						100000	100000
Di-n-butyl phthalate	84-74-2	0.1911	0.33	7800		2300		270		0.14979		0.1105		2300		18000		6100	88000
Di-n-octyl phthalate	117-84-0	0.1961	0.33	1600		10000		10000		709		40.6		2000		3700		1200	10000
Diphenylamine	122-39-4	---	0.33							1.01		0.0346						1500	22000
Ethyl methane sulfonate	62-50-0	0.059	0.33																
Ethyl parathion	56-38-2	0.052	0.33							0.00034		0.00034						370	5300
Fluoranthene (by SIM)	206-44-0	0.000512	0.0066	3100				210		122		0.1113		880		6300		2300	30000
Fluorene (by SIM)	86-73-7	0.000723	0.0066	3100				28		122		0.0212		170		6300		2600	33000
Hexachlorobenzene	118-74-1	0.1231	0.33	0.4		1		0.1		0.19878		0.02		2.2	C	2.7	C	3	1.5
Hexachlorobutadiene	87-68-3	0.1394	0.33	6		8		0.1		0.03976		1.38		16	C	36	C	6	32
Hexachlorocyclopentadiene	77-47-4	0.05693	0.33	550		10		20		0.75537		0.90074		400		1300		420	5900
Hexachloroethane	67-72-1	0.1575	0.33	46		55		0.02		0.59634		2.23		2.6	C	183	C	35	180
Hexachloropropene	1888-71-7	0.126	0.33									0.0002							
Indeno(1,2,3-cd)pyrene (by SIM)	193-39-5	0.001023	0.0066	0.9				0.7		109		0.2		3	C	5	C	0.62	2.9
Isodrin	465-73-6	0.057	0.33							0.00332		0.05516							
Isophorone	78-59-1	0.148	0.33	670		4600		0.03		139		0.4223		5.3	C	4500	C	510	2600
Isosafrole	120-58-1	0.058	0.33							9.94		0.00412							
Kepone	143-50-0	0.072	0.83							0.03272		0.00331						0.027	0.14
Methapyrilene	91-80-5	0.215	0.83							2.78		0.0000144							
Methyl methane sulfonate	66-27-3	0.172	0.83																
Methyl parathion	298-00-0	0.058	0.33							0.000292		0.000755						15	220
Naphthalene (by SIM)	91-20-3	0.000559	0.0066	3100				4		0.09939		0.0346		0.7		3200		56	190
n-Nitrosodiethylamine	55-18-5	0.07	0.33							0.06933		0.02277						0.0032	0.016
n-Nitrosodimethylamine	62-75-9	0.125	0.33							0.0000321		0.00000275						0.0095	0.048
n-Nitrosodi-n-butylamine	924-16-3	0.045	0.33							0.26707		0.77204						0.024	0.061
n-Nitrosodi-n-propylamine	621-64-7	0.1753	0.33	0.09				0.000002		0.54368		0.000217		0.0006	C	0.61	C	0.069	0.35
n-Nitrosomethylethylamine	10595-95-6	0.1026	0.33							0.00166		0.00000485						0.022	0.11
n-Nitrosomorpholine	59-89-2	0.063	0.33							0.07057		0.0000037							
n-Nitrosopiperidine	100-75-4	0.073	0.33							0.00665		0.0000226							
n-Nitrosopyrrolidine	930-55-2	0.073	0.33							0.01258		0.000000908						0.23	1.2
O,O,O-Triethyl phosphorothioate	126-68-1	0.087	0.33																
o-Toluidine	95-53-4	0.086	0.33							2.97		0.000199						2	10
p-(Dimethylamino)azobenzene	60-11-7	0.024	0.33																
Pentachlorobenzene	608-93-5	0.038	0.33							0.49695		1.26						49	700
Pentachloroethane	76-01-7	0.0016	0.83							10.7		0.68918							
Pentachloronitrobenzene	82-68-8	0.059	0.83							7.09		18.2						1.9	9.5
Phenacetin	62-44-2	0.051	0.33							11.7		0.00225							
Phenanthrene (by SIM)	85-01-8	0.000723	0.0066							45.7		0.0419		0.7 (15)				56 (15)	190 (15)

TABLE C-2

TABULAR PRESENTATION OF SOIL AND SEDIMENT RBSLs FOR RBTL SELECTION
NSWC CRANE, CRANE,
INDIANA

PARAMETER	CAS	Solid Matrix Laboratory MDL (mg/kg)	Solid Matrix Laboratory RL (mg/kg)	EPA GENERIC SSLs INGESTION (mg/kg)	Footnote	EPA GENERIC SSLs INHALATION (mg/kg)	Footnote	EPA GENERIC SSLs MIGRATION TO GW (mg/kg) DAF = 1	Footnote	REGION 5 ECO DQLs SOIL (mg/kg)	Footnote	REGION 5 ECO DQLs SEDIMENT (mg/kg)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL SOIL CLOSURE LEVELS (mg/kg)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL SOIL DIRECT CONTACT (mg/kg)	Footnote	REGION 9 SOIL PRGs FOR RESIDENTIAL LAND USE (mg/kg)	REGION 9 SOIL PRGs FOR INDUSTRIAL LAND USE (mg/kg)
Phenol	108-95-2	0.1906	0.33	47000				5		120		0.02726		110		89000		37000	100000
Phorate	298-02-2	---	0.67							0.000496		0.000861						11	
Pronamide	23950-58-5	0.047	0.33							0.0136		0.0016						4600	66000
Pyrene (by SIM)	129-00-0	0.001022	0.0066	2300				210		78.5		0.053		570		5500		2300	54000
Pyridine	110-86-1	0.221	0.33							1.03		0.10617						61	880
Safrole	94-59-7	0.078	0.33							0.40398		0.16486							
Tetraethyl dithiopyrophosphate (Sulfotepp)	3689-24-5	---	0.67																0.0055
Thionazin	297-97-2	---	0.67							0.000000199		0.0000033							
APPENDIX IX ORGANOCHLORINE PESTICIDES and PCBs (SW-846 METHOD 8081A and 8082)																			
4,4'-DDD	72-54-8	0.00029	0.0033	3				0.8		0.75815		0.00553		28	C	28	C	2.4	17
4,4'-DDE	72-55-9	0.00035	0.0033	2				3		0.59587		0.00142		20	C	20	C	1.7	12
4,4'-DDT	50-29-3	0.00038	0.0033	2				2		0.0175		0.00119		20	C	20	C	1.7	12
Aldrin	309-00-2	0.00018	0.0017	0.04		3		0.02		0.00332		0.002		0.25	C	0.25	C	0.029	0.15
Alpha-BHC	319-84-6	0.00014	0.0017	0.1		0.8		0.00003		0.09939		0.006		0.0072	C	0.99	C	0.09	0.59
Alpha-chlordane	5103-71-9	0.00024	0.0017	0.5	7	20	7	0.5	7	0.224	7	0.0045	7	9.6 (7)				1.6 (7)	11 (7)
Aroclor-1016	12674-11-2	0.0138	0.033	1	8					0.67971	8	0.0341	8	1.8 (8)	C		C	3.9	29
Aroclor-1221	11104-28-2	0.0105	0.033	1	8					0.67971	8	0.0341	8	1.8 (8)	C		C	0.22	1
Aroclor-1232	11141-16-5	0.0122	0.033	1	8					0.67971	8	0.0341	8	1.8 (8)	C		C	0.22	1
Aroclor-1242	53469-21-9	0.0117	0.033	1	8					0.67971	8	0.0341	8	1.8 (8)	C		C	0.22	1
Aroclor-1248	12672-29-6	0.0162	0.033	1	8					0.67971	8	0.0341	8	1.8 (8)	C		C	0.22	1
Aroclor-1254	11097-69-1	0.0214	0.033	1	8					0.67971	8	0.0341	8	1.8 (8)	C		C	0.22	1
Aroclor-1260	11096-82-5	0.0065	0.033	1	8					0.67971	8	0.0341	8	1.8 (8)	C		C	0.22	1
Beta-BHC	319-85-7	0.00031	0.0017	0.4				0.0001		0.00398		0.005		0.026	C	3.5	C	0.32	2.1
Delta-BHC	319-86-8	0.00016	0.0017							9.94		71.5		0.0072 (18)	C		C	0.09 (18)	0.59 (18)
Dieldrin	60-57-1	0.00032	0.0033	0.04		1		0.0002		0.00238		0.002		0.046	C	0.27	C	0.03	0.15
Endosulfan I	959-98-8	0.1736	0.83	470	13			0.9	13	0.11927		0.000175		20 (13)				370 (13)	5300 (13)
Endosulfan II	33213-65-9	0.00038	0.0033	470	13			0.9	13	0.11927		0.000104		20 (13)				370 (13)	5300 (13)
Endosulfan sulfate	1031-07-8	0.00049	0.0033							0.03578		0.0346		20 (13)				370 (13)	5300 (13)
Endrin	72-20-8	0.00021	0.0033	23				0.05		0.0101		0.00267		0.99		54		18	260
Endrin aldehyde	7421-93-4	0.00044	0.0033							0.0105		3.2		0.99 (19)				18 (19)	260 (19)
Gamma-BHC (Lindane)	58-89-9	0.00015	0.0017	0.5				0.0005		0.005		0.00094		0.0094	C	4.8	C	0.44	2.9
Gamma-chlordane	12789-03-6	0.0002	0.0017	0.5	7	20	7	0.5	7	0.224	7	0.0045	7	9.6 (7)				1.6 (7)	11 (7)
Heptachlor	76-44-8	0.00016	0.0017	0.1		0.1		1		0.00598		0.0006		0.56	C	0.56	C	0.11	0.55
Heptachlor epoxide	1024-57-3	0.0002	0.0017	0.07		5		0.03		0.15188		0.0006		0.46	C	0.46	C	0.053	0.27
Methoxychlor	72-43-5	0.0016	0.017	390				8		0.01988		0.00359		160		900		310	4400
Toxaphene	8001-35-2	0.0016	0.17	0.6		89		2		0.11927		0.000109		3.9	C	3.9	C	0.44	2.2
APPENDIX IX HERBICIDES (SW-846 METHOD 8151A)																			
2,4-D	94-75-7	---	0.0027							0.02725		0.00579						690	12000
2,4,5-T	93-76-5	---	0.0027							0.59634		58.7						610	8800
2,4,5-TP (Silvex)	93-72-1	---	0.00133							0.1088		7.35						490	7000
Dinoseb	88-85-7	---	0.0027							0.0218		0.01178						61	880
Hexachlorophene	70-30-4	---	0.0167							0.19878		231						18	260
Pentachlorophenol	87-86-5	---	0.00066	3				0.001		0.11927		30.1		0.028	C	20	C	3	11
MISCELLANEOUS PARAMETERS (ANALYTICAL METHODS TO BE DETERMINED BASED ON LABORATORY CAPABILITIES)																			
Cyanide (SW-846 Method 9012A)	74-90-8	0.1	1	1600				2		1.33	20	0.0001	20					1100	
CEC (SW-846 Method 9081)	NA (3)	---	6 meq/100g																
Hardness (standard Methods 2340B)	NA	ANR (2)	ANR																
Nitrate	14797-55-8	ANR	ANR																
Nitrite	14797-65-0	ANR	ANR																
pH (SW-846 9045C)	NA	---	1 (S.U.)																
Total Organic Carbon (TOC) (EPA 415.1)	NA	---	1000																
Total Suspended Solids (EPA 160.1)	NA	ANR	ANR																

Footnotes:
1 Dinitrotoluene mixture.
2 ANR - Analysis not Required
3 NA - Not Applicable
4 Assume hexavalent chromium.
5 trans-1,2-Dichloroethene.
6 EPA Region 3 risk-based concentration.
7 Chlordane.
8 Total for all Aroclor congeners.
9 Value for 1,4-dichloro-2-butene presented.
10 Value for 4-nitrophenol presented
11 1,3-Dichloropropene.
12 Value for acenphthene presented
13 Endosulfan.
14 OSWER soil screening level for residential land use (USEPA, July 1994).
15 Value for naphthalene presented.
16 Thallium carbonate.
17 o-Xylene.
18 Value for alpha-BHC presented.
19 Value for endrin presented.
20 F[illegible]ide

APPENDIX B

LABORATORY SOPs

LABORATORY SOPs ARE PROVIDED IN VOLUME III

APPENDIX C

FIELD AUDIT CHECKLIST

Location: NSWC Crane, Crane, Indiana

Project: NSWC Crane SWMUs 4, 5, 9, and 10, CTO 010

Date of Audit: _____

Instructions: Record answers to questions below, providing comments as required for clarification.

QA/QC Procedures

1. Were any field observations, deficiencies, non-conformances, or complaints recorded by the site QA/QC Officer or other personnel?
   If so, summarize below.

   _____
   _____
   _____
   _____
   _____

2. Based on personnel interviews, did any variances from the project planning documents occur? If so, what were they?

   _____
   _____
   _____
   _____

3. Were field modification records pertinent to the above initiated in an appropriate manner?

   _____

4. If applicable, were corrective action plans implemented (according to proper procedure) regarding Question 2?

   _____
   _____
   _____

5. Were field QC samples obtained with the frequency specified in the QAPP?

   _____

6. For this site, were field duplicates submitted "blind" to the laboratory?

7. For this site, are sufficient replicate aliquots of samples designated for the laboratory for the matrix spike/duplicate analyses specified in the QAPP?

Boring/Drilling

8. Is the drilling method specified in the QAPP being used?

9. In accordance with TtNUS policies and field SOPs, the FOL has the authority to change drilling methods if site conditions so dictate. Did any change in drilling methods from that cited in the project planning documents occur? If so, discuss.

10. If a change in drilling methods was required, did the FOL properly document the change and the rationale for the change?

11. Were any field changes initiated by the drilling subcontractor? If so, was the FOL notified and were the changes documented?

12. Per TtNUS SOP CTO 10-8, was the auger plugged until the desired sampling depth was reached? (If the sample is to be taken at a relatively deep point, the auger may be advanced without a plug to within five feet of the sample depth. Beyond that point, the procedure outlined in the SOP must be observed.)

_____
_____
_____
_____

13. Have all abandoned borings been backfilled as specified in the QAPP or applicable SOP?

_____
_____

14. When applicable, was the casing cleaned before sampling? (In most cases, an inch or two of cuttings may be left in the borehole with little or no problem. However, if more than a few inches for cuttings are encountered, the borehole must be recleaned prior to attempting sampling.)

water wash (disturbed samples above and below water table) _____
clean-out auger (undisturbed samples below water table) _____
dry method (undisturbed samples above water table) _____

15. Were any drilling lubricants used? If so, were the procedures cited in TtNUS SOP CTO10-8 observed?

_____
_____
_____

16. Were detailed boring logs maintained by the site geologist for each borehole? (Logging is not required if explicitly stated so in the associated FSAP.)

_____
_____
_____
_____

17. Was the following information complete on the borehole logs:
description of materials _____
description of samples _____
sampling method _____
blow counts _____
final location for drilling _____

Soil Sampling

18. Are the sampling devices and boring methods designated in the QAPP or applicable project-specific SOP being used?

_____
_____
_____
_____

19. Was the following information recorded in the boring logs or the field notebook?

For soil classification:

Was the USCS classification and soil type (clay, silt, sand) indicated?

_____

Were the following characteristics identified per the relevant TtNUS SOP CTO10-7 sections?

color _____
soil type _____
relative density and consistency _____
stratification _____
texture/fabric/bedding _____

20. For surface soil samples obtained by hand auger or scoop or trowel, were the following activities performed?

area cleared of loose debris prior to sampling _____
location marked with numbered stake or pin flag _____
sketch of approximate locations of sample points in site notebook _____

21. Were VOC samples NOT collected from the top 6" soil interval? Yes/No

Groundwater Sampling

22. Were all monitoring wells properly developed, purged and recovered prior to sampling?

_____
_____

23. When applicable, were well volumes calculated as described in SOP CTO10-3?

_____

24. If a peristaltic pump was used to obtain Volatile Organic Compound (VOC) samples, was it verified that no degassing "bubbles" developed?

_____

25. If samples were acquired by a pump, was the pump lowered to midscreen (middle of open section of uncased wells) for sample acquisition?

_____

26. If samples were collected using bailers, were only bailers equipped with check balls used?

_____

27. For samples acquired by packer assembly, was the packer positioned just above the screen (or open section for uncased wells), prior to inflating?

_____

Surface Water and Sediment Sampling

28. In accordance with SOP 10-5, surface water samples taken from different depths or cross-sectional locations may be composited. However, samples collected along the length of the water course or a different times shall not be composited. If composited surface water samples were obtained, was the above rule observed?

_____
_____

29. Per SOP CTO10-5; it is preferable to sample larger streams (and rivers) by compositing a sample from (1) just below the surface, (2) at mid-depth, (3) just above the bottom. If applicable, was this practice observed?

_____
_____

30. SOP CTO10-5 states that it is preferable to obtain surface water samples from a stream area that is well mixed. If applicable, was this observed?

_____
_____
_____
_____

31. SOP CTO10-5 states that "For sampling running water, it is suggested that the farthest downstream sample be obtained first and that subsequent samples be taken as one works upstream." Furthermore, the SOP states that work should be directed from "zones suspected of low contamination to zones of high contamination". If applicable, were these practices observed?

_____

_____

32. In accordance with SOP CTO10-5, sampling at the surface should never be performed unless specifically sampling for a known constituent which is immersible and on top of the water. Sample containers should be inverted, lowered to the approximate sample depth, then positioned at an approximate 45-degree angle with the mouth of the bottle facing upstream in order to acquire the sample. If applicable, was this technique observed?

_____

_____

Equipment Decontamination Procedures

33. Has an adequate, pre-determined area for steam cleaning of equipment been established?

_____

_____

34. Is the decontamination (decon) area lined and/or bermed?

_____

_____

35. Are hand augers decontaminated as required?

_____

_____

36. Was steam cleaning conducted:

prior to commencement of field activities? _____
between boring/pit locations? _____
at the end of field activities? _____

37. Verify that all sampling equipment not subject to steam cleaning (e.g., trowels, mixing bowls, etc.) are subjected to decontamination per the sequence outlined in the QAPP and project-specific SOP

_____
_____

Calibration and Use of Field Monitoring Equipment

38. Were the following calibration criteria observed:

calibration according to manufacturer's instructions _____
calibration only by qualified individuals _____
calibrated and operationally checked prior to project assignment _____
use of certified/traceable standards _____
calibration documented _____
if applicable, maintenance documented _____

39. For Photoionization Detectors (PIDs), is the proper eV Lamp (e.g., 9.5, 10.2, 11.7) installed?

_____
_____
_____
_____

40. Confirm that proper PID Start-up and Shut-down procedures are performed as required.

_____
_____
_____
_____

41. Has PID UV light source window cleaning been conducted as required?

_____

42. Has the PID ionization chamber been cleaned as required?

_____

43. Has the PID unit been recharged after every use?

_____
_____

Waste Handling Procedures

44. Were cuttings or fluids disposed of in accordance with the QAPP Section 4 requirements (i.e., discharged to ground, drummed, or tanked)?

_____

45. Do the project planning documents provide for the disposal of Personal Protective Equipment (PPE) by double-bagging and discard?

_____

46. By what method are PPE disposed of?

_____

47. If applicable, were used spill-containment materials containerized or otherwise acceptably disposed of?

_____
_____

Sample Handling

48. Are the appropriate containers provided by the laboratory being used for each sample?

_____
_____
_____

49. Has the temperature blank been handled properly and one submitted with each cooler of samples?

_____
_____

50. Have equipment rinsate blanks of the proper type and frequency been obtained?

_____
_____

51. Have source water blanks been obtained from water sources applicable to the field effort?

_____
_____

52. Have the rinsate and source water blanks been designated for the same analyses as the associated samples?

53. Has sample custody been maintained with regard to the following criteria:

A sample is under an individual's custody if:

- it is in the individual's actual possession
- it is in the individual's view after possession
- it was locked up to prevent tampering
- it was placed in a designated and identified secure area

(The sample remains in the individual's custody until it is entrusted to a laboratory courier or commercial express carrier.)

Documentation

54. Are all sample logs complete (i.e., containing all information stipulated in SOPs)?

55. Have chain-of-custody (COC) forms been filled out for all samples, including field quality control samples?

56. Have the COC forms been signed by the appropriate individual at each step that the samples are relinquished?

57. Have the COC forms been filled-out using black waterproof ink?

58. If the COC form or other field document was corrected, was a line drawn through the information and was the change dated and initialed? (Use of white-out or erasure is not permitted.)

59. Have the appropriate analyses (per the QAPP) been properly designated for each sample on the COC form?

60. Have all sample labels been filled out appropriately and completely?

61. Have sample tags been properly completed and attached securely to samples?

62. Have all sample labels been filled out using indelible ink?

63. Do the sample identifications agree between the sample log, field notebook, sample label and COC form?

64. When applicable, have the name of the photographer, date, time, site location, and site description been entered sequentially into the site logbook as documentational photographs of the sampling have been taken?

65. Has the following information (at a minimum) been recorded in the site logbook:

- arrival/departure of site visitors
- arrival/departure of equipment
- sample pickup, COC form numbers, carrier company, time
- sampling activities/sample log sheet numbers
- start/completion of boreholes, trenches, monitoring wells
- health and safety issues

66. Is the site logbook a bound notebook with consecutively numbered pages that cannot be easily removed?

_____

_____

67. As required by SOP CTO10-11, does the cover of the site logbook contain the following information?

project name _____
project number _____
contractor (or Teaming firm) name _____
sequential book number _____
start date _____
end date _____

68. As required by SOP CTO10-11, has the following information been recorded at the beginning of each day?

date _____
start time _____
weather conditions _____
all field personnel present _____
any visitors present _____

69. Do the site logbook entries summarize the daily activities and refer to other site notebooks or log sheets where applicable?

_____

70. Have all site logbook entries been made in black indelible ink?

_____

_____

71. If a logbook entry was corrected, was a line drawn through the information and was the change dated and initialed? (Use of white-out or erasure is not permitted.)

