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QUALITY ASSURANCE PROJECT PLAN/SAMPLING AND ANALYSIS PLAN FOR MUNITIONS RESPONSE PROGRAM RANGES VOLUME I AND II NS GREAT LAKES IL
3/1/2010
TETRA TECH

298

Quality Assurance Project Plan/ Sampling and Analysis Plan

for

Munitions Response Program Ranges
Volume I of II

Naval Station Great Lakes
Great Lakes, Illinois

Naval Facilities Engineering Command
Midwest

Naval Facilities Engineering Command Midwest

Contract Number N62472-03-D-0057

Contract Task Order F274

March 2010

SAP WORKSHEET #1 – TITLE AND APPROVAL PAGE

(UFP-QAPP Manual Section 2.1)

QUALITY ASSURANCE PROJECT PLAN/ SAMPLING AND ANALYSIS PLAN FOR SITE INSPECTIONS AT MUNITION RESPONSE PROGRAM RANGES NAVAL STATION GREAT LAKES GREAT LAKES, ILLINOIS

Volume I of II - Munitions Constituents Plan

March 2010

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Comprehensive Long-Term Environmental Action Navy
CLEAN Contract Number N62472-03-D-0057
Contract Task Order F274

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ACRONYMS

AA	Anti-Aircraft
bgs	Below Ground Surface
BL&P	Blind Loaded and Plugged
BTU	British Thermal Unit
C	Celsius
CA	Corrective Action
CCB	Continuing Calibration Blank
CCC	Calibration Check Compounds
CCV	Continuing Calibration Verification
CD	Compact Disc
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
CSM	Conceptual Site Model
CTO	Contract Task Order
°	Degree
%D	Percent Difference or Percent Drift
DDESB	Department of Defense Explosive Safety Board
DFTPP	Decafluorotriphenylphosphine
DI	Dark Ignition
DMM	Discarded Military Munitions
DoD	Department of Defense
DoE	Department of Energy
DPT	Direct Push Technology
DQI	Data Quality Indicator
DQO	Data Quality Objective
DVM	Data Validation Manager
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Accreditation Program
EPA	Environmental Protection Agency
F	Fahrenheit
FD	Field Duplicate

FOL	Field Operations Leader
FTMR	Field Task Modification Request
GC/MS	Gas Chromatograph/Mass Spectrometer
GIS	Geographic Information System
GPS	Global Positioning System
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HPLC	High Performance Liquid Chromatography
HDOP	Horizontal Dilution of Precision
HE	High Explosive
HEI	High Explosive Incendiary
HEIT-SD	High Explosive Incendiary Tracer – Self Destruct
HET	High Explosive Tracer
HET-SD	High Explosive Tracer – Self Destruct
HSM	Health and Safety Manager
ICAL	Initial Calibration
ICB	Initial Calibration Blank
ICP-AES	Inductively Coupled Plasma - Atomic Emissions Spectrometer
ICV	Initial Calibration Verification
IDQTF	Intergovernmental Data Quality Task Force
IDW	Investigation-Derived Waste
INRMP	Integrated Natural Resources Management Plan
IS	Internal Standard
ITRC	Interstate Technology and Regulatory Council
LANT	Mid-Atlantic
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LIMS	Laboratory Information Management Systems
LOD	Limit of Detection
LOQ	Limit of Quantitation
MC	Munitions Constituents
MDL	Method Detection Limit
MEC	Munitions and Explosives of Concern
mg/kg	Milligrams/Kilogram
mm	Millimeter

MPC	Measurement Performance Criteria
MRP	Munitions Response Program
MRS	Munitions Response Site
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NA	Not Applicable
NAVFAC	Naval Facilities Engineering Command
NAVSTA	Naval Station
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFA	No Further Action
NG	Nitroglycerin
NIST	National Institute of Standards and Technology
NOSSA	Naval Ordnance Safety and Security Activity
NSGL	Naval Station Great Lakes
NTC	Navy Training Center
OLS	Ordinary least Squares
OMOE	Ontario Ministry of Environment
OSHA	Occupational Safety and Health Administration
PA	Preliminary Assessment
PAH	Polycyclic Aromatic Hydrocarbon
PAL	Project Action Limit
PCB	Polychlorinated Biphenyl
PETN	Pentaerythritol Tetranitrate
PM	Project Manager
POC	Point of Contact
PPE	Personal Protective Equipment
ppm	Parts Per Million
QA	Quality Assurance
QAM	Quality Assurance Manager
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
QSM	Quality Systems Manual
RCRA	Resource Conservation and Recovery Act
%R	Percent Recovery
RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine

RF	Response Factor
RI	Remedial Investigation
RPD	Relative Percent Difference
RPM	Remedial Project Manager
RSD	Relative Standard Deviation
RSL	Regional Screening Level
R-RSL	Residential – Regional Screening Level
RV	Recreational Vehicle
SAP	Sampling and Analysis Plan
SDG	Sample Delivery Group
SDZ	Safety Danger Zone
SI	Site Inspection
SIM	Selected Ion Monitoring
SOP	Standard Operating Procedure
SPCC	System Performance Check Compound
SQL	Structured Query Language
SSC	Service School Command
SSO	Site Safety Officer
TACO	Tiered Approach to Corrective Action Objectives
TBD	To Be Determined
TCLP	Toxicity Characteristic Leaching Procedure
Tetra Tech	Tetra Tech NUS, Inc.
Tetryl	N-methyl-N-2,4,6-tetranitroaniline
TNT	Trinitrotoluene
TOC	Total Organic Carbon
TP	Technical Paper
TSA	Trap, Skeet, and Archery
UFP	Uniform Federal Policy
USEPA	United States Environmental Protection Agency
U.S.	United States
UV	Ultraviolet
UXO	Unexploded Ordnance
WAMS	Water Area Munitions Study
XRF	X-ray Fluorescence Spectrometer

EXECUTIVE SUMMARY

Tetra Tech NUS, Inc. (Tetra Tech) has prepared this Uniform Federal Policy Sampling and Analysis Plan (UFP-SAP) under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract No. N62472-03-D-0057, Contract Task Order (CTO) F274. This plan has been prepared for a Site Inspection (SI) for Munitions Constituents (MC) under the Munitions Response Program (MRP) at four Munitions Response Sites (MRSs) located at Naval Station Great Lakes (NSGL), Great Lakes, Illinois. The MRP sites included in the scope of this SI are the former Trap, Skeet, and Archery (TSA) Ranges; the former Pistol Butts; the former Machine Gun Range; and the former Naval Training Center (NTC) Lakefront anti-aircraft (AA) Range (NTC Lakefront). Figure ES-1 presents a Site Location Map depicting the location of the four MRSs on the NSGL installation. The MRSs are described briefly below.

The U.S. Department of Navy (Navy) has conducted various testing and training activities involving military munitions at the MRSs. Because of these activities, Munitions and Explosives of Concern (MEC) and MC may be present at these locations. The term MEC includes Discarded Military Munitions (DMM), Unexploded Ordnance (UXO), and MC in high enough concentrations to pose an explosive hazard. The term MC includes constituents associated with munitions such as metals, nitroglycerin (NG), RDX, and TNT. The Department of Defense (DoD) has established the MRP to address MC and MEC environmental concerns at closed ranges. The DoD is following the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) process for the investigation and remediation of these sites. The Navy is responsible for implementing the MRP at NSGL.

The four MRP SIs at NSGL will be on-site inspections to determine the nature of the potential hazards associated with MC linked to past on-site training activities. Potential MEC issues are addressed separately in Volume II of this UFP-SAP.

This UFP-SAP describes the MC investigation and is designed to be "stand alone" in regards to the technical details that are specific to the MC investigation. This MC SAP has been prepared in accordance with the DoD, Department of Energy (DoE), and United Stated Environmental Protection Agency (USEPA) Intergovernmental Data Quality Task Force (IDQTF) environmental requirements for federal facilities. To comply with IDQTF requirements, the SAP is presented in the format of 37 standard worksheets as specified in the Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP, aka UFP-SAP), Parts 1, 2A, and 2B (USEPA, 2005), along with Navy-developed template to combine the required elements of the UFP-QAPP and a Field Sampling Plan (FSP) to create a complete UFP-SAP.

This UFP-SAP documents the existing conceptual site models (CSMs) for each area of concern in Worksheet #10, defines the data quality objectives (DQOs) for the SI, and describes the process of obtaining and evaluating the data needed for the project. This collected data will be used to approximate site boundaries, collect broad site information, and assess the potential hazards posed by any MC remaining at a site in order to support the final site recommendations. The SI will augment the data collected in the Preliminary Assessment (PA) Reports and Water Area Munitions Study (WAMS) investigation phases prepared by Malcolm Pirnie in 2005 and 2008 and generate field data to determine if further response action or remedial investigation (RI) is appropriate. However, this MC SI investigation is not intended as a full-scale study of the nature and extent of MC hazards, but to confirm the absence of significant MC. The SI investigative plan is based on background information provided in the PA Reports and decisions made by the Project Team, which are documented in Worksheet #9. The CSMs were the basis for the development of the project specific DQOs, which are contained in Worksheet #11. The remaining worksheets describe the data collection and data evaluation procedures, including quality requirements specific to the geophysical investigation. The investigation samples will be analyzed for MC potentially associated with historical training activities at each site using a combination of on-site field analyses for lead and off-site fixed-base laboratory analyses for other constituents and confirmation of the on-site lead results. If concentrations of these chemicals exceed risk-based screening values, further investigation or a response action may be recommended; otherwise, no further action (NFA) will be recommended.

Trap, Skeet, and Archery (TSA) Range

The former TSA Ranges site encompasses approximately 35 acres, including the land and water portions. The land portion consists of approximately 1.1 acres of Lake Michigan beachfront, which included the former firing arcs for the skeet and trap ranges and all structures. Fill material was placed to extend the shoreline for the addition of the skeet range. The water portion of the TSA Ranges, where munitions were fired, incorporates a safety danger zone (SDZ) of approximately 29.4 acres. Munitions use was limited to small arms ammunition, primarily shotgun ammunition. The land and water portions are not suspected to contain MEC, therefore no MEC investigation is planned for the TSA Range. The land portion has been redeveloped as a recreational vehicle (RV) park, leaving no evidence of the TSA Ranges. There are no records of previous sampling. The SI will focus on both the land and water portions of the TSA Ranges. On the land portion surface soil samples will be collected and analyzed on-site for lead by X-ray Fluorescence (XRF) and off-site for Polycyclic Aromatic Hydrocarbon (PAHs) and select metals (antimony, arsenic, and lead). In the water portion, sediment samples will be collected and analyzed off-site for PAHs and select metals (antimony, arsenic, and lead). Figure ES-2 depicts the TSA Ranges and associated range features.

Pistol Butts

The former Pistol Butts site is located in a flat area on the shore of the NSGL Outer Harbor, south of the installation's former sewage treatment plant, and is approximately four acres in size. The site boundary on the west is an approximately 50-foot high bluff and on the east is Lake Michigan. Currently, the site is covered by the northern end of a concrete retention pond and paved roadway southwest of the landing craft storage building (see Figure ES-3). There is no evidence of the Pistol Butts remaining on the surface of NSGL. There are very limited records available on the history of this site, which only appears on one archival map from 1909 (Appendix A). The 1909 archival map indicates that the firing line was located immediately west of a former seawall located at the edge of Lake Michigan. Individual firing lines were not noted on the map; however, the firing lanes are indicated and appear to be approximately 40 yards long. The location of the former firing points and range floor has been developed into a concrete retention pond, vegetated grass strip, and a roadway. The location of the former pistol range bullet stop/butt (the natural bluff to the west of the site) appears to have been buried during redevelopment. Subsurface soil sampling is planned at the suspected bullet impact (former Pistol Butts) area. It is assumed that only small arms training occurred on this site. MEC would not be expected to be present at a pistol range; therefore, no MEC investigation is planned for the Pistol Butts site. The SI will focus on the buried bullet stop/butt area where subsurface soil samples will be collected and analyzed on-site for lead by XRF and off-site for select metals (antimony, arsenic, and lead).

Machine Gun Range

The former Machine Gun Range site is located immediately south of Building 13 (the Boat House) and the man-made boat channel entering in the harbor in the southern portion of the installation. The range was used for the training of naval personnel on small arms of 0.50-caliber or less. Based on the 1905, 1915, and 1918 archival maps, it appears that targets were located on the inner breakwater of the harbor and were fired upon from a 200- and 300-yard firing line on land; therefore, this range contains land-based firing locations and an impact area in Lake Michigan. A paved roadway and an area for landing craft storage now cover the majority of the site. The SI will focus on the land portion of the site where surface soil samples will be collected and analyzed off-site for select metals (antimony, arsenic, and lead) and select propellants (NG). The SI will also focus on the water portion or target area immediately in front of the breakwater where sediment samples will be collected and analyzed off-site for select metals (antimony, arsenic, and lead). Figure ES-4 depicts the Machine Gun Range site features. MEC would not be expected to be present at the Machine Gun Range and therefore no MEC investigation is planned for this site.

NTC Lakefront

The former NTC Lakefront Site was a 3,728 acre AA range and target training area located on the eastern edge of the NSGL, with a 3.3-acre portion of beachfront along Lake Michigan and the remaining 3,725 acres extending east over Lake Michigan. Potential MC issues are associated with the use of AA ammunition with tracers, which includes 20-millimeter (mm) high explosive (HE), high explosive incendiary (HEI), high explosive tracers (HET), and HET-dark ignition (DI) rounds, 40-mm blind loaded and plugged (BL&P), high explosive tracer – self destruct (HET-SD), and high explosive incendiary tracer – self destruct (HEIT-SD) rounds, 1.1-inch AA artillery, 3-inch 0.50-caliber artillery, and DI tracers. The AA gun mounts were located along the shoreline, on fill material, and aimed at targets towed by plane with cables over Lake Michigan. Approximately 1,350 sailors per day were instructed on the 20- and 40-mm guns during AA training exercises and several million rounds were fired into Lake Michigan over the range's existence. The NTC Lakefront PA Report indicated that only AA ammunition was used at the range. The expected dud rates of the types of AA ammunition used was five percent resulting in several hundred thousand rounds containing explosives which may be present in lake Michigan sediment.

The land portion is currently paved and bordered by a RV park, is used for the storage of fuel oil for the facility's power plant, and is not suspected for the presence of MC or MEC. There is a potential that MEC and associated MC is present within the sediment in Lake Michigan. Due to the paved roadway covering the location of the former gun mounts and high rates of erosion and deposition immediately in front of the gun mounts, MC sampling will not occur at the former firing line. The MC SI will be focused on the lake sediment in close proximity to potential MEC, which will be identified during the MEC SI as described under a separate SAP (UFP-SAP Volume II). The SI will focus on the water portion of NTC Lakefront where sediment samples will be collected and analyzed off-site for select explosives [Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX), Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), trinitrotoluene (TNT), N-methyl-N,2,4,6-tetranitroaniline (tetryl), and pentaerythriotol tetranitrate (PETN)] and select metals (antimony, arsenic, copper, iron, lead, magnesium, strontium, and zinc). Figure ES-5 depicts the NTC Lakefront site features.

Table ES-1
SI Site and Scope Summary

Subarea	Current Conditions (Land)	MC/MEC Types	MC Sampling (1)							
			Surface Soil				Subsurface Soil	Sediment		
			XRF	Metals	Propellants	PAHs	Metals	Metals	Explosives	PAH
TSA Ranges (Land Portion) (Water Portion)	RV park	Small arms (shotgun)/No MEC present	✓ --	✓ --	-- --	✓ --	-- --	-- ✓	-- --	-- ✓
Pistol Butts (Buried Berm/Butts Area)	Concrete retention pond, vegetated grass strip, and a roadway.	Small arms (pistol)/No MEC present	✓	✓	--	--	✓	--	--	--
Machine Gun Range (Land Portion) (Water Portion)	Paved roadway and an area for landing craft storage.	Small arms (machine gun)/No MEC present	-- --	✓ --	✓ --	-- --	-- --	-- ✓	-- --	-- --
NTC Lakefront (Land Portion) (Water Portion)	Paved and bordered by a RV park, and is used for the storage of fuel oil for the facility's power plant.	Various anti-aircraft munitions/No MC or MEC present on land, but MC and MEC may be present in lake sediment	-- --	-- --	-- --	-- --	-- --	-- ✓	-- ✓	-- --

✓ = Planned　　-- = Not Planned

1 Specific analytes associated with potential MC include:

XRF (X-ray fluorescence) **=** Lead
Metals = TSA Ranges – Antimony, Arsenic, and Lead
Pistol Butts – Antimony, Arsenic, and Lead
Machine Gun Range – Antimony, Arsenic, and Lead
NTC Lakefront - Antimony, Arsenic, Copper, Iron, Lead, Magnesium, Strontium, and Zinc
Propellants = Machine Gun Range – NG
Explosives = NTC Lakefront – HMX, PETN, RDX, tetryl, and TNT
Non-MC = TSA Ranges - PAHs – Polycyclic Aromatic Hydrocarbons (individual target analytes as identified in Worksheet #15)

SAP WORKSHEET #2 -- SAP IDENTIFYING INFORMATION

(UFP-QAPP Manual Section 2.2.4)

Site Name/Number:	Naval Station Great Lakes (NSGL), Great Lakes, Illinois/Trap, Skeet, and Archery (TSA) Ranges, Pistol Butts, Machine Gun Range, Naval Training Center (NTC) Lakefront Site
Operable Unit:	Not Applicable (NA)
Contractor Name:	Tetra Tech NUS, Inc. (Tetra Tech)
Contract Number:	No. N62472-03-D-0057
Contract Title:	Comprehensive Long-Term Environmental Action Navy (CLEAN)
Contract Task Order (CTO):	F274

1. This Sampling and Analysis Plan (SAP) was prepared in accordance with the requirements of the *Uniform Federal Policy for Quality Assurance Plans (UFP-QAPP)* (USEPA, 2005) and *Guidance for Quality Assurance Project Plans, EPA QA/G-5, QAMS (USEPA, 2002).*

2. Identify regulatory program: Department of Defense (DoD) Munitions Response Program (MRP), consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and the processes established by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).

3. This SAP is a project-specific SAP.

4. List dates of scoping sessions that were held:

Scoping Session	Date
Site visit and Data Quality Objective (DQO) Development	June 15 through 16, 2009

5. List dates and titles of any SAP documents written for previous site work that are relevant to the current investigation

Title	Date
No previous UFP-SAP documents have been prepared for this site.	

6. List organizational partners (stakeholders) and connection with lead organization:
Illinois Environmental Protection Agency (EPA) – regulatory stakeholder

7. Lead organization (see Worksheet #7 for detailed list of data users)
Naval Facilities Engineering Command (NAVFAC), Midwest

8. If any required SAP elements or required information are not applicable to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion below:
NA - there are no exclusions.

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
A. Project Management		
Documentation		
1	Title and Approval Page	NA
2	Table of Contents SAP Identifying Information	NA
3	Distribution List	NA
4	Project Personnel Sign-Off Sheet	NA
Project Organization		
5	Project Organizational Chart	NA
6	Communication Pathways	NA
7	Personnel Responsibilities and Qualifications Table	NA
8	Special Personnel Training Requirements Table	NA
Project Planning/Problem Definition		
9	Project Planning Session Documentation (including Data Needs tables) Project Scoping Session Participants Sheet	NA
10	Conceptual Site Model, Site History, and Background. Site Maps (historical and current)	NA
11	Site-Specific Project Quality Objectives	NA
12	Measurement Performance Criteria Table	NA
13	Sources of Secondary Data and Information, Secondary Data Criteria and Limitations Table	NA

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
14	Summary of Project Tasks	NA
15	Reference Limits and Evaluation Table	NA
16	Project Schedule/Timeline Table	NA
B. Measurement Data Acquisition		
Sampling Tasks		
17	Sampling Design and Rationale	NA
18	Sampling Locations and Methods/Standard Operating Procedure (SOP) Requirements Table Sample Location Map(s)	NA
19	Analytical Methods/SOP Requirements Table	NA
20	Field Quality Control Sample Summary Table	NA
21	Project Sampling SOP References Table, Sampling SOPs	NA
22	Field Equipment Calibration, Maintenance, Testing, and Inspection Table	NA
Analytical Tasks		
23	Analytical SOPs, Analytical SOP References Table	NA
24	Analytical Instrument Calibration Table	NA
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	NA

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
Sample Collection		
26	Sample Handling System, Documentation Collection, Tracking, Archiving, and Disposal Sample Handling Flow Diagram	NA
27	Sample Custody Requirements, Procedures/SOPs Sample Container Identification Example Chain-of-Custody Form and Seal	NA
Quality Control (QC) Samples		
28	Laboratory QC Samples Table, Screening/Confirmatory Analysis Decision Tree	NA
Data Management Tasks		
29	Project Documents and Records Table	NA
30	Analytical Services Table Analytical and Data Management SOPs	NA
C. Assessment Oversight		
31	Planned Project Assessments Table, Audit Checklists	NA
32	Assessment Findings and Corrective Action Responses Table	NA
33	QA Management Reports Table	NA
D. Data Review		
34	Verification (Step I) Process Table	NA
35	Validation (Steps IIa and IIb) Process Table	NA
36	Analytical Data Validation (Steps IIa and IIb) Summary Table	NA

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
37	Usability Assessment	NA

SAP WORKSHEET #3 -- DISTRIBUTION LIST

(UFP-QAPP Manual Section 2.3.1)

Name of SAP Recipient	Title/Role	Organization	Telephone Number	E-Mail Address or Mailing Address	Document Control Number
Jonathan Tucker (electronic upload)	NAVFAC Chemist/-Quality Assurance Officer (QAO)/ Reviews UFP-SAP and quality assurance documentation for Navy	NAVFAC Mid-Atlantic (LANT)	757.322.8288	jonathan.tucker@navy.mil	NA
Howard Hickey	NAVFAC Remedial Project Manager (RPM) and NGSL Point of Contact (POC)/Manages project activities for the Navy	NAVFAC-Midwest	847.688.2600 x243	howard.hickey@navy.mil	NA
Bonnie Capito (final cover letter only)	Administrative Record Librarian/Manages Navy project records	NAVFAC LANT	757.322.4785	bonnie.capito@navy.mil	NA
Glenn Wagner (copy of final cover letter only)	Administrative Record Assistant	Tetra Tech	412.220.2211	glenn.wagner@tetratech.com	NA
Brian Conrath	Illinois EPA RPM /Provides Illinois regulatory input	Illinois EPA	217.557.8155	brian.conrath@illinois.gov	NA

Name of SAP Recipient	Title/Role	Organization	Telephone Number	E-Mail Address or Mailing Address	Document Control Number
John Trepanowski	Program Manager/Manages the Navy CLEAN Program for Tetra Tech	Tetra Tech	610.491.9688	john.trepanowski@tetratech.com	NA
Ralph Basinski	Project Manager (PM)/Manages project activities for Tetra Tech	Tetra Tech	412.921.8308	ralph.bassinski@tetratech.com	NA
To Be Determined (TBD)	Tetra Tech Field Operations Leader (FOL)/Site Safety Officer (SSO)/Manages field operations and site safety	Tetra Tech	TBD	TBD	NA
Tom Johnston	Tetra Tech Quality Assurance Manager (QAM)/Manages Corporate Quality Assurance (QA) Program and Implementation	Tetra Tech	412.921.8615	tom.johnston@tetratech.com	NA
Matt Soltis (Health and Safety Plan [HASP] only)	Tetra Tech Health and Safety Manager (HSM)/Manages Corporate Health and Safety Program	Tetra Tech	412.921.8912	matt.soltis@tetratech.com	NA
Matthew Kraus (shared copy with Joe Samchuck)	Tetra Tech Project Chemist/Provides Technical Coordination with Laboratories	Tetra Tech	412.921.8729	matthew.kraus@tetratech.com	NA

Name of SAP Recipient	Title/Role	Organization	Telephone Number	E-Mail Address or Mailing Address	Document Control Number
Joe Samchuck (shared copy with Matthew Kraus)	Tetra Tech Data Validation Manager (DVM)/Manages Data Validation	Tetra Tech	412.921.8510	joseph.samchuck@tetratech.com	NA
Ralph Brooks	Unexploded Ordnance (UXO)/Munitions and Explosives of Concern (MEC) Manager/Manages Corporate MEC Hazards and Risks	Tetra Tech	770.413.0965 x231	ralph.brooks@tetratech.com	NA
Jeff Fournier	Project UXO Manager/Manages Project MEC Hazards and Risks	Tetra Tech	770.413.0965 x227	jeffrey.fournier@tetratech.com	NA
Kim Kostzer	Laboratory PM/Representative for Laboratory and Analytical Issues	Empirical Laboratories, LLC	615.345.1115	kkostzer@empirlabs.com	NA
TBD	Direct Push Technology (DPT) Subcontractor/Provides DPT Services	TBD	TBD	TBD	NA

SAP WORKSHEET #4 -- PROJECT PERSONNEL SIGN-OFF SHEET

(UFP-QAPP Manual Section 2.3.2)

One of the following three methods, as applicable, will obtain certification that project personnel have read the text:

1. In the case of regulatory agency personnel with oversight authority, approval letters or e-mails stating approval will constitute verification that applicable sections of the UFP-SAP have been reviewed. Copies of regulatory agency approval letters or e-mails will be retained in the project files and are listed in Worksheet #29 as project records.
2. E-mails will be sent to Navy, Tetra Tech, and subcontractor project personnel who will be requested to verify by e-mail that they have read the applicable UFP-SAP Worksheets and the date on which they were reviewed. Copies of the verification e-mail will be included in the project files as identified in Worksheet #29.
3. A copy of the signed Worksheet #4 will be retained in the project files and is identified as a project document in Worksheet #29.

