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FINAL TIER II SAMPLING AND ANALYSIS PLAN FOR REMEDIAL INVESTIGATION OF FORMER MACHINE GUN RANGE COMPLEX WITH REGULATOR RESPONSE TO COMMENTS AND TRANSMITTAL NAS JACKSONVILLE FL
12/3/2012
TETRA TECH

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND SOUTHEAST
JACKSONVILLE, FL 32212-0030

5090
Ser OPDE3/0488
December 3, 2012

Mr. David Grabka
Florida Department of Environmental Protection
Division of Waste Management
Federal Programs Section
Bob Martinez Center
2600 Blairstone Road, Mail Station 4535
Tallahassee, FL 32399-2400

Dear Mr. Grabka:

SUBJECT: SUBMISSION OF FINAL REMEDIAL INVESTIGATION UFPSAP OPERABLE UNIT 10 MUNITIONS RESPONSE PROGRAM SITES AT NAVAL AIR STATION JACKSONVILLE, FLORIDA

The subject Uniform Federal Policy Sampling and Analysis Plan (UFPSAP) is enclosed for your records. We are in receipt of your approval of the draft final. This document is being transmitted to you in both hard copy and electronic format.

If you have any questions, please contact me at commercial (904) 542-6160 or e-mail: adrienne.wilson@navy.mil.

Sincerely,

A. T. WILSON
Restoration Project Manager
South Atlantic Integrated
Product Team
By direction of the
Commanding Officer

Enclosure: Final OU10 MRP RI UFPSAP

Copy to:
Mr. Tim Curtin, NAS Jacksonville
Mr. Peter Dao, USEPA Region IV (w/o encl)
Mr. Mark Peterson, Tetra Tech (CD only)
Mr. Mike Singletary, NAVFACSE (CD only)
Mr. Eric Davis, CH2MHill (CD only)
Mr. Todd Haverkost, Resolutions (CD only)

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND SOUTHEAST
JACKSONVILLE, FL 32212-0030

5090
Ser OPDE3/0489
December 3, 2012

Mr. Peter Dao
U. S. Environmental Protection Agency Region IV
Federal Facilities Branch
61 Forsyth Street, SW
Atlanta, GA 30303

Dear Mr. Dao:

SUBJECT: SUBMISSION OF FINAL REMEDIAL INVESTIGATION UFPSAP OPERABLE UNIT 10 MUNITIONS RESPONSE PROGRAM SITES AT NAVAL AIR STATION JACKSONVILLE, FLORIDA

The subject Uniform Federal Policy Sampling and Analysis Plan (UFPSAP) is enclosed for your records. We are in receipt of your approval of the draft final. This document is being transmitted to you in an electronic format per your request.

If you have any questions, please contact me at commercial (904) 542-6160 or e-mail: adrienne.wilson@navy.mil.

Sincerely,

A. T. WILSON
Restoration Project Manager
South Atlantic Integrated
Product Team
By direction of the
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Enclosure: Final OU10 MRP RI UFPSAP

Copy to:
Mr. Tim Curtin, NAS Jacksonville
Mr. David Grabka, FDEP (w/o encl)
Mr. Mark Peterson, Tetra Tech (CD only)
Mr. Mike Singletary, NAVFACSE (CD only)
Mr. Eric Davis, CH2MHill (CD only)
Mr. Todd Haverkost, Resolutions (CD only)

TETRA TECH

PHIL-25001

November 8, 2012

Project Number 03401

Ms. Adrienne Wilson
Remedial Project Manager
Naval Facilities Engineering Command (NAVFAC) Southeast
AJAX Street, Building 135N
Code OPDE3 / IPT SA
Jacksonville, Florida 32212-0030

Reference: CLEAN Contract Number N62470-08-D-1001
Contract Task Order Number JM55

Subject: Submittal of Draft Final Tier II Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan) for Munitions Response Program
Remedial Investigation of Former Machine Gun Range Complex
Naval Air Station (NAS) Jacksonville
Jacksonville, Florida

Dear Ms. Wilson:

Tetra Tech, Inc. (Tetra Tech) is pleased to submit the subject Sampling and Analysis Plan (SAP) for concurrence and signature (see enclosed). Also enclosed are responses to comments (RTCs) from Florida Department of Environmental Protection on the Draft (April 2012) version of this SAP. Copies of this SAP and RTCs are being distributed to members of the NAS Jacksonville Partnering Team, as reflected in your transmittal letters. Electronic files (PDF) are provided on CD with each hard copy.