_____

_____

72. Did the individual making the logbook entry sign it?

_____

73. Did the Field Operations Leader sign all logbook pages utilized that day at the end of each day?

_____

_____

Auditor Name:_____

Auditor Signature:_____

Date:_____

APPENDIX D

RISK-BASED SCREENING LEVELS

TABLE D-1

TABULAR PRESENTATION OF RBSLs FOR RBTL SELECTION
NSWC CRANE, CRANE, INDIANA

PARAMETER	CAS	Aqueous Matrix Laboratory MDL (ug/L)	Aqueous Matrix Laboratory RL (ug/L)	REGION 5 ECO DQLs SURFACE WATER (ug/L)	Footnote	FEDERAL MCLs (ug/L)	Footnote	FEDERAL AWQCs FRESHWATER ACUTE (ug/L)	Footnote	FEDERAL AWQCs FRESHWATER CHRONIC (ug/L)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL GW CLOSURE LEVELS (ug/L)	Footnote	IDEM TIER 1 DEFAULT INDUSTRIAL GW CLOSURE LEVELS (ug/L)	Footnote	REGION 9 TAP WATER PRGs (ug/L)	Footnote
DIOXINS/FURANS																	
1,2,3,4,6,7,8-HPCDD	35822-46-9	0.0000084	5E-5													4.50E-05	
1,2,3,4,6,7,8-HPCDF	67562-39-4	0.0000108	5E-5													4.50E-05	
1,2,3,4,7,8,9-HPCDF	55673-89-7	0.0000778	5E-5													4.50E-04	
1,2,3,4,7,8-HXCDD	39227-28-6	0.0000194	5E-5													4.50E-06	
1,2,3,4,7,8-HXCDF	70648-26-9	0.0000305	5E-5													4.50E-06	
1,2,3,6,7,8-HXCDD	57653-85-7	0.00000312	5E-5													4.50E-06	
1,2,3,6,7,8-HXCDF	57117-44-9	0.0000081	5E-5													4.50E-06	
1,2,3,7,8,9-HXCDD	19408-74-3	0.0000421	5E-5													4.50E-06	
1,2,3,7,8,9-HXCDF	72918-21-9	0.0000075	5E-5													4.50E-06	
1,2,3,7,8-PECDD	40321-76-4	0.0000134	5E-5													4.50E-07	
1,2,3,7,8-PECDF	57117-41-6	0.0000184	5E-5													9.00E-06	
2,3,4,6,7,8-HXCDF	60851-34-5	0.0000901	5E-5													4.50E-06	
2,3,4,7,8-PECDF	57117-31-4	0.0000337	5E-5													9.00E-07	
2,3,7,8-TCDD	1746-01-6	0.0000046	1E-5			0.00003										4.50E-07	
2,3,7,8-TCDF	51207-31-9	0.0000047	1E-5													4.50E-06	
1,2,3,4,6,7,8,9-OCDD	3268-87-9	0.0000317	1E-4													4.50E-03	
1,2,3,4,6,7,8,9-OCDF	39001-02-0	0.0000388	1E-4													4.50E-03	
EXPLOSIVES (SW-846 METHOD 8330)																	
1,3,5-Trinitrobenzene	99-35-4	0.3	0.65													1100	
1,3-Dinitrobenzene	99-65-0	0.3	0.65	2.36												3.6	
2,4,6-Trinitrotoluene (TNT)	118-96-7	0.44	0.65													2.2	
2,4-Dinitrotoluene	121-14-2	0.44	0.65	230								1.2	15	4.2	15	73	
2,6-Dinitrotoluene	606-20-2	0.44	0.65	42								1.2	15	4.2	15	36	
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	0.38	0.65													1800	
2-Nitrotoluene	88-72-2	0.59	0.65													61	
3-Nitrotoluene	99-08-1	0.59	0.65													61	
4-Nitrotoluene	99-99-0	0.59	0.65													61	
4-Amino-2,6-dinitrotoluene	19406-51-0	0.26	0.65														
2-Amino-4,6-dinitrotoluene	35572-78-2	0.18	0.65														
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	479-45-8	0.51	0.65													360	
Nitrobenzene	98-95-3	0.3	0.65	740								4.3		51		3.4	
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	0.31	0.61													0.61	
Nitroglycerin	55-63-0	0.39	13														
Pentaerythritol tetranitrate (PETN)	78-11-5	0.38	26														
APPENDIX IX METALS (SW-846 Method 6020 ICP/MS)																	
Antimony	7440-36-0	0.082	1	31		6						6		41		15	
Arsenic	7440-38-2	0.1	1	53		50		340		150		50		50		0.045	
Barium	7440-39-3	0.022	1	5000		2000						2000		7200		2600	
Beryllium	7440-41-7	0.048	1	7.6		4						4		4		73	
Cadmium	7440-43-9	0.063	1	0.66		5		4.3	1	2.2	1	5		51		18	
Chromium (total)	7440-47-3	0.035	5	42		100		16	10	11	10	100		510		110	10
Cobalt	7440-48-4	0.02	3	5												2200	
Copper	7440-50-8	0.038	2	5		1300	2,3	13	1	9	1	1300		3800		1400	
Lead	7439-92-1	0.053	1	1.3		15	2	65	1	2.5	1	15		42			
Mercury (SW-846 Method 7470A/7471A)	7439-97-6	0.07	0.2	0.0013		2		1.4		0.77		2		31		11	

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NSWC CRANE, CRANE, INDIANA

PARAMETER	CAS	Aqueous Matrix Laboratory MDL (ug/L)	Aqueous Matrix Laboratory RL (ug/L)	REGION 5 ECO DQLs SURFACE WATER (ug/L)	Footnote	FEDERAL MCLs (ug/L)	Footnote	FEDERAL AWQCs FRESHWATER ACUTE (ug/L)	Footnote	FEDERAL AWQCs FRESHWATER CHRONIC (ug/L)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL GW CLOSURE LEVELS (ug/L)	Footnote	IDEM TIER 1 DEFAULT INDUSTRIAL GW CLOSURE LEVELS (ug/L)	Footnote	REGION 9 TAP WATER PRGs (ug/L)	Footnote
Nickel	7440-02-0	0.063	5	29		100	4	470	1	52	1	100		2000		730	
Selenium	7782-49-2	0.35	1	5		50				5		50		510		180	
Silver	7440-22-4	0.014	3	1		100	7	3.4	1			180		510		180	
Thallium	7440-28-0	0.0058	1	0.56		2						2		9		2.9	11
Tin	7440-31-5	0.023	10	73												22000	
Vanadium	7440-62-2	0.031	2	19												260	
Zinc	7440-66-6	0.38	10	58.9		5000	7	120	1	120	1	11000		31000		11000	
MISCELLANEOUS METALS (SW-846 METHOD 6010B Trace)																	
Aluminum	7429-90-5	47	200			50-200	1	750		87						36000	
Calcium	7440-70-2	12	5000														
Iron	7439-89-6	11	100			300	1			1000						11000	
Magnesium	7439-95-4	18	5000														
Manganese	7439-96-5	1.5	15			50	1									880	
Potassium	7440-09-7	102	5000														
Sodium	7440-23-5	80	5000														
APPENDIX IX VOLATILE ORGANIC COMPOUNDS (SW-846 METHOD 8260B WITH 25mL PURGE - WATER, 5g PURGE - SOIL or 8015B WITH 10mL PURGE - WATER AND 5g PURGE - SOIL)																	
1,1,1,2-Tetrachloroethane	630-20-6	0.11	0.5	90.25								6.9		110		0.43	
1,1,1-Trichloroethane	71-55-6	0.1	1	88		200						200		9200		790	
1,1,2,2-Tetrachloroethane	79-34-5	0.18	0.5	13								0.9		14		0.055	
1,1,2-Trichloroethane	79-00-5	0.054	0.5	650		5						5		50		0.2	
1,1-Dichloroethane	75-34-3	0.11	1	47								990		10000		810	
1,1-Dichloroethene	75-35-4	0.14	0.5	78		7						7		7		0.046	
1,2,3-Trichloropropane	96-18-4	0.11	1	12.11												0.0016	
1,2-Dibromo-3-chloropropane	96-12-8	0.17	1	11.2		0.2										0.048	
1,2-Dibromoethane	106-93-4	0.14	0.5	22.5		0.05										0.00076	
1,2-Dichloroethane	107-06-2	0.061	0.5	190		5						5		31		0.12	
1,2-Dichloropropane	78-87-5	0.083	0.5	380		5						5		42		0.16	
1,4-Dioxane	123-91-1	100	100													6.1	
2-Butanone	78-93-3	1	5	7100								2500		61000		1900	
2-Chloro-1,3-butadiene (chloroprene)	126-99-8	1	1													14	
2-Hexanone	591-78-6	0.81	5	1710												1500	13
4-Methyl-2-pentanone	108-10-1	0.38	5	3680												160	
Acetone	67-64-1	0.81	5	78000								770		10000		610	
Acetonitrile	75-05-8	18.1	40													79	
Acrolein	107-02-8	2.3	10	0.205								0.056		2000		0.042	
Acrylonitrile	107-13-1	0.66	3	0.89												0.039	
Allyl chloride (3-chloro-1-propene)	107-05-1	0.29	5													1800	
Benzene	71-43-2	0.093	0.5	114		5						5		99		0.41	
Bromodichloromethane	75-27-4	0.093	0.5			80	9					100		100		0.18	
Bromoform	75-25-2	0.12	1	466		80	9					100		360		8.5	
Bromomethane	74-83-9	0.24	1									11		140		8.7	
Carbon disulfide	75-15-0	0.078	1	84.1								1300		10000		1000	
Carbon tetrachloride	56-23-5	0.12	0.3	5.9		5						5		22		0.17	
Chlorobenzene	108-90-7	0.12	1	10		100						100		2000		110	
Chloroethane	75-00-3	0.13	1	230000												4.6	

TABLE D-1

TABULAR PRESENTATION OF RBSLs FOR RBTL SELECTION
NSWC CRANE, CRANE, INDIANA

PARAMETER	CAS	Aqueous Matrix Laboratory MDL (ug/L)	Aqueous Matrix Laboratory RL (ug/L)	REGION 5 ECO DQLs SURFACE WATER (ug/L)	Footnote	FEDERAL MCLs (ug/L)	Footnote	FEDERAL AWQCs FRESHWATER ACUTE (ug/L)	Footnote	FEDERAL AWQCs FRESHWATER CHRONIC (ug/L)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL GW CLOSURE LEVELS (ug/L)	Footnote	IDEM TIER 1 DEFAULT INDUSTRIAL GW CLOSURE LEVELS (ug/L)	Footnote	REGION 9 TAP WATER PRGs (ug/L)	Footnote
Chloroform	67-66-3	0.054	0.3	79		80	9					100		470		0.16	
Chloromethane	74-87-3	0.18	1													1.5	
cis-1,2-Dichloroethene	156-59-2	0.1	1	310	5	70						70		1000		61	
cis-1,3-Dichloropropene	10061-01-5	0.057	0.3	7.9								1.3'	12	16	12	0.081	12
Dibromochloromethane	124-48-1	0.093	0.5	6400		80	9									0.13	
Dibromomethane	74-95-3	0.11	1													61	
Dichlorodifluoromethane	75-71-8	0.14	1													390	
Ethyl methacrylate	97-63-2	0.21	1													550	
Ethylbenzene	100-41-4	0.076	1	17.2		700						700		10000		1300	
Isobutyl alcohol	78-83-1	0.32	40													1800	
Methacrylonitrile	126-98-7	0.48	1													1	
Methyl iodide	74-88-4	0.66	1														
Methyl methacrylate	80-62-6	0.28	1	2800												1400	
Methylene chloride	75-09-2	0.22	1	430		5						5		380		4.3	
Proprionitrile	107-12-0	2	20	6080													
Styrene	100-42-5	0.11	1	56		100						100		20000		1600	
Tetrachloroethene	127-18-4	0.1	1	8.9		5						5		55		1.1	
Toluene	108-88-3	0.096	1	253		1000						1000		20000		720	
Total Xylenes	1330-20-7	0.17	5	117		10000						10000		180000		1400	
trans-1,2-Dichloroethene	156-60-5	0.1	1	310		100						100		2000		120	
trans-1,3-Dichloropropene	10061-02-6	0.061	0.5	7.9								1.3	12	16	12	0.081	12
trans-1,4-Dichloro-2-butene	110-57-6	5	10													0.0012	2
Trichloroethene	79-01-6	0.11	1	75		5						5		260		1.6	
Trichlorofluoromethane	75-69-4	0.12	1													1300	
Vinyl acetate	108-05-4	0.63	5	248.03								550		100000		410	
Vinyl chloride	75-01-4	0.15	0.5	9.2		2						2		2		0.02	
APPENDIX IX SEMIVOLATILE ORGANIC COMPOUNDS (SW-846 METHOD 8270C; 8270C SIM OR 8310, BASED ON LABORATORY CAPABILITIES, WHERE NOTED)																	
1,2,4,5-Tetrachlorobenzene	95-94-3	3	10	26.24												11	
1,2,4-Trichlorobenzene	120-82-1	1.231	5	69.2		70						70		1000		190	
1,2-Dichlorobenzene	95-50-1	0.434	5	11		600						600		9200		370	
1,3-Dichlorobenzene	541-73-1	0.342	5	87								22		3100		5.5	
1,4-Dichlorobenzene	106-46-7	0.286	2	43		75						75		120		0.5	
1,4-Naphthoquinone	130-15-4	1	10														
1,4-Phenylenediamine	106-50-3	25	25													6900	
1-Naphthylamine	134-32-7	2	10	0.67													
2,3,4,6-Tetrachlorophenol	58-90-2	5	10	14.06												1100	
2,4,5-Trichlorophenol	95-95-4	0.753	25									3600		10000		3600	
2,4,6-Trichlorophenol	88-06-2	0.858	3	2								77		26		6.1	
2,4-Dichlorophenol	120-83-2	0.698	10	18								110		310		110	
2,4-Dimethylphenol	105-67-9	1.909	10	100.17								730		2000		730	
2,4-Dinitrophenol	51-28-5	1.202	10	4.07								73		200		73	
2,6-Dichlorophenol	87-65-0	3	10														
2-Acetylaminofluorene	53-96-3	1	10	534.97													
2-Chloronaphthalene	91-58-7	0.6	2	0.396												490	
2-Chlorophenol	95-57-8	0.853	3	8.8								38		510		30	
2-Methylnaphthalene (by SIM)	91-57-6	0.0191	0.2	329.55													

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NSWC CRANE, CRANE, INDIANA

PARAMETER	CAS	Aqueous Matrix Laboratory MDL (ug/L)	Aqueous Matrix Laboratory RL (ug/L)	REGION 5 ECO DQLs SURFACE WATER (ug/L)	Footnote	FEDERAL MCLs (ug/L)	Footnote	FEDERAL AWQCs FRESHWATER ACUTE (ug/L)	Footnote	FEDERAL AWQCs FRESHWATER CHRONIC (ug/L)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL GW CLOSURE LEVELS (ug/L)	Footnote	IDEM TIER 1 DEFAULT INDUSTRIAL GW CLOSURE LEVELS (ug/L)	Footnote	REGION 9 TAP WATER PRGs (ug/L)	Footnote
2-Methylphenol	95-48-7	1.03	10									1800		5100		1800	
2-Naphthylamine	91-59-8	4	10														
2-Nitroaniline	88-74-4	0.993	2													2.1	
2-Nitrophenol	88-75-5	0.913	10	13.5												290	14
2-Picoline	109-06-8	5	10	3790													
3,3'-Dichlorobenzidine	91-94-1	0.527	10	99.75								1.9		6.4		0.15	
3,3'-Dimethylbenzidine	119-93-7	8	50													0.0073	
3-Methylcholanthrene	56-49-5	1	12	0.0891													
3-Methylphenol	108-39-4	5	10													1800	
3-Nitroaniline	99-09-2	0.634	25														
4,6-Dinitro-2-methylphenol	534-52-1	0.872	10	2.3													
4-Aminobiphenyl	92-67-1	1	10														
4-Bromophenyl phenyl ether	101-55-3	0.65	2	1.5													
4-Chloro-3-methylphenol	59-50-7	0.559	10	20													
4-Chloroaniline	106-47-8	1.094	10	231.97								150		410		150	
4-Chlorophenyl phenyl ether	7005-72-3	0.634	10														
4-Methylphenol	106-44-5	0.96	10													180	
4-Nitroaniline	100-01-6	0.67	25														
4-Nitrophenol	100-02-7	0.876	25	35												290	
4-Nitroquinoline-1-oxide	56-57-5	19	25														
5-Nitro-o-toluidine	99-55-8	2	16													2	
7,12-Dimethylbenz(a)anthracene	57-97-6	2	10														
a,a-Dimethylphenethylamine	122-09-8	13	25	300.16												37	
Acenaphthene (by SIM)	83-32-9	0.077	0.2	9.9								460		4200		370	
Acenaphthylene (by SIM)	208-96-8	0.0108	0.2	4840								460	19	460	19	370	19
Acetophenone	98-86-2	2	20	687.89												0.042	
Aniline	62-53-3	0.57	5	0.44												12	
Anthracene (by SIM)	120-12-7	0.0175	0.2	0.029								43		43		1800	
Aramite	140-57-8	2	10	3.09												2.7	
Benzo(a)anthracene (by SIM)	56-55-3	0.0141	0.2	0.839								1.2		3.9		0.092	
Benzo(a)pyrene (by SIM)	50-32-8	0.0153	0.2	0.014		0.2						0.2		0.39		0.0092	
Benzo(b)fluoranthene (by SIM)	205-99-2	0.0157	0.2	9.07								1.2		1.5		0.092	
Benzo(g,h,i)perylene (by SIM)	191-24-2	0.0141	0.2	7.64								8.3	20	8.3	20	6.2	20
Benzo(k)fluoranthene (by SIM)	207-08-9	0.0178	0.2	0.0056								0.8		0.8		0.92	
Benzyl alcohol	100-51-6	1.473	10	281.24												11000	
Bis(2-chloroethoxy)methane	111-91-1	1.801	10	6400													
Bis(2-chloroethyl)ether	111-44-4	0.826	1	1140								0.15		2.6		0.0098	
Bis(2-chloroisopropyl)ether	39638-32-9	0.0000194	5E-5													0.27	
Bis(2-ethylhexyl)phthalate	117-81-7	0.722	2	2.1		6						6		200		4.8	
Butyl benzyl phthalate	85-68-7	0.813	10	49								2700		2700		7300	
Chlorobenzilate	510-15-6	1	5	7.16												0.25	
Chrysene (by SIM)	218-01-9	0.0149	0.2	0.033								1.6		1.6		9.2	
Diallate	2303-16-4	1	10	29												1.1	
Dibenzo(a,h)anthracene (by SIM)	53-70-3	0.0119	0.2	0.0016								0.12		0.39		0.0092	
Dibenzofuran	132-64-9	0.653	10	20												24	
Diethyl phthalate	84-66-2	0.599	2	3								29000		82000		29000	

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NSWC CRANE, CRANE, INDIANA

PARAMETER	CAS	Aqueous Matrix Laboratory MDL (ug/L)	Aqueous Matrix Laboratory RL (ug/L)	REGION 5 ECO DQLs SURFACE WATER (ug/L)	Footnote	FEDERAL MCLs (ug/L)	Footnote	FEDERAL AWQCs FRESHWATER ACUTE (ug/L)	Footnote	FEDERAL AWQCs FRESHWATER CHRONIC (ug/L)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL GW CLOSURE LEVELS (ug/L)	Footnote	IDEM TIER 1 DEFAULT INDUSTRIAL GW CLOSURE LEVELS (ug/L)	Footnote	REGION 9 TAP WATER PRGs (ug/L)	Footnote
Dimethyl phthalate	131-11-3	0.638	10	73												360000	
Dimethoate	60-51-5	---	10	41.2												7.3	
Di-n-butyl phthalate	84-74-2	0.512	10	3								3600		10000		3600	
Di-n-octyl phthalate	117-84-0	0.486	10	30								20		20		730	
Diphenylamine	122-39-4	3.6	10	412.51												910	
Disulfoton	296-04-4	---	16														
Ethyl methane sulfonate	62-50-0	2	10														
Ethyl parathion	56-38-2	1	15	0.008				0.065		0.013						220	
Famphur	52-85-7	---	10														
Fluoranthene (by SIM)	206-44-0	0.0141	0.2	8.1								210		210		1500	
Fluorene (by SIM)	86-73-7	0.0153	0.2	3.9								310		2000		240	
Hexachlorobenzene	118-74-1	0.516	2	0.00024		1						1		1.8		0.042	
Hexachlorobutadiene	87-68-3	0.504	1	0.223								7.3		20		0.86	
Hexachlorocyclopentadiene	77-47-4	0.129	10	77.04		50						50		720		260	
Hexachloroethane	67-72-1	0.445	2	30.5								36		100		4.8	
Hexachloropropene	1888-71-7	5	10	20													
Indeno(1,2,3-cd)pyrene (by SIM)	193-39-5	0.0084	0.2	4.31								0.022		0.022		0.092	
Isodrin	465-73-6	1	10	0.0309													
Isophorone	78-59-1	0.766	10	900								900		3000		71	
Isosafrole	120-58-1	1	10														
Kepone	143-50-0	1	25	0.132												0.0037	
Methapyrilene	91-80-5	16	25														
Methyl methane sulfonate	66-27-3	2	25														
Methyl parathion	298-00-0	1	10													9.1	
Naphthalene (by SIM)	91-20-3	0.0141	0.2	44								8.3		2000		6.2	
n-Nitrosodiethylamine	55-18-5	2	10	767.94												0.00045	
n-Nitrosodimethylamine	62-75-9	3.6	10													0.0013	
n-Nitrosodi-n-butylamine	924-16-3	2	10	1000												0.002	
n-Nitrosodi-n-propylamine	621-64-7	0.938	2									0.12		0.41		0.0096	
n-Nitrosomethylethylamine	10595-95-6	1.909	10													0.0031	
n-Nitrosomorpholine	59-89-2	1	10														
n-Nitrosopiperidine	100-75-4	1	10														
n-Nitrosopyrrolidine	930-55-2	2	10													0.032	
O,O,O-Triethyl phosphorothioate	126-68-1	1	10	58.25													
o-Toluidine	95-53-4	2	15													0.28	
p-(Dimethylamino)azobenzene	60-11-7	1	10														
Pentachlorobenzene	608-93-5	4	10	0.47												29	
Pentachloroethane	76-01-7	1.4	25	56.42													
Pentachloronitrobenzene	82-68-8	1	10	50												0.26	
Phenacetin	62-44-2	1	10														
Phenanthrene (by SIM)	85-01-8	0.0191	0.2	2.1								8.3	20	2000	20	6.2	20
Phenol	108-95-2	1.022	10	100								22000		61000		22000	
Phorate	296-02-2	---	10	3.62												7.3	
Pronamide	23950-58-5	1	10	160												2700	
Pyrene (by SIM)	129-00-0	0.0168	0.2	0.3								140		140		180	
Pyridine	110-86-1	2.078	10	2380												37	