Name	Title/Role	Telephone Number	Signature/E-Mail Receipt	UFP-SAP Section Reviewed	Date UFP-SAP Read
Navy and Regulator Project Team Personnel					
Howard Hickey	NAVFAC RPM and NSGL POC/Manages project activities for the Navy	847.688.2600 x243	See Worksheet #1 for signature.	All	
Jonathan Tucker (electronic upload)	NAVFAC Chemist/Reviews UFP-SAP and QA documentation for Navy	757.322.8288	See Worksheet #1 for signature.	All	
Brian Conrath	Illinois EPA RPM Provides Regulatory Input	217.557.8155	See Worksheet #1 for signature.	All	

Name	Title/Role	Telephone Number	Signature/E-Mail Receipt	UFP-SAP Section Reviewed	Date UFP-SAP Read
Tetra Tech Project Team Personnel					
Ralph Basinski	PM/Manages project activities	412.921.8308	See Worksheet #1 for signature.	All	
TBD	FOL/SSO/Manages field operations and site safety	TBD		All	
Tom Johnston	QAM/Manages Corporate QA program and implementation	412.921.8615	See Worksheet #1 for signature.	All	
Matt Soltis	HSM/Manages Corporate Health and Safety Program	412.921.8912		HASP(1)	
Matthew Kraus	Project Chemist/Provides Technical Coordination with Laboratories	412.921.8729		Worksheets #12, #14, #15, #19, #20, #23-28, #30, #34-37	
Joseph Samchuck	DVM/Manages Data Validation	412.921.8510		Worksheets #12, #14, #15, #19, #20, #23-28, #30, #34-37	
Ralph Brooks	UXO/MEC Manager/Manages Corporate MEC Hazards and Risks	770.413.0965 x231		Worksheets #10, #11, #14, #17, #18	
Jeff Fournier	Project UXO Manager/Manages Project MEC Hazards and Risks	770.413.0965 x227		Worksheets #10, #11, #14, #17, #18	

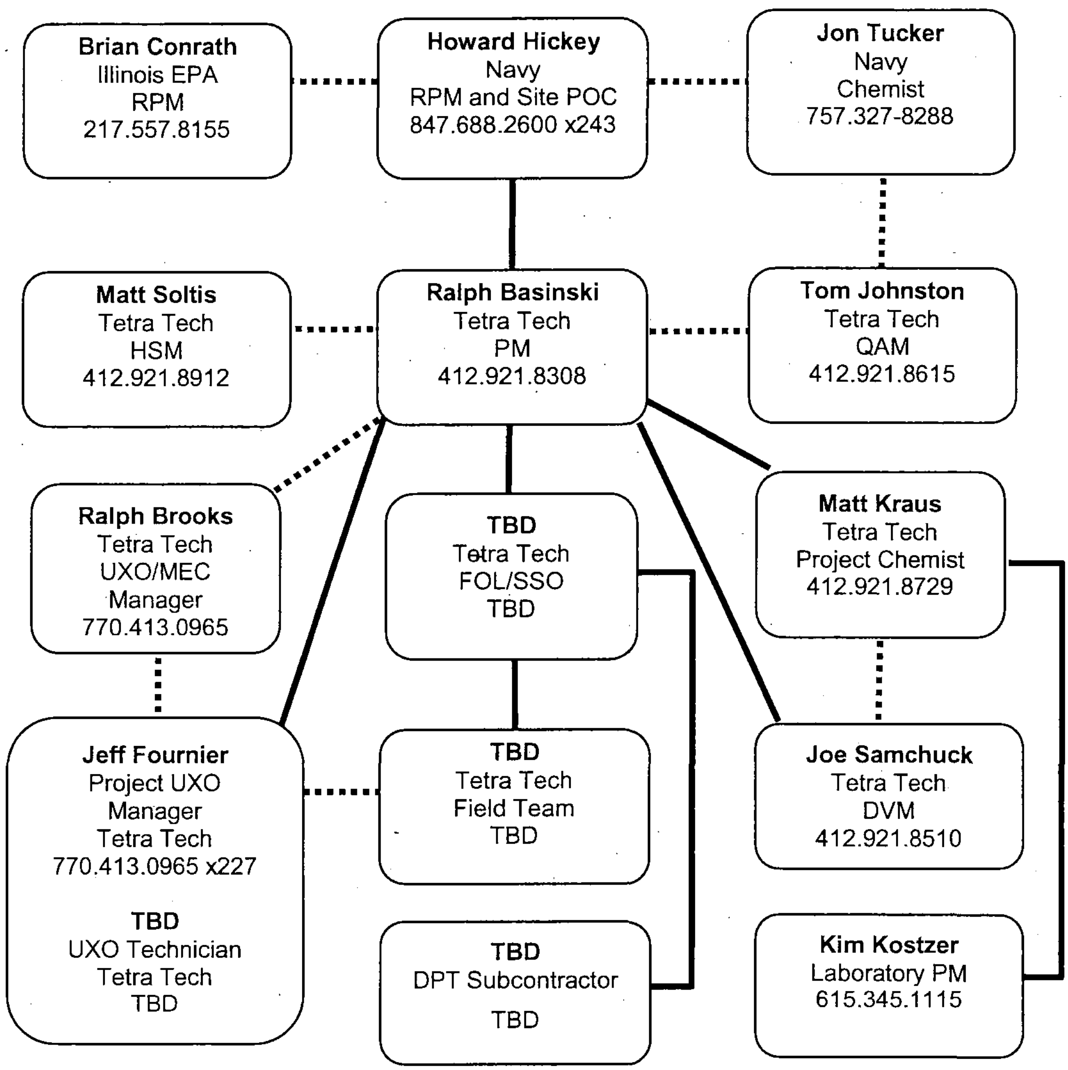
Name	Title/Role	Telephone Number	Signature/E-Mail Receipt	UFP-SAP Section Reviewed	Date UFP-SAP Read
Subcontractor Personnel					
Kim Kostzer	Laboratory PM/ Representative for Laboratory and Analytical Issues	615.345.1115		Worksheets #12, #14, #15, #19, #20, #23-28, #30, #34-36	
TBD	DPT Subcontractor/ Provides DPT Services	TBD		Worksheets #10, #11, #14, #17, #18	

1. The HASP is a stand-alone document, which is provided to the Navy under separate cover.

SAP WORKSHEET #5 -- PROJECT ORGANIZATIONAL CHART

(UFP-QAPP Manual Section 2.4.1)

Lines of Authority ——— .... Lines of Communication



SAP WORKSHEET #6 -- COMMUNICATION PATHWAYS

(UFP-QAPP Manual Section 2.4.2)

Communication Driver	Responsible Person Affiliation	Name	Phone Number and/or E-Mail	Procedure
MEC encountered	Tetra Tech FOL/SSO Tetra Tech Field Team Staff Tetra Tech UXO/MEC Manager Tetra Tech PM Navy RPM (and NSGL POC) Illinois EPA RPM	TBD TBD Ralph Brooks Ralph Basinski Howard Hickey Brian Conrath	TBD TBD 770.413.0965 x231 412.921.8308 847.688.2600 x243 217.557.8155	Within 30 minutes, Tetra Tech FOL will verbally notify field staff, secure area, and contact NSGL POC Tetra Tech UXO Manager and Tetra Tech PM. Tetra Tech UXO Manager will verbally inform Tetra Tech PM the same day. Tetra Tech PM will verbally inform Navy RPM on the same day. Navy RPM will make base emergency notifications and inform Naval Ordnance Safety and Security Activity (NOSSA) and State on the same day.
Field issues that require changes in field tasks	Tetra Tech FOL/SSO Tetra Tech PM Navy RPM (and NSGL POC) Illinois EPA RPM	TBD Ralph Basinski Howard Hickey Brian Conrath	TBD 412.921.8308 847.688.2600 x243 217.557.8155	Tetra Tech FOL will verbally inform Tetra Tech PM on the day the issue is discovered. Tetra Tech PM will verbally inform Navy RPM within 1 business day. Navy RPM will inform the Illinois EPA RPM of issue and propose scope change within 1 business day. Navy RPM will issue scope change approval (verbally or via e-mail) if warranted; scope change to be implemented before work is executed. Document the change via Field Task Modification Request (FTMR) form within two days of identifying the need for change within 5 days of initiating form.

Communication Driver	Responsible Person Affiliation	Name	Phone Number and/or E-Mail	Procedure
SAP amendments	Tetra Tech FOL/SSO Tetra Tech PM Navy RPM (and NSGL POC) Illinois EPA RPM	TBD Ralph Basinski Howard Hickey Brian Conrath	TBD 412.921.8308 847.688.2600 x243 217.557.8155	Tetra Tech FOL will verbally inform Tetra Tech PM within 24 hours of realizing a need for an amendment. Tetra Tech PM will document the proposed changes via a FTMR form within five days and send the Navy RPM a concurrence letter within seven days of identifying the need for change. SAP amendments will be submitted by Tetra Tech PM to NAVFAC Midwest Program Management Office for review and approval. Tetra Tech PM will send scope changes to Project Team via e-mail within 1 business day.
Field work schedule changes	Tetra Tech PM Navy RPM (and NSGL POC) Illinois EPA RPM	Ralph Basinski Howard Hickey Brian Conrath	412.921.8308 847.688.2600 x243 217.557.8155	Tetra Tech PM will verbally inform Navy RPM on the day that schedule change is known and document via schedule impact letter if necessary. Navy will notify the Illinois EPA RPM on the day that schedule change is known and document via schedule impact letter if necessary.

Communication Driver	Responsible Person Affiliation	Name	Phone Number and/or E-Mail	Procedure
Field issues that require changes in scope of field work	Tetra Tech FOL/SSO Tetra Tech PM Navy RPM (and NSGL POC) Illinois EPA RPM	TBD Ralph Basinski Howard Hickey Brian Conrath	TBD 412.921.8308 847.688.2600 x243 217.557.8155	Tetra Tech FOL will verbally inform Tetra Tech PM on the day that the issue is discovered. Tetra Tech PM will verbally inform Navy RPM within 1 business day of discovery. Navy RPM will inform Illinois EPA RPM within 1 business day of discovery. Navy RPM will issue scope change (verbally or via e-mail), if warranted; scope change to be implemented before further work is executed. Tetra Tech PM will document the change via a FTMR form within 2 days of identifying the need for change and obtain required approvals within 5 days of initiating the form.
Recommendation to stop work and initiate work upon corrective action (CA)	Tetra Tech PM Tetra Tech FOL/SSO Tetra Tech QAM Tetra Tech Project Chemist Tetra Tech HSM Navy RPM (and NSGL POC) Illinois EPA RPM	Ralph Basinski TBD Tom Johnston Matthew Kraus Matt Soltis Howard Hickey Brian Conrath	412.921.8308 TBD 412.921.8615 412.921.8729 412.921.8912 847.688.2600 x243 217.557.8155	If Tetra Tech is the responsible party for a stop work command, the Tetra Tech FOL will inform onsite personnel, subcontractor(s), the Navy RPM and Site POC, and the identified Project Team members within 1 hour (verbally or by e-mail). If a subcontractor is the responsible party, the subcontractor PM must inform the Tetra Tech FOL within 15 minutes, and the Tetra Tech FOL will then follow the procedure listed above.

Communication Driver	Responsible Person Affiliation	Name	Phone Number and/or E-Mail	Procedure
Field or laboratory quality data issues	Empirical PM Tetra Tech Project Chemist Tetra Tech PM Tetra Tech FOL	Kim Kostzer Matthew Kraus Ralph Basinski TBD	615.345.1115 412.921.8729 412.921.8308 TBD	Within 1 day of discovery, the Laboratory PM will notify the Tetra Tech Project Chemist when a quality issue is related to laboratory data. Tetra Tech Project Chemist will notify (verbally or via e-mail) data validation staff and Tetra Tech PM within one business day, if appropriate. When a quality issue is related to field data, Tetra Tech FOL will verbally inform the Tetra Tech PM on the same day.
Corrective action for field program	Tetra Tech QAM Tetra Tech PM	Tom Johnston Ralph Basinski	412.921.8615 412.921.8308	Tetra Tech QAM will notify (verbally or via e-mail) Tetra Tech PM within one business day that the corrective action has been completed. The Tetra Tech PM will then notify (verbally or via e-mail) the Navy RPM within one business day.

SAP WORKSHEET #7 -- PERSONNEL RESPONSIBILITIES AND QUALIFICATIONS TABLE

(UFP-QAPP Manual Section 2.4.3)

Name	Title/Role	Organizational Affiliation	Responsibilities
Howard Hickey	RPM	NAVFAC Midwest	Oversees project scoping implementation, including, data review, and evaluation and approves UFP-SAP. Serves as the on-site point of contact, oversees site activities, and participates in scoping, data review, and evaluation.
Brian Conrath	PM	Illinois EPA	Participates in project scoping and implementation, including data review and evaluation, and approves the UFP-SAP.
John Trepanowski	Program Manager	Tetra Tech	Oversees NAVFAC CLEAN Program for Tetra Tech.
Ralph Basinski	PM	Tetra Tech	Oversees project, financial, schedule, and technical day-to-day management of the project, including the following: • Ensures timely resolution of project-related technical, quality, and safety questions associated with Tetra Tech operations. • Functions as the primary Tetra Tech interface with the Navy RPM, Tetra Tech field and office personnel. • Ensures that Tetra Tech health and safety issues related to this project are communicated effectively to all personnel and off-site laboratory. • Monitors and evaluates all Tetra Tech subcontractor performance. • Coordinates and oversees work performed by Tetra Tech field and office technical staff (including data validation, data interpretation, and report preparation). • Coordinates and oversees maintenance of all Tetra Tech project records. • Coordinates and oversees review of Tetra Tech project deliverables. • Prepares and issues final Tetra Tech deliverables to the Navy.

Name	Title/Role	Organizational Affiliation	Responsibilities
TBD	FOL, SSO	Tetra Tech	Supervises, coordinates, and performs field sampling activities, including the following: • Ensures that all health and safety requirements unique to the SI are implemented. • Functions as the on-site communications link between field staff members, the Navy RPM and NSGL POC, and the Tetra Tech PM. • Alerts off-site analytical laboratory of any special health and safety hazards associated with environmental samples. • Oversees the mobilization and demobilization of all field equipment and subcontractors. • Coordinates and manages the field technical staff. • Adheres to the work schedules provided by the Tetra Tech PM. • Ensures the proper maintenance of site logbooks, field logbooks, and field recordkeeping. • Initiates FTMRs (field change orders) when necessary. • Identifies and resolves problems in the field, resolving difficulties via consultation with the Navy RPM and NSGL POC, implementing and documenting CA procedures, and providing communication between the field team and project management. • As the SSO is responsible for training and monitoring site conditions. The SSO reports to the HSM and to the Tetra Tech PM. Details of the SSO's responsibilities are presented in the HASP.

Name	Title/Role	Organizational Affiliation	Responsibilities
Tom Johnston	QAM	Tetra Tech	Reviews UFP-SAP, oversees preparation of laboratory scope, coordinates with laboratory, and conducts data quality reviews. Ensures quality aspects of the CLEAN program, including the following: • Develops, maintains, and monitors QA policies and procedures. • Provides training to Tetra Tech staff in QA/QC policies and procedures. • Conducts systems and performance audits to monitor compliance with environmental regulations, contractual requirements, UFP-SAP requirements, and corporate policies and procedures. • Audits project records. • Monitors subcontractor quality controls and records. • Assists in the development of corrective action plans and ensuring correction of non-conformances reported in internal or external audits. • Ensures that this UFP-SAP meets Tetra Tech, Navy, and Illinois EPA requirements. • Prepares QA reports for management.
Matt Soltis	HSM	Tetra Tech	Oversees CLEAN Program Health and Safety Program, including the following: • Provides technical advice to the Tetra Tech PM on matters of health and safety. • Oversees the development and review of the HASP. • Conducts health and safety audits. • Prepares health and safety reports for management.

Name	Title/Role	Organizational Affiliation	Responsibilities
Matthew Kraus	Project Chemist	Tetra Tech	Coordinates analyses with laboratory chemists, ensures the scope is followed, reviews data packages, and communicates with Tetra Tech staff. • Ensures that the project meets objectives from the standpoint of laboratory performance. • Provides technical advice to the Project Team on matters of project chemistry. • Monitors and evaluates subcontractor laboratory performance. • Ensures timely resolution of laboratory-related technical, quality, or other issues affecting project goals. • Functions as the primary interface with the subcontracted laboratory and the Tetra Tech PM. • Coordinates and oversees work performed by the subcontracted laboratory. • Oversees the completion of Tetra Tech data validation. • Coordinates and oversees review of laboratory deliverables. • Recommends appropriate laboratory corrective actions.
Joseph Samchuck	DVM	Tetra Tech	Ensures the QA of data validation deliverables, including the following: • Oversees data validation activities • Serves as communication link between Tetra Tech and laboratory on data validation and electronic data positing activities. • Establishes Tetra Tech data validation protocols in support of projects
Ralph Brooks	UXO/MEC Manager	Tetra Tech	Oversees selection of qualified UXO personnel, establishes overall QC program for UXO activities, and addresses UXO related issues as identified by field personnel.
Jeff Fournier	Project UXO Manager	Tetra Tech	Oversees implementation of daily UXO related activities.
TBD	UXO Technician III	Tetra Tech	Provides anomaly avoidance services. Will have a minimum of 8 years prior military EOD and/or commercial UXO experience in munitions response actions or range clearance activities. [Department of Defense Explosive Safety Board (DDESB) Technical Paper (TP) 18]
Kim Kostzer	Laboratory PM	Empirical	Ensures that the scope is followed, coordinates analyses with laboratory chemists, performs QA on data packages, and communicates with Tetra Tech staff.
TBD	DPT PM	TBD	Ensures that the scope is followed and communicates with Tetra Tech staff.

In some cases, one person may be designated responsibilities for more than one position.

(1) For this project, the FOL will also be responsible for SSO duties. This action will be performed only as credentials, experience, and availability permits

SAP WORKSHEET #8 -- SPECIAL PERSONNEL TRAINING REQUIREMENTS

(UFP-QAPP Manual Section 2.4.4)

Project Function	Specialized Training by Title or Description of Course	Training Provider	Training Date	Personnel / Groups Receiving Training	Personnel Titles / Organizational Affiliation	Location of Training Records / Certificates
Field Technicians	40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) 8-hour HAZWOPER Refresher	Various	Current	Field sampling personnel	All field staff/Tetra Tech	Tetra Tech project office and field office
Field Supervisor	Same as field technician HAZWOPER requirements, plus Supervisor training	Various	Current	FOL	FOL/Tetra Tech	Tetra Tech project office and field office
X-Ray Fluorescence Spectrometer (XRF) Technician	Operation of XRF	Previously trained personnel	Current	XRF Technician	XRF Technician/ Tetra Tech	Tetra Tech project office and field office
Field Health and Safety	First Aid/Cardiopulmonary Resuscitation Training	Red Cross	Current	Field Personnel	SSO/Tetra Tech	Tetra Tech project office and field office
UXO Avoidance	Various training elements, as required in DDESB TP-18[(1)]	DoD or other approved formal course	Current	UXO Technicians supporting UXO avoidance	UXO Technician/ Tetra Tech	Tetra Tech project office and field office

All Field personnel will have appropriate training to conduct the field activities to which they are assigned. Additionally, each site worker will be required to have completed a 40-hour course (and 8-hour refresher, if applicable) in Health and Safety Training as described under Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.120(b)(4).

SAP WORKSHEET #9 -- PROJECT SCOPING SESSION PARTICIPANTS SHEET

(UFP-QAPP Manual Section 2.5.1)

Project Name: Site Inspection at the NSGL. **Projected Date(s) of Sampling:** April, 2010 **Project Manager:** Ralph Basinski	**Site Name:** NSGL, TSA Ranges, Pistol Butts, Machine Gun Range, and NTC Lakefront **Site Location:** Great Lakes, Illinois

Date of Session: June 15, 2009
Scoping Session Purpose: The purpose of the meeting was to conduct a windshield tour of the sites, develop a project schedule, obtain relevant supplemental information necessary to support update of the Conceptual Site Models (CSMs), begin to discuss SI sampling plan, and preparation of initial project DQOs.

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Howard Hickey	RPM	NAVFAC Midwest	847.688.2600 x243	howard.hickey@navy.mil	Navy Project Management
Benjamin Simes		Navy	847.688.2600 x320	benjamin.simes@navy.mil	NSGL Representative
Brian Conrath	Illinois EPA RPM	Illinois EPA	217.557.8155	brian.conrath@illinois.gov	Regulatory Input
Ralph Basinski	PM	Tetra Tech	412.921.8308	ralph.basinski@tetratech.com	Tetra Tech Project Management
Peggy Churchill	DQO Facilitator	Tetra Tech	321.636.6470 x1300	peggy.churchill@tetratech.com	DQO Facilitator
Robert Feldpausch	In-water Survey Manager	Tetra Tech	425.482.7862	robert.feldpausch@tteci.com	Underwater Geophysicist

Comments/Decisions: Discussed the general information provided to the Project Team for the sites. A general CSM was developed for each site, and DQOs were developed, but sample locations were not determined. A summary of meeting minutes regarding the Pistol Butts, Machine Gun Range, and NTC Lakefront AA Range (NTC Lakefront) Munitions Constituent (MC) sites are included below. The TSA Ranges were not discussed at this meeting. All meeting minutes regarding MEC will be contained in the MEC UFP-SAP.

Action Items:

1. Tetra Tech requested all available PA data or other historical information as information inputs to the CSMs.

2. Tetra Tech to determine if the site boundaries are sufficient based on the available background information.

Consensus Decisions:

The consensus decisions below concerning the MC sampling program were based on the understanding of the CSM at the time of the meeting.

<u>Pistol Butts</u>

The initial understanding of the location of the Pistol Butts was discussed at this scoping meeting however, based on the examination of the 1909 archival maps of the area the location of the former range has moved northward approximately 500 feet. The changes to the CSM and consensus decisions have been addressed in the November 2009 meeting notes.

<u>Machine Gun Range</u>

1. Firing Line - Three discrete samples at each firing point (200-yards and 300-yards). Sample depths will be 0- to 6-inches for each sample location. Samples will be analyzed for nitroglycerin (NG) and antimony, arsenic, and lead.

2. Breakwater - Twenty discrete sediment samples will be collected at ten locations staggered from 3- to 5-feet west of the breakwater. These lake bottom sediment samples will be collected from the 0- to 6-inch and 6- to 12-inch depth intervals and analyzed off-site for antimony, arsenic, and lead.

3. Outer Harbor - No samples will be collected in the Outer Harbor. A biased sampling approach will be used on the east side of the breach water of the Inner Harbor. MC in the Outer Harbor would be scattered and difficult to locate because of sediment transport, carry distance, and bullet skip or ricochet.

4. If any concentrations in soil exceed human health or ecological (whichever is more protective) screening criteria, then proceed to a Remedial Investigation (RI) to determine nature and extent and assess risk; if no exceedance, then no further investigation for MC is required.

5. If any concentrations in sediment exceed the ecological screening criteria, then proceed to an RI to determine nature and extent and assess risk, evaluate the MC and include tracer-related metals; if no exceedance, then no further investigation for MC is required.

NTC Lakefront

1 The NTC Lakefront site (Water Portion) boundaries will be the AA range fan /the safety danger zone (SDZ) area in the horizontal direction and the vertical boundary will be lake bottom sediment from the 0- to 6-inch depth interval, limited to areas where the lake bottom is less than 120 feet below the water surface. MEC and MC investigations will not take place in waters greater than 120 feet deep.
   a. Vertical boundary for risk assessment of sediment is 0 to 6 inches.
   b. In the NTC Lakefront (Water Portion), sediment will be sampled for explosives (HMX, RDX, TNT, tetryl, PETN) and select metals (antimony, arsenic, copper, iron, lead, magnesium, strontium, and zinc).

2. At the NTC Lakefront (Water Portion), if any concentrations of MC in sediment ecological screening criteria, then proceed to an RI to determine nature and extent and assess risk; if no exceedances, then no further investigation for MC is required.

3. At the NTC Lakefront (Land Portion)
   a. Investigation and sampling for MC in soil on Lakefront.
   b. If any concentrations in soil exceed human or ecological (whichever is more protective) screening criteria, then proceed to RI to determine nature and extent and assess risk and if no exceedances, then no further investigation for MC is required.

4. Upgradient data is not available for this site, collect 10 upgradient samples - three north of the TSA Ranges and FBI Range and seven samples north of the SDZ for select metals.

Project Name: Site Inspection at the NSGL **Projected Date(s) of Sampling:** April, 2010 **Project Manager:** Ralph Basinski	**Site Name:** NSGL, TSA Ranges, Pistol Butts, Machine Gun Range, and NTC Lakefront **Site Location:** Great Lakes, Illinois

Date of Session: November 23-25, 2009
Scoping Session Purpose: The purpose of these conference calls were to discuss the CSM for the Pistol Butts and discuss the SI sampling plan based on the updated site location.

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Howard Hickey	RPM	NAVFAC Midwest	847.688.2600 x243	howard.hickey@navy.mil	Navy Project Management
Brian Conrath	PM	Illinois EPA	217.557.8155	brian.conrath@illinois.gov	State RPM
Ralph Basinski	PM	Tetra Tech	412.921.8308	ralph.basinski@tetratech.com	Tetra Tech Project Management
Erica Love	Project Scientist	Tetra Tech	412.920.7009	erica.love@tetratech.com	Project Scientist

Comments/Decisions: Discussed the 1909 archival map information for the Pistol Butts. A general CSM was developed for the Pistol Butts based on the updated understanding of the site location and preliminary sample locations were determined.

Action Items:

1. Tetra Tech will include the updated CSM and sampling design in the UFP-SAP.

Consensus Decisions:

The consensus decisions below concerning the MC sampling program were based on the understanding of the CSM at the time of the meeting.

1. No sampling will occur at the firing line, which is approximately located in the roadway, approximately 10 feet bgs.

2. Due diligence sampling will be required in the area of the bullet impact area on the former hillside. Because no evidence remains of the location of the Pistol Butts Site and the storm water retention pond was built on top of the former range, staggered DPT sampling will occur near the location of the former impact area to a depth of approximately 16 to 20 feet bgs. The impact area is estimated at 16

to 20 feet below the current ground surface based on historical topographic features. XRF samples will be collected to determine if there is lead located at depth, and determine which samples are to be sent to the Laboratory. Step out samples may be needed to focus the sampling efforts at the site.