If you have any questions regarding the enclosed material, or if I can be of assistance in any way, feel free to contact me by phone at (610) 382-3770, or by e-mail at barb.becker@tetratech.com.

Very Respectfully,

Barb Becker

Barb Becker, PMP®
Sr. Project Manager

BB/pg

Enclosures

c: Mark Peterson (Tetra Tech)
Garth Glenn (Tetra Tech) (cover letter only)
John Trepanowski (Tetra Tech) (cover letter only)
Project File (cover letter only)

Tetra Tech, Inc.
234 Mall Boulevard, Suite 260, King of Prussia, PA 19406-2954
Tel 610.491.9688 Fax 610.491.9645 www.tetratech.com

Responses-to-Comments (RTCs) from Partnering Team on
Draft Tier II Sampling and Analysis Plan (SAP)
Munitions Response Program (MRP)
Remedial Investigation (RI) of Former Machine Gun Range Complex
Naval Air Station (NAS) Jacksonville
Jacksonville, Florida

Comments from U.S. Environmental Protection Agency (USEPA) Region IV:

USEPA approved of the Draft SAP (dated April 2012) on July 3, 2012 with no comments.

Comments from Florida Department of Environmental Protection (FDEP):

FDEP submitted comments on the Draft SAP (dated April 2012) on July 9, 2012. Below are RTCs for those comments. (Note: where the comment response provides revised text, text additions are shown in ***bold italics*** and deleted text is shown as ~~strikethrough~~.)

1. **Section 1.0, Identify Navy QAO/Chemist.**

   Comment: In Section 1.0, in the box for the Navy QAO/Chemist, the name Jonathan Tucker should replace TBD.

   Response: *At the direction of the Navy Chemist(s) in response to previously received comments on other SAPs, SAPs do not typically identify the Navy Chemist by name because there are multiple persons who might review a SAP upon submittal, including Jonathan Tucker. However, since the Chemist for this SAP has already been assigned, the requested change has been made to the box on page 12 of 114.*

2. **Section 4.3.2, Identify UXO 1 Exceedances.**

   Comment: In Section 4.3.2, for UXO 1, page 37 of 114, fourth paragraph, last sentence, it says that ten surface soil and five sediment samples also exceeded the tiered select ecological PAL, but it does not state for what contaminant or sum of contaminants there were exceedances.

   Response: *The "tiered select ecological PAL" exceedances mentioned in this sentence referred to various PAHs; thus, an associated threshold value should not have been cited. The referenced text has been revised as follows:*

   "Benzo(a)pyrene (BaP) equivalents were calculated, which indicated exceedances of the human health PAL (100 ***micrograms per kilogram [***µg/kg***]***) in twenty-eight surface soil, five subsurface soil, and five sediment samples. In addition, ***concentrations of one or more individual PAHs exceeded their respective ecological screening values in*** ten surface soil and five sediment samples~~ also exceeded the tiered select ecological PAL (1,100 mg/kg)~~."

3. **Section 4.3.2, UXO 1 Skeet Layer Questions.**

   Comment: In Section 4.3.2, for UXO 1, page 37 of 114, sixth paragraph, it says a 6- to 12-inch layer of skeet fragments was observed at six sampling locations and that no samples were collected from that layer for those 6 samples. Has the Navy considered delineating the area of buried skeet fragments? Has the Navy considered putting a well in the area where the buried skeet fragments were observed?

   Response: *In response to this comment, the 6- to 12-inch layer of skeet fragments observed on the surface at these six sampling locations will be further investigated during the RI. The SAP has been*

revised to include a visual inspection and shovel-aided investigation of the area, as necessary, to define the horizontal and vertical extent of the skeet layer. Also, the groundwater sampling program has been revised to include an additional temporary well (TW07), collocated with soil sampling location X1SB034, to measure the impact of PAHs in the skeet layer on the underlying groundwater. Revisions have been made to the appropriate SAP sections as follows:

- *Section 7.1, first paragraph, seventh and eight sentences, have been revised as follows:*