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Safrole	94-59-7	1	10	40												18	
Tetraethyl dithiopyrophosphate (Sulfotepp)	3689-24-5	---	10	13.9													
Thionazin	297-97-2	---	100														
APPENDIX IX ORGANOCHLORINE PESTICIDES and PCBs (SW-846 METHOD 8081A and 8082)																	
4,4'-DDD	72-54-8	0.0042	0.05	0.0011								3.6		12		0.28	
4,4'-DDE	72-55-9	0.0052	0.05	0.00000000451								2.5		8.4		0.2	
4,4'-DDT	50-29-3	0.0057	0.05	0.001				1.1		0.001		2.5		8.4		0.2	
Aldrin	309-00-2	0.0089	0.01	0.0309				3				0.05		0.17		0.004	
Alpha-BHC	319-84-6	0.0025	0.01	12.38								0.14		0.45		0.011	
Alpha-chlordane	5103-71-9	0.0026	0.03	0.00029	6	2	6	2.4	6	0.0043	6	2	6	8.2	6	0.19	6
Aroclor-1016	12674-11-2	0.072	0.5	0.000029	8	0.5	8			0.014	8	0.5	8	1.4	8	0.96	
Aroclor-1221	11104-28-2	0.08	0.5	0.000029	8	0.5	8			0.014	8	0.5	8	1.4	8	0.034	
Aroclor-1232	11141-16-5	0.21	0.5	0.000029	8	0.5	8			0.014	8	0.5	8	1.4	8	0.034	
Aroclor-1242	53469-21-9	0.33	0.5	0.000029	8	0.5	8			0.014	8	0.5	8	1.4	8	0.034	
Aroclor-1248	12672-29-6	0.061	0.5	0.000029	8	0.5	8			0.014	8	0.5	8	1.4	8	0.034	
Aroclor-1254	11097-69-1	0.11	0.5	0.000029	8	0.5	8			0.014	8	0.5	8	1.4	8	0.034	
Aroclor-1260	11096-82-5	0.041	0.5	0.000029	8	0.5	8			0.014	8	0.5	8	1.4	8	0.034	
Beta-BHC	319-85-7	0.0029	0.03	0.495								0.47		1.6		0.037	
Delta-BHC	319-86-8	0.0059	0.05	666.67								0.14	17	0.45	17	0.011	17
Dieldrin	60-57-1	0.0046	0.02	0.000026				0.24		0.056		0.053		0.18		0.0042	
Endosulfan I	959-98-8	0.753	25	0.003				0.22		0.056		0.22	16	0.51	16	220	
Endosulfan II	33213-65-9	0.0062	0.05	0.003				0.22		0.056		0.22	16	0.51	16	220	
Endosulfan sulfate	1031-07-8	0.0059	0.08	2.22								0.22	16	0.51	16	220	
Endrin	72-20-8	0.0052	0.06	0.002		2		0.086		0.036		2		31		11	
Endrin aldehyde	7421-93-4	0.0058	0.08	0.15								2	18	31	18	11	
Gamma-BHC (Lindane)	58-89-9	0.0024	0.05	0.01		0.2		0.95				0.2		2.2		0.052	
Gamma-chlordane	12789-03-6	0.0021	0.03	0.00029(6)		2	6	2.4	6	0.0043	6	2		8.2		0.19	6
Heptachlor	76-44-8	0.0078	0.03	0.00039		0.4		0.52		0.0038		0.4		0.64		0.015	
Heptachlor epoxide	1024-57-3	0.003	0.03	0.00048		0.2		0.52		0.0038		0.2		3.2		0.0074	
Methoxychlor	72-43-5	0.0312	0.12	0.005		40				0.03		40		45		180	
Toxaphene	8001-35-2	0.7	3	0.0002		3		0.73		0.0002		3		3		0.061	
APPENDIX IX HERBICIDES (SW-846 METHOD 8151A)																	
2,4-D	94-75-7	---	0.08			70										360	
2,4,5-T	93-76-5	---	0.04	686.33												360	
2,4,5-TP (Silvex)	93-72-1	---	0.04	326.64		50										290	
Dinoseb	88-85-7	---	0.08	0.39		7										37	
Hexachlorophene	70-30-4	---	0.1	0.228												11	
Pentachlorophenol	87-86-5	---	0.02	5.23		1		19		15		1		24		0.56	
MISCELLANEOUS PARAMETERS																	
Cyanide (SW-846 Method 9012A)	74-90-8	0.74	10	5.2	21	200				5.2	21					730	
CEC (SW-846 Method 9081)	NA	ANR	ANR														
Hardness (Standard Methods 2340B)	NA	---	1000													10000	
Nitrate	14797-55-8	2	10			10000										1000	
Nitrite	14797-65-0	2	10			1000											
pH (SW-846 9045C)	NA	ANR	ANR			6.5-8.5	7			6.5-9							
TOC (EPA 415.1)	NA	350	1000														

TABLE D-1

TABULAR PRESENTATION OF RBSLs FOR RBTL SELECTION
NSWC CRANE, CRANE, INDIANA

PARAMETER	CAS	Aqueous Matrix Laboratory MDL (ug/L)	Aqueous Matrix Laboratory RL (ug/L)	REGION 5 ECO DQLs SURFACE WATER (ug/L)	Footnote	FEDERAL MCLs (ug/L)	Footnote	FEDERAL AWQCs FRESHWATER ACUTE (ug/L)	Footnote	FEDERAL AWQCs FRESHWATER CHRONIC (ug/L)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL GW CLOSURE LEVELS (ug/L)	Footnote	IDEM TIER 1 DEFAULT INDUSTRIAL GW CLOSURE LEVELS (ug/L)	Footnote	REGION 9 TAP WATER PRGs (ug/L)	Footnote
TSS (EPA 160.1)	NA	---	2000														

ANR Analysis Not Required
AWQC Ambient Water Quality Criteria
CEC Cation Exchange Capacity
DQL Data Quality Level
GW Groundwater
IDEM Indiana Department of Environmental Management
MCL Maximum Contaminant Level
MDL Method Detection Limit
NA Not Applicable
PRG Preliminary Remediation Goal
RBC Risk-Based Concentration
RBSL Risk-Based Screening Level
RBTL Risk-Based Target Level
RL Reporting Limit
TOC Total Organic Carbon
TSS Total Suspended Solids
USEPA U.S. Environmental Protection Agency

1 Criteria are hardness dependent.
2 Action level.
3 Secondary MCL for copper is 1,000 ug/L.
4 Value is being remanded.
5 Trans-1,2-Dichloroethene.
6 Chlordane.
7 Secondary MCL, based on aesthetic drinking water qualities (i.e., color, odor, taste, etc.).
8 Total for all Aroclor congeners.
9 1994 Proposed rule for Disinfectants and Disinfection By-Products: Total for all trihalomethanes combined cannot exceed 80 ug/L.
10 Hexavalent chromium.
11 Thallium carbonate.
12 1,3-Dichloropropene.
13 USEPA Region 3 RBC presented.
14 Value for 4-nitrophenol presented.
15 Dinitrotoluene mixture.
16 Endosulfan.
17 Value for alpha-BHC presented.
18 Value for endrin presented.
19 Value for acenahpthene presented.
20 Value for naphthalene presented.
21 Free cyanide.

TABLE D-2

TABULAR PRESENTATION OF SOIL AND SEDIMENT RBSLs FOR RBTL SELECTION
NSWC CRANE, CRANE,
INDIANA

PARAMETER	CAS	Solid Matrix Laboratory MDL (mg/kg)	Solid Matrix Laboratory RL (mg/kg)	USEPA GENERIC SSLs INGESTION (mg/kg)	Footnote	USEPA GENERIC SSLs INHALATION (mg/kg)	Footnote	USEPA GENERIC SSLs MIGRATION TO GW (mg/kg) DAF = 1	Footnote	REGION 5 ECO DQLs SOIL (mg/kg)	Footnote	REGION 5 ECO DQLs SEDIMENT (mg/kg)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL SOIL CLOSURE LEVELS (mg/kg)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL SOIL DIRECT CONTACT (mg/kg)	Footnote	REGION 9 SOIL PRGs FOR RESIDENTIAL LAND USE (mg/kg)	Footnote	REGION 9 SOIL PRGs FOR INDUSTRIAL LAND USE (mg/kg)
DIOXINS/FURANS																				
1,2,3,4,6,7,8-HPCDD	35822-46-9	0.0000016	0.0000025															3.90E-04		
1,2,3,4,6,7,8-HPCDF	67562-39-4	0.0000031	0.0000025															3.90E-04		
1,2,3,4,7,8,9-HPCDF	55673-89-7	0.0000095	0.0000025															3.90E-03		
1,2,3,4,7,8-HXCDD	39227-28-6	0.0000021	0.0000025															3.90E-05		
1,2,3,4,7,8-HXCDF	70648-26-9	0.0000027	0.0000025															3.90E-05		
1,2,3,6,7,8-HXCDD	57653-85-7	0.0000024	0.0000025															3.90E-05		
1,2,3,6,7,8-HXCDF	57117-44-9	0.0000014	0.0000025															3.90E-05		0.00040
1,2,3,7,8,9-HXCDD	19408-74-3	0.0000024	0.0000025															3.90E-05		
1,2,3,7,8,9-HXCDF	72918-21-9	0.0000019	0.0000025															3.90E-06		
1,2,3,7,8-PECDD	40321-76-4	0.0000026	0.000001															7.80E-05		
1,2,3,7,8-PECDF	57117-41-6	0.0000038	0.000001															3.90E-05		
2,3,4,6,7,8-HXCDF	60851-34-5	0.0000014	0.0000025															7.80E-06		
2,3,4,7,8-PECDF	57117-31-4	0.000003	0.000001															3.90E-06		0.000027
2,3,7,8-TCDD	1746-01-6	0.00000054	0.000001															3.90E-05		
2,3,7,8-TCDF	51207-31-9	0.0000062	0.000001															3.90E-02		
1,2,3,4,6,7,8,9-OCDD	3268-87-9	0.0000051	0.000005															3.90E-02		
1,2,3,4,6,7,8,9-OCDF	39001-02-0	0.0000041	0.000005																	
EXPLOSIVES (SW-846 METHOD 8330)																				
1,3,5-Trinitrobenzene	99-35-4	0.22	0.5															1800		26000
1,3-Dinitrobenzene	99-65-0	0.22	0.5							0.6547		0.000924						6.1		88
2,4,6-Trinitrotoluene (TNT)	118-96-7	0.13	0.5															16		82
2,4-Dinitrotoluene	121-14-2	0.136	0.5	0.9				0.00004		1.28		0.07513		0.0085	1			120		1800
2,6-Dinitrotoluene	606-20-2	0.13	0.5	0.9				0.00003		0.03283		0.02062						61		880
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX	2691-41-0	0.144	0.5															3100		44000
2-Nitrotoluene	88-72-2	0.392	0.5															370		1000
3-Nitrotoluene	99-08-1	0.392	0.5															370		1000
4-Nitrotoluene	99-99-0	0.392	0.5															370		1000
4-Amino-2,6-dinitrotoluene	19406-51-0	0.188	0.5																	
2-Amino-4,6-dinitrotoluene	35572-78-2	0.072	0.5															610		8800
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	479-45-8	0.19	0.5															20		110
Nitrobenzene	98-95-3	0.222	0.5	39		92		0.007		1.31		0.4876		0.028		91		4.4		22
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	0.253	0.5																	
Nitroglycerin	55-63-0	---	---																	
Pentaerythritol tetranitrate (PETN)	78-11-5	---	1																	
APPENDIX IX METALS (SW-846 Method 6020 ICP/MS)																				
Antimony	7440-36-0	0.008	0.5	31				0.3		0.1423				5.4		138		31		820
Arsenic	7440-38-2	0.028	0.5	0.4		750		1		5.7		0.0059		3.9	c	3.9		0.39		2.7
Barium	7440-39-3	0.014	0.5	5500		690000		82		1.04				1600		24000		5400		100000
Beryllium	7440-41-7	0.008	0.5	0.1		1300		3		1.06				1.9		1.9		150		2200
Cadmium	7440-43-9	0.01	0.5	78		1800		0.4		0.00222		0.596		7.5		12		3		810
Chromium (total)	7440-47-3	0.063	2.5	390	4	270	4	2	4					38		470		210		450
Cobalt	7440-48-4	0.019	1.5							0.14033		50						4700		100000
Copper	7440-50-8	0.015	1							2.96		16		580		13000		2900		76000
Lead	7439-92-1	0.011	0.5	400	14					0.05373		31		81		350		400		1000
Mercury (SW-846 Method 7470A/7471A)	7439-97-6	0.03	0.1	23		10		0.1		0.073		0.174		2.1		55				
Nickel	7440-02-0	0.031	2.5	1600		13000		7		13.6		16		130		6900		1600		41000
Selenium	7782-49-2	0.055	1	390				0.3		0.02765				5.2		1700		390		10000
Silver	7440-22-4	0.002	1.5	390				2		4.04		0.5		31		1700		390		10000
Thallium	7440-28-0	0.003	0.5					0.04		0.05692				2.9		31		6.3	16	160
Tin	7440-31-5	---	5							7.62								47000		100000
Vanadium	7440-62-2	0.011	2	550				300		1.59								550		14000
Zinc	7440-66-6	0.098	5	23000				620		6.62		120		10000		104000		23000		100000
MISCELLANEOUS METALS (SW-846 METHOD 6010B Trace)																				
Aluminum	7429-90-5	9.6	20															76000		100000
Calcium	7440-70-2	2.3	500																	

TABLE D-2

TABULAR PRESENTATION OF SOIL AND SEDIMENT RBSLs FOR RBTL SELECTION
NSWC CRANE, CRANE,
INDIANA

PARAMETER	CAS	Solid Matrix Laboratory MDL (mg/kg)	Solid Matrix Laboratory RL (mg/kg)	USEPA GENERIC SSLs INGESTION (mg/kg)	Footnote	USEPA GENERIC SSLs INHALATION (mg/kg)	Footnote	USEPA GENERIC SSLs MIGRATION TO GW (mg/kg) DAF = 1	Footnote	REGION 5 ECO DQLs SOIL (mg/kg)	Footnote	REGION 5 ECO DQLs SEDIMENT (mg/kg)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL SOIL CLOSURE LEVELS (mg/kg)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL SOIL DIRECT CONTACT (mg/kg)	Footnote	REGION 9 SOIL PRGs FOR RESIDENTIAL LAND USE (mg/kg)	Footnote	REGION 9 SOIL PRGs FOR INDUSTRIAL LAND USE (mg/kg)
Iron	7439-89-6	2.8	10															23000		100000
Magnesium	7439-95-4	3.7	500																	
Manganese	7439-96-5	0.12	1.5															1800		32000
Potassium	7440-09-7	19	500																	
Sodium	7440-23-5	6.7	500																	
APPENDIX IX VOLATILE ORGANIC COMPOUNDS (SW-846 METHOD 8260B WITH 25mL PURGE - WATER, 5g PURGE - SOIL or 8015B WITH 10mL PURGE - WATER AND 5g PURGE - SOIL)																				
1,1,1,2-Tetrachloroethane	630-20-6	0.0006	0.005							225		0.01089		0.050		39		3		7
1,1,1-Trichloroethane	71-55-6	0.0008	0.005			1200		0.1		29.8		0.24685		1.9		2400		770		1400
1,1,2,2-Tetrachloroethane	79-34-5	0.0006	0.005	3		0.6		0.0002		0.12722		0.02908		0.007		5.4		0.38		0.9
1,1,2-Trichloroethane	79-00-5	0.0007	0.005	11		1		0.0009		28.6		0.67351		0.03		10		0.84		1.9
1,1-Dichloroethane	75-34-3	0.0009	0.005	7800		1300		1		20.1		0.000575		5.6		1400		590		2100
1,1-Dichloroethene	75-35-4	0.0011	0.005	1		0.07		0.003		8.27		0.02327		0.058		0.73		0.054		0.12
1,2,3-Trichloropropane	96-18-4	0.0018	0.005							3.36		0.00835						0.0014		0.0031
1,2-Dibromo-3-chloropropane	96-12-8	0.0019	0.005							0.03518		0.01998						0.45		4
1,2-Dibromoethane	106-93-4	0.0006	0.005							1.23		0.01237						0.0069		0.048
1,2-Dichloroethane	107-06-2	0.0009	0.005	7		0.4		0.001		21.2		0.05418		0.024		4		0.35		0.76
1,2-Dichloropropane	78-87-5	0.0007	0.005	9		15		0.001		32.7		0.35161		0.03		5		0.35		0.77
1,4-Dioxane	123-91-1	0.025	0.5							2.05		0.00000543						44		220
2-Butanone	78-93-3	0.0045	0.005							89.6		0.13696		10		20000		7300		28000
2-Chloro-1,3-butadiene (chloroprene)	126-99-8	0.0009	0.005							0.0029		0.00106						3.6		12
2-Hexanone	591-78-6	0.0023	0.005							12.6		1.01						3100	6	82,000
4-Methyl-2-pentanone	108-10-1	0.0024	0.005							443		0.54437						790		2900
Acetone	67-64-1	0.0046	0.005	7800		100000		0.8		2.5		0.45337		3.1		4200		1600		6200
Acetonitrile	75-05-8	0.0019	0.2							1.37		0.13905						270		1700
Acrolein	107-02-8	0.013	0.05							5.27		0.0000144		0.00027		0.28		0.1		0.34
Acrylonitrile	107-13-1	0.008	0.05							0.02393		0.0000157						0.21		0.51
Allyl chloride (3-chloro-1-propene)	107-05-1	0.0008	0.005							0.01338		0.000266						3000		43000
Benzene	71-43-2	0.0006	0.005	22		0.8		0.002		0.25462		0.14157		0.34		9		0.67		1.5
Bromodichloromethane	75-27-4	0.0008	0.005	10		3000		0.03		0.53978		0.00113		0.63		11		1		2.4
Bromoform	75-25-2	0.0013	0.005	81		53		0.04		15.9		0.99627		0.75		290		62		310
Bromomethane	74-83-9	0.005	0.005	110		10		0.01		0.23516		0.94674		0.052		11		3.9		13
Carbon disulfide	75-15-0	0.0008	0.005	7800		720		2		0.09412		0.13397		10		990		360		720
Carbon tetrachloride	56-23-5	0.0009	0.005	5		0.3		0.003		2.98		0.03573		0.066		3.6		0.24		0.53
Chlorobenzene	108-90-7	0.0007	0.005	1600		130		0.07		13.1		0.06194		1.3		150		1		540
Chloroethane	75-00-3	0.0018	0.005									58.6						3		6.5
Chloroform	67-66-3	0.0009	0.005	100		0.3		0.03		1.19		0.027		0.59		3.3		0.24		0.52
Chloromethane	74-87-3	0.0006	0.005							10.4		0.0000785						1.2		2.7
cis-1,2-Dichloroethene	156-59-2	0.0009	0.005	780		1200		0.02		0.78373	5	0.20894	5	0.4		119		43		150
cis-1,3-Dichloropropene	10061-01-5	0.0008	0.005	4	11	0.1	11	0.0002	11	0.39786		0.00296		0.0091	11			0.082	11	0.18
Dibromochloromethane	124-48-1	0.0007	0.005	8		1300		0.02		2.05		0.26761						1.1		2.7
Dibromomethane	74-95-3	0.0006	0.005							65		0.0000859						67		240
Dichlorodifluoromethane	75-71-8	0.0008	0.005							39.5		0.00133						94		310
Ethyl methacrylate	97-63-2	0.0009	0.005							30		0.000602						140		140
Ethylbenzene	100-41-4	0.0007	0.005	7800		400		0.7		5.16		0.0001		13		5000		230		230
Isobutyl alcohol	78-83-1	0.053	0.2							20.8		3.35						13000		40000
Methacrylonitrile	126-98-7	0.01	0.1							0.05705		0.0000297						2.1		8.8
Methyl iodide	74-88-4	0.0017	0.005																	
Methyl methacrylate	80-62-6	0.0015	0.005							984		0.16756						2200		2700
Methylene chloride	75-09-2	0.0017	0.005	85		13		0.001		4.05		1.26		0.023		120		8.9		21
Proprionitrile	107-12-0	0.01	0.1							0.04983		0.11466								
Styrene	100-42-5	0.0006	0.005	16000		1500		0.2		4.69		0.44496		3.5		12000		1		1700
Tetrachloroethene	127-18-4	0.001	0.005	12		11		0.003		9.92		0.19583		0.058		50		5.7		19
Toluene	108-88-3	0.0006	0.005	16000		650		0.6		5.45		52.5		12		1800		520		520
Total Xylenes	1330-20-7	0.0018	0.005	160000		410	17	9	17	10		1.88		190		5300		210		210
trans-1,2-Dichloroethene	156-60-5	0.0007	0.005	1600		3100		0.03		0.78373		0.20894		0.68		190		63		210