3. On-site XRF screening analysis will include lead for the samples collected.

4. Off-site laboratory analysis will include antimony, arsenic, and lead.

5. Illinois EPA Tiered Approach to Corrective Action Objectives (TACO) site-specific remedial objectives will be used as screening criteria.

6. If any concentrations in soil exceed the human health or ecological screening criteria, then proceed to an RI to determine nature and extent and assess risk, if no exceedance, then no further investigation from MC is required.

SAP WORKSHEET #10 – CONCEPTUAL SITE MODEL

(UFP-QAPP Manual Section 2.5.2)

This worksheet presents the CSMs for the TSA Ranges, Pistol Butts, Machine Gun Range, and the NTC Lakefront site. Figures ES-2 through ES-5 illustrate the current site layouts and Figures 10-1 through 10-4 illustrate a pictorial CSM of each of the four Munitions Response Sites (MRSs). Archival Maps showing the historical layout of the sites are included in Appendix A. The following elements of the CSM for each MRS are discussed in this worksheet.

- Facility Background
- Site Description and Locations
- Site Background
- Munitions Profile
- MC
- Land Use, Potential Receptors, and Exposure Pathways

10.1 FACILITY BACKGROUND

NSGL sits on approximately 1,628 acres in Great Lakes, Illinois, approximately 20 miles north of Chicago, in Lake County, Illinois. The installation is located along the western shores of Lake Michigan just east of U.S. Route 41 and south of an adjacent town, North Chicago. The other population center in the vicinity is the town of Waukegan, approximately eight miles north on U.S. Route 41. NSGL is bound by Lake Michigan to the east and Skokie Highway (U.S. Route 41) to the west. The Shore Acres Country Club is the southern border of NSGL. Figure ES-1 shows the general location of NSGL.

NSGL is the largest active duty DoD Naval training center in the United States. NSGL is home to enlisted men training and officer accession training. The installation is one of Illinois' largest employers with over 25,000 military and civilian personnel. The Great Lakes Naval Hospital trains 4,000 Navy Corpsmen annually and is the Navy Regional Processing Site for several hundred reservists.

NSGL provides support for the Navy through the intense training and specialized itinerary for enlisted men preparing for the fleet. Major commands at NSGL include Naval Station (NAVSTA), a shore activity reporting command; the Recruit Training Command, which trains sailors; and the Service School Command (SSC), which provides initial technical training. The SSC can also be broken down into combat systems schools, engineering systems schools, and a training department.

The four MC MRSs being investigated at NSGL include the TSA Ranges, Pistol Butts, Machine Gun Range, and NTC Lakefront.

10.2 SITE ENVIRONMENTAL SETTING

The following sections summarize the most pertinent information related to site environmental setting, recognizing that no investigations have been conducted at the four MRSs to date. Hydrogeology is only briefly discussed because a groundwater investigation is not included in this MC investigation.

10.2.1 Climate

The climate at NSGL is influenced primarily by its proximity to Lake Michigan and the southerly Gulf Stream. The average temperature ranges from 20.3 degrees Fahrenheit (°F) in January to 71.5 °F in July, with an annual average of 47.3 °F. The annual average precipitation recorded is 34.1 inches, with monthly average peaks as high as 4.2 inches in October and as low as 1.4 inches in February. The mean seasonal snowfall is 37.9 inches. Because of the proximity to Lake Michigan, winter precipitation in the Chicago area is often in the form of wet snow.

Prevailing winds are from the northwest, but during the summer months, they become more southerly. The average annual wind speed is eight to 12 miles per hour; however, winds may reach 50 to 60 miles per hour or higher in severe thunderstorms, tornadoes, or general winter storms.

10.2.2 Topography and Hydrology

Lakeshore bluffs rise from 20 to 75 feet in height above Lake Michigan and continue this trend through the west coast of the lake. Perpendicular to the bluff are ravines that discharge surface runoff to Lake Michigan. The topography of NSGL is similar to the surrounding area with buildings constructed along the bluff ravines and beachfront (see Figure ES-1).

Lake County has a surplus of water available from the surface waters of Lake Michigan. Communities near Lake Michigan, including Great Lakes, utilize this source for potable water rather than groundwater aquifers. NSGL consumes lake water due to proximity. NSGL has two drainage basins: Skokie Ditch and Pettibone Creek ravine and water from these sources is not potable. There are two storm water discharges to Skokie Ditch: a storm sewer discharge from Forrestal Village (a residential area of the base) and a storm sewer located underneath the Willow Glen Golf Course that discharges to the headwaters of Skokie Ditch. Pettibone Creek receives runoff from the main area of the installation and this water discharges into Lake Michigan from the inner harbor location of the installation.

10.2.3 Geology

The Wheaton Morainal Complex characterizes the geology of the area around NSGL. NSGL is listed as part of the Bluff-Ravine Complex of the Central Lowland Providence due to the flat land cut by ravines and edged on the east with the bluff overlooking Lake Michigan. Pettibone Creek ravine runs perpendicular to the shoreline of Lake Michigan, dividing NSGL. This land formation is the result of Pleistocene continental glacial deposits that released unconsolidated glacial drift along the bedrock. The glacial till is composed of varying proportions of clay, sand, silt, pebbles, and boulders and ranges from 40 to 200 feet in thickness because of the numerous glacial events that took place. The lakeshore presents the sandy phase of this formation. Underneath the glacial till are layers of dolomites, sand stones, and shale from sea deposits. The bedrock is Precambrian granite that is relatively horizontal.

10.2.4 Soil and Vegetation

The soil predominately found in NSGL is located on the tops of morainic ridges. Silt deposits overlay a calcareous glacial till of a silty, sandy, clay soil, which have moderate to poor draining capacity. Soil of the first five feet in depth is relatively uniform in grain size distribution, liquid limit, and plasticity. The shoreline at NSGL has eroded over the centuries; however, fill material was placed to extend the shoreline in the early 1940s. The lakefront area, composed of fill material, includes soil and other various materials, such as concrete and consolidated material, serving as a foundation for the sandy beach and adjacent structures on-site, including Ziegemeier Street. The majority of the land acquired by NSGL was cleared for buildings to accommodate housing and classroom needs; however, some native woodland remains. Terrestrial vegetation in the undeveloped sections of NSGL consists predominately of woodland species. The individual stand compositions are the result of a combination of natural seeding, forest management and planting. The majority of trees in the area are oak, maple, hickory, and other hardwoods. Native shrubbery consists of blackberry, black oak, blueberry, huckleberry, maple, osier, sassafras, and willow. Beach-grass, Kentucky bluegrass, Canada bluegrass, creeping red fescue, sheep fescue, tall fescue, and clover are all turf vegetation found in this location.

10.2.5 Hydrogeology

Groundwater in the Lake County area consists of four aquifers: the Glacial Drift Aquifer, the Silurian Dolomite formation, the Cambrian-Ordovician Aquifer, and the Mount Simon Sandstone. The Glacial Drift and Silurian Dolomite are shallow aquifers reaching depths of 150 to 500 feet. The shallow aquifer located along the shoreline at the installation has a depth to groundwater between two and five feet bgs due to the proximity to the lake. This water is not potable and is not utilized at NSGL or the surrounding area. The remaining aquifer system is known as the deep aquifer system, with depths ranging from 900 to 1,900 feet bgs. The shallow aquifer system recharges from local rainfall infiltration, while the deep aquifer system receives sources from areas of central Wisconsin.

10.2.6 Historical and Cultural Resources

The National Register of Historical Places added NSGL to the register in 1986. This includes 1,932 acres of land, 43 buildings, 14 structures and 6 objects of architectural/engineering significance. A Phase I Cultural Resource Investigation that outlines the properties examined is provided in the PA (Malcolm Pirnie, 2008). No structures placed on the National Register are located at the TSA Ranges, Pistol Butts, Machine Gun Range, or NTC Lakefront.

10.2.7 Ecology and Natural Resources

Natural resources at NSGL include Lake Michigan and the associated potable water and fish derived from the lake. However, the Navy's Integrated Natural Resources Management Plan (INRMP) for NSGL has no species of mammals, amphibians, fish, reptiles, or invertebrates documented at NSGL listed on state threatened or endangered species lists. Although undocumented during the surveys, threatened and/or endangered species may be present at the installation (INRMP, NTC Great Lakes, 2001). Protected species that are known to, or have the potential to, inhabit NSGL (as presented in the 2001 INRMP for NTC Great Lakes).

10.2.8 Site Access

Guarded entrance gates limit access to NSGL; however, access to the lakefront is not restricted once through the main installation gates. Thus, any Navy personnel or authorized visitor who has access through the main installation gates can access the four MRP sites without restriction. Additionally, access is not limited from the beach side of the installation off Lake Michigan. There are no specific restrictions associated with the sites.

10.3 SITE DESCRIPTION AND HISTORY

Each MRS is discussed below and includes information from the previous PA Reports performed by Malcolm Pirnie (2005 and 2008) and observations from the June 15, 2009 site walk conducted by Tetra Tech.

10.3.1 TSA Ranges

10.3.1.1 Site Background

Information regarding the TSA Ranges is limited to the history and site description presented in the Final Water Area Munitions Study NTC Lakefront (Malcolm Pirnie, 2005) and the PA (Malcolm Pirnie, 2008). The TSA Ranges site (including the land and water portions) encompasses approximately 30.5 acres. The land portion of the TSA Ranges is a small area (approximately 1.1 acre) located east of the bluff on the beachfront of Lake Michigan. The site consists of a trap range, a skeet range, and an archery range. Fill material was placed at the site to extend the shoreline for the addition of the skeet range to the installation. The water portion of this site, where munitions were fired, incorporates a SDZ of approximately 29.4 acres [consisting of overlapping areas for the skeet range (29 acres) and the trap range (6.6 acres)] located over Lake Michigan. The site originally consisted of only the trap range (constructed in the early 1940's), which was used in conjunction with the NTC Lakefront for Navy personnel to first experience targeting a moving object before handling the large caliber AA guns. The use of the trap range in conjunction with the AA training center ended with the closing of the NTC Lakefront site in October 1945; however, the trap range was likely used recreationally afterward, as it was common practice to allow enthusiasts to enjoy these ranges to offset costs for maintenance. Based on the construction drawings for the site, the skeet and archery ranges were added to the site in 1968 and were likely used for recreational purposes and for military practice sessions. Munitions use was limited to small arms ammunitions, primarily shotgun ammunition.

The equipment storage building and trap/skeet houses that were originally located at the site were demolished, and the ranges were decommissioned. Construction of a recreational vehicle (RV) park in July 2000 within the TSA Ranges site removed all visible signs of the ranges and trap house. No investigations have been conducted at the NSGL TSA Ranges site to date.

10.3.1.2 Conceptual Site Model

The CSM is based on available information and is depicted in Figures 10-1. The land portion of the site was originally divided into a trap range, a skeet range, and an archery range. The SDZs for the trap and skeet ranges extend into Lake Michigan as shown on Figure ES-2. The trap range consisted of shooting stations and a pull house for the target thrower. The skeet range had shooting stations along a firing arc and low and high houses to dispense the clay targets. The archery range had no structures and it is assumed that only archery took place on this range. Currently, an RV park is located at the site and no features of the former ranges are evident.

Archival data for ammunition orders from the 1940s and 1950s included the following munitions-related items that may have been used at the site:

- Shotguns, 12-gauge with slide repeating action and modified choke, 26-inch or 28-inch barrel.
- Shells, shotgun, 12-gauge, No. 7 ½ shot.
- Targets, clay pigeon.

However, during the 2008 visual survey of the site by Malcolm Pirnie, no physical evidence of the skeet range firing arc and trap range firing points/stations was visible due to the construction of the RV park. Additionally, no evidence of broken clay targets was observed during the site walk. The TSA Ranges site was dedicated to the use of small arms; therefore, MEC is not expected to be present at the site. A visual survey of the land portion of the range did not indicate any evidence of small arms ammunition (shotgun shells, pellets, or clay targets). The land was cleared for the construction of the RV park in July 2000 for 20 RV sites, 10 tent sites, and one group camping site. Malcolm Pirnie did not conduct a visual survey of the water portion of the TSA Ranges.

According to the Interstate Technology and Regulatory Council's (ITRC) "Characterization and Remediation of Soil at Closed Small Arms Firing Ranges," dated January 2003, shotgun ranges (skeet, trap, and sporting clays) typically involve widely dispersed lead particles that fall with little impact energy resulting in a penetration depth of small arms on the range floor of 1 foot or less. The document states that rounds that impact the range floor are typically a flat trajectory that fell short of or missed the target or those resulting from ricochet, and these fragments are usually found within the top 6 inches of soil. For skeet and trap ranges, the SDZs are the parts of the range receiving most of the impact from the munitions used on site. Clay pigeons typically are expected to be found in the area of maximum shotfall with potential fragmentation accumulation located less than 350 feet from the firing lines. While lead, from munitions, which missed the targets, is expected to accumulate in, the lead shot accumulation zone between 350 feet and 770 feet from the firing line. Munitions are spread out over a large area, and therefore, MC would likely be present throughout the combined SDZ. However, at NSGL, the majority of the SDZ is over Lake Michigan. The penetration depth would be decreased due to the frictional affects of the lead shot and clay pigeon pieces falling through the water column.

10.3.1.3 Potential or Known Sources of MC Contamination

No previous MC investigation has been performed at the TSA Ranges and no confirmation sampling for MCs was conducted during the redevelopment of the land portion of the site for use as an RV park. In addition, no records of the quantity of soil that may have been removed or the quantity of fill that may have been added to the site during construction activities were found. Therefore, the presence of MC in environmental media at the land portion of the range must be suspected. Because historical documents confirm the firing of small arms ammunition over Lake Michigan for training exercises at the TSA Ranges site, the presence of MC in environmental media in the water portion of the site was suspected in the PA. However, the concentrations of MC in Lake Michigan resulting from the use of munitions at the range would likely become extremely diluted by the large volume of surface water. The primary MC of concern includes lead and polycyclic aromatic hydrocarbons (PAHs). It is anticipated that other metals (antimony, arsenic. copper, and zinc) contamination will be spatially correlated with lead. Although these metals are associated with lead in bullets, their concentrations are expected to be much less than lead concentrations. However, elevated levels of lead and PAHs are not suspected to be detectable in Lake Michigan sediment because the relatively small and light lead shot and clay pigeon pieces have been subject to lake currents, storm surges, and other erosion forces within the shallow water column of the lake for decades. This amount of sediment transport, greatest in shallow waters near shore, would disperse and dilute the PAH and lead concentrations in the shallow unconsolidated lake sediment such that they would not be expected to be detected in the shallow lake sediment.

The land and water portions of the TSA Ranges are not suspected to contain MEC. The TSA Ranges site was dedicated to the use of small arms, which do not contain explosive components. Based on the information obtained during the data collection process, no special consideration munitions are known or suspected to have been used at the site. Therefore, the TSA Ranges site is not suspected to contain chemical warfare material filled munitions, electrically fuzed munitions, or depleted uranium associated munitions.

10.3.1.4 Contaminant Migration Pathways and Receptors

Potential MC on the land portion of TSA Ranges may potentially migrate in the soil and groundwater. Contaminants at the TSA Ranges site would likely migrate horizontally within the highly permeable soil located along the lakefront, which is primarily composed of sand. Although the upper portions of the surficial deposits do contain water, this supply is not used as a source of potable water at NSGL. The primary route of contaminant migration in groundwater would be through the perched shallow water-bearing zone present in the surficial deposits. Any potential contaminants entering the shallow water bearing zones would be expected to move laterally towards Lake Michigan, the lowest hydraulic point in the area. Therefore, no leaching of contaminants into the deeper groundwater aquifer would be expected. Potential MC in soil may be released to surface water runoff at the site during storm events; surface water would move laterally across the site and discharge to Lake Michigan. Potential MC may also migrate through the food chain; contaminants in the soil or groundwater may bioaccumulate in vegetation or small animals that may be consumed by human and ecological receptors. Potential MC in the water portion of the site may potentially migrate in the surface water of Lake Michigan or in lake sediment. Potential MC in the surface water of the lake is likely to become extremely diluted by the large volume of surface water, and it is unlikely that potential MC affects the drinking water supply from Lake Michigan. Potential MC in lake sediment may also migrate via dredging activities that may take place in Lake Michigan.

An exposure pathway is the course contamination takes from a contaminant source to a living organism (i.e., receptor). The potentially complete exposure pathways are based on expected future land usage similar to the current land usage patterns. Potentially complete exposure pathways exist on the land portion of the site for MC in both surface and subsurface soil (direct contact, ingestion, and inhalation during intrusive activities) for all potential human receptors. Slow migration rates, shallow potentiometric surface, and close proximity to Lake Michigan are anticipated to influence the migration of MC directly into the lake and limit migration into deeper aquifers.

Groundwater on-site is considered an incomplete pathway because it is not used as a drinking water source for the installation or for any other purpose. A formal land use restriction or land use control (LUC) prohibiting the installation of groundwater wells (with the exception of environmental monitoring wells) and the consumption of groundwater at NSGL was issued in the Memorandum of Agreement between the Illinois EPA and the Navy in September 2002. Any MC in groundwater discharging into Lake Michigan are expected to become extremely diluted by the large volume of surface water and are not expected to be a concern to the potable water use of the lake. Therefore, no receptors are expected to be exposed to contaminated groundwater via potable water consumption, although because the groundwater table is shallow, construction workers could be exposed during excavation activities. If an RI is warranted based on the investigation of the TSA Ranges, then groundwater will be addressed during the RI.

Human and ecological receptors could potentially contact, disturb, or remove soil from the site that was impacted by MC. Potential human receptors include Navy and civilian personnel (e.g., personnel who maintain or visit the RV park at the site), installation residents, authorized contractors and visitors, trespassers, and commercial and recreational anglers. Potential ecological receptors include common flora and fauna. Aquatic ecological receptors in Lake Michigan may include various species of fish, amphibians, and aquatic/wetlands vegetation. Human receptors may come into direct contact with MC while conducting grounds maintenance operations or environmental studies, or during recreational uses. Human and ecological receptors may also be exposed to MC that have been incorporated into the food chain (bio-accumulated in plants or small animals). No threatened or endangered species are known to occur on or near the sites.

10.3.2 Pistol Butts

10.3.2.1 Site Background

The former Pistol Butts site is located in a flat area on the shore of the NSGL Outer Harbor, south of the installation's former sewage treatment plant and is approximately four acres in size. The site boundary is bordered on the west by an approximately 50-foot high bluff and on the east by Lake Michigan. North of the Pistol Butts site is the storage building used to house landing craft and to the south is the area known as SeaBee Park. Currently the site is covered by the concrete retention pond, vegetated strip, and paved roadway southwest of the landing craft storage building (see Figure ES-3). There are very limited records available on the history of this site, which only appears on one archival map from 1909 (Appendix A). There is no evidence of the Pistol Butts remaining on the surface of NSGL and key features, such as a nearby seawall which would aid in locating the exact location of the berm/butts, are no longer in existence. The 1909 map indicates that the range was located immediately west of a seawall found at the edge of Lake Michigan. However, there remains some uncertainty regarding the exact location of the berm/butts based on current site features, and it is assumed that the firing direction was to the west into the natural hillside. Individual firing lines were not noted on the map; however, the firing lanes are indicated and appear to be approximately 40-yards long. It is assumed that only small arms training occurred on this site. MEC would not be expected to be present at a pistol range.

10.3.2.2 Conceptual Site Model

The CSM is based on available information and is depicted in Figures 10-2a and 10-2b (in profile). The Pistol Butts site has gone through multiple phases of redevelopment. Currently, the site is covered by the northern end of a concrete retention pond and paved roadway southwest of the landing craft storage building. The location of the former firing points and range floor has been developed into a concrete retention pond, vegetated grass strip, and a roadway and is currently several feet below the current ground surface. The location of the former bullet stop/butt (the natural bluff to the west of the site) appears to have been buried during redevelopment. The ITRC guidance document (ITRC, 2003), provides information on the general layout of pistol ranges, and areas that may be impacted with MC. The small arms range most likely included a primary impact berm/butt, a range floor, and a safety fan, which is a fan-shaped area around the site within which projectiles may fall under a wide range of conditions. If present, expended bullets passing through the targets or passing above the targets would continue on a trajectory into the impact berm/butt behind the range targets. The downrange berm/butt (or hillside in this case), which was directly behind the range targets, would contain concentrated metal from the expended bullets. Bullets aimed below the range targets would impact the soil near the toe of the berm/butt slope. Range fire that overshot the targets would impact the soil above and behind the targets, but most likely within the surficial soil of the impact berm/butt. However, the primary impacts from MC would be expected at the berms/butts.

The penetration depth of small arms on the range floor is generally 1 foot or less. The ITRC document states that rounds that impact the range floor are typically at a flat trajectory that fell short of or missed the target, or those that resulted from ricochet usually found within the top 6 inches of soil. Penetration depths within the side of the berms/butts may vary depending on the soil type and other conditions, but are expected to be as deep as one foot.

10.3.2.3 Potential or Known Sources of MC Contamination

Typically, the target areas of small arms ranges are constructed berms/butts or natural embankments in which bullets would serve as potential sources of metals contamination of surface soil. Lead is the primary metal of concern because it is the primary constituent in the munitions used at small arms ranges and because of its documented toxicity to human and ecological receptors. It is anticipated that other metals (antimony, arsenic, copper, and zinc) contamination will be spatially correlated with lead. Although these metals are associated with lead in bullets, their concentrations are expected to be much less than lead concentrations. Past investigations at other small arms ranges also indicate that NG has been detected at firing lines. At NSGL, the former Pistol Butts firing lines associated with this range have been excavated and the area has been developed into a concrete stormwater retention pond and access roadway; therefore, NG is no longer expected to be present (Figure 10-2b). The former berm/butts were potentially disturbed and buried during the redevelopment of the area as a wastewater treatment plant and currently a stormwater retention pond (Figure 10-2b). If present, antimony, arsenic, and lead are suspected in the subsurface approximately 6 to 16 feet bgs near the western edge of the stormwater retention pond. This depth corresponds to the approximate location of the hillside prior to redevelopment.

10.3.2.4 Contaminant Migration Pathways and Receptors

As described in Section 10.3.1.4, an exposure pathway is the course contamination takes from a contaminant source to a living organism (i.e., receptor). The removal of the potential contaminant source at the firing lines likely precludes it as a complete contaminant migration pathway. The potential contaminant source at the bullet impact area is a potentially complete pathway for construction workers and approved Navy contractors performing environmental sampling.

10.3.3 Machine Gun Range

10.3.3.1 Site Background

The Machine Gun Range was located immediately south of Building 13 (the Boat House) and the man-made boat channel at the harbor in the southern portion of the installation (Figure ES-4). The range was used for the training of naval personnel on small arms of 0.50-caliber or less. The dates of operation are unknown; however, an archival map (dated 1909) indicates that the Navy used the range during the early years of the Naval Station (Appendix A). The Machine Gun Range was not previously investigated. As a result, Malcolm Pirnie did not conduct a Preliminary Assessment (PA) for the Machine Gun Range because sufficient information on the site.

10.3.3.2 Conceptual Site Model

The CSM is based on available information and is depicted in Figures 10-3. Based on the 1909 archival map (Appendix A), electronic targets were placed on the breakwater for the Outer Harbor and were fired upon from the land western side of the harbor (over the water). There were two firing lines associated with the range - at 200-yards and 300-yards. The 200-yard range was located on the western edge of the Inner Harbor immediately west of the water's edge and the 300-yard range was located across the Boat Basin south of the western edge of the Boat House. The majority of the range floor consists of the Inner Harbor and the primary impact from MC (lead) is expected to be near the breakwater and would contain concentrated metal from the expended bullets. A paved road covers the majority of the 300-yard firing line and the 200-yard firing line is now an open grassy area with picnic tables near the area where landing craft are housed, as shown on Figure ES-4.

The area east of the Inner harbor is within the range fan for the Machine Gun Range; however, the MC concentrations in the Outer harbor and beyond resulting from use of munitions at the range would likely become extremely diluted by sediment transport and the large body of surface water. Elevated levels of lead are not expected to be detectable in Lake Michigan sediment because of the scattered nature of the shots, lake currents, storm surges, and other erosional forces on the unconsolidated sediments, in the shallow water column of the lake.

10.3.3.3 Potential or Known Sources of MC Contamination

Typically, the target areas of small arms ranges are constructed berms/butts or natural embankments in which bullets would serve as potential sources of metals contamination of surface soil, as described above. Lead is the primary metal of concern because it is the primary constituent in the munitions used at small arms ranges and because of its documented toxicity to human and ecological receptors. It is anticipated that other metals (antimony, arsenic, copper, and zinc) contamination will be spatially correlated with lead. Although these metals are associated with lead in bullets, their concentrations are expected to be much less than lead concentrations. Past investigations at other small arms ranges also indicate that NG has been detected at firing lines.

The 200-yard and 300-yard firing lines have been disturbed since the use of the range. The 300-yard firing line has been graded and paved to allow access to the shoreline, while the 200-yard firing line is a grass-covered area beside the harbor seawall. Potential MC (antimony, arsenic, lead, and NG) suspected at the firing lines may remain in shallow soil beside the road at the 300-yard firing line or in the soil exposed at the 200-yard firing line.