"In addition, three temporary groundwater wells will be installed at locations where SPLP analyses and SCTL comparisons showed a potential for soil contamination to leach to groundwater, and ***one temporary groundwater well will be installed in the vicinity of the skeet debris layer.*** Groundwater samples collected from ~~these~~ ***the first three*** wells will be shipped to the fixed base laboratory for antimony, arsenic, and lead analysis, ***and a sample from the fourth well will be shipped to the laboratory for low-level PAH analysis."***

- *Section 7.1, the following paragraph has been added:*

"To delineate the skeet debris layer observed during the SI in the south-central portion of the site, a visual inspection and shovel-aided investigation of the area will be conducted. Working outward from the known locations of debris (e.g., SI sample locations JAX-22-SBSS001 through JAX-22-SBSS006), surface material will be removed manually at discrete locations (to be determined by field personnel), as necessary, to define the boundaries of the debris. The horizontal extent of the debris will be marked using handheld GPS units, and the depth of the debris will be measured using a shovel and ruler or measuring tape. It is estimated that approximately 20 to 30 discrete locations will need to be investigated to sufficiently define the horizontal and vertical boundaries of the debris layer. The FOL will ensure that the groundwater and collocated soil samples intended to monitor the impacts of this debris layer are installed at an appropriate location."

- *Section 8.5, Sample Details Table, has been revised to include a groundwater sample at TW07 and collocated soil samples at X1SB037, both specifying laboratory analyses for low-level PAHs.*

- *Section 8.7, Field Quality Control Summary Table, has been revised to include one PAH groundwater sampling location, with an associated field duplicate and MS/MSD; and two additional PAH analyses for surface soil samples.*

- *Figures 7-1 and 7-6 have been revised to indicate the proposed location of X1SB037/TW07.*

4. Section 4.3.2, Identify UXO 3 Exceedances.

Comment: In Section 4.3.2, for UXO 3, page 39 of 114, fourth paragraph, same comment as (2) above. Also, in that paragraph, first sentence micrograms per liter should be micrograms per kilogram (µg/kg).

Response: *See response to Comment #2. The referenced text has been revised as follows:*

"BaP equivalents were calculated, which indicated exceedances of the human health PAL ~~[~~***(***100 ~~micrograms per liter~~ (µg/~~L~~***kg***)~~]~~ in nine surface soil and six sediment samples. In addition, ***concentrations of one or more individual PAHs exceeded their respective ecological screening values in*** two surface soil and six sediment samples~~ also exceeded the tiered select ecological PAL (1,100 mg/kg)~~."

5. Section 4.3.2, Clarify UXO 4 PAL Exceedances.

Comment: In Section 4.3.2, for UXO 4, page 40 of 114, first paragraph, last sentence, it says that several metals exceeded their respective PALs at numerous surface soil sampling locations and that several metals exceeded their respective PALs in all of the sediment samples, but it does not state whether human health or ecological PALs are being discussed.

Response: *For each site-specific discussion in Section 4.3.2, the first paragraph was intended as a broad summary of the detailed information presented in the paragraphs that follow. To clarify, the phrase "**As detailed below,**…" has been added to the first paragraph of each subsection at the beginning of the sentence that introduces the analytical results. In addition, the last sentence of the third paragraph in the UXO 4 discussion has been revised as follows:*

"UXO 4 - Exceedances of the ecological and/or human health PALs were reported for antimony ~~in seventeen~~ ***(17*** surface soil and two sediment samples ***exceeded the ecological PAL and one surface soil sample also exceeded the human health PAL)***, ~~for~~ arsenic ~~in~~ ***(***four surface soil and one sediment samples ***exceeded the human health PAL and two surface soil samples also exceeded the ecological PAL)***, copper ~~in~~ ***(***nine surface soil and three sediment samples ***exceeded the ecological PAL and seven of the surface soil and three of the sediment samples also exceeded the human health PAL)***, and zinc ~~in~~ ***(***four surface soil samples ***exceeded the ecological PAL)."***

Because this comment is also relevant to the discussion on select metals exceedances at UXO 1, the last sentence of the third paragraph in the UXO 1 discussion has been revised as follows:

"UXO 1 - Human health and/or ecological PALs ~~for antimony, arsenic, copper, tin, and zinc~~ were also exceeded in a large number of ***soil*** samples ***for antimony (12 samples exceeded the ecological PAL and two samples also exceeded the human health PAL), arsenic (five samples exceeded the human health PAL and one sample also exceeded the ecological PAL), copper (three samples exceeded the ecological PAL and one sample also exceeded the human health PAL), tin (one sample exceeded the ecological PAL), and zinc (two samples exceeded the ecological PAL and one sample also exceeded the human health PAL)."***

6. Section 4.3.2, Identify UXO 6 Exceedances.

Comment: In Section 4.3.2, for UXO 6, page 42 of 114, fourth paragraph, same comments as in (4) above.