TABLE D-2

TABULAR PRESENTATION OF SOIL AND SEDIMENT RBSLs FOR RBTL SELECTION
NSWC CRANE, CRANE,
INDIANA

PARAMETER	CAS	Solid Matrix Laboratory MDL (mg/kg)	Solid Matrix Laboratory RL (mg/kg)	USEPA GENERIC SSLs INGESTION (mg/kg)	Footnote	USEPA GENERIC SSLs INHALATION (mg/kg)	Footnote	USEPA GENERIC SSLs MIGRATION TO GW (mg/kg) DAF = 1	Footnote	REGION 5 ECO DQLs SOIL (mg/kg)	Footnote	REGION 5 ECO DQLs SEDIMENT (mg/kg)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL SOIL CLOSURE LEVELS (mg/kg)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL SOIL DIRECT CONTACT (mg/kg)	Footnote	REGION 9 SOIL PRGs FOR RESIDENTIAL LAND USE (mg/kg)	Footnote	REGION 9 SOIL PRGs FOR INDUSTRIAL LAND USE (mg/kg)
trans-1,3-Dichloropropene	10061-02-6	0.0008	0.005	4	11	0.1	11	0.0002	11	0.39786		0.00296		0.0091	11			0.082	11	0.18
trans-1,4-Dichloro-2-butene	110-57-6	0.25	0.33									0.00182						0.0079	9	0.018
Trichloroethene	79-01-6	0.001	0.005	58		5		0.003		12.4		0.17956		0.057		48		2.8		6.1
Trichlorofluoromethane	75-69-4	0.0021	0.005							16.4		0.00307						390		2000
Vinyl acetate	108-05-4	0.0023	0.005	78000		1000		8		12.7		0.01295		2.3		1200		430		1400
Vinyl chloride	75-01-4	0.006	0.005	0.3		0.03		0.0007		0.64614		0.002		0.013		0.31		0.022		0.049
APPENDIX IX SEMIVOLATILE ORGANIC COMPOUNDS (SW-846 METHOD 8270C; 8270C SIM OR 8310, BASED ON LABORATORY CAPABILITIES, WHERE NOTED)																				
1,2,4,5-Tetrachlorobenzene	95-94-3	0.092	0.33							2.02		20.9						18		260
1,2,4-Trichlorobenzene	120-82-1	0.1627	0.33	780		3200		0.3		11.1		11.7		5.3		1800		6		3000
1,2-Dichlorobenzene	95-50-1	0.186	0.33	7000		560		0.9		2.96		0.23132		17		3000		370		370
1,3-Dichlorobenzene	541-73-1	0.1706	0.33							37.7		3.01		0.42		114		13		52
1,4-Dichlorobenzene	106-46-7	0.1823	0.33	27				0.1		0.54559		1.45		2.2		42		3		8.1
1,4-Naphthoquinone	130-15-4	0.059	0.33																	
1,4-Phenylenediamine	106-50-3	0.308	0.83							6.16		0.00000568						12000		100000
1-Naphthylamine	134-32-7	0.169	0.33																	
2,3,4,6-Tetrachlorophenol	58-90-2	0.096	0.33							0.19878		1.51						1800		26000
2,4,5-Trichlorophenol	95-95-4	0.1736	0.83	7800				14		14.1		0.08556		250		18000		6100		88000
2,4,6-Trichlorophenol	88-06-2	0.1516	0.33	58		200		0.008		9.94		0.08484		1.5		390		44		220
2,4-Dichlorophenol	120-83-2	0.1773	0.33	230				0.05		87.5		0.13363		1.1		550		1		2600
2,4-Dimethylphenol	105-67-9	0.1026	0.33	1600				0.4		0.01		0.30453		9		3600		1		18000
2,4-Dinitrophenol	51-28-5	0.04052	0.83	160				0.01		0.06086		0.00133		0.29		360		120		1800
2,6-Dichlorophenol	87-65-0	0.104	0.33							1.17		0.00394								
2-Acetylaminofluorene	53-96-3	0.073	0.33							0.59634		0.01532								
2-Chloronaphthalene	91-58-7	0.153	0.33							0.01218		0.41723						4900		27000
2-Chlorophenol	95-57-8	0.1935	0.33	390		53000		0.2		0.24266		0.0117		0.75		380		6		240
2-Methylnaphthalene (by SIM)	91-57-6	0.000561	0.0066							3.24		0.0202								
2-Methylphenol	95-48-7	0.1916	0.33	3900				0.8		40.4		0.000826		14		7600		3100		44000
2-Naphthylamine	91-59-8	0.194	0.33							3.03		0.00174								
2-Nitroaniline	88-74-4	0.1435	0.83							74.1		0.000222						3.5		50
2-Nitrophenol	88-75-5	0.1674	0.33							1.6		0.00777						490	10	7000
2-Picoline	109-06-8	0.25	0.33							9.9		0.75305								
3,3'-Dichlorobenzidine	91-94-1	0.1395	0.33	1				0.0003		0.64636		0.02822		0.062		9.5		1.1		5.5
3,3'-Dimethylbenzidine	119-93-7	--	0.33							0.1042		0.002						0.053		0.27
3-Methylcholanthrene	56-49-5	0.384	0.33							0.07794		8190								
3-Methylphenol	108-39-4	0.079	0.33							163		0.000808						3100		44000
3-Nitroaniline	99-09-2	0.1372	0.83							3.16		0.000222								
4,6-Dinitro-2-methylphenol	534-52-1	0.109	0.83							0.14408		0.01038								
4-Aminobiphenyl	92-67-1	0.135	0.33							0.00305		0.00566								
4-Bromophenyl phenyl ether	101-55-3	0.1661	0.33									1.68								
4-Chloro-3-methylphenol	59-50-7	0.1938	0.33							7.95		0.38818								
4-Chloroaniline	106-47-8	0.07858	0.33	310				0.03		1.1		0.14608		0.97		730		240		3500
4-Chlorophenyl phenyl ether	7005-72-3	0.2104	0.33									0.656112								
4-Methylphenol	106-44-5	0.2021	0.33							3.49		0.000845						310		4400
4-Nitroaniline	100-01-6	0.1128	0.83							21.9		0.000222								
4-Nitrophenol	100-02-7	0.1257	0.83							5.12		0.00778						490		7000
4-Nitroquinoline-1-oxide	56-57-5	0.783	0.83							0.12222		0.00124								
5-Nitro-o-toluidine	99-55-8	0.086	0.33							8.73		0.000845						15		75
7,12-Dimethylbenz(a)anthracene	57-97-6	0.249	0.33																	
a,a-Dimethylphenethylamine	122-09-8	0.153	0.83															61		880
Acenaphthene (by SIM)	83-32-9	0.000559	0.0066	4700				29		682		0.00671		130		9500		3700		38000
Acenaphthylene (by SIM)	208-96-8	0.000511	0.0066							682		0.00587		130 (12)				3700	12	38000
Acetophenone	98-86-2	0.052	0.33							300		0.246						0.49		1.6
Aniline	62-53-3	0.05256	0.33							0.05678		0.0000338						85		430
Anthracene (by SIM)	120-12-7	0.000722	0.0066	23000				590		1480		0.0469		51		47000		22000		100000
Aramite	140-57-8	0.043	0.83							166		0.00000111						19		99

TABLE D-2

TABULAR PRESENTATION OF SOIL AND SEDIMENT RBSLs FOR RBTL SELECTION
NSWC CRANE, CRANE,
INDIANA

PARAMETER	CAS	Solid Matrix Laboratory MDL (mg/kg)	Solid Matrix Laboratory RL (mg/kg)	USEPA GENERIC SSLs INGESTION (mg/kg)	Footnote	USEPA GENERIC SSLs INHALATION (mg/kg)	Footnote	USEPA GENERIC SSLs MIGRATION TO GW (mg/kg) DAF = 1	Footnote	REGION 5 ECO DQLs SOIL (mg/kg)	Footnote	REGION 5 ECO DQLs SEDIMENT (mg/kg)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL SOIL CLOSURE LEVELS (mg/kg)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL SOIL DIRECT CONTACT (mg/kg)	Footnote	REGION 9 SOIL PRGs FOR RESIDENTIAL LAND USE (mg/kg)	Footnote	REGION 9 SOIL PRGs FOR INDUSTRIAL LAND USE (mg/kg)
Benzo(a)anthracene (by SIM)	56-55-3	0.000791	0.0066	0.9				0.08		5.21		0.0317		5.0		5		0.62		2.9
Benzo(a)pyrene (by SIM)	50-32-8	0.002627	0.0066	0.09				0.4		1.52		0.0319		0.50		0.5		0.062		0.29
Benzo(b)fluoranthene (by SIM)	205-99-2	0.001166	0.0066	0.9				0.2		59.8		10.4		5.0		5		0.62		2.9
Benzo(g,h,i)perylene (by SIM)	191-24-2	0.000723	0.0066							119		0.17		0.7	15			56	15	190
Benzo(k)fluoranthene (by SIM)	207-08-9	0.000397	0.0066	9				2		1480		0.24		39		50		6.2		29
Benzyl alcohol	100-51-6	0.1887	0.33							65.8		0.03394						18000		100000
Bis(2-chloroethoxy)methane	111-91-1	0.1705	0.33							0.30209		0.34971								
Bis(2-chloroethyl)ether	111-44-4	0.1754	0.33	0.6		0.2		0.00002		23.7		0.21196		0.0007		1.6		0.21		0.62
Bis(2-chloroisopropyl)ether	39638-32-9	0.2238	0.33											0.027				2.5		7.4
Bis(2-ethylhexyl)phthalate	117-81-7	0.171	0.33	46		31000		180		0.92594		0.182		300		300		35		180
Butyl benzyl phthalate	85-68-7	0.161	0.33	16000		930		810		0.23889		4.19		930		36000		12000		100000
Chlorobenzilate	510-15-6	0.051	0.33							5.05		0.86029						1.8		9.1
Chrysene (by SIM)	218-01-9	0.001023	0.0066	88				8		4.73		0.0571		26		500		62		290
Diallate	2303-16-4	0.046	0.33							0.45214		0.00151						8		40
Dibenzo(a,h)anthracene (by SIM)	53-70-3	0.000792	0.0066	0.09				0.08		18.4		0.00622		0.5		0.5		0.062		0.29
Dibenzofuran	132-64-9	0.1824	0.33									1.52						290		5100
Diethyl phthalate	84-66-2	0.2017	0.33	63000		2000		23		24.8		0.00804		450		150000		49000		100000
Dimethoate	60-51-5	---	0.67							0.21802		0.19015						12		180
Dimethyl phthalate	131-11-3	0.2083	0.33							734		0.02495						100000		100000
Di-n-butyl phthalate	84-74-2	0.1911	0.33	7800		2300		270		0.14979		0.1105		2300		18000		6100		88000
Di-n-octyl phthalate	117-84-0	0.1961	0.33	1600		10000		10000		709		40.6		2000		3700		1200		10000
Diphenylamine	122-39-4	---	0.33							1.01		0.0346						1500		22000
Ethyl methane sulfonate	62-50-0	0.059	0.33																	
Ethyl parathion	56-38-2	0.052	0.33							0.00034		0.00034						370		5300
Fluoranthene (by SIM)	206-44-0	0.000512	0.0066	3100				210		122		0.1113		880		6300		2300		30000
Fluorene (by SIM)	86-73-7	0.000723	0.0066	3100				28		122		0.0212		170		6300		2600		33000
Hexachlorobenzene	118-74-1	0.1231	0.33	0.4		1		0.1		0.19878		0.02		2.2		2.7		3		1.5
Hexachlorobutadiene	87-68-3	0.1394	0.33	8		8		0.1		0.03976		1.38		16		36		6		32
Hexachlorocyclopentadiene	77-47-4	0.05693	0.33	550		10		20		0.75537		0.90074		400		1300		420		5900
Hexachloroethane	67-72-1	0.1575	0.33	46		55		0.02		0.59634		2.23		2.8		183		35		180
Hexachloropropene	1888-71-7	0.126	0.33									0.0002								
Indeno(1,2,3-cd)pyrene (by SIM)	193-39-5	0.001023	0.0066	0.9				0.7		109		0.2		3.0		5		0.62		2.9
Isodrin	465-73-6	0.057	0.33							0.00332		0.05516								
Isophorone	78-59-1	0.148	0.33	670		4600		0.03		139		0.4223		5.3		4500		510		2600
Isosafrole	120-58-1	0.058	0.33							9.94		0.00412								
Kepone	143-50-0	0.072	0.83							0.03272		0.00331						0.027		0.14
Methapyrilene	91-80-5	0.215	0.83							2.78		0.0000144								
Methyl methane sulfonate	66-27-3	0.172	0.83																	
Methyl parathion	298-00-0	0.058	0.33							0.000292		0.000755						15		220
Naphthalene (by SIM)	91-20-3	0.000559	0.0066	3100				4		0.09939		0.0346		0.7		3200		56		190
n-Nitrosodiethylamine	55-18-5	0.07	0.33							0.06933		0.02277						0.0032		0.016
n-Nitrosodimethylamine	62-75-9	0.125	0.33							0.0000321		0.00000275						0.0095		0.048
n-Nitrosodi-n-butylamine	924-16-3	0.045	0.33							0.26707		0.77204						0.024		0.061
n-Nitrosodi-n-propylamine	621-64-7	0.1753	0.33	0.09				0.000002		0.54368		0.000217		0.0006		0.61		0.069		0.35
n-Nitrosomethylethylamine	10595-95-6	0.1026	0.33							0.00166		0.00000485						0.022		0.11
n-Nitrosomorpholine	59-89-2	0.063	0.33							0.07057		0.0000037								
n-Nitrosopiperidine	100-75-4	0.073	0.33							0.00665		0.0000226								
n-Nitrosopyrrolidine	930-55-2	0.073	0.33							0.01258		0.000000908						0.23		1.2
O,O,O-Triethyl phosphorothioate	126-68-1	0.087	0.33																	
o-Toluidine	95-53-4	0.086	0.33							2.97		0.000199						2		10
p-(Dimethylamino)azobenzene	60-11-7	0.024	0.33																	
Pentachlorobenzene	608-93-5	0.038	0.33							0.49695		1.26						49		700
Pentachloroethane	76-01-7	0.0016	0.83							10.7		0.68918								
Pentachloronitrobenzene	82-68-8	0.059	0.83							7.09		18.2						1.9		9.5
Phenacetin	62-44-2	0.051	0.33							11.7		0.00225								

TABLE D-2

TABULAR PRESENTATION OF SOIL AND SEDIMENT RBSLs FOR RBTL SELECTION
NSWC CRANE, CRANE,
INDIANA

PARAMETER	CAS	Solid Matrix Laboratory MDL (mg/kg)	Solid Matrix Laboratory RL (mg/kg)	USEPA GENERIC SSLs INGESTION (mg/kg)	Footnote	USEPA GENERIC SSLs INHALATION (mg/kg)	Footnote	USEPA GENERIC SSLs MIGRATION TO GW (mg/kg) DAF = 1	Footnote	REGION 5 ECO DQLs SOIL (mg/kg)	Footnote	REGION 5 ECO DQLs SEDIMENT (mg/kg)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL SOIL CLOSURE LEVELS (mg/kg)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL SOIL DIRECT CONTACT (mg/kg)	Footnote	REGION 9 SOIL PRGs FOR RESIDENTIAL LAND USE (mg/kg)	Footnote	REGION 9 SOIL PRGs FOR INDUSTRIAL LAND USE (mg/kg)
Phenanthrene (by SIM)	85-01-8	0.000723	0.0066							45.7		0.0419		0.7 (15)				56	15	190
Phenol	108-95-2	0.1906	0.33	47000				5		120		0.02726		110		89000		37000		100000
Phorate	296-02-2	---	0.67							0.000496		0.000861						11		
Pronamide	23950-58-5	0.047	0.33							0.0136		0.0016						4600		66000
Pyrene (by SIM)	129-00-0	0.001022	0.0066	2300				210		78.5		0.053		570		5500		2300		54000
Pyridine	110-86-1	0.221	0.33							1.03		0.10617						61		880
Safrole	94-59-7	0.078	0.33							0.40398		0.16486								
Tetraethyl dithiopyrophosphate (Sulfotepp)	3689-24-5	---	0.67																	0.0055
Thionazin	297-97-2	---	0.67							0.000000199		0.0000033								
APPENDIX IX ORGANOCHLORINE PESTICIDES and PCBs (SW-846 METHOD 8081A and 8082)																				
4,4'-DDD	72-54-8	0.00029	0.0033	3				0.8		0.75815		0.00553		28		28		2.4		17
4,4'-DDE	72-55-9	0.00035	0.0033	2				3		0.59587		0.00142		20		20		1.7		12
4,4'-DDT	50-29-3	0.00038	0.0033	2				2		0.0175		0.00119		20		20		1.7		12
Aldrin	309-00-2	0.00018	0.0017	0.04		3		0.02		0.00332		0.002		0.25		0.25		0.029		0.15
Alpha-BHC	319-84-6	0.00014	0.0017	0.1		0.8		0.00003		0.09939		0.006		0.0072		0.99		0.09		0.59
Alpha-chlordane	5103-71-9	0.00024	0.0017	0.5	7	20	7	0.5	7	0.224	7	0.0045	7	9.6	7			1.6	7	11
Aroclor-1016	12674-11-2	0.0138	0.033	1	8					0.67971	8	0.0341	8	1.8	8			3.9		29
Aroclor-1221	11104-28-2	0.0105	0.033	1	8					0.67971	8	0.0341	8	1.8	8			0.22		1
Aroclor-1232	11141-16-5	0.0122	0.033	1	8					0.67971	8	0.0341	8	1.8	8			0.22		1
Aroclor-1242	53469-21-9	0.0117	0.033	1	8					0.67971	8	0.0341	8	1.8	8			0.22		1
Aroclor-1248	12672-29-6	0.0162	0.033	1	8					0.67971	8	0.0341	8	1.8	8			0.22		1
Aroclor-1254	11097-69-1	0.0214	0.033	1	8					0.67971	8	0.0341	8	1.8	8			0.22		1
Aroclor-1260	11096-82-5	0.0065	0.033	1	8					0.67971	8	0.0341	8	1.8	8			0.22		1
Beta-BHC	319-85-7	0.00031	0.0017	0.4				0.0001		0.00398		0.005		0.026		3.5		0.32		2.1
Delta-BHC	319-86-8	0.00016	0.0017							9.94		71.5		0.0072	18			0.09	18	0.59
Dieldrin	60-57-1	0.00032	0.0033	0.04		1		0.0002		0.00238		0.002		0.046		0.27		0.03		0.15
Endosulfan I	959-98-8	0.1736	0.83	470	13			0.9	13	0.11927		0.000175		20	13			370	13	5300
Endosulfan II	33213-65-9	0.00038	0.0033	470	13			0.9	13	0.11927		0.000104		20	13			370	13	5300
Endosulfan sulfate	1031-07-8	0.00049	0.0033							0.03578		0.0346		20	13			370	13	5300
Endrin	72-20-8	0.00021	0.0033	23				0.05		0.0101		0.00267		0.99		54		18		260
Endrin aldehyde	7421-93-4	0.00044	0.0033							0.0105		3.2		0.99	3			18	3	260
Gamma-BHC (Lindane)	58-89-9	0.00015	0.0017	0.5				0.0005		0.005		0.00094		0.0094		4.8		0.44		2.9
Gamma-chlordane	12789-03-6	0.0002	0.0017	0.5	7	20	7	0.5	7	0.224	7	0.0045	7	9.6	7			1.6	7	11
Heptachlor	76-44-8	0.00016	0.0017	0.1		0.1		1		0.00598		0.0006		0.56		0.56		0.11		0.55
Heptachlor epoxide	1024-57-3	0.0002	0.0017	0.07		5		0.03		0.15188		0.0006		0.46		0.46		0.053		0.27
Methoxychlor	72-43-5	0.0016	0.017	390				8		0.01988		0.00359		160		900		310		4400
Toxaphene	8001-35-2	0.0016	0.17	0.6		89		2		0.11927		0.000109		3.9		3.9		0.44		2.2
APPENDIX IX HERBICIDES (SW-846 METHOD 8151A)																				
2,4-D	94-75-7	---	0.0027							0.02725		0.00579						690		12000
2,4,5-T	93-76-5	---	0.0027							0.59634		58.7						610		8800
2,4,5-TP (Silvex)	93-72-1	---	0.00133							0.1088		7.35						490		7000
Dinoseb	88-85-7	---	0.0027							0.0218		0.01178						61		880
Hexachlorophene	70-30-4	---	0.0167							0.19878		231						18		260
Pentachlorophenol	87-86-5	---	0.00066	3				0.001		0.11927		30.1		0.028		20		3		11

TABLE D-2

TABULAR PRESENTATION OF SOIL AND SEDIMENT RBSLs FOR RBTL SELECTION
NSWC CRANE, CRANE,
INDIANA

PARAMETER	CAS	Solid Matrix Laboratory MDL (mg/kg)	Solid Matrix Laboratory RL (mg/kg)	USEPA GENERIC SSLs INGESTION (mg/kg)	Footnote	USEPA GENERIC SSLs INHALATION (mg/kg)	Footnote	USEPA GENERIC SSLs MIGRATION TO GW (mg/kg) DAF = 1	Footnote	REGION 5 ECO DQLs SOIL (mg/kg)	Footnote	REGION 5 ECO DQLs SEDIMENT (mg/kg)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL SOIL CLOSURE LEVELS (mg/kg)	Footnote	IDEM TIER 1 DEFAULT RESIDENTIAL SOIL DIRECT CONTACT (mg/kg)	Footnote	REGION 9 SOIL PRGs FOR RESIDENTIAL LAND USE (mg/kg)	Footnote	REGION 9 SOIL PRGs FOR INDUSTRIAL LAND USE (mg/kg)
MISCELLANEOUS PARAMETERS (ANALYTICAL METHODS TO BE DETERMINED BASED ON LABORATORY CAPABILITIES)																				
Cyanide (SW-846 Method 9012A)	74-90-8	0.1	1	1600				2		1.33	2	0.0001	2					1100		
CEC (SW-846 Method 9081)	NA	---	6 meq/100g																	
Hardness (standard Methods 2340B)	NA	ANR	ANR																	
Nitrate	14797-55-8	ANR	ANR																	
Nitrite	14797-65-0	ANR	ANR																	
pH (SW-846 9045C)	NA	---	1 (S.U.)																	
TOC (EPA 415.1)	NA	---	1000																	
TSS (EPA 160.1)	NA	ANR	ANR																	

ANR Analysis Not Required
CEC Cation Exchange Capacity
DAF Dilution and Attenuation Factor
DQL Data Quality Level
GW Groundwater
IDEM Indiana Department of Environmental Management
MDL Method Detection Limit
NA Not Applicable
OSWER Office of Solid Waste and Emergency Response
PRG Preliminary Remediation Goal
RBC Risk-Based Concentration
RBSL Risk-Based Screening Level
RBTL Risk-Based Target Level
RL Reporting Limit
SSL Soil Screening Level
S.U. Standard Units
TOC Total Organic Carbon
TSS Total Suspended Solids
USEPA U.S. Environmental Protection Agency

1 Dinitrotoluene mixture.
2 Free cyanide.
3 Value for endrin presented.
4 Assume hexavalent chromium.
5 Trans-1,2-Dichloroethene.
6 USEPA Region 3 RBC.
7 Chlordane.
8 Total for all Aroclor congeners.
9 Value for 1,4-dichloro-2-butene presented.
10 Value for 4-nitrophenol presented
11 1,3-Dichloropropene.
12 Value for acenphthene presented
13 Endosulfan.
14 OSWER soil screening level for residential land use (USEPA, July 1994).
15 Value for naphthalene presented.
16 Thallium carbonate.
17 o-Xylene.
18 Value for alpha-BHC presented.

APPENDIX E

DATA MANAGEMENT CHECKLIST

DATABASE PLANNING CHECKLIST

PROJECT NAME _____ PROJECT NUMBER _____

PROJECT MANAGER _____ PLANNING DATE _____

1. Provide a general description of the project (regulatory authority, media to be samples, approximate number of samples by media, analyses by media, data evaluation tasks required):

_____
_____
_____
_____
_____

2. Provide a general description of the sample nomenclature that will be used for samples collected by Brown & Root Environmental:

_____
_____
_____
_____

3. Will historical data be entered in the database? Yes No

4. Will historical data be used to define the nature and extent of contamination? Yes No

5. Will historical data be used for risk assessment purposes? Yes No

6. How much historical data exists (i.e., number of samples by matrix, analysis by matrix)?

_____
_____
_____
_____

7. In what format will the historical data be provided? Hardcopy Electronic

8. If historical data are in electronic form, what software was used and what is the format?

_____
_____
_____
_____

9. If historical data are in hardcopy form, will Form I's, summary tables, or reports be provided? Copies of historical data will be necessary to generate a budget estimate.

_____
_____
_____
_____

10. Will Quality Assurance review of historical data be necessary? Yes No

11. If Quality Assurance review of historical data is necessary, describe the scope of the Quality Assurance review:

_____
_____
_____
_____

12. Will a GIS database be necessary for the project? Yes No

13. What nomenclature has been (will be) used to identify field duplicate samples?

14 Will field duplicate results be averaged and presented as one result in the data base? Will they be presented as distinct results, or will both the average and the distinct results be presented?

15. How will the average value for duplicate samples be determined on a matrix-specific basis?

16. Are any unvalidated data to be included in the database? Yes No

17. Will unvalidated data be used for defining the nature and extent of contamination? Yes No

18. Will unvalidated data be used for risk assessment purposes? Yes No

19. Are any field screening data to be included in the database? Yes No

20. Will field screening data be used for defining the nature and extent of contamination? Yes No

21. Will field screening data be used for risk assessment purposes? Yes No

22. Will statistical correlation of laboratory and field screening data be necessary? Yes No

23. If a correlation exists between field screening and laboratory data, will the results of regression analysis be used to define nature and extent? Yes No

24. If a correlation exists between field screening and laboratory data, will the results of regression analysis be used to support the risk assessment? Yes No

25. Will field parameters be included in the database (e.g., pH, conductance, temperature)? Yes No

26. Will statistical correlations be necessary for TCLP versus RAS/SAS data? Yes No

27. Will statistical correlations be necessary for filtered versus unfiltered samples? Yes No

28. Will any other statistical correlations be necessary? Yes No

29. Are there wells that have been screened in different aquifers? Yes No

30. Will data for various aquifers be segregated by depth? Yes No

31. Can the sample nomenclature system be used to identify wells in different aquifers? Yes No

32. Will samples from other matrices (soil, sediment, or surface water) be segregated by depth? Yes No

33. Can the sample nomenclature system be used to identify depth-specificity? Yes No

34. Have any removal actions be performed at the site? Yes No

If removal actions have been performed, plan and cross-sectional views reflecting the extent of the removal action must be provided.