The Machine Gun Range did not use a berm/butt and targets were placed on, or in front of, the harbor breakwater. Bullets impacting the target area would be expected to collect in the lake sediment west of the breakwater of the Inner Harbor. The sediment east of the breakwater are subjected to lake currents and storm events which redistribute and dilute the bullet distribution, thereby decreasing the possibility of MC remaining in the sediment immediately beyond the target area. According to the Army Technical Manuals on small arms ranges (AR u50-10, TM 9-855), the maximum range for 0.50-caliber weapons is 7,500 feet with a muzzle velocity of 2,545 feet per second. The maximum range for .30-caliber weapons is 3,450 feet with a muzzle velocity of 2,700 feet per second. The SDZ for a 0.50-caliber bore sight range extends downrange from each firing line at a 5° angle for 7,600 feet. It is unclear from available information how many firing points existed at the machine gun range. The low angle of the fired munitions relative to the surface of Lake Michigan also increase, the potential for the bullet to skip or ricochet off the water surface, further dispersing the bullets beyond the breakwater. The maximum travel distance, uneven distribution of bullets, and sediment migration decrease the potential for identifying MC beyond the breakwater. However, in front of the breakwater, sediment is more sheltered from lake currents and storm events but may be disturbed by dredging activities of the harbor. Because the target area is south of the primary harbor travel path and situated near the corner of the harbor walls, potential MC may have remained partially undisturbed in this area.

The land and water portions of the Machine Gun Range are not suspected to contain MEC. The Machine Gun Range site was dedicated to the use of small arms (0.50-caliber or less), which do not contain explosive components. Based on the information obtained during the data collection process, no special consideration munitions are known or suspected to have been used at the site. Therefore, the Machine Gun Ranges site is not suspected to contain chemical warfare material filled munitions, electrically fuzed munitions, or depleted uranium associated munitions.

10.3.3.4 Contaminant Migration Pathways and Receptors

The soil at the firing lines is expected to be moderately to poorly drained, and contaminants could have infiltrated from surface to subsurface soil prior to the development of these areas. However, the presence of the concrete Inner Harbor walls immediately adjacent to the firing lines is expected to limit the migration of potential contaminants into groundwater by limiting the movement of infiltrated water. Therefore, no leaching of contaminants into the deeper groundwater aquifer would be expected. The potential MC in soil may be released to surface water runoff at the site during storm events; surface water would move laterally across the site and discharge to Inner Harbor in Lake Michigan. Potential MC may also migrate through the food chain; contaminants in the soil or groundwater may bioaccumulate in vegetation or small animals that may be consumed by human and ecological receptors.

Potential MC in the water portion of the site may potentially migrate in the surface water of Lake Michigan or in lake sediment. Potential MC in the surface water of the lake is likely to become extremely diluted by the large volume of surface water, and it is unlikely that potential MC would affect the drinking water supply from Lake Michigan. Potential MC in lake sediment may also migrate via dredging activities that may take place in Lake Michigan.

An exposure pathway is the course contamination takes from a contaminant source to a living organism (i.e., receptor). The potentially complete exposure pathways are based on expected future land usage similar to the current land usage patterns. Potentially complete exposure pathways exist on the land portion of the site for MC in both surface and subsurface soil (direct contact, ingestion, and inhalation during intrusive activities) for all potential human receptors.

Groundwater on-site is considered an incomplete pathway because it is not used as a drinking water source for the installation or for any other purpose as discussed above in Section 10.3.1.4. Any MC in groundwater discharging into Lake Michigan are expected to become extremely diluted by the large volume of surface water and are not expected to be a concern to the potable water use of the lake. Therefore, no receptors are expected to be exposed to contaminated groundwater via potable water consumption, although because the groundwater table is shallow, construction workers could be exposed during excavation activities. If an RI is warranted based on the investigation of the Machine Gun Range, then groundwater will be addressed during the RI.

Human and ecological receptors could potentially contact, disturb, or remove soil from the site that was impacted by MC. Potential human receptors include Navy, installation residents, authorized contractors and visitors, trespassers, and commercial and recreational anglers. Potential ecological receptors include common flora and fauna. Aquatic ecological receptors in Lake Michigan may include various species of fish, amphibians, and aquatic/wetlands vegetation. Human receptors may come into direct contact with MC while conducting grounds maintenance operations or environmental studies, or during recreational uses. Human and ecological receptors may also be exposed to MC that have been incorporated into the food chain (bio-accumulated in plants or small animals). No threatened or endangered species are known to occur on or near the four sites.

10.3.4 NTC Lakefront

10.3.4.1 Site Background

Between 1942 and 1945, personnel stationed at NSGL used the NTC Lakefront for AA artillery training. At that time, 25 gun mounts located on the beachfront were used to fire at targets towed over Lake Michigan. For purposes of the SI field investigation, the site has been divided into two portions: the land portion, which includes the firing line and all structures, and the water portion, which includes the range fan over Lake Michigan. Information regarding the NTC Lakefront site is limited to the history and site description presented in the Final Water Area Munitions Study NTC Lakefront (Malcolm Pirnie, 2005) and the PA (Malcolm Pirnie, 2008). The following sections include the NTC Lakefront site description, CSM and the contaminant migration pathways and potential receptors.

10.3.4.2 Conceptual Site Model

The land portion of the NTC Lakefront site is approximately one acre in size and is located east of the bluff on the beachfront of Lake Michigan. Prior to using the site as an AA range, the shoreline was extended with fill material in order to install the machine gun mounts. The water portion of this site includes a fan area of approximately 4,765 acres that extends out from the shoreline over Lake Michigan. Several million 20-millimeter (mm), 40-mm, and 1.1-inch rounds were fired during training activities. Potential munitions issues associated with the site are related to its former use as an AA training area and are not associated with the magazine building sited at this location. Figure ES-5 illustrates the NTC Lakefront site and the surrounding area.

The NTC Lakefront site is bordered by Lake Michigan to the east, a RV park to the north, the bluff to the west, and the Outer Harbor and Boat House to the south. The site is accessible via Ziegemeir Street, which is built over the former gun mount roundels. A magazine, Building 120, is the present lakefront magazine according to a March 17, 2003 listing of known ammunition storage and firing locations at NSGL. Over the years, the buildings associated with the Site, including the Garage and Storage, the Machine Gun Training Building, the Armory, and the Clippings and Empties building, were demolished. Sometime after 1962 a tank farm for fuel storage was constructed in the location of the former Machine Gun Training Building to meet the needs of the power plant. No construction records for the tank farm were available that could provide information regarding potential munitions findings and no visible signs of the demolished buildings exist today. The power plant is adjacent to the tank farm that services it (former location of the NTC Lakefront).

The topography of the NTC Lakefront greatly changes from the bluff to the lake. The bluff is steeply sloped and is the western boundary of the site. The former location of the AA training school buildings and firing points is presently paved over with concrete and asphalt and is generally flat. A sandy beach with a concrete breakwater to help control beach erosion is located to the east of the former gun mounts.

The Malcolm Pirnie survey team visited the site March 17 through 21, 2003, and observed the location of the firing points along Ziegemeir Street. The roundels for the gun emplacements were identified under the asphalt-paved road. There were no visual findings of ammunition or other ordnance during the site walk. The visual survey was non-intrusive; further investigation may lead to findings in the subsurface of the soil. No evidence of the former structures or the targets used for training purposes remains on the land surface with the exception of the roundels in the street for the AA artillery. A visual survey of the water portion of the range was not conducted.

10.3.4.3 Potential or Known Contaminant Sources

MEC is anticipated at the NTC Lakefront site as approximately 1,350 sailors a day were instructed in AA training using 20- and 40-millimeter guns and shot several million shells at cable-drawn targets towed by airplanes over Lake Michigan. The ammunition used included 20-mm, 40-mm, and 1.1-inch High Explosive (HE), High Explosive Incendiary (HEI), High Explosive Tracers (HET) and/or HET-Dark Ignition (DI) rounds. Based on the information obtained during the data collection process, no special consideration munitions are known or suspected to have been used at the site. Therefore, the NTC Lakefront Site is not suspected to contain chemical warfare material filled munitions, electrically fuzed munitions, or depleted uranium associated munitions (Malcolm Pirnie, 2005). Additional technical data regarding the munitions used at the NTC Lakefront site are included in Appendix A-3.

It is estimated that more than ten million rounds of ammunition were fired between 1942 and 1945. The dud rate is estimated at five percent resulting in several hundred thousand rounds containing explosives which may be present in the Lake Michigan sediment. Munitions that missed the target could have auto-detonated 3,000 yards from the firing point, which indicates that MEC or MEC debris may be present at this distance from the firing point within Lake Michigan. Munitions that did not detonate at this distance may have traveled a considerable distance before impact, depending on the munition type and typical range. Some of the munitions fired had potential ranges of more than 30,000 feet (5.68 miles). There may be "bands" of munitions or related debris stretching across the lake bottom in the SDZ at locations equivalent to the auto detonation distance and at other distances corresponding to impact areas associated with frequently used gun elevations or aerial target corridors. These "bands" would more likely resemble flattened ovals since firing would be concentrated near the center of the SDZ. Bands closer to the shore are expected to have lower density distribution and increasing density towards the middle of the SDZ. The density is then expected to decrease again closer to the maximum range of the munitions items. These bands correspond to the area of secondary impact and primary impact based on the historical trajectory of munitions and flight paths of the towed targets (Figure 10-4). MC (select metals – antimony, arsenic, copper, iron, lead, magnesium, strontium, and zinc; and select explosives – HMX, RDX, PETN, tetryl, and TNT) are expected in lake sediment associated with the remaining MEC in the SDZ, primarily in the primary impact zone. However, the concentrations of MC in Lake Michigan surface water resulting from the use of munitions at the range would likely become extremely diluted by the large volume of surface water and the length of time since the placement of the MC occurred.

10.3.4.4 Contaminant Migration Pathways and Receptors

Within the water portion of the Site, MEC in the form of 20-mm, 40-mm, and 1.1-inch HE rounds, and associated MEC debris, are expected to be located along the lake bottom within the range fan that extends over Lake Michigan. Many times these types of AA rounds used a self-destroying tracer. When the tracer detonated, it would set off the projectile burster, thereby destroying the projectile. The projectile debris would eventually settle on the lake bottom, and in the process, some MC (explosives and metals) might have been mixed into the lake surface water at that time. Undetonated AA rounds may corrode and decay over time, depositing explosives and metals to the lake bottom sediment. These MC may become entrained in the water column by lake mixing activities and may be transported beyond the site boundary by lake currents and storm events. These contaminants may eventually settle out onto the lake bottom, or may be diluted to very low levels.

Potentially complete exposure pathways exist for surface and subsurface sediment within Lake Michigan. Navy personnel, their visitors, recreationists, and commercial fishermen may be exposed to MC in sediment while diving, fishing, or swimming. Human and ecological receptors could also be exposed to MC via dredging activities that may take place in Lake Michigan. Wave action, internal mixing, or dredging activities may result in potential MC in subsurface sediment being transported to the lake bottom surface.

SAP WORKSHEET #11 – PROJECT QUALITY OBJECTIVES/SYSTEMATIC PLANNING PROCESS STATEMENTS

(UFP-QAPP Manual Section 2.6.1)

The ranges that will be investigated for the presence of MC include the TSA Ranges (PAHs, antimony, arsenic, and lead), the Pistol Butts (antimony, arsenic, and lead), the Machine Gun Range (antimony, arsenic, lead and NG), and the NTC Lakefront Water Portion (HMX, RDX, PETN, tetryl, TNT, antimony, arsenic, copper, iron, lead, magnesium, strontium, and zinc).

11.1 PROBLEM STATEMENT

Depending on the specific site uses and CSMs, surface soil, subsurface soil, and/or sediment at each NSGL MRS may be contaminated with a variety of constituents associated with munitions-related operations. Therefore, human and ecological receptors may be at risk from exposure to potentially contaminated media. An SI must be conducted to determine if MC is present at concentrations that exceed human and ecological screening criteria (and background for metals) so that the Project Team can decide if further investigation is required or not.

11.2 INFORMATION INPUTS

Data required for making the decisions include the following:

1. Field Screening Data: Lead concentrations in surface and subsurface soil determined with a Field Portable XRF Spectrometer. These "real time" measurements will be used as a field-screening tool for ensuring that samples are being collected in the areas most likely to be contaminated and to begin delineation of potential contamination. The XRF SOP-09 is included in Appendix B. The field results will be used to determine which samples are going to be sent to the off-site laboratory for definitive analysis from the TSA Ranges and Pistol Butts.

2. Laboratory Target Analyte Data: Laboratory analyses will be used to determine the concentrations of the select metals of concern, select explosives of concern, select propellants of concern, and select PAHs of concern in surface soil, subsurface soil, and sediment.

3. PALs: This investigation requires field screening and chemical data that can be used to determine whether further investigation is necessary. To conduct comparisons of site data to screening values and background concentrations, the laboratory method detection limits (MDLs), limits of detection

(LOD) and limits of quantitation limits (LOQs) must be low enough to measure MC concentrations to regulatory or other stringent and conservative values. The PALs are presented in Worksheet #15. For these SIs, the screening values, which are also the PALs, are as follows:

- XRF Field Measurement Lead PAL: A value of 100 milligrams per kilogram (mg/kg) will be used in the field as a screening value to determine which samples will be sent to the Laboratory for confirmation results. This value represents one quarter of the human health lead.
- USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites-Residential Direct Contact (R-RSL) Values (December 2009).
- Illinois EPA Tier 1 Soil Remediation Objectives - Residential/Industrial/Commercial (Online, 2009).
- Illinois EPA Proposed Amendments to Tiered Approach to Corrective Action Objectives (TACO) - Residential/Industrial/Commercial (2008).
- Threshold Effects Concentration from MacDonald, D.D., C.G. Ingersoll, and T.A. Berger, 2000. "Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems." Archives of Environmental Contamination and Toxicology, Vol. 39, pp. 20-31.
- Ontario Ministry of Environment (OMOE), 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. Ontario Ministry of Environment and Energy. August.
- Illinois EPA, 2000. Tiered Approach for Evaluation and Remediation of Petroleum Product Releases to Sediments. Draft, Update 2. Office of Chemical Safety. September 21.
- Talmage, S. S., D. M. Opresko, C. J. Maxwell, C. J. E. Welsh, F. M. Cretella, P. H. Reno, and F. B. Daniel. 1999. Nitroaromatic munition compounds: environmental effects and screening values. Reviews of Environmental Contamination and Toxicology 161:1-156.
- Background concentrations were considered for use as PALs because the MC metals occur naturally in soil and it is Navy policy to consider chemicals in the background concentration range as not representing contamination. However, there are no available background concentrations of soil or sediment for these MRSs.

4. Upgradient Samples: Upgradient samples will be collected to discern the presence of metals and PAH contamination from site activities relative to potential contamination entering the site from upgradient industrial sources. Explosives will not be included in the analyte list because they are not expected to occur as the result of military or industrial activities north of NSGL.

11.3 DEFINE THE BOUNDARIES OF THE STUDY (STEP 4)

Four MRSs at NSGL are being investigated for the presence of MC in surface soil, subsurface soil, and/or sediment. Each site has particular study areas of interest. These study areas include areas that are likely to be contaminated, such as target areas or firing lines. The table below describes the study areas within each munitions site at NSGL. The study areas within each site are presented in Figures 10-1 to 10.4. The extent of each study area represents the horizontal boundary(s) for the investigation within each MRS.

Table 11-1 NSGL Study Area Boundary Summary

NSGL MRS	Study Area
TSA Ranges (surface soil and sediment)	Firing Points Potential PAH Area/Shot Fall Zone
Pistol Butts (subsurface soil)	Target Area
Machine Gun Range (surface soil and sediment)	Firing Lines Target Area
NTC Lakefront (sediment)	Range Fan Lake Floor (less than 120 feet deep)

The initial vertical study boundary for surface soil or sediment investigation as described above will be limited to the top six inches of surface soil (except for the Machine Gun Range lake bottom sediments, which will also be investigated at the 6- to 12-inch depth interval), as this is the interval of soil that is expected to contain the maximum concentration of MC. For the Pistol Butts subsurface samples, the vertical study boundary is estimated to be between 6- to 16-feet bgs due to redevelopment around the pistol range target area.

11.4 DEVELOP THE ANALYTIC APPROACH (STEP 5)

Screening and definitive analytical data will be utilized for characterizing potential MC contamination at the MRSs. Screening-level lead soil concentrations will be measured in the field via an XRF Spectrometer, while the definitive analytical data will be generated off-site by the Laboratory. The XRF data will be used in the field to locate potential hot spots, thereby ensuring data is being collected from the most contaminated soil within each site. The XRF field-measured soil lead concentrations will be correlated to the off-site laboratory lead data. If the laboratory results and the field measurement correlate, the XRF data will be used in the future for guiding data collection during the RI (if required). The primary goal is to determine if MC concentrations are present in soil or sediment at concentrations that exceed PALs or background concentrations (metals and PAH only). All of the factors, including field screening and characterization of potential soil contamination, must be considered when planning further studies or response actions for the MRSs at NSGL.

Characterization Approach

Individual MC chemical concentrations will be determined definitively in soil and sediment for each of the selected metals, selected explosives and NG, and selected PAHs through analysis by the Laboratory. These concentrations will be compared to the PALs listed in Worksheet #15.

If the individual MC concentrations in all soil and/or sediment samples are less than each PAL, then no further investigation of MC is required at the site. If the individual MC concentrations in any surface soil, subsurface soil, or sediment sample are greater than the PAL, then the Project Team will return to the site to define the nature and extent of contamination, and conduct a human health and/or ecological risk assessment during an RI.

11.5 SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA

Data will be collected from areas known to be or most likely to be contaminated. Because the biased sampling locations were strategically selected to locate potential contamination and ensure that any MC are detected, probability limits for false positive and false negative decision errors were not established. Simple comparisons of measured concentrations to action levels are being used. The project team will use the measured results to determine whether the amount and type of data collected are sufficient to support the attainment of the project objectives. This will involve an evaluation of contaminant concentrations and an evaluation of uncertainty for contaminants that have action levels which are less than the method detection limits (MDLs) to ensure that contaminants are likely to have been detected, if present. If all data have been collected as planned and no data points are missing or rejected for quality reasons, the sampling event completeness will be considered satisfactory. If any data gaps are identified, including missing or rejected data, the project team will assess whether a claim of having obtained project objectives is reasonable. This assessment will depend on the number and type of identified data gaps; therefore, a more detailed strategy cannot be presented. All stakeholders will be involved in rendering the final conclusion regarding adequacy of the data. The data usability assessment will be conducted according to the approach presented in Worksheet #37.

11.6 DEVELOP THE PLAN FOR OBTAINING DATA

The sampling plan and rationale for the MC investigation at all four of the NSGL MRSs is presented in Worksheet #17.

SAP WORKSHEET #12 -- MEASUREMENT PERFORMANCE CRITERIA TABLE FIELD QUALITY CONTROL SAMPLE – ALL FRACTIONS

(UFP-QAPP Manual Section 2.6.2)

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria (MPC)	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Equipment Rinsate Blanks	Select Metals	One per 20 field samples per matrix per sampling equipment[1].	Accuracy/Bias/ Contamination	No analytes > ½ LOQ, except common lab contaminants, which must be < LOQ.	S&A
Field Duplicate	All Fractions	One per 10 field samples collected.	Precision	Values > 5X LOQ: Relative Percent Difference (RPD) ≤50%[2, 3] (solid).	S
Cooler Temperature Indicator	All Fractions	One per cooler.	Representativeness	Temperature between 2 and 6 degrees Celsius (4 ± 2 °C).	S

1 - Equipment rinsate blanks will be collected if non-dedicated hand augers or other sampling equipment are used.
2 - If duplicate values for non-metals are < 5x LOQ, the absolute difference should be < 2x LOQ.
3 - If duplicate values for metals are < 5x, the absolute difference should be < 4x LOQ.

SAP WORKSHEET #13 -- SECONDARY DATA CRITERIA AND LIMITATIONS TABLE

(UFP-QAPP Manual Section 2.7)

Secondary Data	Data Source (originating organization, report title and date)	Data Generator(s) (originating organization, data types, data generation / collection dates)	How Data Will Be Used	Limitations on Data Use
Final Preliminary Assessment	Final Preliminary Assessment Naval Station Great Lakes, Illinois, NTC Lakefront and TSA Ranges (Malcolm Pirnie, Inc.)	Malcolm Pirnie, February, 2008	PA Report data will be used as a guide to identify former target locations and to establish the SDZ boundary and investigation boundary.	None
Final Water Area Munitions Study	Final Water Area Munitions Study - Naval Training Center Lakefront, Naval Station Great Lakes, Illinois (Malcolm Pirnie, Inc.)	Malcolm Pirnie, April, 2005	Final Water Area Munitions Study data will be used as a guide to identify former target locations and to establish the SDZ boundary and investigation boundary.	None

SAP WORKSHEET #14 -- SUMMARY OF PROJECT TASKS

(UFP-QAPP Manual Section 2.8.1)

The MRP Site Investigation project activities consist of the following tasks:

- Field tasks, including:
  - Mobilization/demobilization and utility clearance
  - Soil and sediment sample collection
  - Quality control sample collection and other QC tasks
  - Field instrument calibration
  - Equipment decontamination
  - Investigation-derived wastes (IDW) removal and disposal
  - Geographical Positioning System (GPS) locating
  - XRF field screening of lead in soil
- Analytical tasks
- Data management
- Assessment and oversight
- Data review
- Project report

These tasks are summarized below. The SOPs and field documents referenced below and in other worksheets are included in Appendix B.

Field Tasks

- **Mobilization/Demobilization:** Mobilization/demobilization activities include field equipment procurement and transport to the work site, subcontractor procurement and coordination, utility awareness and clearance, location and setup of areas for decontamination and waste storage, acquisition of vehicles, and establishment of an on-site staging area.

  Equipment requirements will be finalized by the Tetra Tech FOL following the acceptance of the UFP-SAP. The FOL will review the scope of work and assemble equipment (e.g., vehicles, sampling, personal protection, and decontamination equipment) to implement and complete the field investigations.

  This list will be reviewed by the Tetra Tech PM. The Tetra Tech FOL will be responsible for receiving and unpacking the equipment and ensuring that all equipment is operable and calibrated.

The Tetra Tech FOL will be responsible for tracking equipment used in the field. The Tetra Tech FOL will be responsible for coordinating associated field activities with the Laboratory. The Tetra Tech Project Chemist will be responsible for coordinating the analytical services and the acquisition and delivery of sample containers to the site.

Prior to mobilization, the Tetra Tech FOL will review the roles and responsibilities of each field team member and review the requirements of the various field activities. A series of meetings will be conducted to review the sampling and analytical requirements. Upon mobilization, the Tetra Tech FOL will ensure that all field personnel have read and understand this UFP-SAP and the associated HASP, and ensure that all non-health and safety-related equipment is available and operational. The Tetra Tech SSO will ensure that all health and safety-related equipment is available and operational. The Tetra Tech SSO or designee will be responsible for reviewing the HASP with the field team members and subcontractors. Daily safety meetings will be held each morning by Tetra Tech to address the days planned activities.

Upon completion of all site investigation activities, the Tetra Tech FOL and field crew will demobilize from the site and transport field equipment back to the Tetra Tech Pittsburgh office or third party vendor, as necessary. All sample location pin flags will be removed from the sites, work areas will be thoroughly checked, and trash will be bagged and disposed of in a trash dumpster outside the field office.

- **Soil and Sediment Collection Tasks:** Surface soil samples will be collected in accordance with SOP-05 (Soil Sampling) and SOP-07 (Borehole and Soil Sample Logging). Sediment samples will be collected in accordance with SOP-06 (Surface Water and Sediment Sampling) and SOP-08 (Large Water Body Sediment Sampling). The sample-numbering scheme will be in accordance with SOP-02 (Sample Nomenclature). Methods for recording data are included in each of the above SOPs and in SOP-01 (Field Documentation). Sample labeling will be in accordance with SOP-01 (Field Documentation), and selection of sample containers, sample preservation, packaging, and shipping will be in accordance with SOP-09 (Non-Radiological Sample Handling).

The numbers and types of samples to be collected at each site along with associated analytical programs are presented in Worksheets #18.1 through #18.6.

Quality Control Tasks: Field blanks, equipment rinsate blanks, and field duplicates (FD) will be collected as identified in Worksheet #12. Matrix spike (MS) and matrix spike duplicate (MSD) (for organics) and MS/sample duplicate (for metals) field QC samples will be collected as identified in Worksheet #28. Initial and continuing calibration requirements are identified in Worksheet #24, and tuning, reagent blanks, surrogates, duplicates, laboratory control sample(LCS)/laboratory control sample duplicate (LCSD), and all other applicable QC for the analytical methods are presented in Worksheet #28.

- **Field Instrument Calibration**: These procedures are described in Worksheet #22.

- **Equipment Decontamination**: All reusable sampling equipment (e.g., stainless steel trowels and hand augers, etc.) will be decontaminated prior to sampling and between samples, according to the sequence established in SOP-10 (Decontamination of Field Sampling Equipment).

- **IDW Tasks:** Small quantities of waste material are anticipated to be generated during the field investigation, only surface soil, subsurface soil, and sediment samples are proposed for collection. Disposable trowels and personal protective equipment (PPE) will be properly bagged and disposed of in NSGL facility dumpsters. Excess soil from samples will be containerized and sampled for Resource Conservation and Recovery Act (RCRA) Toxicity Characteristic Leaching Procedure (TCLP) characteristics and general characterization parameters (listed below) in accordance with SOP-10 and Worksheet #19. Decontamination water will be collected and disposed of following SOP-10 and Worksheet #19, which provides information on the handling and collection of IDW. The waste containers will be stored on-site in a designated waste storage area designated by the NSGL POC. NSGL will be responsible for disposal of all wastes generated during the SIs.

IDW Sample Analysis includes the following:

TCLP RCRA Metals
TCLP Volatile Organic Compounds
TCLP Semi-volatile Organic Compounds
TCLP Polychlorinated Biphenols
TCLP Organochlorine Pesticides
TCLP Chlorinated Herbicides
Density
British Thermal Units (BTU)
Flashpoint
pH
Reactive Cyanide and Sulfide
Phenolics (Low Level Detection)

Water Content (Karl Fisher method)

Paint Filter Test

Color

Odor

- **GPS**: A hand-held GPS unit capable of sub-meter accuracy (i.e., Trimble GeoXM or Trimble GeoHX) will be used to locate all sampling points according to SOP-04 (Global Position System). The GPS equipment will be checked on third order control monuments before and after each day's use, and these checks will be documented in the field notebooks. The GPS coordinate system will be set up so all data points are collected in North American Datum of 1983 (NAD83) Illinois State Plane coordinates in U.S. survey feet. To ensure sub-meter accuracy, the GPS SOP requires a minimum of six satellites to capture a position.