Response: *See responses to Comments #2 and 4. The referenced text has been revised as follows:*

"BaP equivalents were calculated, which indicated exceedances of the human health PAL (100 µg/~~L~~***kg***) in five surface soil and eight sediment samples. In addition, ***concentrations of one or more individual PAHs exceeded their respective ecological screening values in*** five surface soil and seven sediment samples ~~also exceeded the tiered select ecological PAL (1,100 mg/kg)~~."

7. **Section 4.3.2, Address UXO 6 Sediment and Surface Water Issues.**

Comment: In Section 4.3.2, for UXO 6, page 42 of 114, last sentence on page, it says "Surface water sampling was recommended to investigate the possible migration of contaminated sediment through the site drainages." Surface water sampling may provide information on how contaminated sediment or discharging contaminated groundwater may be affecting surface water, but unless the surface water samples are collected during a storm event where sediments are entrained in surface water at the time of sampling, the sampling of surface water will be of little value in determining sediment migration. Further sediment sampling along the reaches of those site drainages would be a typical method for investigating sediment contaminant migration and its nature and extent.

Response: *Surface water samples are planned in order to investigate that particular environmental medium for potential contaminants that may have migrated from sediments and soils into the nearby surface water in ponds. The referenced text has been revised as follows to clarify this objective for the surface water samples:*

"Surface water sampling was recommended to investigate the possible ***impact*** ~~migration~~ of ~~contaminated~~ ***soil and*** sediment ***contaminant migration*** through the site drainages ***into nearby surface ponds, where contaminants could leach into the surface water, or through the underlying groundwater, which could seep into the ponds."***

8. Section 5.2, Risk Assessment PALs and Risk Management Processes.

Comment: In Section 5.2, subsection 8., page 50 of 114, Project Action Limits, it says that human health risk PALs are based on an incremental lifetime cancer risk greater than 1 x 10^{-4} or a non-cancer Hazard Index (HI) greater than 1. PALs are based on either the Department's residential soil cleanup target level (SCTL), which is based on an incremental lifetime cancer risk greater than 1 x 10^{-6} or a non-cancer Hazard Index (HI) greater than 1; or they are based on EPA's Regional Screening Levels (RSLs), which I believe are based on the same criteria but possibly using different exposure assumptions. Also, in the paragraph after the two bullets, it discusses risk management processes that are not relevant to the identification of PALs for the investigation being described in the UFP SAP.

Response: *The Project Action Limits (PALs) for the RI, which are discussed in Section 5.2, Subsection 8, address the action limits to be used during the risk assessment to identify contaminants of concern (COC), if any, and to determine the appropriate next step in the CERCLA process. The RI PALs are not to be confused with the risk-based screening criteria (also called Project Screening Levels [PSLs]) that are discussed in Section 5.2, Subsection 7. The PSLs were used in selecting contaminants of potential concern (COPCs) during the risk screening evaluation conducted during the SI and will be used again during the first step in the risk assessment to be conducted during the RI. Potential confusion may arise because the PSLs were identified as PALs under the SI since they were used to determine the next step in the CERCLA process at that time (i.e., whether each site should proceed to an RI). Consequently, the "PAL exceedances" reported for the SI in Section 4.3.2 and elsewhere represent exceedances of the respective PSLs for each contaminant, not exceedances of general human health and ecological risk management criteria.*

In response to this comment, the RI PAL based on incremental lifetime cancer risk (ILCR) has been changed to 1 x 10^{-6}, the title of Appendix D has been corrected to reflect "Project Screening Level Support Documentation" rather than Project Action Limit Support Documentation," and Subsection 8 has been revised as follows:

"Project Action Limits (PALs): PALs are necessary to make decisions ***regarding the appropriate next step in the CERCLA process*** based on risk to identified receptors from exposure to surface soil, subsurface soil, sediment, surface water, and groundwater data. The selected human health and ecological PALs for this RI are as follows:

- Human Health Risk: An incremental lifetime cancer risk (ILCR) greater than 1 x 10-$^{\cancel{6}\,4}$ or a non-cancer Hazard Index (HI) greater than 1 (based on common target organs or effects) is considered to be unacceptable ***or indicative of the need to make risk management decisions***.