35. Will any composite sample results be included in the database? Yes No

36. If composite samples are included how will they be used for the nature and extent of contamination?

37. If composite samples are included how will they be used for the risk assessment?

38. Will the site be segregated into Areas of Concern, Solid Waste Management Units, etc? Yes No

39. Is the sample nomenclature adequate for such segregation? Yes No

If the sample nomenclature is inadequate for assigning samples to an AOC or SWMU, the Project Manager or designee must provide a base map of tabular summary clearly delineating the relationship between each sample and each AOC/SWMU.

40. Were any temporal samples collected (e.g., quarterly sampling of wells)? Yes No

41. If temporal samples were collected, how will they be used to define the nature and extent of contamination?

42. If temporal samples were collected, how will they be used to support the risk assessment?

43. Are State, Federal, or Regional criteria to be included in data summary tables? Yes No

44. Identify the criteria that must be presented in the summary tables.

45. Will State, Federal, or Regional criteria be used to select COPCs? Yes No

46. Identify the criteria to be used as COPC selection tools.

47. Are filtered and unfiltered surface water samples differentiated? Yes No

48. If such samples are differentiated, how?

49. Which of these samples will be used for the human health risk assessment?

Surface Water Filtered Unfiltered
Groundwater Filtered Unfiltered

50. Which of these samples will be used for the ecological assessment?

Surface Water	Filtered	Unfiltered
Groundwater	Filtered	Unfiltered

51. Will background data be included in the database? Yes No

52. How are background samples identified?

53. Will background results be used to support selection of COPCs? Yes No

53. What statistical analyses will be required for the background data?

54. Will background data be segregated by depth? Yes No

55. What background matrices must be segregated by depth?

56. What format will be used for data presentation (e.g., appendices and summary tables, comprehensive text tables, tag maps, isoconcentration contours, etc.)?

APPENDIX F

EDD FORMAT

ELECTRONIC DATA FORMAT REQUIREMENTS

1.0 INTRODUCTION

The laboratory is to provide 3.5" high density diskette(s) containing separate database (DBF) files in the format specified in this Attachment. The electronic deliverable includes all environmental samples, sample dilutions, sample reanalyses, and laboratory quality control samples. **All entries in the electronic deliverable must agree exactly with the final entries reported on the hardcopy data package sample result summaries.** Any corrections made to the hardcopy data must also be made to the electronic file. Appropriate qualifiers as identified by the analytical protocol must also be designated; laboratory QC non-compliance codes are not to be depicted.

Each diskette is to be properly labeled with the laboratory name, project name, file name(s), and laboratory point of contact. Electronic files should be delivered in the same fashion as are the hard copy data packages. A separate .dbf file shall be made for each analytical fraction (by method) and each sample delivery group (SDG). The files shall be named with the first character being the analytical fraction designator, followed by an underscore, followed by the SDG name. For example, the file for the volatile fraction for SDG BR001 should be named V_BR001.DBF. Additionally, the laboratory must provide a hardcopy listing all electronic files saved to the diskette, indicating what analytical fraction and matrix the file data contained therein pertain to. All electronic data deliverables are due within the same time established for the associated hardcopy data packages.

In addition, the laboratory QC officer must read and sign a copy of the Quality Assurance Review Form displayed on the next page of this Attachment. Electronic deliverables are not considered to be complete without the accompanying Quality Assurance Review Form.

I _____, as the designated Quality Assurance Officer, hereby attest that all electronic deliverables have been thoroughly reviewed and are in agreement with the associated hardcopy data. The enclosed electronic files have been reviewed for accuracy (including significant figures), completeness and format. The laboratory will be responsible for any labor time necessary to correct enclosed electronic deliverables that have been found to be in error. I can be reached at (_____)_____if there are any questions or problems with the enclosed electronic deliverables.

Signature:_____ Title: _____ Date: _____

The analytical data shall be delivered electronically in a Dbase III file format (filename.dbf). The exact structure of the database is described in the table below. It shall be the responsibility of the laboratory to ensure that all electronic entries are in strict accordance with the information provided on the Form I.

An example database shall be sent for review prior to the first electronic deliverable in Dbase III format. The example file will be examined for completeness and comments will be sent to the laboratory. Any questions regarding the electronic deliverable shall be directed to Patrick Hooper at Brown and Root Environmental (412)921-8250.

DATA FIELD	DATA TYPE	FIELD WIDTH	DATA FIELD DESCRIPTION
SAMPLE_NO	C	25	Field sample ID as listed on the chain-of-custody. The sample number indicated in this field should never be truncated. The only exception for this field not matching the chain-of-custody is for reanalyses and matrix spike results in which a RE or MS suffix will be added to the sample number respectively.
TRUNCATE	C	15	If the field sample ID listed on the Chain of Custody is truncated by the laboratory for use with the laboratory software, the truncated sample ID should appear in this field.
LAB_ID	C	15	Laboratory number for the given sample.
LABORATORY	C	25	Laboratory name.
BATCH_NO	C	10	Laboratory code for batch of samples included in a given run.
ASSOC_BLNK	C	15	Laboratory name of the method blank associated with that particular batch of samples.
QC_TYPE	C	15	Normal Environmental Sample = "NORMAL", Laboratory Duplicate = "DUPLICATE", Matrix Spike = "MS", Matrix Spike Duplicate = "MSD", Laboratory Control Sample = "LCS", Laboratory Control Sample Duplicate = "LCSD", Method Blank = "M_BLANK", Preparation Blank = "P_BLANK".
SAMP_DATE	D	8	Date of sample collection as indicated on the Chain of Custody. Example: 11/07/93.
REC_DATE	D	8	Date sample was received by the laboratory.
EXTR_DATE	D	8	Date sample was extracted or prepared by the laboratory.
ANAL_DATE	D	8	Date sample was analyzed by the laboratory.
RUN_NUMBER	N	2 (0)	The number of the analytical run for a given sample in sequence. For example, if a sample is diluted and reanalyzed, the original run number would be 1 and the reanalysis would be 2.
SDG	C	15	Sample delivery group identifier assigned by the laboratory. This number should exactly match the SDG designated on the hardcopy data package.

DATA FIELD	DATA TYPE	FIELD WIDTH	DATA FIELD DESCRIPTION
PROJECT_NO	C	10	Identification of Project Number or CLEAN Task Order (CTO) number.
PROJ_MNGR	C	25	The Brown & Root Project Manager's last name, followed by a comma, followed by the first initial of the Project Manager (e.g. Hutson, D).
PARAMETER	C	45	Chemical or analyte name exactly as reported on Form I.
CAS_NO	C	10	Chemical Abstract Service number for the parameter listed. The CAS number should be reported exactly as it is listed in publications such as the Merck Index. This field should be left blank for those parameters not having CAS numbers (e.g. Total Organic Carbon).
FRACTION	C	5	Metals = 'M', Volatiles = 'OV', Semivolatiles/BNAs = 'OS', Pesticides = 'PEST', Herbicides = 'HERB', Polychlorinated Biphenyls = 'PCB', Explosives = 'EXP', Any petroleum hydrocarbon or fuel = 'TPH', Wet Chemistry = 'WET', Radionuclide = 'RAD', Miscellaneous = 'MISC'
METHOD	C	20	Analytical method used to quantitate parameter concentrations as listed in the laboratory technical specification (e.g. '8270A' for SW-846 Method 8270A.
LAB_RESULT	N	20 (6)	Reported value in units specified in the UNITS field containing the proper number of significant digits. The % Recovery shall be placed in this field for matrix spike and laboratory control sample results.
UNITS	C	5	The units of measure as reported on the Form I.
LAB_QUAL	C	2	The laboratory qualifier as reported on the Form I. For example, a 'U' qualifier should be used for all nondetected results.
IDL	N	15 (6)	Instrument detection limit in units specified in the UNITS field.
MDL	N	15 (6)	Method detection limit in units specified in the UNITS field and method specified in the METHOD field.
CRDL_CRQL	N	15 (6)	Contract Required Detection/Quantitation Limit in the units specified in the UNITS field. RDL for non-CLP parameters.
DIL_FACTOR	N	6 (1)	Dilution factor.
PCT_MOIST	N	5 (1)	Percent moisture for soil samples; blank for water samples.
COMMENTS	C	20	Analytical result qualifier or comment other than that listed in the LAB_QUAL field. Example: 'Reanalysis'.

C = Character string (everything shall be reported in capital letters)
N = Numeric string (decimal places are in parentheses in field width column)
D = Date (Ex: 05/25/97)

APPENDIX G

DATABASE STRUCTURE

Database Structure

The NSWC Crane CTO10 master database shall contain 18 standard tables to store all chemical, geological, and hydrogeological data. The structure, indexes, primary keys, and relations for each table are defined below.

TABLE: well
PRIMARY KEY: location

Table Structure

FIELD	TYPE	DESCRIPTION
Location	C (25)	Unique location name.
post_id	C (20)	Location name as derived from original source document.
instal_date	D (8)	Date the monitoring well was installed. Null for other location types.
loc_type	C (4)	Type of location.
Northing	N (15,4)	Northing coordinate in horizontal datum referenced in the HORIZ_DATUM field.
Easting	N (15,4)	Easting coordinate in horizontal datum referenced in the HORIZ_DATUM field.
horiz_datum	C (8)	Datum in which the horizontal coordinates were derived.
grnd_surf	N (15,4)	Ground surface elevation with reference to mean sea level in vertical datum referenced in the VERT_DATUM field
vert_datum	C (25)	Datum in which the vertical coordinates were derived.
datum_state	C (2)	State for which datum was developed
Surveyed	L (1)	Logical field denoting whether positional data were surveyed or digitized.
Surveyor	C (50)	Company who performed the survey.
survey_date	D (8)	Date in which survey was performed.
surv_method	C (25)	Surveying method used.
Longitude	N (15,4)	Longitude
Latitude	N (15,4)	Latitude

Table Indexes

INDEX	TYPE
Location	Primary
Hd	Regular
Vd	Regular
loc_type	Regular

Table Relations:

Relation 1
*RelatedChild loc_type
*RelatedTable loc_type_vvl
*RelatedTag loc_type

Relation 2
*RelatedChild hd
*RelatedTable horiz_datum_vvl
*RelatedTag hd

Relation 3
*RelatedChild vd
*RelatedTable vert_datum_vvl
*RelatedTag vd

TABLE: loc_type_vvl - Valid value list for LOC_TYPE field in the well table.

PRIMARY KEY: loc_type

Table Structure

FIELD	TYPE	DESCRIPTION
loc_type	C (4)	Location type
Description	C (40)	Description of location type

Table Indexes

INDEX	TYPE
loc_type	Primary

TABLE: horiz_datum_vvl - Valid value list for HORIZ_DATUM field in the well table.
PRIMARY KEY: hd (horiz_datum)

Table Structure

FIELD	TYPE	DESCRIPTION
Horiz_datum	C (15)	Datum in which x,y coordinates reflect

Table Indexes

INDEX	TYPE
hd (horiz_datum)	Primary

Table Indexes

INDEX	TYPE
loc_type	Primary

TABLE: vert_datum_vvl - Valid value list for VERT_DATUM field in the well table.
PRIMARY KEY: vd (vert_datum)

Table Structure

FIELD	TYPE	DESCRIPTION
Vert_datum	C (15)	Datum in which z coordinate reflects

Table Indexes

INDEX	TYPE
vd (vert_datum)	Primary

TABLE: sample_data - Sample data table
PRIMARY KEY: nsample

Table Structure

FIELD	TYPE	DESCRIPTION
Location	C (25)	Unique location name.
Matrix	C (4)	Sample matrix
Nsample	C (35)	Unique sample identification
Sample	C (25)	Sample identification as designated on Chain-of-Custody
Sacode	C (8)	Sample code for reference to field duplicates
top_depth	N (5,1)	Depth in feet to the top of the sample interval. Applicable for soil and sediment samples.
Bottom_depth	N (5,1)	Depth in feet to the bottom of the sample interval. Applicable for soil and sediment samples. *Rule Expression*: if(bottom_depth>0,top_depth<=bottom_depth)

qc_type	C (2)	Quality control type
Status	C (10)	Status of sample location – Normal or excavated
sample_date	D (8)	Date in which sample was collected
Validated	L (1)	Logical field denoting whether or not data validation was performed on sample
coll_method	C (10)	Sample collection method
cto_proj	C (5)	Clean task order (Navy) or project number in which the sample was collected (e.g. "129")
proj_manager	C (25)	Internal projcect manager for which the data was originally generated (e.g. "Hutson, D.").

Table Indexes

INDEX	TYPE
Location	Regular
Nsample	Primary
Sacode	Regular
Matrix	Regular
Status	Regular
qc_type	Regular
coll_meth	Regular

Table Relations:

Relation 1
*RelatedChild sacode
*RelatedTable sacode_vvl
*RelatedTag sacode

Relation 2
*RelatedChild qc_type
*RelatedTable qc_type_vvl
*RelatedTag qc_type

Relation 3
*RelatedChild matrix
*RelatedTable matrix_vvl
*RelatedTag matrix

Relation 4
*RelatedChild location
*RelatedTable well
*RelatedTag location

Relation 5
*RelatedChild coll_meth
*RelatedTable coll_method_vvl
*RelatedTag coll_meth

TABLE: sacode_vvl - Sample code valid value list for SACODE field in sample_data.dbf
PRIMARY KEY: sacode

Table Structure

FIELD	TYPE	DESCRIPTION
Sacode	C (8)	Sample code designating whether sample is a normal environmental sample, a field duplicate or the average of field duplicate pairs
Description	C (30)	Description of sacode entry

Table Indexes

INDEX	TYPE
Sacode	Primary

TABLE: qc_type_vvl - Quality control valid value list for QC_TYPE field in sample_data.dbf
PRIMARY KEY: qc_type

Table Structure

FIELD	TYPE	DESCRIPTION
qc_type	C (10)	Quality control type
Description	C (30)	Description of quality control type

Table Indexes

INDEX	TYPE
qc_type	Primary

TABLE: matrix_vvl - Matrix valid value list for MATRIX field in sample_data.dbf
PRIMARY KEY: matrix

Table Structure

FIELD	TYPE	DESCRIPTION
Matrix	C (4)	Sample matrix
Description	C (25)	Description of sample matrix code

Table Indexes

INDEX	TYPE
Matrix	Primary

TABLE: well_completion
PRIMARY KEY: None

Table Structure

FIELD	TYPE	DESCRIPTION
Location	C (25)	Unique location name
top_casing	N (8,2)	Elevation of top of well casing in vertical datum found in VERT_DATUM in the well table
hole_diameter	N (5,1)	Diameter of the drilled hole in inches *Rule Expression*: hole_diameter>casing_id.AND.hole_diameter>casing_od
scr_aquifer	C (30)	Aquifer name in which the screen resides
screen_material	C (15)	Type of material in which the screen is constructed from
scrn_slot_size	N (5,1)	Screen slot size in thousandths of an inch
scrn_top_depth	N (5,2)	Depth below ground surface to the top of the screen (in feet)
scrn_bot_depth	N(5,2)	Depth below ground surface to the bottom of the screen *Rule Expression*: if(scrn_bot_depth>0,scrn_top_depth<scrn_bot_depth)
scrn_top_elev	N (6,2)	Elevation the top of the screen in vertical datum found in VERT_DATUM in the well table.
scrn_bot_elev	N (6,2)	Elevation the top of the screen in vertical datum found in VERT_DATUM in the well table. *Rule Expression*: if(scrn_bot_elev>0,scrn_top_depth>scrn_bot_depth)
drill_method	C (15)	Drilling method for well installation
Contractor	C (20)	Drilling contractor
casing_material	C (15)	Type of material in which the casing is constructed from
depth_to_seal	N (8,2)	Depth below ground surface to seal (in feet)

seal_material	C (15)	Type of material in which the seal is constructed from
fill_top_depth	N (6,2)	Depth below ground surface to the top of fill material (in feet)
fill_bot_depth	N (6,2)	Depth below ground surface to the bottom of fill material (in feet). *Rule Expression*: if(fill_bot_depth>0,fill_top_depth<scrn_bot_depth)
fill_material	C (20)	Type of material used for fill.
comments	M (4)	Geologist's comments

Table Indexes

INDEX	TYPE
location	Regular

Table Relations:
Relation 1
*RelatedChild location
*RelatedTable well
*RelatedTag location

TABLE: lithology
PRIMARY KEY: None

FIELD	TYPE	DESCRIPTION
location	C (25)	Unique location name
top_lithology	N (6,2)	Depth in feet below ground surface to the top of lithologic unit
bottom_lithology	N (6,2)	Depth in feet below ground surface to the bottom of lithologic unit
uscs_code	C (5)	Unified Soil Classification Service Code for lithology type
blow_counts	C (8)	Number of blow counts recorded on boring log
description	C (80)	Geologist's description of lithology
comments	M (4)	Geologist's comments.

Table Indexes

INDEX	TYPE
location	Regular
uscs_code	Regular

Table Relations:
Relation 1
*RelatedChild location
*RelatedTable well
*RelatedTag location
Relation 2
*RelatedChild uscs_code
*RelatedTable lithology_vvl
*RelatedTag uscs_code

TABLE: lithology_vvl - Lithology valid value list for USCS_CODE field in lithology.dbf
PRIMARY KEY: uscs_code

Table Structure

FIELD	TYPE	DESCRIPTION
uscs_code	C (4)	Unified Soil Classification Service Code for lithology type
descript	C (70)	Description of lithology for given USCS code

Table Indexes

INDEX	TYPE
uscs_code	Primary

TABLE: coll_method_vvl - Collection method valid value list for COLL_METHOD field in sample_data.dbf
PRIMARY KEY: coll_meth

Table Structure

FIELD	TYPE	DESCRIPTION
coll_method	C (10)	Sample collection method

Table Indexes

INDEX	TYPE
coll_method	Primary

TABLE: cas_vvl - CAS number valid value list for CAS field in analytical results.dbf
PRIMARY KEY: cas

Table Structure

FIELD	TYPE	DESCRIPTION
parameter	C (40)	Parameter or chemical name
cas	C (11)	Chemical Abstracts Service Number

Table Indexes

INDEX	TYPE
parameter	Regular
cas	Primary

TABLE: analytic_results
PRIMARY KEY: nfp (nsample+fraction+parameter)

Table Structure

FIELD	TYPE	DESCRIPTION
nsample	C (35)	Unique sample identification
lab_id	C (15)	Laboratory sample identification
laboratory	C (25)	Laboratory name
batch_no	C (10)	Analytical batch number
assoc_blnk	C (15)	Associated blank
extr_date	D (8)	Extraction date
anal_date	D (8)	Analysis date
run_number	I (4)	Sequential analytical run number
sdg	C (15)	Sample delivery group
parameter	C (45)	Parameter or chemical name (using IUPAC nomenclature where appropriate)
cas	C (11)	Chemical Abstracts Service Number
fraction	C (5)	Analtytical fraction
method	C (20)	Analytical method
lab_result	N (20,6)	Analytical result as reported by the laboratory
lab_qual	C (5)	Qualifier as reported by the laboratory
val_res	N (20,6)	Final result (via validation or otherwise)

result	C (20)	Final analytical result with the correct number of significant figures
val_qual	C (3)	Validation qualifer (null if data were not validated)
qual	C (3)	Final qualifer (validation or otherwise)
units	C (5)	Units of measure for the RESULT field
idl	N (15,6)	Instrument detection limit (same units as UNITS field)
mdl	N (15,6)	Method detection limit (same units as UNITS field)
crdl_crql	N (15,6)	Contract required detection/quantitation limit (same units as UNITS field)
dil_factor	N (6,1)	Dilution factor
pct_moist	N (5,1)	Percent moisture
comments	C (20)	Comments from laboratory analyst

Table Indexes

INDEX	TYPE
nfp	Primary
units	Regular
qual	Regular
fraction	Regular
parameter	Regular
nsample	Regular
cas	Regular

Table Relations:

Relation 1
*RelatedChild cas
*RelatedTable cas_vvl
*RelatedTag cas
Relation 2
*RelatedChild units
*RelatedTable units_vvl
*RelatedTag units
Relation 3
*RelatedChild qual
*RelatedTable qual_vvl
*RelatedTag qual
Relation 4
*RelatedChild fraction
*RelatedTable fraction_vvl
*RelatedTag fraction
Relation 5
*RelatedChild parameter
*RelatedTable para_vvl
*RelatedTag para
Relation 6
*RelatedChild nsample
*RelatedTable sample_data
*RelatedTag nsample

TABLE: units_vvl - Units valid value list for UNITS field in analytical_results.dbf
PRIMARY KEY: Units

Table Structure

FIELD	TYPE	DESCRIPTION
Units	C (8)	Units of measure for chemical analysis
Description	C (20)	Description of units

Table Indexes

INDEX	TYPE
Units	Primary

TABLE: qual_vvl
PRIMARY KEY: qual - Qualifier valid value list for QUAL field in analtyic_results.dbf

Table Structure

FIELD	TYPE	DESCRIPTION
Qual	C (5)	Final QA qualifier
Description	C (60)	Definition of qualifier

Table Indexes

INDEX	TYPE
Qual	Primary

TABLE: fraction_vvl - Analytical fraction valid value list for FRACTION field in analytic_results.dbf
PRIMARY KEY: fraction

Table Structure

FIELD	TYPE	DESCRIPTION
Fraction	C (10)	Analytical fraction
Description	C (35)	Description of fraction

Table Indexes

INDEX	TYPE
Fraction	Primary

TABLE: para_vvl
PRIMARY KEY: parameter

Table Structure

FIELD	TYPE	DESCRIPTION
Para	C (60)	Parameter or chemical name
frac_name	C (35)	Analytical fraction for given parameter

Table Indexes

INDEX	TYPE
Para	Primary

TABLE: fluid
PRIMARY KEY: None

Table Structure

FIELD	TYPE	DESCRIPTION
Location	C (25)	Unique location name
Fluid_date	D (8)	Date measurement was taken
meas_elev	N (8,2)	Measuring point elevation
dep_to_water	N (6,2)	Depth below ground surface to water table (in feet)
dep_to_fp	N (6,2)	Depth below ground surface to free product (in feet)
elev_water	N (8,2)	Elevation of water level
elev_fp	N (8,2)	Elevation of free product
prod_thick	N (6,2)	Product thickness in feet

Table Indexes

INDEX	TYPE
location	Regular

Table Relations:
Relation 1
*RelatedChild location
*RelatedTable well
*RelatedTag location

APPENDIX H

ARCVIEW GIS STRUCTURE

ArcView GIS Structure

The NSWC Crane CTO10 ArcView GIS shall have the following directory structure and database table structure.

Part One: Directory Structure

The following table defines the directory structure and major file names/types located within each directory.