- **XRF Field Screening:** On-site field XRF analysis for lead in soil will be conducted at the TSA Ranges and Pistol Butts sites. Analysis will be performed according to SOP-09 (Field Portable X-Ray Fluorescence Analysis of Soil and Sediment Using the INNOV-X Alpha Series Instrument). A minimum of 20 samples collected from each site where XRF field screening is being conducted will be sent to the Laboratory for confirmation analysis.

Analytical Tasks - Chemical analysis for select metals, select PAHs, select explosives and NG will be performed by Empirical, which is a Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) accredited laboratory. A copy of the laboratory certification for Empirical can be found in Appendix C. Analyses will be performed in accordance with the analytical methods identified in Worksheet #19. The Laboratory will meet the PALs specified in Worksheet #15. The Laboratory will perform the chemical analyses following laboratory-specific SOPs (Worksheets #19 and #23) developed based on the methods listed in Worksheets #19 and #30. Copies of the Laboratory SOPs are included in Appendix C.

Data Management

- Project documentation and records
  - Field sample collection and field measurement records are described in Worksheets #27 and #29.
  - Laboratory data package deliverables are described in the analytical specifications in Appendix C.
  - Data assessment documents and records are listed in Worksheet #29.

Data Handling and Management - After the field investigation is completed, the field sampling log sheets will be organized by date and media and filed in the project files. The field logbooks for this project will be used only for these sites, and will also be categorized and maintained in the project files after the completion of the field program. Project personnel completing concurrent field sampling activities may maintain multiple field logbooks. When possible, logbooks will be segregated by sampling activity. The field logbooks will be titled based on date and activity. The data handling procedures to be followed by the Laboratory will meet the requirements of the technical specification. The electronic data results will be automatically downloaded into the Tetra Tech database in accordance with proprietary Tetra Tech processes.

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

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

- **Data Storage, Archiving, and Retrieval**. The data packages received from the subcontracted laboratory are tracked in the data validation logbook. After the data are validated, the data packages are entered into the Tetra Tech CLEAN file system and archived in secure files. The field records including field logbooks, sample logs, chain-of-custody records, and field calibration logs will be submitted by the Tetra Tech FOL to be entered into the CLEAN file system prior to archiving in secure project files. The project files are audited for accuracy and completeness. At the completion of the Navy contract, the records will be stored by Tetra Tech and eventually handed over to NAVFAC.

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

Assessment and Oversight – Refer to Worksheet #32 for assessment findings and corrective actions and Worksheet #33 for QA management reports.

Data Review

- Data verification is described in Worksheet #34.
- Data validation is described in Worksheets #35 and #36.
- Usability assessment is described in Worksheet #37.

Project Report - Draft and Final versions of the site inspection (SI) report will be prepared and submitted to the Navy and Illinois EPA for review. The project reports will include the following sections:

- Executive Summary – includes a brief description of the work conducted and the findings.

- Introduction and Background – includes a description of the history of operations and activities at the site and a summary of any previous investigations and removal actions.

- Description of Field Investigations – includes a summary of the work performed in the approved UFP-SAP and any field modifications as documented by the Tetra Tech FOL. This section will include maps showing the sampling locations and tables summarizing the data collected.

- Data Quality – includes a summary of quantitative analytical performance indicators such as completeness, precision, bias and sensitivity, as well as qualitative indicators such as representativeness and comparability. Includes a reconciliation of project data with the DQOs and an identification of deviations from this UFP-SAP.

  A data usability assessment will be used to identify significant deviations in analytical performance that could affect the ability to meet project objectives. The elements of this review are presented in Worksheet #37.

- Nature and Extent of Contamination – includes the contamination previously (if applicable) found in each medium sampled in relation to the conceptual site model. This section will note the removals previously conducted (if applicable), the contamination addressed and any additional contaminants found during this field effort. Detected contaminant concentrations will be tabulated for each medium and depicted on maps.

- Contaminant Fate and Transport – includes a description of the contaminants detected and their behavior in the soil, bedrock, and sediment, particularly with emphasis on the future migration of these contaminants to any possible exposure areas.

- Summary and Conclusions – includes a summary of the findings, a conclusion assessing whether delineation of contamination is adequate, and a recommendation for further investigations if needed.

Tetra Tech will submit the draft report before any additional sampling begins. The final version of the report will submitted in hardcopy and electronic format to the project stakeholders.

SAP WORKSHEET #15 -- REFERENCE LIMITS AND EVALUATION TABLE

(UFP-QAPP Manual Section 2.8.1)

Matrix: Surface and Subsurface Soil
Analytical Group: Select Metals

Analyte	CAS Number	PAL [1] (mg/kg)	PAL Reference	Project Quantitation Limit Goal (mg/kg)	Empirical Laboratories [2]		
					LOQ	LOD	MDL
					(mg/kg)		
Antimony	**7440-36-0**	**0.27**	**Eco SSL**	**0.090**	**0.5**	**0.40**	**0.25**
Arsenic	**7440-38-2**	**0.39**	**R-RSL**	**0.13**	**0.5**	**0.3**	**0.15**
Copper	7440-50-8	28.0	Eco SSL	9.3	0.5	0.4	0.25
Iron	7439-89-6	55,000	R-RSL	18,300	5	3	1.5
Lead	7439-92-1	11.0	Eco SSL	3.7	0.25	0.15	0.075
Magnesium	7439-95-4	325,000	TACO	108,000	250	150	50
Strontium	7440-24-6	47,000	R-RSL	15700	TBD	TBD	TBD
Zinc	7440-66-6	46.0	Eco SSL	15.3	1	0.5	0.25

Bold rows indicate that the PAL is less than the corresponding LOQ but greater than the corresponding MDL.

Notes:
CAS = Chemical Abstracts Service
Eco SSL = Eco Soil Screening Level. USEPA, February 2005. Guidance for Developing Ecological Soil Screening level. Office of Solid Waste and Emergency and Response. OSWER Directive 92857-55, February. Separate documents are available for each chemical at http://www.epa.gov/decotox/ecossl/
LOD = Limit of Detection
LOQ = Limit of Quantitation
MDL = Method of Detection Limit
mg/kg = milligrams per liter
PAL = Project Action Limit
R-RSL = USEPA Residential Regional Screening Level. USEPA, December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tales/index.htm/
TACO = Tiered Approach to Corrective Actions Objectives, residential soil ingestion criteria (http://www.ipcb.state.il.us/documents/dsweb/Get/Document-38408/)
TBD = To Be Determined

Footnotes:

1. The PAL is the lesser of the Illinois EPA TACO residential soil criteria, the proposed Illinois EPA update to the TACO criteria, the USEPA R-RSL, and the ecological screening criteria for soil. See detailed references in Appendix A-2 for further information.
2. The LOQs, LODs, and MDLs from Empirical are presented and are current as of January 2010. Detection limits are subject to change, and actual limits will be evaluated during the data usability assessment to ensure that the MDLs and LOQs actually achieved are satisfactory to support the data evaluations.

Matrix: Sediment
Analytical Group: Select Metals

Analyte	CAS Number	PAL [1] (mg/kg)	PAL Reference	Project Quantitation Limit Goal (mg/kg)	Empirical Laboratories [2]		
					LOQ	LOD	MDL
					(mg/kg)		
Antimony	7440-36-0	2.0	Illinois EPA	0.67	0.5	0.4	0.25
Arsenic	7440-38-2	9.79	TEC	3.3	0.5	0.3	0.15
Copper	7440-50-8	31.6	TEC	10.5	0.5	0.4	0.25
Iron	7439-89-6	20,000	OMOE	6670	5	3	1.5
Lead	7439-92-1	35.8	TEC	11.9	0.25	0.15	0.075
Magnesium	7439-95-4	NA	--	NA	250	150	50
Strontium	7440-24-6	NA	--	NA	1.2	0.6	0.3
Zinc	7440-66-6	121	TEC	40.3	1	0.5	0.25

Bold rows indicate that the PAL is less than the corresponding LOQ but greater than the corresponding MDL.

Notes:
CAS = Chemical Abstracts Service
Illinois EPA = Illinois Environmental Protection Agency, 2000. Tiered Approach for Evaluation and Remediation of Petroleum Product Releases to Sediment. Draft, Update 2. Office of Chemical Safety, September 21.
LOD = Limit of Detection
LOQ = Limit of Quantitation
MDL = Method Detection Limit
mg/kg = milligram per kilogram
OMOE = Ontario Ministry of the Environment, 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. Ontario Ministry of Environment and Energy. August.
TEC = Threshold Effects Concentration from MacDonald, D.D., C.G. Ingersol, and T.A. Berger, 2000. "Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems." Archives of Environmental Contamination and Toxicology, vol. 39, pp. 20-31.
TBD = To Be Determined

Footnotes:
1. The LOQs, LODs, and MDLs from Empirical are presented and are current as of January 2010. The detection limits are subject to change, and actual limits will be evaluated during the data usability assessment to ensure that the MDLs and LOQs actually achieved are satisfactory to support the data evaluations.

Matrix: Soil
Analytical Group: Select Propellants

Analyte	CAS Number	PAL [1] (mg/kg)	PAL Reference	Project Quantitation Limit Goal (mg/kg)	Empirical Laboratories [2]		
					LOQ	LOD	MDL
					(mg/kg)		
Nitroglycerin (NG)	55-63-0	6.1	R-RSL	2.0	2.0	1.0	0.0005

Notes:
CAS = Chemical Abstracts Service
LOD = Limit of Detection
LOQ = Limit of Quantitation
MDL = Method of Detection
mg/kg = milligrams per kilogram
PAL = Project Action Limit
R-RSL = USEPA Residential Regional Screening Level, USEPA, December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm/

Footnotes:
1. The LOQs, LODS, and MDLs from Empirical are presented and are current as of January 2010. The detection limits are subject to change, and actual limits will be evaluated during the data usability assessment to ensure that the MDLs and LOQs actually achieved are satisfactory to support the data evaluations.

Matrix: Sediment
Analytical Group: Select Explosives

Analyte	CAS Number	PAL [1] (mg/kg)	PAL Reference	Project Quantitation Limit Goal (mg/kg)	Empirical Laboratories [2]		
					LOQ	LOD	MDL
					(mg/kg)		
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	**2691-41-0**	**0.0047**	**Talmage**	**0.002**	**0.32**	**0.2**	**0.001**
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	**121-82-4**	**0.013**	**Talmage**	**0.0043**	**0.4**	**0.2**	**0.001**
2,4,6-Trinitrotoluene (TNT)	**118-96-7**	**0.092**	**Talmage**	**0.0307**	**0.32**	**0.2**	**0.001**
Pentaerythritol tetranitrate (PETN)	78-11-5	NA	--	NA	2.0	1.0	0.5
2,4,6-Trinitrophenylmethylnitramine (Tetryl)	479-458	NA	--	NA	0.32	0.16	0.1

Bold rows indicate that the PAL is less than the corresponding LOQ but greater than the corresponding MDL.

Notes:
CAS = Chemical Abstracts Service
LOD = Limit of Detection
LOQ = Limit of Quantitation
MDL = Method of Detection
mg/kg = milligrams per kilogram
NA = Not available
PAL = Project Action Limit
Talmage = Talmage, S., Opresko, D., Maxwell, C., Welsh, C., Cretella, F., Reno, P., and Daniel F., 1999 Nitroaromatic munition compounds: Environmental effects and screening values. Review of Environmental Contamination and Toxicology 161:1-156. Value assumes 1 percent total organic carbon (TOC). See detailed references in Appendix A-2 for further information.

Footnotes:
1. Value assumes 1 percent total organic carbon (TOC). See detailed references in Appendix A-2 for further information.
2. The LOQs, LODs, and MDLs from Empirical are presented and are current as of January 2010. The detection limits are subject to change, and actual limits will be evaluated during the data usability assessment to ensure that the MDLs and LOQs actually achieved are satisfactory to support the data evaluations.

Matrix: Soil
Analytical Group: Organics – Select PAHs

Analyte	CAS Number	PAL [1] (mg/kg)	PAL Reference	Project Quantitation Limit Goal (mg/kg)	Empirical [2]		
					LOQ	LOD	MDL
					(mg/kg)		
1-Methylnaphthalene	90-12-0	22	R-RSL	7	0.00667	0.0027	0.0017
2-Methylnaphthalene	91-57-6	29	Eco SSL	10	0.00667	0.0027	0.0017
Acenaphthene	83-32-9	29	Eco SSL	10	0.00667	0.0027	0.0012
Anthracene	12-01-27	29	Eco SSL	10	0.00667	0.0027	0.0008
Benzo(a)anthracene	56-55-3	0.15	R-RSL	0.05	0.00667	0.0027	0.0014
Benzo(a)pyrene	50-32-8	0.015	R-RSL	0.005	0.00667	0.0027	0.0013
Benzo(b)fluoranthene	205-99-2	0.15	R-RSL	0.05	0.00667	0.0027	0.0015
Benzo(g,h,i)perylene	191-24-2	1.1	Eco SSL	0.4	0.00667	0.0027	0.0015
Benzo(k)fluoranthene	207-08-9	1.1	Eco SSL	0.4	0.00667	0.0027	0.0013
Chrysene	218-01-9	1.1	Eco SSL	0.4	0.00667	0.0027	0.0011
Dibenzo(a,h)anthracene	53-70-3	0.015	R-RSL	0.005	0.00667	0.0027	0.0015
Fluoranthene	206-44-0	29	Eco SSL	10	0.00667	0.0027	0.0017
Fluorene	86-73-7	29	Eco SSL	10	0.00667	0.0027	0.0012
Indeno(1,2,3-cd)pyrene	193-39-5	0.15	R-RSL	0.05	0.00667	0.0027	0.0015
Naphthalene	91-20-3	22	TACO	7	0.00667	0.0027	0.0023
Pyrene	129-00-0	1.1	Eco SSL	0.4	0.00667	0.0027	0.0015

Notes:
CAS = Chemical Abstracts Service
Eco SSL = Eco Soil Screening Level. USEPA, February 2005. Guidance for Developing Ecological Soil Screening Level. Office of Solid Waste and Emergency and Response. OSWER Directive 92857-55. February. Separate documents are available for each chemical at http://www.epa.gov/ecotox/ecossl/ .
LOD = Limit of Detection
LOQ = Limit of Quantitation
MDL = Method Detection Limit
mg/kg = milligrams per kilogram

R-RSL = USEPA Residential Regional Screening Level, USEPA, December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm/
TACO = Tiered Approach to Corrective Actions Objectives, residential soil ingestion criteria (http://www.ipcb.state.il.us/documents/dsweb/Get/Document-38408/)
TBD = To Be Determined

Footnotes:

1. The PAL is the lesser of the Illinois EPA TACO residential soil criteria, the IEPA proposed update to the TACO, the USEPA R-RSL, and the ecological screening criteria for soil. See detailed references in Appendix A-2 for further information.

2. The LOQs, LODs, and MDLs for Empirical are presented and are current as of January, 2010. The detection limits are subject to change, and actual limits will be evaluated during the data usability assessment to ensure that the MDLs and LOQs actually achieved are satisfactory to support the data evaluations.

Matrix: Sediment
Analytical Group: Organics – Select PAHs

Analyte	CAS Number	PAL (1) (mg/kg)	PAL Reference	Project Quantitation Limit Goal (mg/kg)	Empirical (2)		
					LOQ	LOD	MDL
					(mg/kg)		
1-Methylnaphthalene	90-12-0	0.0202	R5	0.007	0.00667	0.0027	0.0017
2-Methylnaphthalene	91-57-6	0.0202	R5	0.007	0.00667	0.0027	0.0017
Acenaphthene	83-32-9	0.00671	R5	0.002	0.00667	0.0027	0.0012
Anthracene	12-01-27	0.0572	TEC	0.02	0.00667	0.0027	0.0008
Benzo(a)anthracene	56-55-3	0.108	TEC	0.04	0.00667	0.0027	0.0014
Benzo(a)pyrene	50-32-8	0.15	TEC	0.05	0.00667	0.0027	0.0013
Benzo(b)fluoranthene	205-99-2	10.4	R5	30	0.00667	0.0027	0.0015
Benzo(g,h,i)perylene	191-24-2	0.17	R5	0.6	0.00667	0.0027	0.0015
Benzo(k)fluoranthene	207-08-9	0.24	R5	0.08	0.00667	0.0027	0.0013
Chrysene	218-01-9	0.166	TEC	0.05	0.00667	0.0027	0.0011
Dibenzo(a,h)anthracene	53-70-3	0.033	TEC	0.01	0.00667	0.0027	0.0015
Fluoranthene	206-44-0	0.423	TEC	0.1	0.00667	0.0027	0.0017
Fluorene	86-73-7	0.0774	R5	0.003	0.00667	0.0027	0.0012
Indeno(1,2,3-cd)pyrene	193-39-5	0.2	R5	0.07	0.00667	0.0027	0.0015
Naphthalene	91-20-3	0.176	TEC	0.06	0.00667	0.0027	0.0023
Pyrene	129-00-0	0.795	TEC	0.3	0.00667	0.0027	0.0015

Notes:
CAS = Chemical Abstracts Service
LOD = Limit of Detection
LOQ = Limit of Quantitation
MDL = Method Detection Limit
mg/kg = milligrams per kilogram
R5 = USEPA, 2003. Region 5 Ecological Screening Level, August 22
TBD = To Be Determined

TEC = Threshold Effects Concentration from MacDonald, D.D., C.G. Ingersoll, and T.A. Berger, 2000. "Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems." Archives of Environmental Contamination and Toxicology, Vol. 39, pp. 20-31.

Footnotes:

2. The LOQs, LODs, and MDLs for Empirical are presented and are current as of January, 2010. The detection limits are subject to change, and actual limits will be evaluated during the data usability assessment to ensure that the MDLs and LOQs actually achieved are satisfactory to support the data evaluations

SAP WORKSHEET #16 -- PROJECT SCHEDULE/TIMELINE TABLE

(UFP-QAPP Manual Section 2.8.2)

Activity	Organization	Dates (MM/YY)	
		Anticipated Date(s) of Initiation	Anticipated Date of Completion
Prepare Rough Draft SI Work Plan and Appendices	Tetra Tech	10/2009	11/2009
Submit Rough Draft SI Work Plan and Appendices	Tetra Tech	**11/2009**	**11/2009**
Navy Review	Navy	12/2009	12/2009
Receive Comments/Comment Resolution	Tetra Tech	12/2009	01/2010
Prepare Draft SI Work Plan and Appendices	Tetra Tech	12/2009	01/2010
Submit Draft SI Work Plan and Appendices	Tetra Tech	**01/2010**	**01/2010**
Navy and Regulator Review	Navy and Illinois EPA	02/2010	03/2010
Receive Comments/Comment Resolution	Tetra Tech	03/2010	03/2010
Prepare Final SI Work Plan and Appendices	Tetra Tech	03/2010	03/2010
Submit Final SI Work Plan and Appendices	Tetra Tech	**03/2010**	**03/2010**
Field Investigation	Tetra Tech	04/2010	04/2010
Laboratory Analysis	Empirical	04/2010	04/2010
Data Validation	Tetra Tech	04/2010	**05/2010**
Database Entry	Tetra Tech	06/2010	06/2010
Prepare Rough Draft SI Report	Tetra Tech	04/2010	06/2010
Submit Rough Draft SI Report and Appendices	Tetra Tech	**06/2010**	**06/2010**
Navy Review	Navy	06/2010	06/2010
Receive Comments/Comment Resolution	Tetra Tech	06/2010	06/2010
Prepare Draft SI Report	Tetra Tech	06/2010	07/2010
Submit Draft SI Report	Tetra Tech	07/2010	**07/2010**
Navy and Regulator Review	Navy and Illinois EPA	07/2010	08/2010
Receive Comments/Comment Resolution	Tetra Tech	08/2010	08/2010
Prepare Final SI Report	Tetra Tech	08/2010	09/2010
Submit Final SI Report	Tetra Tech	09/2010	09/2010

SAP WORKSHEET #17 – SAMPLING DESIGN AND RATIONALE

(UFP-QAPP Manual Section 3.1.1)

This section describes sampling locations, methods, and rationale for the sampling activities to be conducted in support of the MC SI at the four MRP sites located at NSGL. These sites are the TSA Ranges, Pistol Butts, Machine Gun Range, and the NTC Lakefront. A separate UFP-SAP (Volume II) has been prepared for the MEC investigation of the NTC Lakefront (Water Portion).

All referenced field SOPs are presented in Appendix B. All proposed surface soil samples will be collected via hand auger in accordance with SOP-05. Surface soil samples will be collected from 0- to 6-inches bgs. Subsurface soil samples will be collected by DPT in accordance with SOP-07 (Borehole and Sample Logging). The proposed data collection programs for the MRS SIs are presented on Figures 17-1 through 17-5.

Most of the sampling designs consist of samples spaced along transects or within grids as shown on the respective figures for each site. The sampling objective is to gather the necessary information to determine whether specific metals, PAHs, and explosives associated with the use of the sites as small arms ranges or AA training ranges, are present in soil or sediment because of contaminants leaching from lead shot, trap and skeet target fragments, or MEC. All field visual observations (including physical observation of lead shot, trap and skeet target fragments, and MEC; topography; and the geology of the site) will be recorded on sample log sheets. Any skeet fragments or lead shot observed in a sample will be removed prior to field screening following SOP-10 for the XRF. Any encounters with metallic objects or other objects that indicate a potential contaminant source or hazard shall be reported to the Tetra Tech FOL/SSO, and appropriate actions will be taken as specified in this UFP-SAP and the associated HASP.

All soil sample locations shall be marked with a stake or a brightly colored pin flag indicating the sample location. Additional brightly colored flagging may be tied to an adjacent tree or shrub to identify a sample location. Sediment samples will be located at the time of collection using GPS. Coordinates will be determined by a handheld sub-meter accuracy GPS device at each individual sample location, which will allow for future studies or guide in any removal action. Existing third-order monuments or existing wells will be used to calibrate the GPS positions to the site. Pre-determined Geographic Information System (GIS) grade sample coordinates may be utilized in locating proposed sample locations. All sample location flip markers will be removed prior to final demobilization.

Soil and Sediment Sampling Strategy

The chosen soil and sediment sampling strategy employs a design to target those areas most likely to be contaminated based on the CSMs presented in Worksheet #10. The data collected under this conservative strategy are expected to represent concentrations greater than those which human or ecological receptors would actually be exposed. The strategy, therefore, ensures that a potential unacceptable human health or ecological risk is not overlooked. Additional sampling strategies can be found under the discussions for each individual site below. Details regarding soil and sediment sampling equipment and procedures are included in Worksheet #14 and the SOPs are contained in Appendix B.

The total number of soil and sediment analyses for each analyte group are tabulated in Worksheet #18 (18.1 through 18.6) and are summarized in Worksheet #20. Soil and sediment QA/QC samples will be collected at the frequencies listed in Worksheet #20. Worksheet #19 presents a summary of the sample analyses, container types and volumes, preservation requirements, and holding times for the samples to be collected.

At all soil sample locations where lead will be screened on-site, the sample material will be placed in a one-gallon Ziploc plastic baggy, which will be marked with the sample ID, depth, date, and time. The samples will then be thoroughly mixed within the baggie. The homogenized samples will be transferred back to the field office where a portion of the samples for the TSA Ranges and Pistol Butts sites will be processed and undergo XRF screening in accordance with SOP-10 (Appendix B). In accordance with Worksheets #18.1 and #18.2, a specified number of these samples will be selected for off-site definitive analysis by the Laboratory for select metals (antimony, arsenic, and lead). Unused portions of a collected soil sample or sediment samples collected using the vibracore method, not used for analysis will be containerized as IDW. Unused portions of surface sediment samples will be placed back into the lake near the sample location in accordance with SOP-08 (Appendix B).

XRF Analysis and Correlation

All surface soil samples collected from the TSA Ranges and all subsurface soil samples from the Pistol Butts will undergo screening in the field utilizing XRF in accordance with SOP-10 (Appendix B). Prior to collection of the XRF samples, a site walkover will be conducted to assess whether any lead shot, bullets, bullet fragments, or clay target remnants are visible on the surface or in the very near surface soil throughout each site. The Tetra Tech FOL will use visual observations and an inspection of the site to determine which areas are most likely to be contaminated, and if necessary, adjust the proposed sample locations accordingly. In the absence of field conditions indicating otherwise, the Tetra Tech FOL shall attempt to collect samples at or near the locations identified on sampling Figures 17-1 through 17-2. In the event all samples analyzed for lead using the XRF are below the screening value, the default samples listed in Worksheet #18 will be sent to the Laboratory.

A correlation study comparing the on-site XRF analytical data and the off-site laboratory analytical data will be completed after the field effort to establish laboratory-equivalent lead concentrations based on the field measurements. The correlation will consist or lead concentrations up to a maximum field concentration of 3,000 mg/kg for the TSA Ranges because elevated concentration may skew the correlation. This approach limits the range of interest to those values near the 200 to 400 mg/kg criteria for field screening and off-site definitive analysis. This limitation will prevent very large lead concentrations from distorting the correlation. The correlation methodology is presented in Appendix B.

The XRF correlation methodology is as follows.

To predict lab concentrations based on XRF results a correlation analysis will be performed on the Ordinary Least Squares (OLS) Regression model. The R-Square statistic will be used to measures how well the regression line fits the data (i.e. how well the XRF data can predict the fixed based laboratory results).

First, the OLS assumptions are evaluated:

1) Determine that there is a linear relationship between the XRF results and fixed based laboratory results.
2) Determine that the residuals of the OLS are normally distributed.
3) Determine that the residuals of the OLS do not display non-constant variance.

If the assumptions of the OLS model are violated, a linear transformation the data is performed so the assumptions of the model are met.

After demonstrating that the assumptions are valid, compute the OLS model.