- Ecological Risk: A Hazard Quotient (HQ) greater than 1 for any receptor in any medium is considered to be unacceptable.

~~If these risk levels are exceeded at any site, the Project Team will take the next step in the CERCLA process and evaluate remedial alternatives in a Feasibility Study (FS). If ILCRs are within the range~~

~~of 1 x 10-4 to 1 x 10-6, then the Partnering Team will make risk management decisions for the site on a case-by-case basis.~~"

9. Section 5.4, Human Health Risk Assessment Issues.

Comment: In Section 5.4, page 54 of 114, Human Health Risk Assessment, it says that only if incremental lifetime cancer risks are greater than 1 x 10^{-4} or hazard quotients of hazard indices are greater than 1, will the Navy proceed to a Feasibility Study. The Department's criteria for incremental lifetime cancer risk is 1 x 10^{-6} and will identify that criteria and the cleanup target levels based on that criteria as State ARARs. Also, it may be premature in discussing how the data to be collected in the Remedial Investigation will be used in risk assessments in the UFP SAP.

Response: *Decision rules governing how the data collected under this SAP will be used in preparing human health and ecological risk assessments are included in the Analytic Approach to provide context for the data collection activities and direction for how the results will be used. To meet State ARARs, the PAL based on ILCR has been changed to 1 x 10^{-6} and the decision rules presented in the referenced Section 5.4 subsection (Human Health Risk Assessment) have been replaced with the following:*

"Human Health Risk Assessment

A human health risk assessment will be conducted in accordance with EPA and FDEP (i.e., F.A.C. Chapter 62.780) regulatory requirements, based on the COPCs identified for each site. The following decision rules will apply:

Step 1 (all media):

- ***All media: If hazard quotients or hazard indices are less than 1 and ILCRs are less than 1 x 10^{-6}, then recommend no further investigation and no further action for that site. Otherwise, proceed to Step 2.***

Step 2 (Applicable Separately to Each Environmental Medium):

- ***Soil: If risks are unacceptable from soil [i.e., hazard quotients or hazard indices are greater than 1, and/or incremental lifetime cancer risks (ILCRs) are greater than 1 x 10^{-6}], then the Partnering Team will make risk management decisions for the site on a case-by-case basis. The decision process may include proceeding to an FS to evaluate remedial alternatives for soil at the site.***

- ***Sediment: If risks are unacceptable from sediment [i.e., hazard quotients or hazard indices are greater than 1, and/or ILCRs are greater than 1 x 10^{-6}], then the Partnering Team will make risk management decisions for the site on a case-by-case basis. The decision process may include proceeding to an FS to evaluate remedial alternatives for sediment at the site.***

- ***Groundwater: If target analyte concentrations in groundwater are greater than the MCL or present a human health risk (i.e., hazard quotients or hazard indices are greater than 1, and/or ILCRs are greater than 1 x 10^{-6}), then the Partnering Team will make risk management decisions for the site on a case-by-case basis. The decision process may include proceeding to an FS to evaluate remedial alternatives for groundwater at the site."***

10. Section 7.2, Add Lead to Analyte List for Groundwater at UXO 2.

Comment: In Section 7.2, first paragraph, page 60 of 114, please add lead (Pb) to the analyses to be done on groundwater at UXO 2.

***Response**: Lead was not identified as a groundwater contaminant for UXO 2 because site-specific SCTL comparisons did not indicate a strong likelihood for lead in soil to impact the groundwater. However, in response to this comment and because the SPLP analyses indicated a potential for leaching, lead has been added to the list of analyses for well TW04 in the Section 8.5 Sample Details Table. In addition, the referenced text has been revised as follows:*

"In addition, one temporary groundwater well will be installed due to SPLP analyses and***/or*** SCTL comparisons showing a potential for ***lead and*** antimony contamination in soil to leach to groundwater. The groundwater sample will be shipped to the fixed base laboratory for ***lead and*** antimony analysis."