Main subdirectory	First tier subdirectories	Second tier subdirectories	Files/Types
p:\gis\project name\	database\		coordinate.dbf cross_reference.dbf res_ gw.dbf res_so.dbf res_sd.dbf res_sw.dbf well_completion.dbf
		criteria\	crit_ gw.dbf crit_so.dbf crit_ sd.dbf crit_sw.dbf crit_des.dbf
	mapping\	aerial\	registered aerial photos
		drg\	USGS Digital Raster Graphic
		image\	GeoStatistic Layers, pictures of sites, equipment, EVS, and all other raster files.
		dwg\	AutoCAD files
		dgn\	Microstation files
		shp\	samp_gw.shp .dbf .shx samp_so.shp .dbf .shx samp_sd.shp .dbf .shx samp_sw.shp .dbf .shx and all other AV shape files
	working\	database\	files used to generate specific drawings will be put under the working subdirectory in subdirectories similar to database & mapping. These will not be included in CD deliverable.
		mapping\	same as above

Part Two: Database Table Structure

The ArcView GIS will contain separate database tables to store analytical, criteria, and coordinate information. The structure of these tables is presented below.

Analyticl Data Table

The following table lists all the fields contained in the analytic database table.

FIELD	VISIBLE	ALIAS	DESCRIPTION
site	Yes	Site or SWMU	Site or SWMU
location	Yes	Location	Unique location name
nsample	Yes	Sample	Unique sample identification
sample	No		Sample identification as designated on Chain-of-Custody
sample_date	Yes	Sample Date	Date in which sample was collected
matrix	Yes	Matrix	Sample matrix
sacode	Yes	Sample Code	Sample code for reference to field duplicates
depth	Yes	Depth	Depth in feet to the middle of the sample interval. Applicable for soil and sediment samples.
top_depth	Yes	Top Depth	Depth in feet to the top of the sample interval. Applicable for soil and sediment samples.
bottom_depth	Yes	Bottom Depth	Depth in feet to the bottom of the sample interval. Applicable for soil and sediment samples. Rule Expression: if(bottom_depth>0,top_depth<=bottom_depth)
parameter	Yes	Parameter	Parameter or chemical name (using IUPAC nomenclature where appropriate)
cas	Yes	CAS	Chemical Abstracts Service Number
fraction	Yes	Fraction	Analytical fraction
val_res	Yes	Numeric Result	Final result (via validation or otherwise)
qual	Yes	Qualifier	Final qualifier (validation or otherwise)
units	Yes	Units	Units of measure for the RESULT field
method	Yes	Method	Analytical method
status	Yes	Status	Status of sample location – Normal or excavated
validated	Yes	Validated	Logical field denoting whether or not data validation was performed on sample
coll_method	Yes	Collection Method	Sample collection method
cto_proj	Yes	CTO	Clean task order (Navy) or project number in which the sample was collected (e.g. "129")
proj_manager	Yes	Project Manager	Internal project manager for which the data was originally generated (e.g. "Hooper, P.").
lab_id	No	Laboratory ID	Laboratory sample identification
laboratory	No	Laboratory	Laboratory name
batch_no	No	Batch Number	Analytical batch number

assoc_blnk	No	Associated Blank	Associated blank
extr_date	No	Extraction Date	Extraction date
anal_date	No	Analysis date	Analysis date
run_number	No	Run Number	Sequential analytical run number
sdg	No	SDG	Sample delivery group
lab_result	No	Result	Analytical result as reported by the laboratory
lab_qual	No	Lab Qualifier	Qualifier as reported by the laboratory
result	No	String Result	Final analytical result with the correct number of significant figures
val_qual	No	Validation Qualifier	Validation qualifier (null if data were not validated)
idl	No	Detection Limit	Instrument detection limit (same units as UNITS field)
mdl	No	Detection Units	Method detection limit (same units as UNITS field)
crdl_crql	No		Contract required detection/quantitation limit (same units as UNITS field)
dil_factor	No	Dilution factor	Dilution factor
pct_moist	No	Percent moisture	Percent moisture
ourresult	No		
qc_type	No		Quality control type
comments	No	Comments	Comments from laboratory analyst

Criteria Table

Each medium will have a criteria table to specify the applicable criteria for all parameters.

FIELD	ALIAS	DESCRIPTION
parameter	Parameter	Parameter or chemical name (using IUPAC nomenclature where appropriate)
epa_mcl	None	Federal MCL – groundwater

Note: usually there will be many criteria fields. This example table only shows the "epa_mcl" criteria field.

Criteria Description Table

This table stores the definition or description of all standards and criteria used in the project. For example, epa_mcl's media would be GW, description would be "Federal Maximum Contaminant Level".

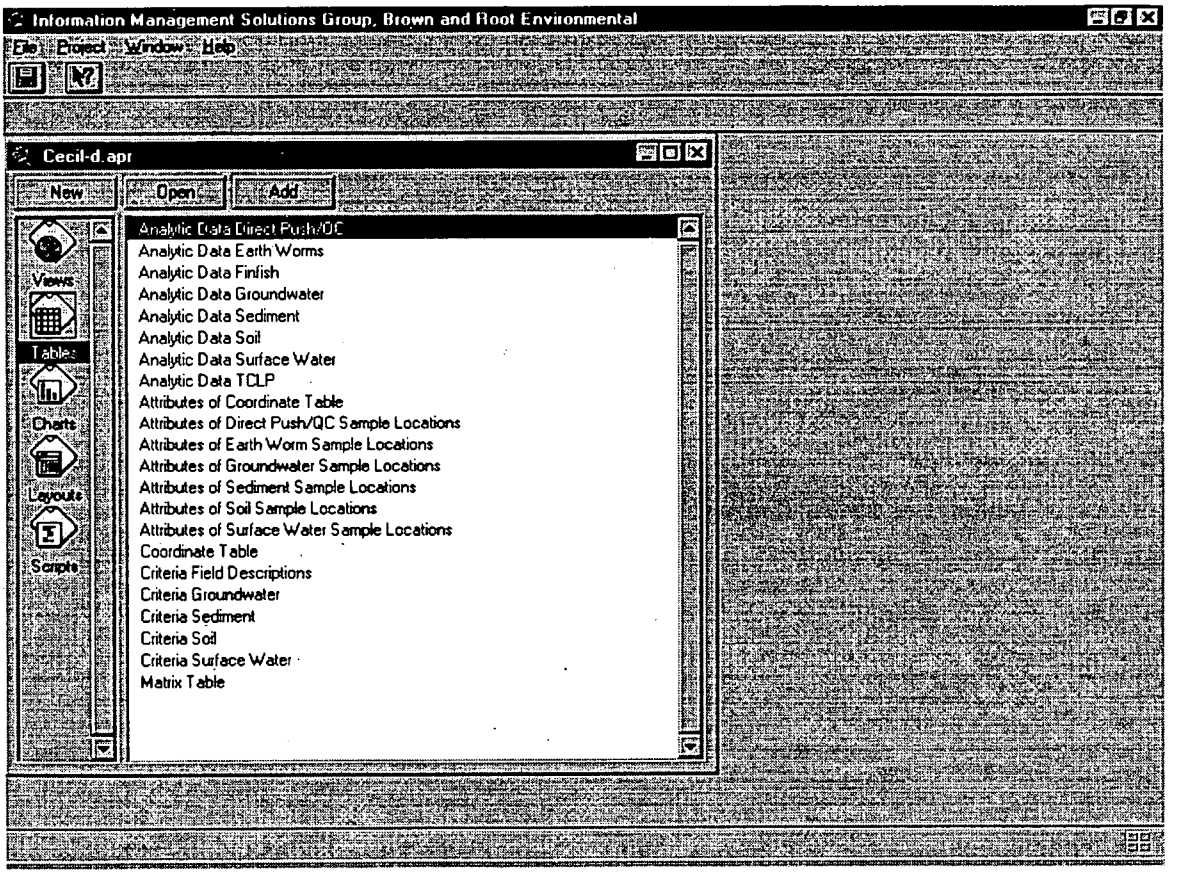
FIELD	Visible	DESCRIPTION
Field	Yes	
Media	Yes	
Descript	Yes	

Coordinate Table

The coordinate table holds all the geographic position information of sampling locations

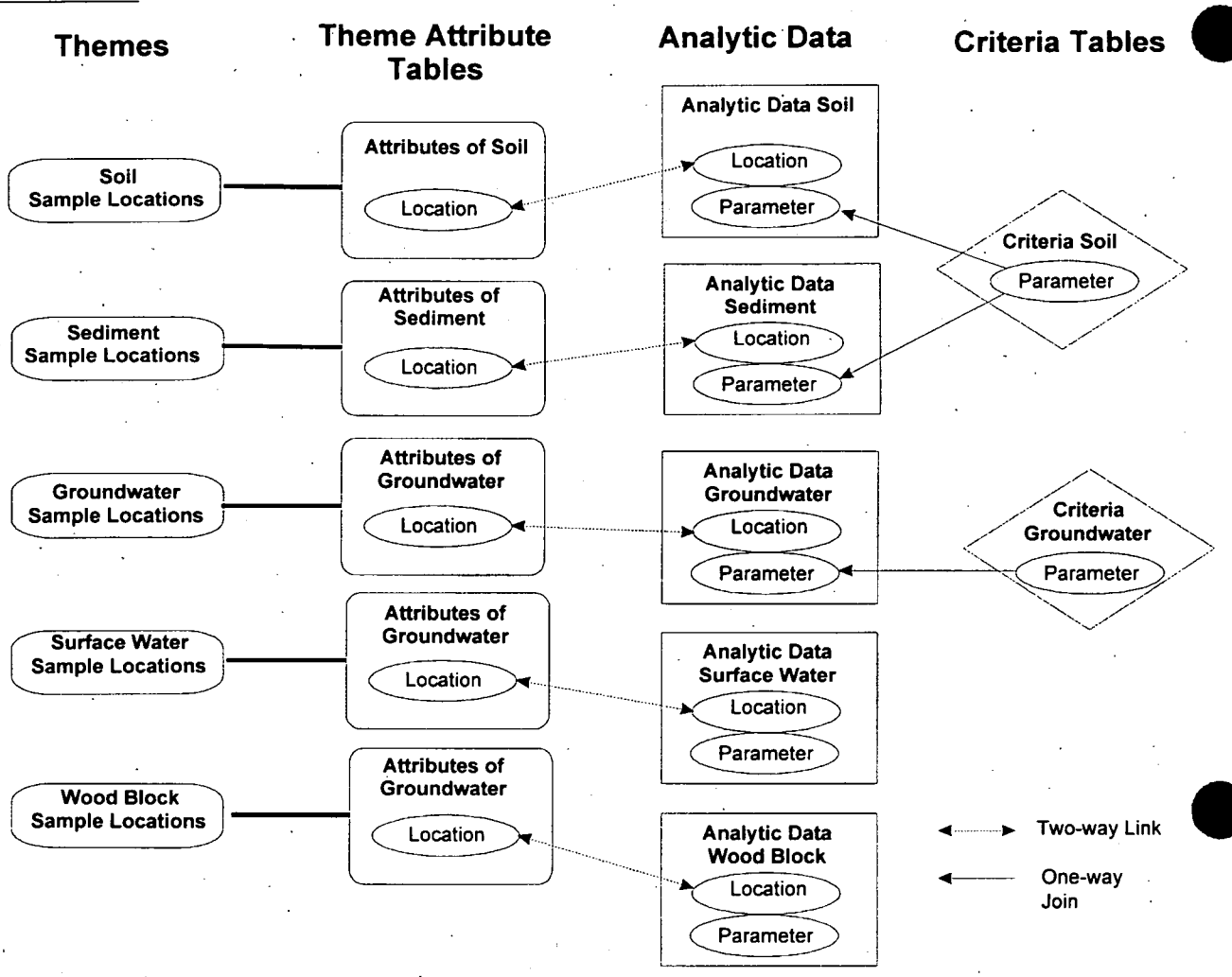
FIELD	Visible	ALIAS	DESCRIPTION
Location	Yes	None	Unique location name.
post_id	Yes	Location Designation	Location name as derived from original source document.
instal_date	No	Installation Date	Date the monitoring well was installed. Null for other location types.
loc_type	Yes	Location Type	Type of location. Example MW, HP, etc.
northing	Yes		Northing coordinate in horizontal datum referenced in the HORIZ_DATUM field.
Easting	Yes		Easting coordinate in horizontal datum referenced in the HORIZ_DATUM field.
Grnd_surf	Yes	Ground Surface Elevation	Ground surface elevation with reference to mean sea level in vertical datum referenced in the VERT_DATUM field
horiz_datum	Yes	Horizontal Datum	Datum in which the horizontal coordinates were derived.
Vert_datum	Yes	Vertical Datum	Datum in which the vertical coordinates were derived.
Datum_state	Yes	Coordinate System	State for which datum was developed
Surveyed	Yes		Logical field denoting whether positional data were surveyed or digitized.
Surveyor	Yes		Company who performed the survey.
Survey_date	No	Survey Date	Date in which survey was performed.
Surv_method	No	Survey Method	Surveying method used.
Longitude	No		Longitude
Latitude	No		Latitude
gw_code	Yes		This will be populated by database personnel. It will be used for event driven theme.
Sd_code	Yes		This will be populated by database personnel. It will be used for event driven theme.
So_code	Yes		This will be populated by database personnel. It will be used for event driven theme.
Sw_code	Yes		This will be populated by database personnel. It will be used for event driven theme.
_nullflags	No		Various fields are put in by database starting here and followed by several fields. Make all of these invisible

Table Links



All sample location theme attribute tables are two-way linked to the corresponding analytical data table. In addition, the analytical data tables are joined to the criteria table. The following diagram illustrates the relationship.

Database Model



APPENDIX I

GEOPHYSICAL SURVEY REPORT

GEOPHYSICAL SURVEY REPORT
SWMU 4 – McCOMISH GORGE
NSWC CRANE, INDIANA

1.0 INTRODUCTION

This report presents the results of the electromagnetic terrain conductivity geophysical survey conducted at Solid Waste Management Unit 4 (SWMU 4), McComish Gorge, at the Naval Surface Warfare Center, Crane Division (NSWC Crane), Crane, Indiana. The geophysical survey was conducted as part of a continuing effort to characterize SWMU 4 by delineating the boundaries of the disposal area. Field work for this geophysical survey was conducted during the period of August 23 through 27, 1999. An electromagnetic induction terrain conductivity survey was conducted, using the Geonics® EM31 terrain conductivity meter. The following sections of this report present the project background, site description, purpose, geophysical approach, data acquisition, data processing and interpretation, and results for the area surveyed. A brief summary of the survey is also included.

2.0 BACKGROUND

NSWC Crane is located within Martin County, Indiana, in the southwestern portion of the state. In 1981, the U. S. Department of the Navy (Navy) initiated the Navy Assessment and Control of Installation Pollutants Program. Program initiation included an investigation for designated sites at NSWC Crane; these investigations were known as the Initial Assessment Study (IAS). The Navy Energy and Environmental Support Agency (NEESA) completed the IAS in 1983, with assistance from the Ordnance Environmental Support Agency and the U.S. Army Corps of Engineers Waterways Experiment Station. The intent of the IAS was to identify and assess sites posing a potential threat to human health and the environment from past hazardous materials operations. Based on the conclusions of the IAS, it was determined that McComish Gorge did not represent an immediate risk to human health and the environment. The IAS recommended that further study be conducted at McComish Gorge, designated as SWMU 4, to evaluate potential long-term impacts to human health and the environment.

Based on requirements of a final Resource Conservation and Recovery Act (RCRA) Part B Permit issued in 1989, RCRA Facility Investigation (RFI) activities were initiated at McComish Gorge. Chemical releases to the environment from past operations conducted at SWMU 4 were identified during RFI activities; this necessitated performance of a human health and ecological risk assessment. In order to characterize potential risks associated with exposure to site media, a geophysical survey (an EM31 terrain conductivity survey) was conducted to delineate the boundaries of SWMU 4, as described in the associated work plan for geophysical investigation (Tetra Tech NUS, Inc. [TtNUS], 1999). Based on the results of the

interpreted boundaries of the disposal area, environmental sampling at McComish Gorge will be completed for risk assessment activities.

3.0 SITE DESCRIPTION

SWMU 4, an approximately 5-acre site, is located in the northwestern corner of NSWC Crane. SWMU 4 is bounded on the north by Culpepper Branch Creek and on the east by roadway HR-140. The southern and western boundaries of the site were not identified prior to the geophysical survey. The site was used from about 1942 to 1972 for disposal of an unknown amount of garbage and debris. Material disposed of at the site may include construction debris, office trash, plaster-filled warheads, metal shavings, and possible small arms ammunition. The site is currently inactive and has become overgrown with trees and brush. A detailed description of the site is included in Section 5.1 of the Work Plan.

4.0 PURPOSE

A geophysical survey was performed to delineate the approximate boundaries of disposal operations at SWMU 4 so that samples for evaluation of human health and ecological risks can be collected from upgradient and site-specific locations. Identification of anomalies, such as buried metallic objects, was a secondary objective of the survey. Placement of soil borings and monitoring wells for risk assessment activities were based on results of the geophysical survey and field observations (surface debris) noted during the geophysical field investigation. The proposed sampling and analysis program for the site is presented in Section 5.5.2 of the Work Plan. Additional sampling may be conducted based on the results of further boundary delineation work, which will be performed during the risk assessment field investigation.

5.0 GEOPHYSICAL APPROACH

Tetra Tech EM Inc. (TtEMI) was contracted by TtNUS to conduct an EM31 terrain conductivity and in-phase geophysical survey at SWMU 4, as described in the associated work plan for geophysical investigation (TtNUS, 1999). Survey lines were designated to be about 100 feet apart in both north-south and east-west orientations. As described in the work plan, data were to be collected continuously at about 1-second intervals, placing fiducials in the records at weigh point for later interpolation of actual data locations. However, it was determined in the field that the continuous survey mode was not feasible. Alternatively, data were collected at 5-foot intervals along the survey lines. Survey limits are shown in Figures I-1 through I-5 of this report.

From August 23 through 25, 1999, vegetation was cleared and 12 north-south and 4 east-west survey lines were established at the site. Vegetation and terrain posed some difficulty for the placement of survey lines within the site. Large trees, steep banks leading out of the disposal area, and thick brush precluded extension of the survey lines in the southern direction. On August 26, 1999, a geophysical survey was conducted at the site. During performance of the survey, it was determined from visual observations and the resulting geophysical data that the expected extent of disposal was significantly smaller than anticipated. For the in-field investigation, a grid-line spacing of 50 feet in the north-south direction and about 50 feet in the east-west direction was implemented. This line spacing was selected based upon in-field observations that incorporated the estimated disposal site dimensions, site conditions, and access for the geophysical equipment and operator.

The survey was conducted using an EM31, which is an electromagnetic induction instrument consisting of a transmitter and a receiver fixed at about a 12-foot separation. A frequency of 9,800 Hertz is transmitted to induce electrical current in the ground. The induced current, in turn, creates secondary fields in the ground, and the receiver coil detects the secondary fields. The intensity and phase of secondary fields are related to electrical properties of materials in the subsurface. The EM31 is designed to directly measure apparent terrain conductivity and the in-phase component of the electromagnetic field. The in-phase component is sensitive to the presence of highly conductive material and is generally considered to be the metal detection mode. Values of apparent terrain conductivity are expressed as milli-siemens per meter (mS/m) and identify differences in soil types. In-phase measurement is expressed in parts per thousand (ppt) and is commonly used to interpret the presence of all types of metal.

6.0 DATA ACQUISITION

A local coordinate grid system was established at SWMU 4 for the geophysical survey. The grid coordinate system was referenced to existing monitoring wells at the site. Survey lines were measured using a compass and tape measure. Pin flags and flagging was placed at 50-foot intervals within the survey area. Several lines were extended during the survey to obtain additional data outside of the disposal area.

Using the EM31 in a reconnaissance mode prior to the geophysical survey, an off-site area south of the disposal site was monitored to obtain background conductivity levels. The EM31 instrument was then checked and adjusted according to the manufacturer's recommendations, including checking the batteries, checking the instrument for zeroing, and adjusting the compensation adjustment, phase adjustment, and in-phase zero. The instrument was again checked and adjusted before the survey, and checked again following the survey, to determine if the instrument had functioned properly. The checks verified that the instrument functioned properly before, during, and following the survey.

Geophysical measurements were collected and stored electronically at a paced interval of 5 feet along survey lines established at the site. When necessary, operator adjustments were made at each flagged interval. These adjustments were generally minimal (less than 5 feet). The continuous reading mode was not used, because it was impossible to maintain a constant pace between survey marker weigh points.

7.0 DATA PROCESSING AND INTERPRETATION

Data from the geophysical datalogger were downloaded to a computer and entered into the Geonics DAT31® software package to ensure accuracy and completeness and to check operator entry errors from the field data collection process. Each data set was then entered into SURFER® or Geosoft Oasis Montaj® data processing software for visual display. Contour maps of each data set, including EM31 terrain conductivity and in-phase data, were displayed on a computer screen and printed for interpretation. Preliminary contour maps were examined in the field to identify existing surface features that could cause anomalous geophysical data.

A sketch map, which documents visual field observations, was generated in the field from preliminary maps of the geophysical data. Wellheads, metal debris, visual indications of the extent of the disposal area and other site features were marked on the map for later use in geophysical data interpretation. Anomalous trends in geophysical data that were suspected to exist, such as subsurface metallic or trench features, were marked on the sketch map to be incorporated into this geophysical report. Results of the geophysical surveys are discussed in the remainder of this report.

8.0 GEOPHYSICAL RESULTS

This section discusses the results of the geophysical survey at SWMU 4. Several figures are presented to aid in the interpretation of the site boundaries and document the results of the geophysical survey. These figures include (1) a contour of apparent terrain conductivity (Figure I-1); (2) a contour of in-phase measurements (Figure I-2); (3) an interpretation of the limits of the disposal area (Figure I-3); (4) a profile of apparent terrain conductivity (Figure I-4); and (5) a profile of in-phase measurements (Figure I-5). All figures are presented at a scale of 1 inch equal to 100 feet.

Data contouring was determined to provide the best presentation of the EM31 results for this geophysical report. All data presentations were processed using Geosoft Oasis Montaj® software. The use of the contoured data, in conjunction with raw line data and field observations, provide the basis for interpretation of disposal boundaries and the presence of metallic objects.

Background apparent conductivity values were measured at about 3 to 9 mS/m and are represented by the yellow color on Figures I-1 and I-2. As previously noted, the in-phase measurement was adjusted to zero at a nearby, off-site location. Areas of the site which exhibit elevated or negative conductivity values are used to define the limits of the disposal area (i.e., values that may be attributable to disposal activities). The values potentially attributable to disposal activities are represented by green and blue (negative values) and red and pink (elevated positive values) colors on the Figures I-1 and I-2. Elevated positive (greater than 9.0 mS/m) or negative (less than –1.0 mS/m) conductivity values on Figure I-1 were generally interpreted as areas of potentially disturbed soil, where disposal activities may have occurred. On Figure I-2, elevated positive (greater than 0.7 ppt) or negative (less than –1.7 ppt) in-phase values were generally interpreted to indicate that metallic objects are likely present.