From the OLS model, compute the R-Square statistic:

$$\left(r = \frac{1}{n-1} \sum \left(\frac{x_i - \bar{x}}{s_x} \right) \left(\frac{y_i - \bar{y}}{s_y} \right) \right)^2$$

TSA Ranges

Fifty-five discrete surface soil samples are proposed for collection at 55 sample locations at the TSA Ranges (divided between the trap range and skeet range), as shown on Figure 17-1. Sample locations are presented in a spatial grid pattern to cover the land portion of the site immediately in front of the former firing arch and firing point. All discrete surface soil samples will undergo field XRF screening for lead in accordance with SOP-10 (Appendix B).

Twenty soil samples from the TSA Ranges are proposed for submittal to the Laboratory for definitive analysis of select metals and PAHs, as presented in Worksheet #18.1. The results of the field XRF analyses or visual evidence of clay pigeons will be the basis for determining which samples will be sent to the Laboratory for analysis. The Tetra Tech FOL will select twenty samples representing both the trap and skeet ranges and the range of concentrations observed in the field with the majority of samples in the 250 to 550 mg/kg range. In the event all samples analyzed for lead using the XRF are below the screening value, the default samples listed in Worksheet #18 will be sent to the Laboratory. All samples selected for submittal to the Laboratory will be prepared and analyzed according to the normal laboratory protocol as identified on Worksheet #30.

All proposed soil sample locations at the former TSA Ranges will be collected via a hand auger in accordance with SOP-05 (Appendix B).

Eighteen discrete sediment samples for collection at 18 sample locations at the TSA Range are shown on Figure 17-1. Sample locations are randomly distributed across the TSA range fan in the target fragment accumulation zone and potential lead shot accumulation zone, between 200 feet and 400 feet from shore. Sediment sample intervals will be from 0- to 6-inches bgs. All 18 samples are proposed for submittal to the laboratory for definitive analysis at select metals (antimony, arsenic, and lead) and PAHs, as presented in Worksheet #18.1. All sample submitted to the laboratory will be prepared and analyzed according to normal laboratory protocol as identified on Worksheet #30.

All proposed sediment sample loctions in the TSA Range will be collected in accordance with SOP-08 (Appendix B).

Pistol Butts

Fifty discrete subsurface, soil samples are proposed for collection at ten sample locations at the former Pistol Butts, as shown on Figure 17-2. Sample locations are proposed in a pattern to cover the vegetative strip between the concrete stormwater retention pond and the tree line, in the approximate location of the former berm/butts area. Due to uncertainty regarding the exact location of the berm/butt, samples will be collected across the width of the suspected area in a zigzag pattern of 10 sample locations approximately 10- to 15-feet apart (total width approximately 100 feet), along the access road. Each boring will be approximately 16 feet deep. Beginning at the 6- to 8-foot bgs interval and ending at 14- to 16-foot bgs interval, each two-foot interval will undergo field XRF screening for lead in accordance with SOP-10 (Appendix B).

A minimum of 20 soil samples from the Pistol Butts are proposed for submittal to the Laboratory for definitive analysis of select metals (antimony, arsenic, and lead), as presented in Worksheet #18.2. The results of the field XRF analyses will be the basis for determining which samples will be sent to the Laboratory for analysis. A range of concentrations will be sent to the Laboratory. Sample XRF concentrations are not to exceed 3000 and the majority of samples will have XRF concentrations in the 250 to 550 mg/kg range. All samples submitted to the Laboratory will be prepared and analyzed according to the normal laboratory protocol as identified on Worksheet #30.

Due to the uncertainty locating the exact position of the bullet impact area on the original hillside, the Tetra Tech Field Geologist will have the discretion to collect no more than 10 step-out samples. Each step-out sample will be approximately 10 feet away from the original boring, or the sampling grid may be shifted based on results of the XRF screening (where sample exceedances of 200 mg/kg are identified) and observed site conditions.

All proposed subsurface sample locations at the former Pistol Butts will be collected via DPT in accordance with SOP-07 (Appendix B).

Machine Gun Range

Three discrete surface soil samples will be collected at the former 200-yard firing line and the 300-yard firing line of the Machine Gun Range (six total), as shown on Figure 17-3. Sample locations are presented in a spatial grid pattern to cover the approximate location of the former 200-yard firing line. The 300-yard firing line is somewhat covered by the existing roadway; therefore, samples will be collected from surface soil on either side of the road.

Twenty discrete sediment samples are proposed for collection at ten sample locations at the former Machine Gun Range target area as shown on Figure 17-3. Sample locations are presented in a spatial grid pattern to cover the water portion of the site immediately west of the former target locations on the existing breakwater. Sediment sample locations will be staggered and collected from 3 to 5 feet west of the existing breakwater. Sediment sample intervals will be from 0- to 6-inches bgs and 6- to 12-inches bgs.

All six discrete surface soil samples from the Machine Gun Range are proposed for submittal to the Laboratory for definitive analysis of select metals (antimony, arsenic, and lead) and NG, as presented in Worksheet #18.3. All 20 sediment samples are proposed for submittal to the Laboratory for definitive analysis of select metals (antimony, arsenic, and lead), as presented in Worksheet #18.3. All samples submitted to the Laboratory will be prepared and analyzed according to the normal laboratory protocol as identified on Worksheet #30.

All proposed surface soil sample locations in the former Machine Gun Range will be collected via a hand auger in accordance with SOP-05 (Appendix B). All proposed sediment sample locations at the former Machine Gun Range will be collected via a sediment sampler in accordance with SOP-06 and/or SOP-08 (Appendix B).

NTC Lakefront Site

No surface soil samples will be collected at the firing line for the AA training site, NTC Lakefront due to the high erosion and deposition rates immediately in front of the firing points at that location. No MC is expected to remain near the firing lines.

A minimum of 30 and no more than 40 discrete sediment samples are proposed for collection at sample locations identified through the NTC Lakefront MEC investigation. Figure 17-4 shows locations for default sample locations, if no anomalies are identified during the MEC investigation. Sample locations are presented in a spatial grid pattern to cover the water portion of the SDZ.

All 30 sediment samples are proposed for submittal to the Laboratory for definitive analysis of select metals (antimony, arsenic, copper, iron, lead, magnesium, strontium, and zinc) and select explosives (HMNX, PETN, RDX, tetryl, and TNT), as presented in Worksheet #18.4. All samples submitted to the Laboratory will be prepared and analyzed according to the normal laboratory protocol as identified on Worksheet #30.

All proposed sediment sample locations in the former NTC Lakefront SDZ will be collected via a sediment sampler in accordance with SOP-08 (Appendix B).

Upgradient Sampling Locations

Ten discrete sediment samples are proposed for collection at sample locations upgradient of the site. Three samples will be collected north of the TSA Ranges and seven samples will be collected north of the NTC Lakefront SDZ primary impact zone. The project stakeholders will determine the locations north of the SDZ based on data collected during the MEC investigation. Figure 17-5 shows locations for the upgradient default sample locations, if no anomalies are identified during the MEC investigation.

All 10 sediment samples are proposed for submittal to the Laboratory for definitive analysis. The three samples north of the TSA Range will be analyzed for select metals (antimony, arsenic, and lead) and PAHs. The seven samples collected north of the NTC Lakefront SDZ will be analyzed for select metals (antimony, arsenic, copper, iron, lead, magnesium, strontium, and zinc) as presented in Worksheet #18.5. All samples submitted to the Laboratory will be prepared and analyzed according to the normal laboratory protocol as identified on Worksheet #30.

All proposed sediment sample locations will be collected via a sediment sampler in accordance with SOP-08 (Appendix B).

SAP WORKSHEET #18.1 – TSA RANGES SAMPLING LOCATIONS AND METHODS/SOP REQUIREMENTS TABLE

(UFP-QAPP Manual Section 3.1.1)

Surface Soil Sample Location (1)	Sample ID (2)	Metals		PAHs
		Field XRF (Lead Only) (3)	SW-846 6010B (As, Pb, Sb) (4)	SW-846 Method 8270 SIM (5)
TSA001	NTC-SS-TSA001-0006	1	1	1
TSA002	NTC-SS-TSA002-0006	1	TBD	TBD
TSA003	NTC-SS-TSA003-0006	1	1	1
TSA004	NTC-SS-TSA004-0006	1	TBD	TBD
TSA005	NTC-SS-TSA005-0006	1	TBD	TBD
TSA006	NTC-SS-TSA006-0006	1	1	1
TSA007	NTC-SS-TSA007-0006	1	TBD	TBD
TSA008	NTC-SS-TSA008-0006	1	TBD	TBD
TSA009	NTC-SS-TSA009-0006	1	1	1
TSA010	NTC-SS-TSA010-0006	1	TBD	TBD
TSA011	NTC-SS-TSA011-0006	1	TBD	TBD
TSA012	NTC-SS-TSA012-0006	1	1	1
TSA013	NTC-SS-TSA013-0006	1	TBD	TBD
TSA014	NTC-SS-TSA014-0006	1	TBD	TBD
TSA015	NTC-SS-TSA015-0006	1	1	1
TSA016	NTC-SS-TSA016-0006	1	TBD	TBD
TSA017	NTC-SS-TSA017-0006	1	TBD	TBD
TSA018	NTC-SS-TSA018-0006	1	1	1
TSA019	NTC-SS-TSA019-0006	1	TBD	TBD

Surface Soil Sample Location (1)	Sample ID (2)	Metals		PAHs
		Field XRF (Lead Only) (3)	SW-846 6010B (As, Pb, Sb) (4)	SW-846 Method 8270 SIM (5)
TSA020	NTC-SS-TSA020-0006	1	TBD	TBD
TSA021	NTC-SS-TSA021-0006	1	1	1
TSA022	NTC-SS-TSA022-0006	1	TBD	TBD
TSA023	NTC-SS-TSA023-0006	1	TBD	TBD
TSA024	NTC-SS-TSA024-0006	1	1	1
TSA025	NTC-SS-TSA025-0006	1	TBD	TBD
TSA026	NTC-SS-TSA026-0006	1	1	1
TSA027	NTC-SS-TSA027-0006	1	1	1
TSA028	NTC-SS-TSA028-0006	1	TBD	TBD
TSA029	NTC-SS-TSA029-0006	1	TBD	TBD
TSA030	NTC-SS-TSA030-0006	1	1	1
TSA031	NTC-SS-TSA031-0006	1	TBD	TBD
TSA032	NTC-SS-TSA032-0006	1	TBD	TBD
TSA033	NTC-SS-TSA033-0006	1	1	1
TSA034	NTC-SS-TSA034-0006	1	TBD	TBD
TSA035	NTC-SS-TSA035-0006	1	TBD	TBD
TSA036	NTC-SS-TSA036-0006	1	1	1
TSA037	NTC-SS-TSA037-0006	1	TBD	TBD
TSA038	NTC-SS-TSA038-0006	1	TBD	TBD
TSA039	NTC-SS-TSA039-0006	1	1	1
TSA040	NTC-SS-TSA040-0006	1	TBD	TBD
TSA041	NTC-SS-TSA041-0006	1	TBD	TBD

Surface Soil Sample Location (1)	Sample ID (2)	Metals		PAHs
		Field XRF (Lead Only) (3)	SW-846 6010B (As, Pb, Sb) (4)	SW-846 Method 8270 SIM (5)
TSA042	NTC-SS-TSA042-0006	1	1	1
TSA043	NTC-SS-TSA043-0006	1	TBD	TBD
TSA044	NTC-SS-TSA044-0006	1	TBD	TBD
TSA045	NTC-SS-TSA045-0006	1	1	1
TSA046	NTC-SS-TSA046-0006	1	TBD	TBD
TSA047	NTC-SS-TSA047-0006	1	TBD	TBD
TSA048	NTC-SS-TSA048-0006	1	1	1
TSA049	NTC-SS-TSA049-0006	1	TBD	TBD
TSA050	NTC-SS-TSA050-0006	1	TBD	TBD
TSA051	NTC-SS-TSA051-0006	1	1	1
TSA052	NTC-SS-TSA052-0006	1	TBD	TBD
TSA053	NTC-SS-TSA053-0006	1	TBD	TBD
TSA054	NTC-SS-TSA054-0006	1	1	1
TSA055	NTC-SS-TSA055-0006	1	TBD	TBD
TSA056	NTC-SD-TSA056-0006	--	1	1
TSA057	NTC-SD-TSA057-0006	--	1	1
TSA058	NTC-SD-TSA058-0006	--	1	1
TSA059	NTC-SD-TSA059-0006	--	1	1
TSA060	NTC-SD-TSA060-0006	--	1	1
TSA061	NTC-SD-TSA061-0006	--	1	1
TSA062	NTC-SD-TSA062-0006	--	1	1
TSA063	NTC-SD-TSA063-0006	--	1	1
TSA064	NTC-SD-TSA064-0006	--	1	1

Surface Soil Sample Location (1)	Sample ID (2)	Metals		PAHs
		Field XRF (Lead Only) (3)	SW-846 6010B (As, Pb, Sb) (4)	SW-846 Method 8270 SIM (5)
TSA065	NTC-SD-TSA065-0006	--	1	1
TSA066	NTC-SD-TSA066-0006	--	1	1
TSA067	NTC-SD-TSA067-0006	--	1	1
TSA068	NTC-SD-TSA068-0006	--	1	1
TSA069	NTC-SD-TSA069-0006	--	1	1
TSA070	NTC-SD-TSA070-0006	--	1	1
TSA071	NTC-SD-TSA071-0006	--	1	1
TSA072	NTC-SD-TSA072-0006	--	1	1
TSA073	NTC-SD-TSA073-0006	--	1	1
Total Soil Samples – TSA Ranges		**55**	**38**	**38**

As = Arsenic
Pb = Lead
Sb = Antimony
XRF = X-ray fluorescence

1 TSA = TSA Ranges
2 SS = Surface soil. SD = Sediment. Last four digits of sample ID indicate depth bgs (in inches).
3 All lead samples will undergo XRF screening in the field.
4 Twenty soil samples and 18 sediment samples will be selected for select metals and PAHs analysis at the Laboratory. If no soil samples exceed the screening criteria for XRF lead analysis, the indicated soil samples will be sent to the laboratory.
5 Low-Level PAHs will be analyzed by Selected Ion Monitoring (SIM). PAHs include: Acenaphthene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenzo(a,h)anthracene, Dimethylbenz(a)anthracene, 7,12-, Fluoranthene, Fluorene, Indeno(1,2,3-cd)pyrene, 1-Methylnaphthalene, 2-Methylnaphthalene, Naphthalene, Pyrene

Note: Surface soil samples will be collected in accordance with SOP-05 (Appendix B). Sediment samples will be collected in accordance with SOP-08 (Appendix B). FD and MS/MSD samples will be collected at a minimum frequency of 1 per 20 samples per media per analyte for laboratory QC. Therefore, field QC samples may not be collected at every site.

SAP WORKSHEET #18.2 – PISTOL RANGE SAMPLING LOCATIONS AND METHODS/SOP REQUIREMENTS TABLE

(UFP-QAPP Manual Section 3.1.1)

Soil Sample Location [(1)]	Sample ID [(2)]	Metals	
		Field XRF (Lead Only) [(3)]	SW-846 6010B (As, Pb, Sb) [(4)]
PBR001	NTC-SB- PBR001-0608	1	1
	NTC-SB- PBR001-0810	1	TBD
	NTC-SB- PBR001-1012	1	TBD
	NTC-SB- PBR001-1214	1	1
	NTC-SB- PBR001-1416	1	TBD
PBR002	NTC-SB- PBR002-0608	1	1
	NTC-SB- PBR002-0810	1	TBD
	NTC-SB- PBR002-1012	1	TBD
	NTC-SB- PBR002-1214	1	1
	NTC-SB- PBR002-1416	1	TBD
PBR003	NTC-SB- PBR003-0608	1	1
	NTC-SB- PBR003-0810	1	TBD
	NTC-SB- PBR003-1012	1	TBD
	NTC-SB- PBR003-1214	1	1
	NTC-SB- PBR003-1416	1	TBD
PBR004	NTC-SB- PBR004-0608	1	1
	NTC-SB- PBR004-0810	1	TBD
	NTC-SB- PBR004-1012	1	TBD
	NTC-SB- PBR004-1214	1	1
	NTC-SB- PBR004-1416	1	TBD
PBR005	NTC-SB- PBR005-0608	1	1
	NTC-SB- PBR005-0810	1	TBD
	NTC-SB- PBR005-1012	1	TBD
	NTC-SB- PBR005-1214	1	1
	NTC-SB- PBR005-1416	1	TBD

Soil Sample Location [1]	Sample ID [2]	Metals	
		Field XRF (Lead Only) [3]	SW-846 6010B (As, Pb, Sb) [4]
PBR006	NTC-SB- PBR006-0608	1	1
	NTC-SB- PBR006-0810	1	TBD
	NTC-SB- PBR006-1012	1	TBD
	NTC-SB- PBR006-1214	1	1
	NTC-SB- PBR006-1416	1	TBD
PBR007	NTC-SB- PBR007-0608	1	1
	NTC-SB- PBR007-0810	1	TBD
	NTC-SB- PBR007-1012	1	TBD
	NTC-SB- PBR007-1214	1	1
	NTC-SB- PBR007-1416	1	TBD
PBR008	NTC-SB- PBR008-0608	1	1
	NTC-SB- PBR008-0810	1	TBD
	NTC-SB- PBR008-1012	1	TBD
	NTC-SB- PBR008-1214	1	1
	NTC-SB- PBR008-1416	1	TBD
PBR009	NTC-SB- PBR009-0608	1	1
	NTC-SB- PBR009-0810	1	TBD
	NTC-SB- PBR009-1012	1	TBD
	NTC-SB- PBR009-1214	1	1
	NTC-SB- PBR009-1416	1	TBD
PBR010	NTC-SB- PBR010-0608	1	1
	NTC-SB- PBR010-0810	1	TBD
	NTC-SB- PBR010-1012	1	TBD
	NTC-SB- PBR010-1214	1	1
	NTC-SB- PBR010-1416	1	TBD
Total Soil Samples – Pistol Butts		**50**	**20**

As = Arsenic
Pb = Lead
Sb = Antimony
XRF = X-ray fluorescence

1 PBR = Pistol Butts Range
2 SB = Subsurface soil. Last four digits of sample ID indicate depth bgs in feet.
3 All samples will undergo XRF screening in the field.
4 Twenty soil samples will be selected for select metals analysis at the Laboratory. If no samples exceed the screening criteria for XRF lead analysis, the indicated samples will be sent to the laboratory.

Note: Subsurface soil samples will be collected in accordance with SOP-07 (Appendix B). FD and MS/MSD samples will be collected at a minimum frequency of 1 per 10 samples per media per analyte for laboratory QC. Therefore, field QC samples may not be collected at every site.

SAP WORKSHEET #18.3 – MACHINE GUN RANGE SAMPLING LOCATIONS AND METHODS/SOP REQUIREMENTS TABLE

(UFP-QAPP Manual Section 3.1.1)

Surface Soil/Sediment Sample Location (1)	Sample ID (2)	Metals		Propellants
		Field XRF (Lead Only))	SW-846 6010B (As, Pb, Sb) (3)	SW-846 8330A (NG)
MGR001	NTC-SB-MGR001-0006	--	1	1
MGR002	NTC-SB-MGR002-0006	--	1	1
MGR003	NTC-SB-MGR003-0006	--	1	1
MGR004	NTC-SB-MGR004-0006	--	1	1
MGR005	NTC-SB-MGR005-0006	--	1	1
MGR006	NTC-SB-MGR006-0006	--	1	1
MGR007	NTC-SD-MGR007-0006	--	1	--
	NTC-SD-MGR007-0612	--	1	--
MGR008	NTC-SD-MGR008-0006	--	1	--
	NTC-SD-MGR008-0612	--	1	--
MGR009	NTC-SD-MGR009-0006	--	1	--
	NTC-SD-MGR009-0612	--	1	--
MGR010	NTC-SD-MGR010-0006	--	1	--
	NTC-SD-MGR010-0612	--	1	--
MGR011	NTC-SD-MGR011-0006	--	1	--
	NTC-SD-MGR011-0612	--	1	--
MGR012	NTC-SD-MGR012-0006	--	1	--
	NTC-SD-MGR012-0612	--	1	--
MGR013	NTC-SD-MGR013-0006	--	1	--
	NTC-SD-MGR013-0612	--	1	--
MGR014	NTC-SD-MGR014-0006	--	1	--
	NTC-SD-MGR014-0612	--	1	--

Surface Soil/Sediment Sample Location (1)	Sample ID (2)	Metals		Propellants
		Field XRF (Lead Only))	SW-846 6010B (As, Pb, Sb) (3)	SW-846 8330A (NG)
MGR015	NTC-SD-MGR015-0006	--	1	--
	NTC-SD-MGR015-0612	--	1	--
MGR016	NTC-SD-MGR016-0006	--	1	--
	NTC-SD-MGR016-0612	--	1	--
Total Soil Samples – Machine Gun Range		**0**	**26**	**6**

AS = Arsenic
Bp = Lead
Sb = Antimony
NG = Nitroglycerin
XRF = X-ray fluorescence

1 MGR = Machine Gun Range
2 SD = Sediment, SB = Subsurface soil, Last four digits of sample ID indicate depth bgs in inches.
3 All soil and sediment samples will be selected for select metals analysis at the Laboratory.

Note: Surface soil and sediment samples will be collected in accordance with SOP-05, SOP-06, and SOP--8 respectively (Appendix B). FD and MS/MSD samples will be collected at a minimum frequency of 1 per 10 samples per media per analyte for laboratory QC. Therefore, field QC samples may not be collected at every site.

SAP WORKSHEET #18.4 – NSGL NTC LAKEFRONT (WATER PORTION) SAMPLING LOCATIONS AND METHODS/SOP REQUIREMENTS TABLE

(UFP-QAPP Manual Section 3.1.1)

Sediment Sample Location (1)	Sample ID (2)	Metals	Explosives
		SW-846 6010B (As, Cu, Fe, Mg, Pb, Sb, Sr, Zn) (3)	SW-846 8330A (HMX, RDX, TNT, PETN, tetryl)
LAK001	NTC-SD-LAK001-0006	1	1
LAK002	NTC-SD-LAK002-0006	1	1
LAK003	NTC-SD-LAK003-0006	1	1
LAK004	NTC-SD-LAK004-0006	1	1
LAK005	NTC-SD-LAK005-0006	1	1
LAK006	NTC-SD-LAK006-0006	1	1
LAK007	NTC-SD-LAK007-0006	1	1
LAK008	NTC-SD-LAK008-0006	1	1
LAK009	NTC-SD-LAK009-0006	1	1
LAK010	NTC-SD-LAK010-0006	1	1
LAK011	NTC-SD-LAK011-0006	1	1
LAK012	NTC-SD-LAK012-0006	1	1
LAK013	NTC-SD-LAK013-0006	1	1
LAK014	NTC-SD-LAK014-0006	1	1
LAK015	NTC-SD-LAK015-0006	1	1
LAK016	NTC-SD-LAK016-0006	1	1
LAK017	NTC-SD-LAK017-0006	1	1
LAK018	NTC-SD-LAK018-0006	1	1
LAK019	NTC-SD-LAK019-0006	1	1
LAK020	NTC-SD-LAK020-0006	1	1
LAK021	NTC-SD-LAK021-0006	1	1
LAK022	NTC-SD-LAK022-0006	1	1

Sediment Sample Location (1)	Sample ID (2)	Metals	Explosives
		SW-846 6010B (As, Cu, Fe, Mg, Pb, Sb, Sr, Zn) (3)	SW-846 8330A (HMX, RDX, TNT, PETN, tetryl)
LAK023	NTC-SD-LAK023-0006	1	1
LAK024	NTC-SD-LAK024-0006	1	1
LAK025	NTC-SD-LAK025-0006	1	1
LAK026	NTC-SD-LAK026-0006	1	1
LAK027	NTC-SD-LAK027-0006	1	1
LAK028	NTC-SD-LAK028-0006	1	1
LAK029	NTC-SD-LAK029-0006	1	1
LAK030	NTC-SD-LAK030-0006	1	1
Total Soil Samples – NTC Lakefront (Water Portion)		**30**	**30**

As = Arsenic
Cu = Copper
Fe = Iron
Pb = Lead
Mg = Magnesium
Sb = Antimony
Sr = Strontium
Zn = Zinc

1 LAK = NTC Lakefront (Water Portion);
2 SD = Sediment Sample. Last four digits of sample ID indicate depth bgs in inches.
3 All sediment samples will be selected for select metals and select explosives analysis at the Laboratory.

Note: Sediment samples will be collected in accordance with SOP-06 (Appendix B). FD and MS/MSD samples will be collected at a minimum frequency of 1 per 10 samples per media per analyte for laboratory QC. Therefore, field QC samples may not be collected at every site.

SAP WORKSHEET #18.5 – NSGL UPGRADIENT SAMPLING LOCATIONS AND METHODS/SOP REQUIREMENTS TABLE

(UFP-QAPP Manual Section 3.1.1)

Sediment Sample Location (1)	Sample ID (2)	Metals	PAHs
		SW-846 6010B (As, Cu, Fe, Mg, Pb, Sb, Sr, Zn) (3)	SW-846 Method 8270 SIM (4)
UPG001	NTC-SD-UPG001-0006	1	1
UPG002	NTC-SD-UGP002-0006	1	1
UPG003	NTC-SD-UPG003-0006	1	1
UPG004	NTC-SD-UPG004-0006	1	--
UPG005	NTC-SD-UPG005-0006	1	--
UPG006	NTC-SD-UPG006-0006	1	--
UPG007	NTC-SD-UPG007-0006	1	--
UPG008	NTC-SD-UPG008-0006	1	--
UPG009	NTC-SD-UPG009-0006	1	--
UPG010	NTC-SD-UPG010-0006	1	--
Total Soil Samples – NTC Lakefront (Water Portion)		**10**	**4**

As = Arsenic
Cu = Copper
Fe = Iron
Pb = Lead
Mg = Magnesium
Sb = Antimony
Sr = Strontium
Zn = Zinc

1 UPG = Upgradient;
2 SD = Sediment Sample. Last four digits of sample ID indicate depth bgs in inches.
3 All sediment samples will be selected for select metals and select explosives analysis at the laboratory.
4 Low-Level PAHs will be analyzed by Selected Ion Monitoring (SIM). PAHs include: Acenaphthene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenzo(a,h)anthracene, Dimethylbenz(a)anthracene, 7,12-, Fluoranthene, Fluorene, Indeno(1,2,3-cd)pyrene, 1-Methylnaphthalene, 2-Methylnaphthalene, Naphthalene, Pyrene

Note: Sediment samples will be collected in accordance with SOP-06 (Appendix B). FD and MS/MSD samples will be collected at a minimum frequency of 1 per 10 samples per media per analyte for laboratory QC. Therefore, field QC samples may not be collected at every site.