Some aspects of the contouring software map may show contour intervals outside the data collection area, as seen in Figures I-1 and I-2. Because a large grid search radius was selected to fill grid cells between survey lines, the software caused color contour cells to be created outside of the actual data (i.e., survey limits). This is particularly evident on the edges of the survey data. In addition, in order to illustrate anomalous regions within the survey area, a detailed contour interval was used. The use of the detailed interval resulted in highlighting the aforementioned, adverse software effects along the edges of the survey. An example of these occurrences are present in the southern portion of the survey area, where extremely negative in-phase and apparent conductivity measurements are caused by surface metal (see Figures I-1 and I-2). The selected grid cell size and extension causes the color contour grid to extend outside of the actual measurement area.

As a secondary visualization of the data used to aid in interpreting the contouring effects along the edges of the survey, profile maps of the apparent conductivity and in-phase data were constructed using data collected along the north-south survey lines. The profile maps are presented as Figures I-4 (apparent conductivity) and I-5 (in-phase data). From these figures, the anomalous areas in the northern and southern portion of the survey area are interpreted to represent background values at the edges of the survey line, where the anomalies are observed in Figures I-1 and I-2. The presence of the negative values on the profile maps may correspond to the edge of the disposal area.

Field observations sketched onto the preliminary geophysical data contour maps were also used to support the interpreted extent of the disposal area. These features include the presence of a bermed area surrounding the disposal area, observed topographic features outside of the disposal area, the presence of large trees south of the disposal area, and actual surface debris. The steep slope present in the southern portion of the site, near the edge of the survey line, could not be surveyed because of the terrain. The presence of the steep slope, which is not likely to be man-made, may support preliminary conclusions derived from interpretations of the profile map that disposal activities do not extent further south of the

survey limits. However, further boundary delineation work will be needed to make sure that the southern boundary of the site has been defined.

The results of the geophysical survey indicate that the extent of the disposal area is about 600 feet in the east-west direction and about 160 feet in the north-south direction. The interpreted extent of the disposal area is illustrated in Figure I-3. The northern, western, and eastern boundaries of the site are considered to be adequately defined. Based on field observations, the disposal area is not likely present east of Roadway HR-140. However, further work to define the southern boundary of the site is necessary; this work will be completed during the risk assessment field investigation.

The highest concentrations of buried metallic debris are within the central and eastern portion of the survey area. This corresponds to the red and pink areas illustrated in Figure I-2. The broadest extent of high apparent conductivity (values greater than about 12 mS/m) is also within this region, as evidenced by the red and pink areas shown in Figure I-1. Several areas containing metallic debris were exposed in the field and are noted on Figure I-3. Exposed drums were found in two areas of the site; a third area of surface debris contained small metallic cylinders (about 4 inches in diameter by 6 inches in length). Similar metallic cylinders and/or debris are likely buried in the region north and east of Well 04/02, as evidenced by the blue color on Figure I-2. The contents of the metallic cylinders and drums are not known.

9.0 SUMMARY

A geophysical survey was performed at SWMU 4, NSWC Crane, Indiana to delineate the boundaries of the disposal area and to identify the extent of buried metallic objects. Vegetation was cleared at the site and surveyed lines were established for the geophysical survey. Geophysical results indicate that the extent of the disposal area is approximately 600 feet in the east-west direction by approximately 160 feet in the north-south direction. The estimated limits of disposal are presented in Figures I-1 through I-5. Based on field observations, the disposal area does not extend east of Roadway HR-140. However, it is not certain whether the southern boundary of the site has been adequately defined. Further boundary delineation work will be completed during the risk assessment field investigation. Surface debris (drums and cylinders) was observed in three specific areas of the site, as noted on Figure I-3.

10.0 REFERENCES

TtNUS (Tetra Tech NUS, Inc.), 1999. Work Plan for Geophysical Investigation at SWMU 4, McComish Gorge, Naval Surface Warfare Center, Crane Division, Crane, Indiana. Pittsburgh, Pennsylvania. July.

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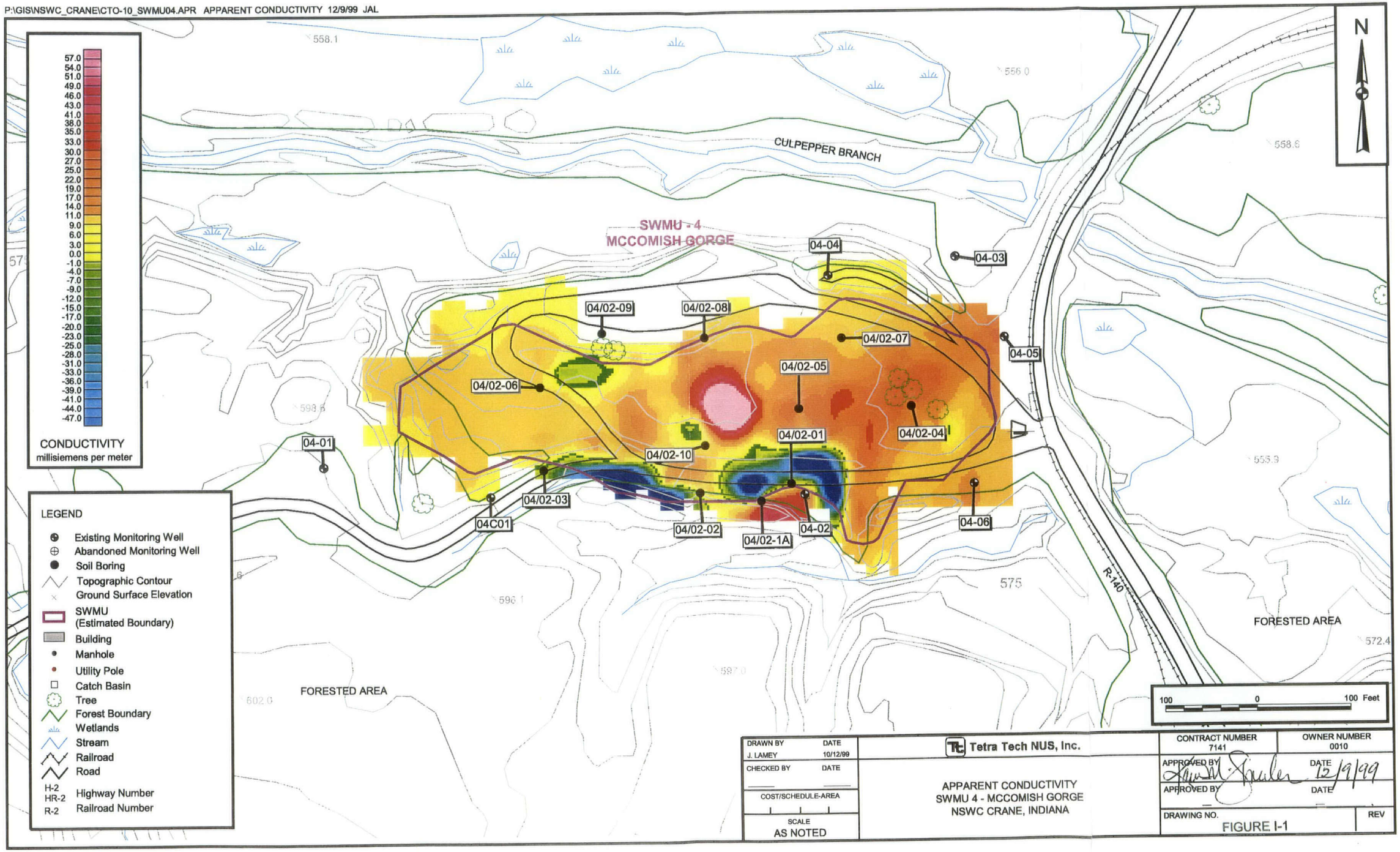

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COST/SCHEDULE-AREA			APPROVED BY / DATE
SCALE AS NOTED			DRAWING NO. FIGURE I-1 / REV

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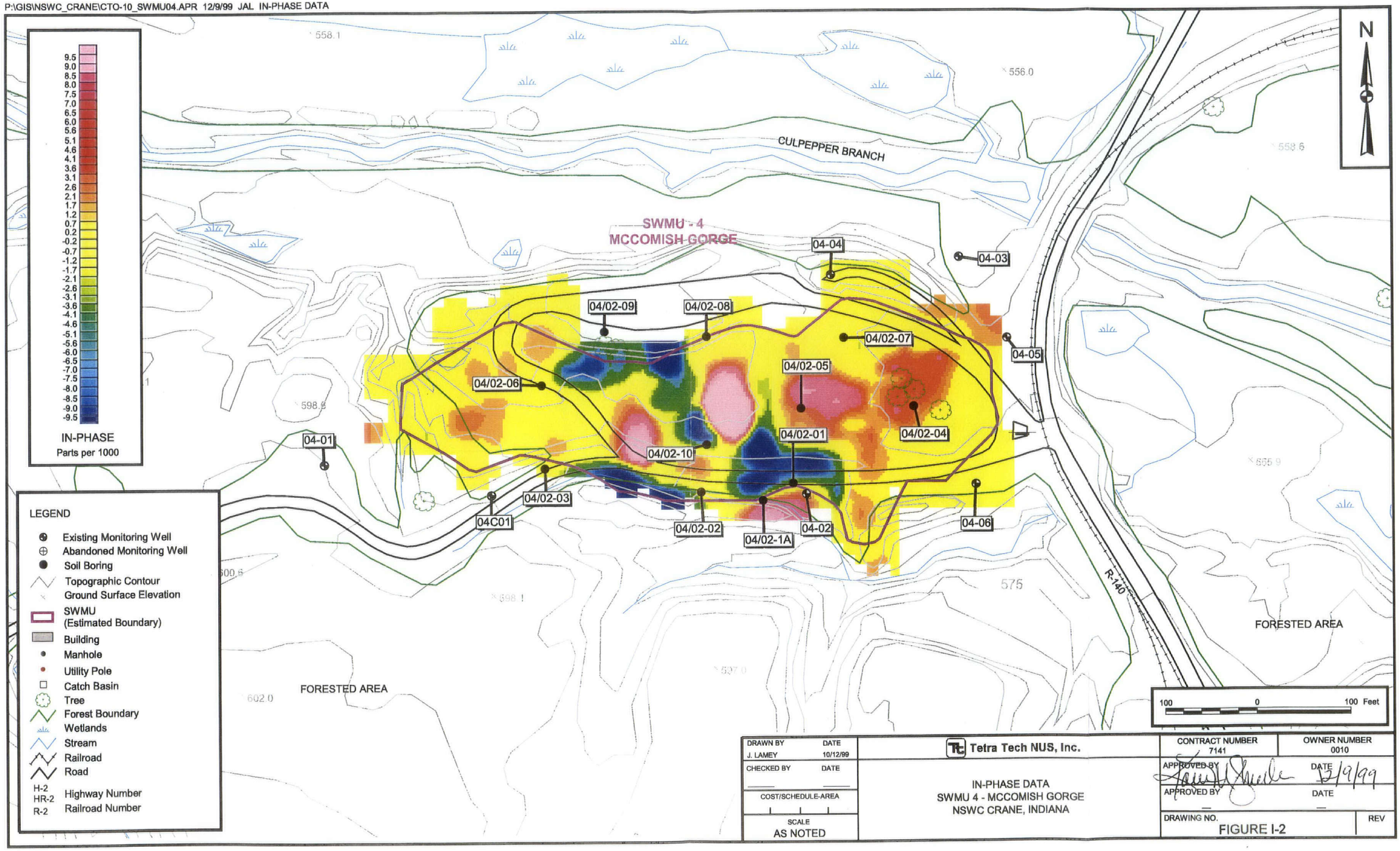

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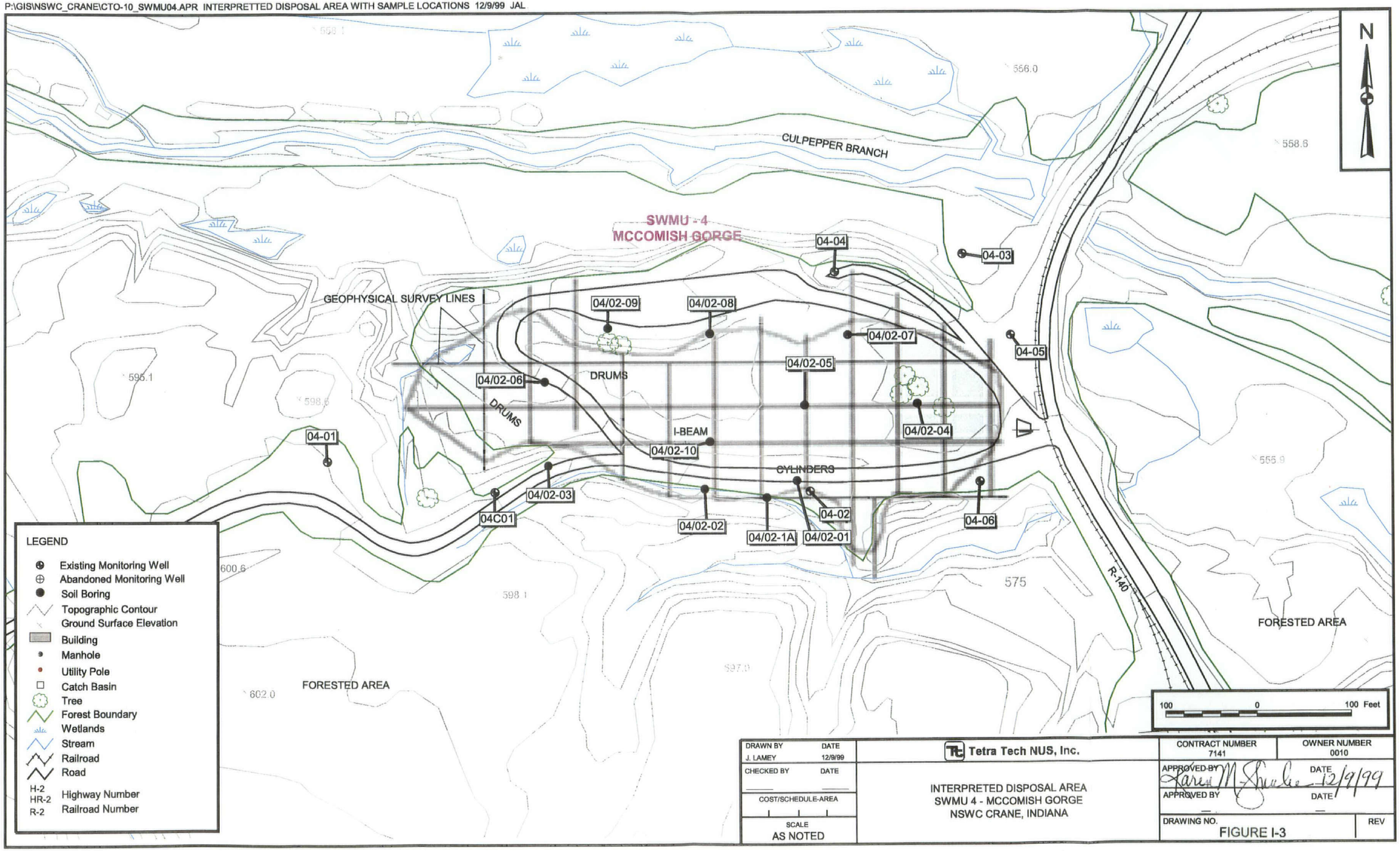

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COST/SCHEDULE-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE I-3 / REV

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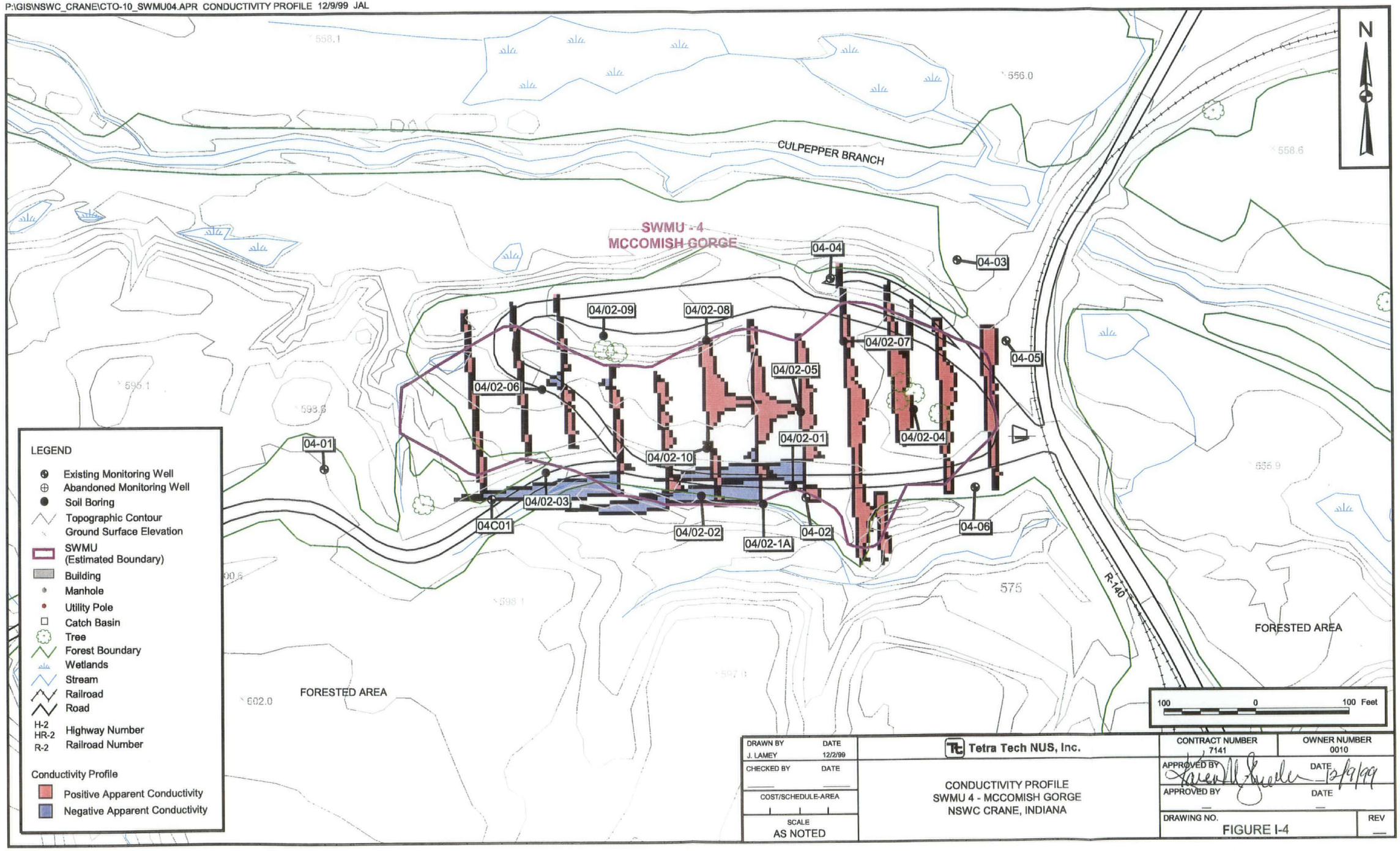

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COST/SCHEDULE-AREA			APPROVED BY / DATE
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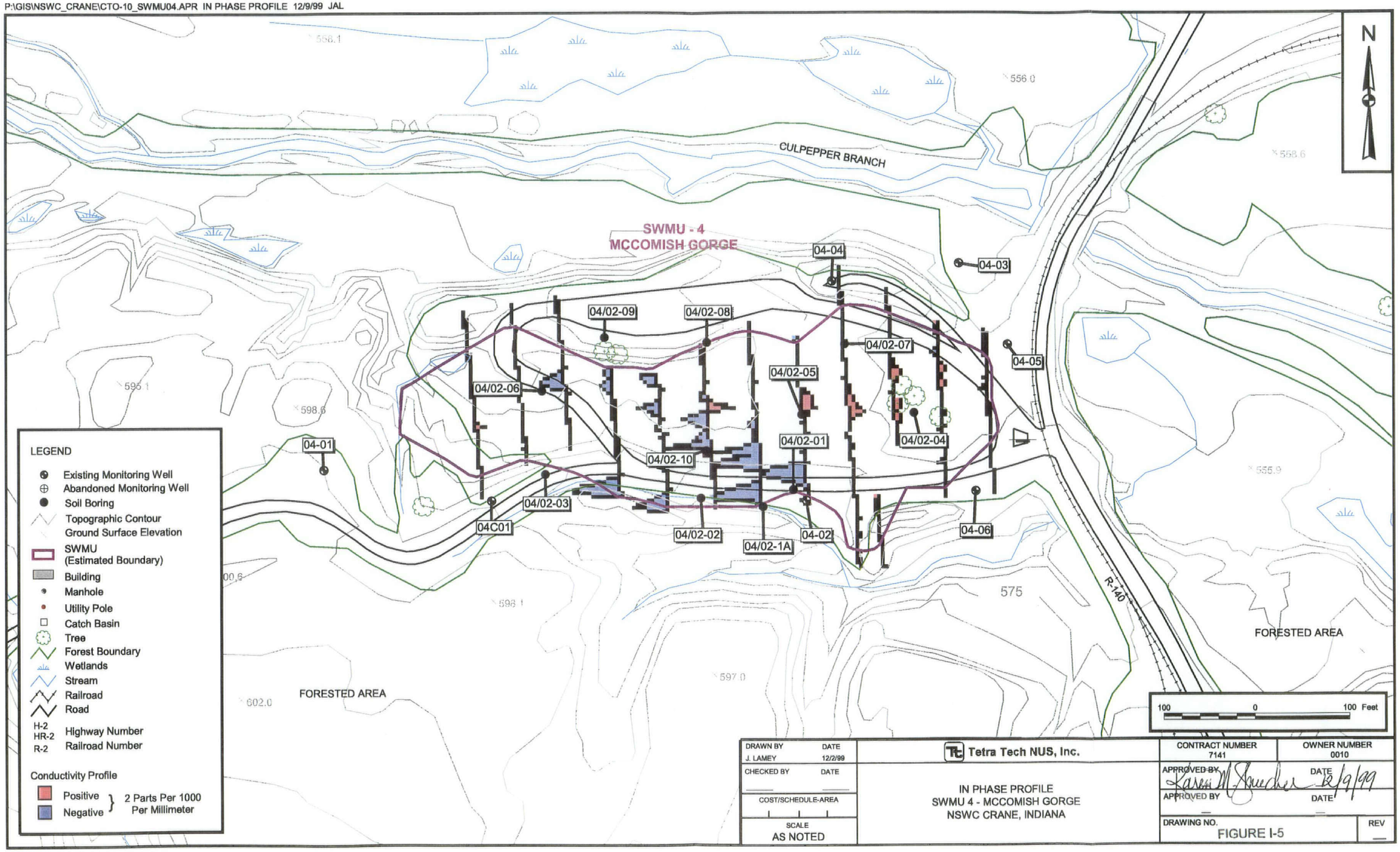

Tetra Tech EM Inc.

Technical Memorandum

To: Ralph Basinski

From: Raye Lahti, P.G. Geophysicist

Date: March 6, 2001

Re: Geophysical Surveys, SWMU 4, NSWC Crane, Indiana

General Discussion

Geophysical surveys were conducted during December 2000 at Naval Surface Weapons Center, Crane, Indiana, Solid Waste Management Unit 4 (SWMU 4) located at McComish Gorge. The field work required 2 days to re-establish local grid coordinates and expand the survey area toward the south and east. The purpose of the surveys were to further delineate anomalous areas adjacent to and south of Jeep Trail 1 that were not fully defined during an EM31 terrain conductivity survey conducted in 1999. The main area of the SWMU had been cleared of vegetation, while the perimeter areas contain trees, brush and hilly terrain. Minor brush cutting and geophysical survey line preparations were the most time consuming portion of the field effort. Survey lines were cut using a brush axe and survey locations were positioned using a compass and tape measure. Plastic pin flags were marked with local coordinates, and placed at 50-foot intervals for position control of the geophysical data. Geophysical surveys were conducted using two geophysical techniques, the Geonics EM31 terrain conductivity meter, and the Geometrics cesium vapor magnetometer.

Geonics EM31

The Geonics EM31 terrain conductivity meter is an electromagnetic instrument containing a transmitter and a receiver mounted on opposite ends of a boom that is about 12 feet long. The instrument is carried along survey lines by a field technician while recording geophysical measurements and associated locations. The EM31 transmitter generates an electromagnetic field in the ground. A secondary electromagnetic field is detected by the receiver. The received measurements are directly proportional to apparent ground conductivity. The unit of measure for apparent conductivity is the milli-Siemen per meter. Terrain conductivity surveys are often useful in determining the presence of buried trenches or disturbed ground associated with land filling

activities. Disturbance of the ground from excavations usually alters the local ground conductivity. These variations can be measured with the EM31. Increased conductivity values above background may indicate ground disturbance or the presence of non-metallic debris. Negative conductivity measurements or values below background may indicate subsurface metal. The EM31 provides a second measurement called the in-phase component of the electromagnetic field, otherwise known as the metal - detection mode. The in-phase component is sensitive to the presence of highly conductive materials such as metal. The unit of measure is parts per thousand. The in-phase measurement is usually near zero when soil conductivity variations are low (variations of less than 10-20 percent of background). Significant changes in measured EM31 in-phase response, either positive or negative, usually indicate the location of metal, or major changes in ground conductivity.

Geometrics 858 Magnetic Gradiometer

A magnetic gradiometer survey was also conducted at SWMU 4 using a Geometrics 858 cesium vapor magnetic gradiometer. This system is used for the detection of ferrous metallic objects. A magnetic gradiometer measures the earth's magnetic field using 2 sensors mounted vertically or horizontally, 0.5 to 1 meter apart. The difference in these two simultaneous measurements is called the magnetic gradient. The unit of measure for the magnetic field of one sensor is the nano-Tesla, while the measured difference calculated between 2 sensors is the nano-Tesla per meter. The instrument is carried along survey lines by an operator on a non-magnetic pole. Data are recorded electronically along with the location of measurement. Iron or ferrous objects cause local changes in the earth's magnetic field. These changes can be sensed by a magnetic gradiometer depending upon the size and distance the ferrous object is from the sensors. For example, a 100 pound piece of ferrous metal may be sensed about 20-30 feet from the sensor, and a 5-pound piece of ferrous metal may only be sensed several feet from the sensor. A departure from the background values of measured vertical magnetic gradient likely indicates the presence of ferrous metallic objects, but can also be caused by variations in the amount of magnetic minerals in the soil or bedrock.

Data Processing

The data from both geophysical instruments were stored on data logging devices, downloaded to a computer, translated to NWSC Crane coordinates and processed using geophysical mapping software to create color intensity anomaly maps and interpretation maps.

SWMU 4 Results

The following discussion provides the findings of the geophysical surveys. Four figures, 5-8A, 5-8B, 5-8C, and 5-8D were developed and forwarded in a letter dated January 15, 2001 for inclusion in the Work Plan for Risk Assessment at SWMUS 4, 5, 9, and 10, August 2000. Figure 5-8A includes proposed sample locations superimposed on the apparent conductivity anomalies. Figure 5-8B shows apparent conductivity anomalies. Figures 5-8C and 5-8D show in–phase data and vertical magnetic gradient, respectively. These figures indicate the interpreted limit of subsurface anomalies from the geophysical survey parameters measured at SWMU 4. Four new sample locations were identified and are marked on Figure 5-8A (04SB09 through 04SB12).

The SWMU 4, McComish Gorge area was previously surveyed during 1999 using a Geonics EM31 terrain conductivity meter. The survey area was expanded to about 300 by 500 feet in size. The site was prepared for geophysical surveys with an average line separation of 50 feet. Lines were measured off of a base line oriented nearly east-west, and tied into wells 04-02 and 04-06. A local grid coordinate system was established. Following the field survey, the geophysical data were converted to the NSWC Crane coordinate system. Lines were measured using a standard surveying tape. Pin flags were placed along each line at 50-foot intervals. The Figures show colored geophysical anomalies, and the interpreted extent of subsurface anomalies that likely define the extent of concentrated disposal activities. Figure 5-8A indicates the location of 4 proposed subsurface sample locations.

Two proposed sample locations are located near Jeep Trail 1 (04SB09 and 04SB10), a third is located in the southeastern portion of the survey area near a surface water drainage (04SB11), and the fourth sample location is outside of the north central portion of the geophysical survey (04SB12). Each proposed sample location is associated with anomalies detected by all geophysical survey

parameters, apparent conductivity, EM31 in-phase, and vertical magnetic gradient. However, the sample location on the north central edge (04SB12) is associated solely with an EM31 in-phase anomaly that is not completely defined. The purpose of this sample location is to provide information to define the northern limit of the SWMU 4 site.

Summary

Two geophysical surveys were conducted at SWMU 4, McComish Gorge in December 2000. The objective of the surveys was to delineate the extent of anomalies on the south side of Jeep Trail 1. This was accomplished, resulting in the discovery of one additional anomalous area in the southwestern portion of the site, which was investigated with the installation of soil boring 04SB09. The closure of anomalies in the south central and southeastern portion of the site, was achieved with the installation of soil borings 04SB10 and 04SB11, respectively. An additional anomaly was considered suspect in the north central portion of the SWMU 4 geophysical survey area, and soil boring 04SB12 was placed north of the extent of geophysical data to investigate this location. The location of the extent of interpreted subsurface anomalies and the proposed sample locations are shown on Figures 5-8A through 5-8D.

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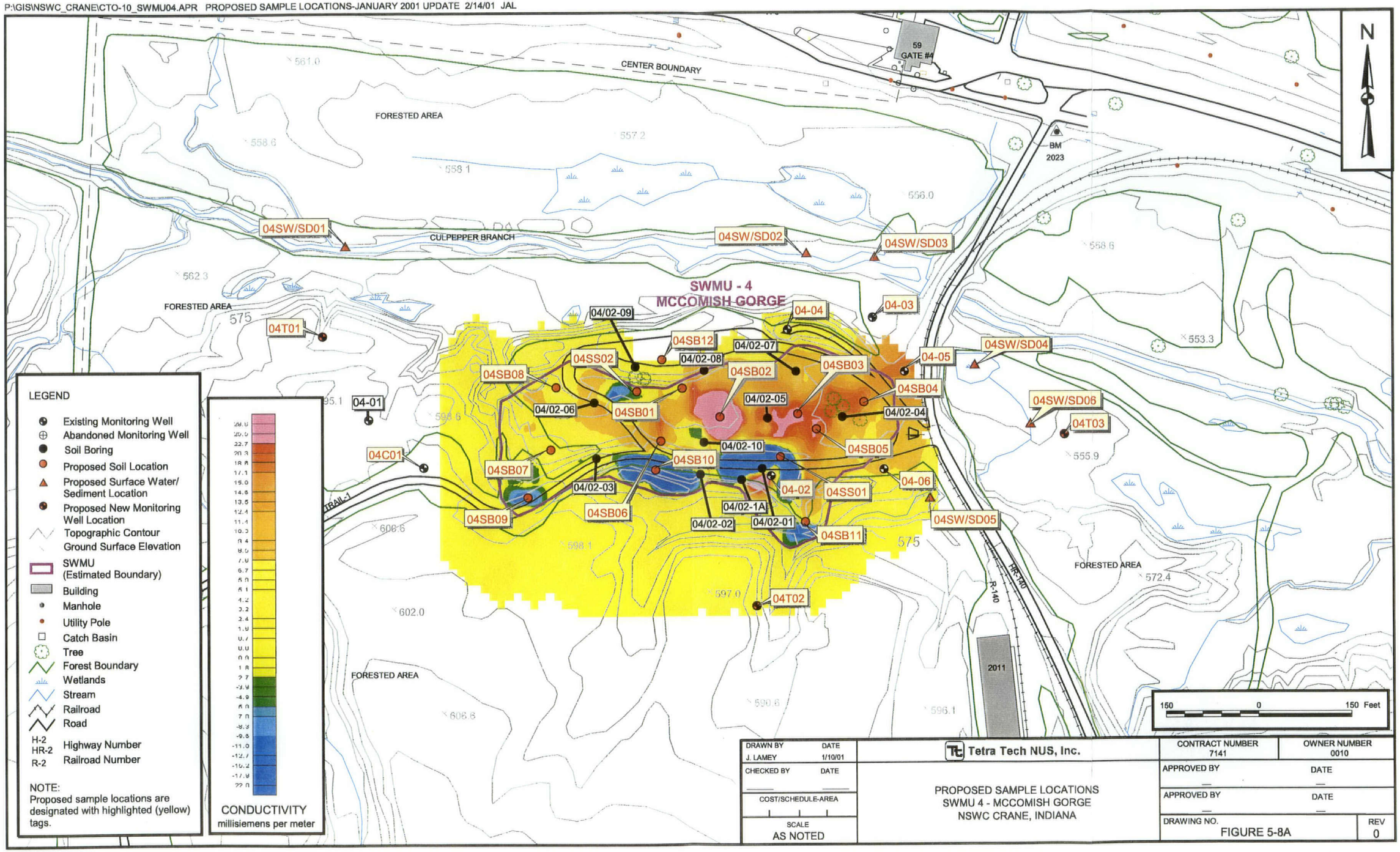

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COST/SCHEDULE-AREA			DRAWING NO. FIGURE 5-8A	REV 0
SCALE AS NOTED				

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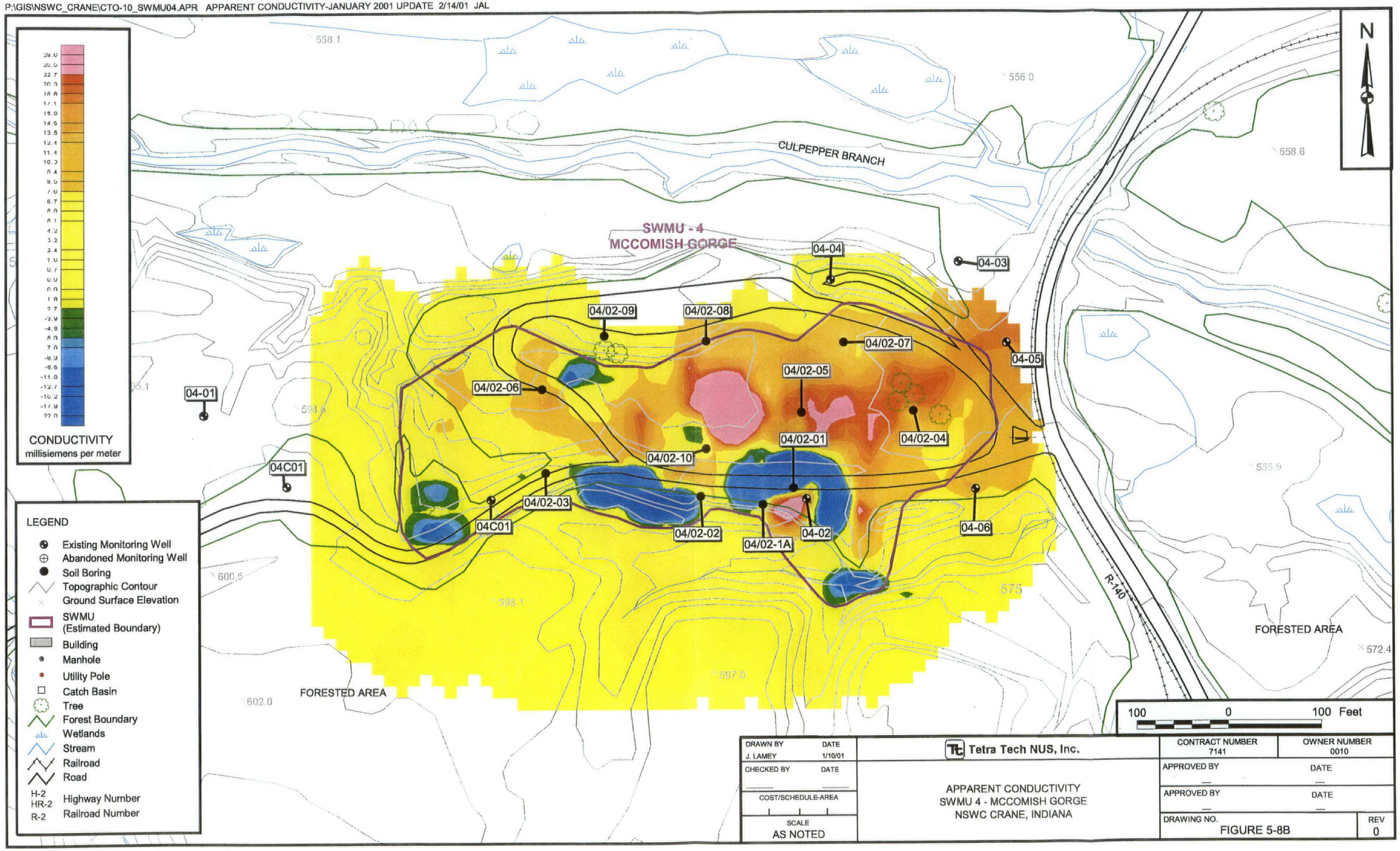
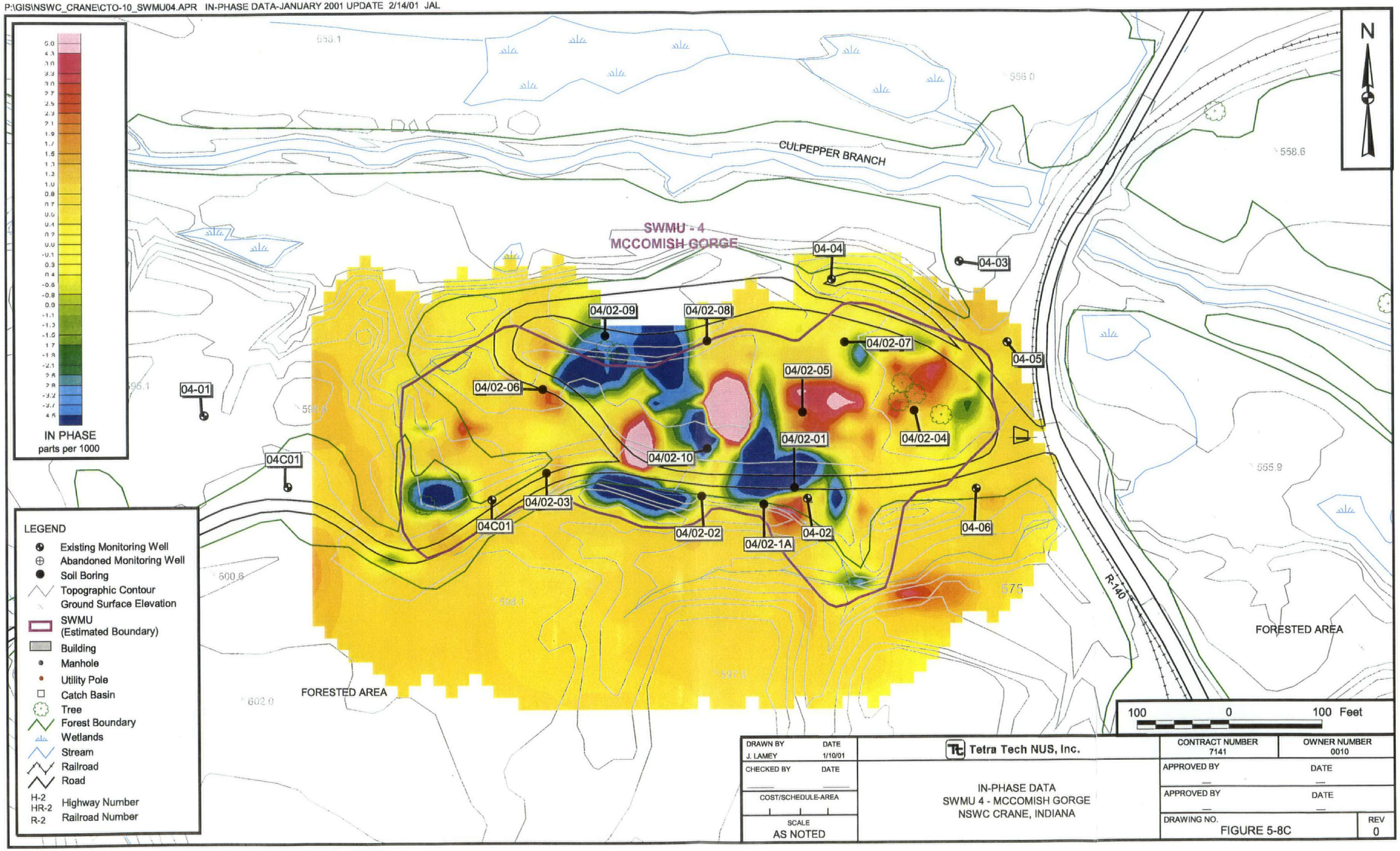


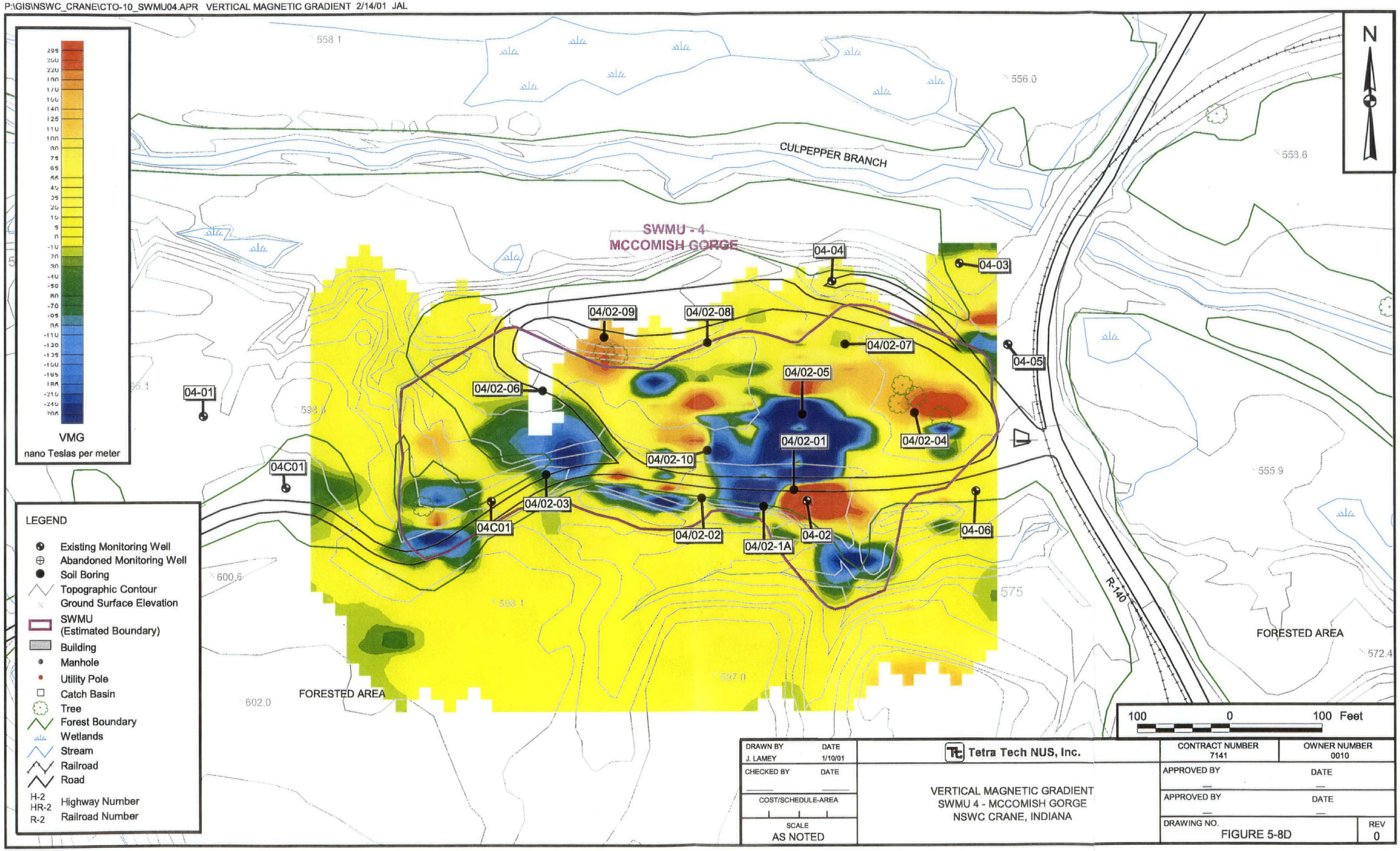
DRAWN BY J. LAMEY	DATE 1/10/01	Tetra Tech NUS, Inc.	CONTRACT NUMBER 7141 / OWNER NUMBER 0010
CHECKED BY	DATE	APPARENT CONDUCTIVITY SWMU 4 - MCCOMISH GORGE NSWC CRANE, INDIANA	APPROVED BY / DATE
COST/SCHEDULE-AREA			APPROVED BY / DATE
SCALE AS NOTED			DRAWING NO. FIGURE 5-8B / REV 0

P:\GIS\NSWC_CRANE\CTO-10_SWMU04.APR IN-PHASE DATA-JANUARY 2001 UPDATE 2/14/01 JAL



DRAWN BY J. LAMEY	DATE 1/10/01	Tetra Tech NUS, Inc.	CONTRACT NUMBER 7141 / OWNER NUMBER 0010
CHECKED BY	DATE	IN-PHASE DATA SWMU 4 - MCCOMISH GORGE NSWC CRANE, INDIANA	APPROVED BY / DATE
COST/SCHEDULE-AREA			APPROVED BY / DATE
SCALE AS NOTED			DRAWING NO. FIGURE 5-8C / REV 0

P:\GIS\NSWC_CRANE\CTO-10_SWMU04.APR VERTICAL MAGNETIC GRADIENT 2/14/01 JAL



DRAWN BY	DATE	Tetra Tech NUS, Inc.	CONTRACT NUMBER	OWNER NUMBER
J. LAMEY	1/10/01		7141	0010
CHECKED BY	DATE	VERTICAL MAGNETIC GRADIENT SWMU 4 - MCCOMISH GORGE NSWC CRANE, INDIANA	APPROVED BY	DATE
			APPROVED BY	DATE
COST/SCHEDULE-AREA			DRAWING NO. FIGURE 5-8D	REV 0
SCALE AS NOTED				