SAP WORKSHEET #18.6 – IDW SAMPLING METHODS/SOP REQUIREMENTS TABLE

(UFP-QAPP Manual Section 3.1.1)

IDW Sample Location (1)	Sample ID (2)	IDW Analysis
		TCLP Organic (SW-846 1311/8260B, 8270C, 8081A, 8151A) TCLP RCRA Metals (SW-846 1311/6010B/7470A) PBS (SW-846 1311/8260B, 8270C, 8081A, 8151A) Density (SM2710F) Flashpoint, (SW-846 1010A) pH, (SW-846 9045C) Reactive Cyanide and Sulfide, (SW-846 ch 7.7.3) Phenolics (SW-846 9065, 9066, or 9067) Total solids (EPA SM2540B) Paint filter Test (SW-846 9095B)
IDW001	IDW001-MMDDYY	1
IDW002	IDW002-MMDDYY	1
Total IDW Samples		**2**

1 IDW = Investigational Derived Wastes;
2 MMDDYY = Date Sample was collected – (month, day, year)

Note: IDW samples will be collected in accordance with SOP-11 (Appendix B). IDW samples will be collected at a minimum frequency of 1 composite per waste stream (aqueous and solid) for laboratory analysis. IDW information is included in Worksheet #18 for FOL QC purposes and QA information is not provided in the remaining chemistry worksheets.

SAP WORKSHEET #19 -- ANALYTICAL SOP REQUIREMENTS TABLE - EMPIRICAL

(UFP-QAPP Manual Section 3.1.1)

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Containers (number, size, and type)	Sample Volume (units)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Soil	PAHs	SW-846 8270C SIM Empirical SOP-329/231	4 ounce glass jar	15 grams	Cool to 4° C ± 2° C	14 days until extraction/40 days to analysis
	Metals	SW-846 6010B Empirical SOP-100/105	4 ounce glass jar	1 to 2 grams	Cool to 4° C ± 2° C	180 days to analysis
	Explosives and NG	SW-846 8330A Empirical SOP-327	4 ounce glass jar	1 to 2 grams	Cool to 4° C ± 2° C	14 days until extraction/40 days to analysis
Sediment	Metals	SW-846 6010B Empirical SOP-100/105	4 ounce glass jar	1 to 2 grams	Cool to 4° C ± 2° C	180 days to analysis
	Explosives	SW-846 8330A Empirical SOP-327	4 ounce glass jar	1 to 2 grams	Cool to 4° C ± 2° C	14 days until extraction/40 days to analysis
Soil (IDW)(1)	TCLP RCRA Metals	SW-846 1311/6010B/7470A Empirical SOP 100/103/104/105/106/ 198	4 ounce glass jar	100 grams	Cool to 4° C ± 2° C	180 days to leach and then 180 days to analyze leachate

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Containers (number, size, and type)	Sample Volume (units)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
	TCLP Organics	SW-846 1311/8260B, 8270C, 8081A, 8151A Empirical SOPs 198/201/202/211/300/302/304	4 ounce glass jar8260 4 ounce glass jar8270C/8081A/ 8151A	8260B = 25 grams 8270C/8081A/ 8151A = 100g	Cool to 4° C $\pm 2^{\circ}$ C	For 8260B = 14 days to leach, 14 days to analyze leachate For 8270C/8081A/ 8151A = 14 days to Leach, 7 days to extract leachate, 40 days to analyze extracts
	Polychlorinated Biphenyls (PCBs)	SW-846 8082 Empirical SOP 211/302	4 ounce glass jar	30 grams	Cool to 4° C $\pm 2^{\circ}$ C	14 days to extract and 40 days to analyze extract
	Density	SM2710F	4 ounce glass jar	10 grams	Cool to 4° C $\pm 2^{\circ}$ C	28 days
	Flashpoint	SW-846 1010A Empirical SOP 149	4 ounce glass jar	50 grams	Cool to 4° C $\pm 2^{\circ}$ C	7 days
	pH	SW-846 9045C Empirical SOP 187	4 ounce glass jar	20 grams	Cool to 4° C $\pm 2^{\circ}$ C	immediate
	Reactive Cyanide and Sulfide	SW-846 ch 7.7.3 Empirical SOP 156/164/175	4 ounce glass jar	10 grams	Cool to 4° C $\pm 2^{\circ}$ C	14 days to analysis
	Phenolics	SW-846 9066 Empirical SOP 181	4 ounce glass jar	10 grams	Cool to 4° C $\pm 2^{\circ}$ C	28 days
	Total Solids (% solids)	EPA SM2540B Empirical SOP 173	4 ounce glass jar	10 grams	Cool to 4° C $\pm 2^{\circ}$ C +/- 2 degrees C	7 days
	Paint Filter Test	SW-846 9095B Empirical SOP 191	4 ounce glass jar	100 grams	Cool to 4° C $\pm 2^{\circ}$ C	NA

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Containers (number, size, and type)	Sample Volume (units)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Aqueous (IDW) (1)	TCLP RCRA Metals	SW-846 1311/6010B/7470A Empirical SOP 198/100	1-250 milliliter (mL) plastic	50mL	Nitric Acid to a pH of less than 2	180 days to analysis
	TCLP Organics	SW-846 1311/8260B, 8270C, 8081A, 8151A Empirical SOP 198/201/202/211/300/ 302/304	8260B = 3-40mL 8270C/8081A/ 8151A = 1 Liter (L) amber glass each method	8260B = 5mL 8270C/8081A/ 8151A = 1L each method	8260B = Hydrochloric acid to a pH of less than 2. Cool 4 degrees +/- 2 degrees C 8270C/8081A/ 8151A = Cool to 4° C ± 2° C	For 8260B = 14 days to analyze For 8270C/8081A/ 8151A = 7 days to extract and 40 days to analyze extract
	TCLP Polychlorinated Biphenols	SW-846 8082 Empirical SOP 198/211	1-1L amber glass	1 L	Cool to 4° C ± 2° C	7 days to extract and 40 days to analyze extract
	Density	SM2710F	1-250mL plastic	1mL	Cool to 4° C ± 2° C	NA
	Flashpoint	SW-846 1010A Empirical SOP 149	1-250mL plastic	250mL	Cool to 4° C ± 2° C	7 days to analysis
	pH	SW-846 9045C Empirical SOP 187	1-250ml plastic	25mL	Cool to 4° C ± 2° C	immediate
	Reactive Cyanide and Sulfide	SW-846 ch 7.7.3 Empirical SOP 156/164/175	CN = 250mL plastic Sulfide = 250mL plastic	CN = 25mL Sulfide = 250mL	CN = sodium hydroxide to a ph of greater than 11 Sulfide = Cool to 4° C ± 2° C	CN and Sulfide = 14 days
	Phenolics (Low Level Detection)	SW-846 9065, 9066, or 9067 Empirical SOP 181	1-250mL plastic	250mL	Sulfuric acid to a pH of less than 2' Cool to 4° C ± 2° C	28 days to analysis

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Containers (number, size, and type)	Sample Volume (units)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
	Total Solids (% solids)	EPA SM2540B Empirical SOP 173	4 ounce glass jar	10 grams	Cool to $4^{\circ}C \pm 2^{\circ}C$	7 days to analysis
	Paint Filter Test	SW-846 9095B Empirical SOP 191	1-250mL plastic	100mL	Cool to $4^{\circ}C \pm 2^{\circ}C$	NA

Footnote:

1. IDW information is provided in Worksheet #19 for the FOL QC purposes and QA information is not provided in the remaining chemistry worksheets.

SAP WORKSHEET #20 -- FIELD QUALITY CONTROL SAMPLE SUMMARY TABLE – ANALYTICAL SAMPLES

(UFP-QAPP Manual Section 3.1.1)

Matrix	Analytical Group	Field Samples	Field Duplicates (1)	MS/MSDs (1)	Equipment Rinsate Blanks (2)	Total Samples to Laboratory
Soil	On-Site XRF (Pb)	105	11	0	0	116 (on-site)
Soil	Select Metals (As, Pb, Sb)	46	5	5	2 (3)	53
Soil	PAHs	20	2	2	1	23
Soil	Propellants (NG)	6	1	1	1	8
Sediment	Metals (Sb, As, Cu, Fe, Pb, Mn, Sr, and Zn)	40	4	4	1	45
Sediment	Explosives (HMX, RDX, PETN, tetryl, TNT)	30	3	3	1	34
Sediment	Metals (As, Pb, Sb)	41	4	4	2 (4)	47
Sediment	PAHs	21	2	2	2 (4)	25

As = Arsenic, Cu=Copper, Fe = Iron, Pb = Lead, Mg = Magnesium, Sb = Antimony, Sr = Strontium, Zn=Zinc
MS/MSD = Matrix Spike/Matrix Spike Duplicate
PAH = Polycyclic Aromatic Hydrocarbon

1 FD and MS/MSD samples will be collected at a minimum frequency of 1 per 10 samples per media and per analyte. Although the MS/MSD is not typically considered a field QC sample, it is included here because location determination is often established in the field. The MS/MSD is not included in the Total Samples to Laboratory summary.
2 Equipment rinsate blanks will be collected at a minimum frequency of one per analysis per lab.
3 Two rinsate blanks will be collected for select metals in soil because some samples for these parameters will be collected by hand auger and others will be collected by DPT methods.
4 Two rinsate blanks will be collected for select metals and PAHs in sediment because some samples for these parameters will be collected by vibracore samplers and others by Van Veen samplers.

Note: Field sample identifications are provided in Worksheets #18.1 through 18.4. Associated QC sample identifications will be in accordance with SOP-02 (Appendix B).

SAP WORKSHEET #21 -- PROJECT SAMPLING SOP REFERENCES TABLE

(UFP-QAPP Manual Section 3.1.2)

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP-01	Field Documentation [SA-6.3]	Tetra Tech	Non-electronic field logbook, sample log sheets, boring logs, GPS, Digital Camera	Y	Contained in Appendix B.
SOP-02	Sample Identification Nomenclature [CT-04]	Tetra Tech	NA	Y	Contained in Appendix B.
SOP-03	Database Records and Quality Assurance [CT-05]	Tetra Tech	NA	Y	Contained in Appendix B.
SOP-04	Global Positioning System [MRP SOP 05]	Tetra Tech	GPS unit	Y	Contained in Appendix B.
SOP-05	Soil Coring and Sampling Using Hand Auger Techniques [SA-1.3]	Tetra Tech	Stainless steel auger bucket, extension rods, T-handle, stainless steel trowels and mixing bowls	Y	Contained in Appendix B.
SOP-06	Surface Water and Sediment Sampling [SA-1.2]	Tetra Tech	Sediment sampling equipment, stainless steel bowl	Y	Contained in Appendix B.
SOP-07	Borehole and Soil Sample Logging [GH-1.5]	Tetra Tech	DPT rig and accessories	Y	Contained in Appendix B.
SOP-08	Large Water Body Sediment Sampling	Tetra Tech	Stainless steel bowl, dredge, boat	Y	Contained in Appendix B.
SOP-09	Non-Radiological Sample Handling [SA-6.1]	Tetra Tech	NA	Y	Contained in Appendix B.
SOP-10	Field Portable X-Ray Fluorescence Analysis of Soil and Sediment Using the INNOV-X Alpha Series Instruments	Tetra Tech	Portable X-ray fluorescence analyzer and accessories	Y	Contained in Appendix B.
SOP-11	Decontamination of Field Equipment [SA-7.1]	Tetra Tech	Decontamination equipment, scrub brushes, 5-gallon buckets, spray bottles, phosphate free detergent, deionized (DI) water	Y	Contained in Appendix B.

SAP WORKSHEET #22 -- FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION TABLE

(UFP-QAPP Manual Section 3.1.2.4)

Field Equipment	Activity	Frequency	Acceptance Criteria	Corrective Action (CA)	Responsible Person	SOP Reference	Comments
DPT Rig	Maintenance	Prior to daily use.	HASP checklist.	Correct deficiencies before operating.	Subcontractor DPT operator	SOP-07	None
GPS	Positioning	Beginning and end of each day used.	Accuracy: sub-meter horizontal dilution of precision (HDOP) <3, number of satellites at least six.	Wait for better signal, replace unit, or choose alternate location technique.	FOL	SOP-04	None
	Standardization Clip	Prior to daily use and after a shutdown of the unit or battery change.	Instrument will either accept or reject the standardization.	If rejected, re-standardize. If still unacceptable, contact manufacturer for further instruction which may include replacement of the unit.	XRF Technician	SOP-09	None
XRF	Instrument Blank verification (silicon dioxide) to ensure there is no contamination on the analyzer window or other component that is being "seen" by the instrument	Prior to daily use and after a shutdown of the unit or battery change.	Zero (to ensure there is no contamination on the analyzer window or other component that is being "seen" by the instrument).	If lead concentrations are observed, reanalyze to confirm. Contact manufacturer for possible replacement.	XRF Technician	SOP-09	None
	Calibration verification	Prior to daily use and after a shutdown of the unit or battery change.	20% or less for the NIST standards shipped with the instrument. Typically includes three standards - high (5,532 ppm), medium (1,162 ppm), and low (18 ppm) for lead.	Reanalyze the standard. Contact manufacturer for possible replacement.	XRF Technician	SOP-09	None

NIST = National Institute of Standards and Technology
ppm = parts per million

SAP WORKSHEET #23 -- ANALYTICAL SOP REFERENCES TABLE

(UFP-QAPP Manual Section 3.2.1)

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
SOP-100	Metals Digestion/Preparation Methods 3005A, 3010A, 3020A, 3030, 3040A, 3050B, USEPA Contract Laboratory Program (CLP) ILMO 4.1 Aqueous and Soil/Sediment, USEPA CLP ILMO 5.2 Aqueous and Soil/Sediment, USEPA Method 200.7 (Standard Methods) 3030C (Revision 19, 4/20/09)	NA	Soil and Sediment/Metals Digestion	NA/ Preparation	Empirical	N
SOP-105	Metals Analysis by ICP Technique Methods 200.7, SW846 Method 6010B, SM 19th Edition 2340B, USEPA CLP ILMO 4.1 (Revision 15, 5/08/09)	Definitive	Soil and Sediment/Metals	Inductively Coupled Plasma – Atomic Emissions Spectrometer (ICP-AES)	Empirical	N
SOP-327	Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC) Method 8330A and 8332 (Revision 14, 9/17/08)	Definitive	Soil and Sediment/ Explosives and Propellants	HPLC/Ultraviolet (UV)	Empirical	N
SOP-231	GC/MS Low Level PAHs By SW-846 Method 8270C SIM (Revision 3, 1/16/09)	Definitive	Soil and Sediment/PAHs	Gas Chromatography/ Mass Spectrometer (GC/MS)	Empirical	N
SOP-329	Soxhlet Extraction- BNA and Pest/PCB Using SW-846 Method 3541 (Revision 17, 6/22/09)	NA	Soil and Sediment/PAHs Extraction	NA/ Preparation	Empirical	N
SOP-404	Laboratory Sample Receiving Log-In and Storage Standard Operating Procedures (Revision 13, 6/29/09)	NA	Log-in	NA	Empirical	N
SOP-405	Analytical Laboratory Waste Disposal (Revision 5, 6/23/09)	NA	Disposal	NA	Empirical	N
SOP-410	SOP for Laboratory Sample Storage, Secure Areas, and Sample Custody (Revision 7, 6/23/09)	NA	Storage	NA	Empirical	N

SAP WORKSHEET #24 -- ANALYTICAL INSTRUMENT CALIBRATION TABLE

(UFP-QAPP Manual Section 3.2.2)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference[1]
GC/MS PAHs by SIM	Initial Calibration (ICAL) - Six-point initial calibration for all analytes.	Instrument receipt, instrument change (new column, source cleaning, etc.), when continuing calibration verification (CCV) is out of criteria. Six-point ICAL for all analytes.	The average response factor (RF) for System Performance Check Compounds (SPCCs) must be ≥0.010 for SIM. The relative standard deviation (RSD) for calibration check compounds (CCCs) must be ≤30%; RSD for each analyte must be ≤15%, or the linear least squares regression (r) must be ≥0.995.	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst, Department Manager	Empirical SOP-231
	Initial Calibration Verification (ICV) – from a second source	Perform after each ICAL.	The percent recovery (%R) of all analytes must be within 75-125%. SPCC RFs ≥0.010 for SIM. CCCs ≤30 percent difference or percent drift (%D) for SIM.	Identify source of problem, correct, repeat calibration, rerun samples.	Analyst, Department Manager	
	CCV	Analyze a standard at the beginning of each 12-hour shift after tune.	SPCC RFs ≥0.010 for SIM. CCCs ≤30%D for SIM).	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst, Department Manager	
	Tune Verification – decafluorotri-phenylphos-phine (DFTPP)	Every 12 hours.	The tune verification must meet the ion abundance criteria. SIM must also meet the mass drift and peak width criteria required by the SOP. No samples may be accepted without a valid tune.	Retune and/or clean source.	Analyst, Department Manager	

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference[1]
ICP-AES Metals	ICAL - the instrument is calibrated by a one-point calibration per manufacturer's guidelines.	At the beginning of each day, or if the QC is out of criteria.	None; only one high standard and a calibration blank must be analyzed. If more than one calibration standard is used, correlation coefficient must be ≥0.995.	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst, Department Manager	Empirical SOP-105
	Second-source ICV	Following ICAL, prior to the analysis of samples.	The %R must be within 90-110% of the true value.	Investigate reasons for failure, reanalyze once. If still unacceptable, repeat ICAL.	Analyst, Department Manager	
	Initial Calibration Blank (ICB)	Before beginning a sample sequence.	No analytes detected > 2x MDL.	Correct the problem, then re-prepare and reanalyze.	Analyst, Department Manager	
	CCV	Analyze a standard at the beginning and end of the sequence and after every 10 samples.	The %R must be within 90-110% of true value.	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst, Department Manager	
	Continuing Calibration Blank (CCB)	After the initial CCV, after every 10 samples, and at the end of the sequence.	No analytes detected > LOQ.	Correct the problem, then re-prepare and reanalyze CCB and previous 10 samples.	Analyst, Department Manager	

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference[1]
	Low-Level Check Standard	Daily after ICAL and before samples.	The %R must be within 80-120 % of the true value.	Investigate and perform necessary equipment maintenance. Recalibrate and reanalyze all affected samples.	Analyst, Department Manager	
	Interference Check Standards (ICS – ICS A and ICS B)	At the beginning and end of an analytical run and after each batch of 20 samples.	ICS A recoveries must be within the absolute value of the LOQ and ICS B %Rs must be within 80-120% of the true value.	Investigate and perform necessary equipment maintenance. Recalibrate and reanalyze all affected samples.	Analyst, Department Manager	
HPLC – Explosives and Propellants	ICAL - minimum 5 points	Annually or more often as needed due to changes in response or retention times or following major instrument maintenance.	Average RF ≤20 %RSD; if a linear fit is used, then correlation coefficient (r) must be ≥0.995; or coefficient of determination (r^2) must be ≥0.99 using 6 points.	Determine and correct reason for failure. Repeat calibration.	Analyst, Department Manager	Empirical SOP-327
	Second-source ICV	Following ICAL prior to the analysis of samples.	The %R must be within 85-115% of the true value.	Investigate reasons for failure, reanalyze once. If still unacceptable, then repeat calibration.	Analyst, Department Manager	
	CCV	Daily prior to the analysis of samples, every 10 sample injections or 12 hours (whichever is more frequent), and at the end of the run.	Less than 15%D for each target analyte.	Investigate reasons for failure, reanalyze once. If still unacceptable, then repeat calibration.	Analyst, Department Manager	
	CCB	After the initial CCV, after every 10 samples, and at the end of the sequence.	No analytes detected > 2x MDL.	Correct the problem, then re-prepare and reanalyze CCB and previous 10 samples.	Analyst, Department Manager	

1 Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet No. 23).

SAP WORKSHEET #25 -- ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION TABLE

(UFP-QAPP Manual Section 3.2.3)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
GC/MS	Check pressure and gas supply daily. Manual tune if DFTPP not in criteria, change septa as needed, change liner as needed cut column as needed. Other maintenance specified in lab Equipment Maintenance SOP.	PAHs by SIM	Check the gas supply. Check the seal, liner, and septum.	Source cleaning is performed when the instrument response deteriorates. Other instrument maintenance is done as needed to keep the instrument at peak performance.	Acceptable ICAL and CCV.	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst, Department Manager	Empirical SOP-231
ICP-AES	Clean torch assembly and spray chamber when discolored or when degradation in data quality is observed. Clean nebulizer, check argon, and replace peristaltic pump tubing as needed. Other maintenance specified in lab Equipment Maintenance SOP.	Metals	Inspect the torch, nebulizer chamber, pump, and tubing.	Maintenance is performed prior to ICAL or as necessary.	Acceptable ICAL and CCV.	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst, Department Manager	Empirical SOP-105
HPLC	Check pressure and gas supply daily – change when <200 pounds per square inch (psi), change analytical column as needed, change mobile phase when insufficient for run or contamination, change inlet filters as needed for contamination.	Explosives and Propellants	Check pump pressure, check for leaks, check for adequate mobile phase.	Prior to ICAL or as necessary.	Acceptable ICAL and CCV.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst, Department Manager	Empirical SOP-327

1 Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet No. 23).

SAP WORKSHEET #26 -- SAMPLE HANDLING SYSTEM

(UFP-QAPP Manual Appendix A)

Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): FOL or designee/Tetra Tech
Sample Packaging (Personnel/Organization): FOL or designee/Tetra Tech
Coordination of Shipment (Personnel/Organization): FOL or designee/Tetra Tech
Type of Shipment/Carrier: Express Mail – overnight courier
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Sample Custodians/Empirical
Sample Custody and Storage (Personnel/Organization): Sample Custodians/Empirical
Sample Preparation (Personnel/Organization): Extraction Lab, Metals Preparation Lab/Empirical
Sample Determinative Analysis (Personnel/Organization): GC/MS Lab, HPLC Lab, Metals Lab/ Empirical
SAMPLE ARCHIVING
Field Sample Storage: 60 days from receipt of collection.
Sample Extract/Digestate Storage (No. of days from extraction/digestion): 60 days
Biological Sample Storage (No. of days from sample collection): NA
SAMPLE DISPOSAL
Personnel/Organization: Sample Custodians/ Empirical

SAP WORKSHEET #27 – SAMPLE CUSTODY REQUIREMENTS TABLE

(UFP-QAPP Manual Section 3.3.3)

SAMPLE CUSTODY REQUIREMENTS

Field Chain of Custody

To ensure the integrity of a sample from collection through analysis, an accurate, written record that traces the possession and handling of the sample is necessary. This documentation is referred to as the chain-of-custody form. The chain-of-custody begins at the time of sample collection.

A sample is under custody if:

- It is in your actual possession, or
- It is in your view, after being in your physical possession, or
- It was in your possession and then you locked or sealed it up to prevent tampering, or
- It is in a secure area.

Custody documentation is designed to provide documentation of preparation, handling, storage, and shipping of all samples collected. A multi-part chain-of-custody form is used with each page of the form signed and dated by the recipient of a sample of portion of sample. The person releasing the sample and the person receiving the sample each will retain a copy of the chain-of-custody form each time a sample transfer occurs.

Preservation of the integrity of the samples collected during the SI will be the responsibility of identified persons from the time the samples are collected until the samples, or their derived data, are incorporated into the final report. Sample custody is described in Worksheet #27.

The Tetra Tech FOL is responsible for the care and custody of the samples collected until they are delivered to the laboratory or are entrusted to a carrier. When transferring samples, the individuals relinquishing and receiving them will sign, date, and note the time on the chain-of-custody form. This form documents the sample custody transfer from the sampler to the laboratory, often through another person or agency (common carrier). Field chain-of-custody requirements are provided in SOP-01. Upon arrival at the laboratory, internal sample custody procedures will be followed as defined in the Laboratory SOPs included in Appendix C.

Laboratory Chain of Custody – Empirical

Laboratory sample custody procedures (receipt of samples, archiving, and disposal) will be used according to Empirical SOPs 404, 405, and 410. Coolers are received and checked for proper temperature. A sample cooler receipt form will be filled out to note conditions and any discrepancies. The chain-of-custody will be checked against the sample containers for correctness. Samples will be logged into the laboratory information management system (LIMS) and given a unique log number, which can be tracked thru processing. The Tetra Tech Project Chemist will be notified by the Laboratory PM of any problems on the same day that any issues are identified.

SAP WORKSHEET #28 -- LABORATORY QC SAMPLES TABLE

(UFP-QAPP Manual Section 3.4)

Matrix	Soil, Sediment, and Aqueous Field QC
Analytical Group	PAHs by SIM
Analytical Method / SOP Reference	SW-846 8270C SIM Empirical SOP-231/329

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria (MPC)
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix.	Contaminants in the method blank must be < ½ LOQ, except common lab contaminants, which must be <LOQ.	(1) Investigate source of contamination. (2) Re-prepare and analyze method blank and all samples processed with the contaminated blank.	Analyst, Laboratory Department Manager and Data Validator	Bias/ Contamination	Same as Method/SOP QC Acceptance Limits.
Surrogates	Two per sample	Empirical statistically-derived %R limits (Appendix C). %Rs: Aqueous: 2-Fluorobiphenyl 34-167 Terphenyl-d14 34-167 Solid: 2-Fluorobiphenyl 14-129 Terphenyl-d14 14-129	(1) Check chromatogram for interference; if found, then flag data. (2) If not found, then check instrument performance; if problem is found, then correct and reanalyze. (3) If still out, then re-extract and analyze sample. (4) If reanalysis is out, then flag data.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/ Bias	Same as Method/SOP QC Acceptance
LCS LCSD (not required)	One is performed for each batch of up to 20 samples.	Empirical statistically-derived %R limits (Appendix C). RPD ≤30% (for LCS/LCSD).	Evaluate and reanalyze, if possible. If an MS/MSD was performed in the same 12-hour time period and is acceptable, then narrate. If the LCS recoveries are high, but the sample results are <LOQ, then narrate. Otherwise, re-prepare and reanalyze.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/ Bias Precision also, if LCSD is analyzed	Same as Method/SOP QC Acceptance
Internal Standards (IS)	Six per sample – 1,4-Dichlorobenzene-d4 Naphthalene-d8 Acenaphthene-d10 Phenanthrene-d10 Chrysene-d12 Perylene-d12	Retention times for ISs must be ± 30 seconds and the responses within -50% to +100% of last calibration verification (12 hours) for each IS.	Reanalyze affected samples.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/ Bias	Same as Method/SOP QC Acceptance

Matrix	Soil, Sediment, and Aqueous Field QC
Analytical Group	PAHs by SIM
Analytical Method / SOP Reference	SW-846 8270C SIM Empirical SOP-231/329

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria (MPC)
MS/MSD	One per sample delivery group (SDG), or every 20 samples of similar matrix.	Empirical statistically-derived %R limits (Appendix C). RPD ≤30% (aqueous). RPD ≤50% (solid).	CA will not be taken for samples when %Rs are outside limits and surrogate and LCS criteria are met. If both the LCS and MS/MSD are unacceptable, then re-prepare the samples and QC.	Analyst, Laboratory Department Manager, and Data Validator	Precision/Accuracy/ Bias	Same as Method/SOP QC Acceptance

Matrix	Soil, Sediment, and Aqueous Field QC
Analytical Group	Select Metals
Analytical Method / SOP Reference	SW-846 3050B/3005A, 6010B Empirical SOP-100/105

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria (MPC)
Method Blank	One per digestion batch of 20 or fewer samples.	No target compounds > ½ the LOQ, except common laboratory contaminants, which must be <LOQ.	Investigate the source of the contamination. Redigest and reanalyze all associated samples if the sample concentration ≥ the LOQ and <10x the blank concentration.	Analyst, Laboratory Department Manager, and Data Validator	Bias/Contamination	Same as Method/SOP QC Acceptance
LCS LCSD (not required)	One per digestion batch of 20 or fewer samples.	Empirical SOP-100/105 %R limits (Appendix C). RPD ≤30% (for LCS/LCSD). Aqueous: The %R must be within 80-120%. Solid: The %R must be within vendor supplied limits.	Redigest and reanalyze all associated samples for affected analyte.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias Precision also, if LCSD is analyzed	Same as Method/SOP QC Acceptance
Duplicate Sample	One per digestion batch of 20 or fewer samples.	RPD ≤20% (aqueous and solid), if both results are >5x LOQ or +/- the LOQ if both results are < 2X the LOQ.	Narrate any results that are outside control limits.	Analyst, Laboratory Department Manager, and Data Validator	Precision	Same as Method/SOP QC Acceptance
MS	One per 20 samples of similar matrix.	%R must be within 80-120% of the true value, if sample < 4x spike added.	Flag results for affected analytes for all associated samples with "N".	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance
ICP Serial Dilution	One is performed for each preparation batch with sample concentration(s) > 50x MDL.	If original sample result is at least 50x the MDL, then 5-fold dilution must agree within ± 10% of the original result.	Flag result or dilute and reanalyze sample to eliminate interference.	Analyst, Laboratory Department Manager, and Data Validator	Precision	Same as Method/SOP QC Acceptance
Post Digestion Spike	One is performed when serial dilution fails or analyte concentration(s) in all samples < 50x MDL.	%R must be within 85-115%.	Flag results of samples of same matrix as estimates in SDG narrative.	Analyst, Laboratory Department Manager, and Data Validator	Precision	Same as Method/SOP QC Acceptance

Matrix	Soil, Sediment, and Aqueous Field QC
Analytical Group	Explosives and Propellants
Analytical Method/ SOP Reference	SW-846 8330A Empirical SOP-327

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria (MPC)
Method Blank	One per batch of 20 samples or less.	No target compounds > ½ LOQ.	Reclean, retest, re-extract, reanalyze, and/or qualify data.	Analyst, Laboratory Department Manager, and Data Validator	Bias/ Contamination	Same as Method/SOP QC Acceptance
Surrogates	One per sample.	Empirical statistically-derived %R limits (Appendix C).	Re-prepare and reanalyze for confirmation of matrix interference when appropriate.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/ Bias	Same as Method/SOP QC Acceptance
LCS LCSD (not required)	One per batch of 20 or less.	Empirical SOP-327 %R limits (Appendix C). 60-120 %R for aqueous. 60-120 %R for solid. RPD ≤30% (for LCS/LCSD).	Evaluate and reanalyze, if possible. If an MS/MSD was performed in the same 12-hour time period and is acceptable, narrate. If the LCS recoveries are high but the sample results are <LOQ, then narrate; otherwise, re-prepare and reanalyze.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/ Bias Precision also, if LCSD is analyzed	Same as Method/SOP QC Acceptance
MS/MSD	One per 20 samples of similar matrix.	Empirical statistically-derived %R limits (Appendix C). RPD ≤30% (aqueous). RPD ≤50% (solid).	CA will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met. If both the LCS and MS/MSD are unacceptable, then re-prepare the samples and QC.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/ Bias Precision	Same as Method/SOP QC Acceptance
Second Column Confirmation	All positive results must be confirmed.	Results between primary and second column - RPD ≤40%.	None.	Analyst, Laboratory Department Manager, and Data Validator	Precision	Same as Method/SOP QC Acceptance

SAP WORKSHEET #29 -- PROJECT DOCUMENTS AND RECORDS TABLE

(UFP-QAPP Manual Section 3.5.1)

Document	Where Maintained
Sample Collection Documents and Records Project Personnel Sign-off Records Field logbook (and sampling notes) Field sample forms (e.g., boring logs, sample log sheets, drilling logs, etc.) Chain-of-custody records Sample shipment airbills Equipment calibration logs Photographs FTMR forms UFP-SAP Field sampling SOPs	Tetra Tech project file (may include hard copy as well as electronic information), results will be discussed in subject document.
Laboratory Documents and Records Sample receipt/log-in forms Sample storage records Sample preparation logs Standard traceability logs Equipment calibration logs Sample analysis run logs Equipment maintenance, testing, and inspection logs FTMR forms Reported field sample results Reported results for standards, QC checks, and QC samples Data completeness checklists Sample storage and disposal records Telephone logs Extraction/clean-up records Raw data	Tetra Tech project file (may include hard copy as well as electronic information), long-term data package storage at third-party professional document storage firm (BRM), results will be discussed in subject document.
Data Assessment Documents and Records Field sampling audit checklist (if an audit is conducted) Analytical audit checklist (if an audit is conducted) Data validation memoranda	Tetra Tech project file (may include hard copy as well as electronic information), results will be discussed in subject document.
Other Documents HASP All versions of UFP-SAP All versions of reports (e.g., SI, RI, FS, etc.) Certification of SAP review	Tetra Tech project file (may include hard-copy as well as electronic information)

SAP WORKSHEET #30 -- ANALYTICAL SERVICES TABLE

Matrix	Analytical Group	Sample Locations/ ID Numbers	Analytical Method	Data Package Turnaround Time	Laboratory/Organization (name and address, contact person and telephone number)	Backup Laboratory/Organization (name and address, contact person and telephone number)
Soil, Sediment, and Aqueous Field QC Samples	Metals	See Worksheet #18	SW-846 6010B	21 days	Kim Kostzer Empirical Laboratories 621 Mainstream Drive Suite 270 Nashville, TN 37228 615.345.1115	NA
	Explosives and NG	See Worksheet #18	SW-846 8330A	21 days		
	PAHs by SIM	See Worksheet #18	SW-846 8270C SIM	21 days		

SAP WORKSHEET #31 -- PLANNED PROJECT ASSESSMENTS TABLE

(UFP-QAPP Manual Section 4.1.1)

Assessment Type	**Frequency**	**Internal or External**	**Organization Performing Assessment**	**Person(s) Responsible for Performing Assessment** (title and organizational affiliation)	**Person(s) Responsible for Responding to Assessment Findings** (title and organizational affiliation)	**Person(s) Responsible for Identifying and Implementing CA** (title and organizational affiliation)	**Person(s) Responsible for Monitoring Effectiveness of CA** (title and organizational affiliation)
Field Sampling System Audit	One per contract year	Internal	Tetra Tech	Person (auditor) assigned by Tetra Tech QAM	Tetra Tech PM and FOL	Tetra Tech Auditor and PM	CLEAN QAM, Tetra Tech
Laboratory System Audit [1]	One every three years	External	DoD ELAP Accrediting Body	DoD ELAP Accrediting Body	Laboratory QAM or Laboratory Manager, Empirical	Laboratory QAM or Laboratory Manager, Empirical	Laboratory QAM, Empirical

1 Empirical is a DoD ELAP accredited laboratory. The accreditation letter is included in Appendix C.

SAP WORKSHEET #32 -- ASSESSMENT FINDINGS AND CORRECTIVE ACTION RESPONSES

(UFP-QAPP Manual Section 4.1.2)

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Timeframe of Notification	Nature of CA Response Documentation	Individual(s) Receiving CA Response (name, title, organization)	Timeframe for Response
Field Sampling System Audit (1)	Audit checklist (as per Navy Installation Restoration Chemical Data Quality Manuel [IRCDQM]) and written audit report	Ralph Basinski, PM, Tetra Tech; TBD, FOL, Tetra Tech; John Trepanowski, Program Manager, Tetra Tech	Dependent on the finding, if major a stop work may be issued immediately; however, if minor, within 1 week of audit	Written memo	Tom Johnston, CLEAN QAM, Tetra Tech; Designee, Field Auditor, Tetra Tech; John Trepanowski, Program Manager, Tetra Tech	Within 48 hours of notification
Laboratory System Audit	Written audit report	Laboratory Manager or Laboratory QAM, Empirical Laboratories	Not specified by DoD	Letter	DoD ELAP Accrediting Body	Specified by DoD

1 Audits are scheduled at the Tetra Tech program level and may or may not include this project.

SAP WORKSHEET #33 -- QA MANAGEMENT REPORTS TABLE

(UFP QAPP Manual Section 4.2)

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (title and organizational affiliation)	Report Recipient(s) (title and organizational affiliation)
Data validation report	Per SDG	Upon completion of data validation	DVM and Staff Chemists, Tetra Tech	PM and project file, Tetra Tech
Major analysis problem identification (internal memo)	When persistent analysis problems are detected	On the same day	CLEAN QAM, Tetra Tech	PM, CLEAN QAM, Program Manager, and project file, Tetra Tech
Project monthly progress report	Monthly for duration of project	Monthly	PM, Tetra Tech	Project file, Navy
Laboratory QA report	When significant plan deviations result from unanticipated circumstances	On the same day	Laboratory PM, Empirical	Project file, Tetra Tech
Audit report	In conjunction with audits	After completion of audits (within 3 weeks)	Auditor(s)	PM, QAM, Tetra Tech, and audited entity

SAP WORKSHEET #34 -- VERIFICATION (STEP I) PROCESS TABLE

(UFP-QAPP Manual Section 5.2.1)

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
Chain-of-custody forms	The Tetra Tech FOL or designee will review and sign the chain-of-custody form to verify that all samples listed are included in the shipment to the laboratory and that the sample information is accurate. The forms will be signed by the sampler and a copy will be retained for the project file, Tetra Tech PM, and data validators.	Internal	Sampler and FOL, Tetra Tech
UFP-SAP sample tables	Verify that all proposed samples listed in the UFP-SAP tables have been collected.	Internal	FOL or designee, Tetra Tech
Sample log sheets	Verify that information recorded on the log sheets is accurate and complete.	Internal	FOL or designee, Tetra Tech
Sample coordinates	Verify that sample locations are correct and in accordance with the UFP-SAP proposed locations.	Internal	FOL or designee, Tetra Tech
Field QC samples	Check that field QC samples listed in Worksheet #20 were collected as required.	Internal	FOL or designee, Tetra Tech
Chain-of-custody forms	The Laboratory Sample Custodian will review the sample shipment for completeness, integrity, and signature accepting the shipment. The Data Validators will check that the chain-of-custody form was signed/dated by the Tetra Tech FOL or designee relinquishing the samples and by the Laboratory Sample Custodian receiving the samples for analyses.	Internal/ External	1 - Laboratory Sample Custodian, Empirical 2 -Data Validators, Tetra Tech
Analytical data package	All analytical data packages will be verified internally for completeness by the laboratory performing the work. The Laboratory QAM will sign the case narrative for each data package.	Internal	Laboratory QAM, Empirical
Analytical data package	The data package will be verified for completeness by Tetra Tech Data Validators. Missing information will be requested from the laboratory, and validation will be suspended until missing data are received.	External	Data Validators, Tetra Tech

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
Analytical data package and electronic data deliverables (EDDs)	The electronic data will be verified against the chain-of-custody form and hard copy data package for accuracy and completeness. Laboratory analytical results will be verified and compared to the electronic analytical results for accuracy. Sample results will be evaluated for laboratory contamination and will be qualified for false positives using the laboratory method/preparation blank summaries. Positive results reported between the MDL and the reporting limit will be qualified as estimated. Extraneous laboratory qualifiers will be removed from the validation qualifier.	External	Data Validators, Tetra Tech

SAP WORKSHEET #35 -- VALIDATION (STEPS IIA AND IIB) PROCESS TABLE

(UFP-QAPP Manual Section 5.2.2) (Figure 37, page 110 UFP-QAPP Manual) (Table 9 UFP-QAPP Manual)

Step IIa / IIb	Validation Input	Description	Responsible for Validation (name, organization)
IIa	Field SOPs/Field Logs/Sample Collection Logs	Ensure that all sampling SOPs were followed. Verify that deviations have been documented and MPC have been achieved. Particular attention will be given to verify that samples were correctly identified, that sampling location coordinates are accurate, and that documentation establishes an unbroken trail of documented chain-of-custody from sample collection to report generation. Verify that the correct sampling and analytical methods/SOPs were applied. Verify that the sampling plan was implemented and carried out as written and that any deviations are documented.	PM or designee, Tetra Tech
IIa	Chain-of-Custody Forms	Ensure that the custody and integrity of the samples were maintained from collection to analysis and that custody records are complete and any deviations are recorded.	Project Chemist or Data Validators, Tetra Tech
IIa	Holding Times	Review that the samples were shipped and stored at the required temperature and sample pH values for chemically preserved samples meet the requirements listed in Worksheet #19. Ensure that the analyses were performed within the holding times listed in Worksheet #19	Project Chemist or Data Validators, Tetra Tech
IIa/IIb	Laboratory Data Results for Accuracy	Ensure that the laboratory QC samples listed in Worksheet #28 were analyzed and that the MPC listed in Worksheet #12 were met for all field samples and QC analyses. Check that specified field QC samples were collected and analyzed and that the analytical quality control criteria set up for this project were met.	Project Chemist or Data Validators, Tetra Tech
IIa/IIb	Field and Laboratory Duplicate Analyses for Precision	Check the field sampling precision by calculating the RPD for field duplicate samples. Check the laboratory precision by reviewing the RPD or %D values from laboratory duplicate analyses, MS/MSD, and LCS/LCSD. Ensure compliance with the methods and project MPC accuracy goals listed in Worksheets #12 and #28.	Project Chemist or Data Validators, Tetra Tech
IIa/IIb	Sample Results for Representativeness	Check that the laboratory recorded the temperature at sample receipt and the pH of chemically preserved samples to ensure sample integrity from sample collection to analysis.	Project Chemist or Data Validators, Tetra Tech

Step IIa / IIb	Validation Input	Description	Responsible for Validation (name, organization)
IIa/IIb	PALs	Discuss the impact on matrix interferences or sample dilutions performed because of the high concentration of one or more contaminant on the other target compounds reported as not-detected. Document this usability issue and inform the Tetra Tech PM.	Project Chemist or Data Validators, Tetra Tech
IIa/IIb	Data Validation Report	Summarize deviations from methods, procedures, or contracts. Qualify data results based on method or QC deviation and explain all the data qualifications. Print a copy of the project database qualified data depicting data qualifiers and data qualifiers codes that summarize the reason for data qualifications. Determine if the data met the MPC and determine the impact of any deviations on the technical usability of the data.	Project Chemist or Data Validators, Tetra Tech
IIa, IIb	UFP-SAP QC Sample Documentation	Ensure that all QC samples specified in the UFP-SAP were collected and analyzed and that the associated results were within prescribed UFP-SAP acceptance limits. Ensure that QC samples and standards prescribed in analytical SOPs were analyzed and within the prescribed control limits. If any significant QC deviations occur, the laboratory shall have contacted the Tetra Tech PM.	PM or designee, Tetra Tech
IIa, IIb	Documentation of Analytical Reports for Completeness	Review the chain-of-custody form generated in the field to ensure that the required analytical samples have been collected, appropriate sample identifications have been used, and correct analytical methods have been applied. Validator will verify that elements of the data package required for validation are present, and if not, the laboratory will be contacted and the missing information will be requested. Validation will be performed as per Worksheet #36. Check that all data have been transferred correctly and completely to the final Structured Query Language (SQL) database.	Project Chemist or Data Validators, Tetra Tech
IIa/IIb	PALs	Review and add PALs to the laboratory EDD. Flag samples and notify Tetra Tech PM of samples that exceed PALs as listed on Worksheet #15.	PM or designee, Tetra Tech
IIb	Project LOQs for sensitivity	Ensure that the project LOQs listed in Worksheet #15 were achieved.	Project Chemist or Data Validators, Tetra Tech
IIb	Analytical Data Deviations	Determine the impact of any deviation from sampling or analytical methods and SOPs requirements and matrix interferences effect on the analytical results.	Project Chemist or Data Validators, Tetra Tech

SAP WORKSHEET #36 –ANALYTICAL DATA VALIDATION (STEPS IIA AND IIB) SUMMARY TABLE

(UFP-QAPP Manual Section 5.2.2.1) (Figure 37, page 110 UFP-QAPP Manual)

Step IIa / IIb	Matrix	Analytical Group	Validation Criteria	Data Validator (title and organizational affiliation)
IIa and IIb	Soil, sediment, and aqueous field QC samples	Select Metals	SW-846 6010B method-specific criteria and those listed in Worksheet #12, #15, #24, and #28 will be used. If not included in these worksheets, the logic outlined in USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review EPA-540-R-04-004, October 2004, will be used to apply qualifiers to data.	Data Validators, Tetra Tech
IIa and IIb	Soil, sediment, and aqueous field QC samples	Select PAHs, Select Explosives, and Select Propellants	SW-846 8270C SIM and 8330A method-specific criteria and those listed in Worksheet #12, #15, #24, and #28 will be used. If not included in these worksheets, the logic outlined in USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review EPA-540/R-99-008, October 1999 will be used to apply qualifiers to data.	Data Validators, Tetra Tech

1) Field XRF data and IDW data will not be validated.

SAP WORKSHEET #37 -- USABILITY ASSESSMENT

(UFP-QAPP Manual Section 5.2.3)

Data Usability Assessment
The usability of the data directly affects whether project objectives can be achieved. The following characteristics will be evaluated at a minimum. The results of these evaluations will be included in the project report. The characteristics will be evaluated for multiple concentration levels if the evaluator determines that this is necessary. To the extent required by the type of data being reviewed, the assessors will consult with other technically competent individuals to render sound technical assessments of these DQI characteristics: **Completeness** o For each matrix that was scheduled to be sampled, the Tetra Tech FOL acting on behalf of the Project Team will prepare a table listing planned samples/analyses to collected samples/analyses. If deviations from the scheduled sample collection or analyses are identified the Tetra Tech PM and risk assessor will determine whether the deviations compromise the ability to meet project objectives. If they do, the Tetra Tech PM will consult with the Navy RPM and other project team members, as necessary (determined by the Navy RPM), to develop appropriate corrective actions. **Precision** o The Tetra Tech Project Chemist acting on behalf of the Project Team will determine whether precision goals for field duplicates and laboratory duplicates were met. This will be accomplished by comparing duplicate results to precision goals identified in Worksheets #12 and #28. This will also include a comparison of field and laboratory precision with the expectation that field duplicate results will be no less precise than laboratory duplicate results. If the goals are not met, or data have been flagged as estimated (J qualifier), limitations on the use of the data will be described in the project report. **Accuracy** o The Tetra Tech Project Chemist acting on behalf of the Project Team will determine whether the accuracy/bias goals were met for project data. This will be accomplished by comparing percent recoveries of LCS, LCSD, MS, MSD, and surrogate compounds to accuracy goals identified in Worksheet #28. This assessment will include an evaluation of field and laboratory contamination; instrument calibration variability; and analyte recoveries for surrogates, matrix spike, and laboratory control samples. If the goals are not met, limitations on the use of the data will be described in the project report. Bias of the qualified results and a description of the impact of identified non-compliances on a specific data package or on the overall project data will be described in the project report. **Representativeness** o A project scientist identified by the Tetra Tech PM and acting on behalf of the Project Team will determine whether the data are adequately representative of intended populations, both spatially and temporally. This will be accomplished by verifying that samples were collected and processed for analysis in accordance with the UFP-SAP, by reviewing spatial and temporal data variations, and by comparing these characteristics to expectations. The usability report will describe the representativeness of the data for each matrix and analytical fraction. This will not

Data Usability Assessment

require quantitative comparisons unless professional judgment of the project scientist indicates that a quantitative analysis is required.

Comparability

- The Tetra Tech Project Chemist acting on behalf of the Project Team will determine whether the data generated under this project are sufficiently comparable to historical site data generated by different methods and for samples collected using different procedures and under different site conditions. This will be accomplished by comparing overall precision and bias among data sets for each matrix and analytical fraction. This will not require quantitative comparisons unless professional judgment of the Tetra Tech Project Chemist indicates that such quantitative analysis is required.

Sensitivity

- The Tetra Tech Project Chemist acting on behalf of the Project Team will determine whether project sensitivity goals listed in Worksheet #15 are achieved. The overall sensitivity and LOQs from multiple data sets for each matrix and analysis will be compared. If sensitivity goals are not achieved, the limitations on the data will be described. The Tetra Tech Project Chemist will enlist the help of the Tetra Tech Project Risk Assessor to evaluate deviations from planned sensitivity goals.

Field XRF/Laboratory Lead Data Correlation

- The Tetra Tech Project Statistician will evaluate the correlation of field XRF data to laboratory data. Factors considered in this evaluation will include the magnitude of the slope and intercept of the correlation equation, the distribution of data points across the plotted concentration range, and the value of the correlation coefficient. If the coefficient is less than 0.65, or the plotted data do not appear to be well correlated in accordance with standard statistical principles, limitations on the use of the data will be described in the project report.

Project Assumptions and Data Outliers

- The Tetra Tech PM and designated team members will evaluate whether project assumptions are valid. This will typically be a qualitative evaluation, but may be supported by quantitative evaluations. The type of evaluation depends on the assumption being tested. Quantitative assumptions include assumptions related to data distributions (e.g., normal versus log-normal) and estimates of data variability. Statistical tests for outliers will be conducted using standard statistical techniques appropriate for this task. Potential outliers will be removed if a review of the associated indicates that the results have an assignable cause that renders them inconsistent with the rest of the data. During this evaluation, the team will consider whether outliers could be indications of unanticipated site conditions. Consideration will be given to whether outliers represent an unanticipated site condition.

Data Usability Assessment
Describe the evaluative procedures used to assess overall measurement error associated with the project: After completion of the data validation, the data and data quality will be reviewed to determine whether sufficient data of acceptable quality are available for decision-making. In addition to the evaluations described above, a series of inspections and statistical analyses will be performed to estimate these characteristics. The statistical evaluations will include simple summary statistics for target analytes, such as maximum concentration, minimum concentration, number of samples exhibiting non-detected results, number of samples exhibiting positive results, and the proportion of samples with detected and non-detected results. The project team members identified by the Tetra Tech PM will assess whether the data collectively support the attainment of project objectives. They will consider whether any missing or rejected data have compromised the ability to make decisions or to make the decisions with the desired level of confidence. The data will be evaluated to determine whether missing or rejected data can be compensated by other data. Although rejected data will generally not be used, there may be reason to use them in a weight of evidence argument, especially when they supplement data that have not been rejected. If rejected data are used, their use will be supported by technically defensible rationales. For statistical comparisons and mathematical manipulations, non-detected values will be represented by a concentration equal to one-half the sample-specific reporting limit. Duplicate results (original and duplicate) will not be averaged for the purpose of representing the range of concentrations. However, the average of the original and duplicate samples will be used to represent the concentration at a particular sampled location.
Identify the personnel responsible for performing the usability assessment: The Tetra Tech PM, Project Chemist, FOL, and Project Scientist will be responsible for conducting the listed data usability assessments. The data usability assessment will be reviewed with the Navy RPM and Illinois EPA RPM. If deficiencies affecting the attainment of project objectives are identified, the review will take place in either a face-to-face meeting or a teleconference depending on the extent of identified deficiencies. If no significant deficiencies are identified, the data usability assessment will simply be documented in the project report and reviewed during the normal document review cycle.
Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies: The data will be presented in tabular format, including data qualifications such as estimation (J, UJ) or rejection (R). Written documentation will support the non-compliance estimated or rejected data results. The project report will identify and describe the data usability limitations and suggest re-sampling or other corrective actions, if necessary.

REFERENCES

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