11. Appendix B, Add Missing Figures.

Comment: In Appendix B, Correlation Between XRF and Laboratory Lead Data, several figures were missing in my copy.

***Response:** The Correlation Analysis presented in Appendix B of the RI SAP included only the changes made to the information originally presented in Appendix E of the Site Inspection (SI) Report (i.e., a revision to the Fort Dix data set that removed one gross outlier and required a change to Figure 2). In response to this comment, the entire SI Appendix E was reviewed and it was noted that: a) errors in the Fort Dix data set revisions needed to be corrected, b) an introductory paragraph was needed to clarify the differences between the information presented in the SI Report Appendix E and the RI SAP Appendix B, c) all figures needed to be included, and d) text introducing Figure 8 needed to be added. The appendix has been revised to incorporate these changes, and the relevant text has been revised as follows:*

- *An introductory paragraph has been added (page 1):*

"The following information was obtained from Appendix E of the Site Inspection Report (Tetra Tech, 2010), with minor revisions that address the usability of the Fort Dix data set (i.e., by removing one gross outlier from the original set of 20 data points and revising Figure 2), and the addition of text that introduces Figure 8."

- *The paragraph on Fort Dix Data Set Corrections (page 1) has been revised:*

"Figure 1 presents the scatter plot of the XRF and FBL lead concentrations for Fort Dix. With the exception of ~~three~~***five*** samples***,*** all the XRF concentrations are less than 406 mg/kg. The correlation between the XRF and FBL concentrations is 0.51 and the corresponding R^2 value is 0.27. The correlation indicates a weak linear relationship. ***However, with the removal of one gross outlier (JAX-22-SBSS033) from the original 20-point data set, a very strong correlation was observed among the remaining data points.*** Figure 2 presents the scatter plot of XRF and FBL lead concentrations ~~where the XRF concentrations are less than 406mg/kg~~ ***when sample JAX-22-SBSS033 is removed***. The correlation between the XRF and FBL concentrations is 0.9~~1~~***9*** and the corresponding R^2 value is 0.~~83~~***99***. Therefore, the correlation between the XRF and FBL is acceptable as outlined by the June 2009 SAP for XRF concentrations. FBL concentrations can be predicted from XRF concentrations from 7 to ~~406~~ ***6000*** mg/kg using the following equation.

FBL = ~~-48.1~~ ***67.0*** + ***1.1***~~2.3~~ * XRF "

- *A sentence introducing Figure 8 has been added (page 5):*

"With the one sample removed, the correlation between the XRF and FBL concentrations is 0.95 and the corresponding R^2 value is 0.90. ***Figure 8 presents the scatter plot of the XRF and FBL lead concentrations for data pairs with XRF concentrations of less than 1960 mg/kg."***

12. Figures 7-1 through 7-5, Provide Additional Details.

Comment: In Figures 7-1 through 7-5, the proposed sample locations are depicted. However, the locations are not shown in the context of the previous sampling location and results from the Site Investigation or the sample depths and analyses to be performed specified in the table in Section 8.5. Please devise figures that place into context why the particular sample locations are being proposed and what are the sample depths and analyses to be performed at those locations.

Response: *It is agreed that including on Figures 7-1 through 7-5 the analytical results from the SI that were used to determine the RI sampling locations, depths, and required analyses would be helpful to provide context and to assist the reader in verifying the appropriateness of proposed step-out locations. However, from a practical standpoint, including tag maps that show all of the SI exceedance data (i.e., each analysis from each depth interval at each sample location, as shown on the Appendix C figures), along with the corresponding analyses and sample depths for each RI step-out sample (as specified in the Section 8.5 tables), would make the figures extremely cumbersome and difficult to interpret.*

As a compromise, Figures 7-1 through 7-5 have been revised to depict the color-coded symbols showing SI exceedances for metals and/or PAHs (as shown on Figures 4-9 through 4-12 and 4-14), along with corresponding color-coded symbols showing the RI step-out sample locations and analyses. Although depth information is not depicted, these revised figures provide an effective visual correlation between the two sets of sample locations to supplement the detailed specifications listed in Section 8.5.

TETRA TECH

PHIL-25039

December 5, 2012

Project Number 03401

Ms. Adrienne Wilson
Remedial Project Manager
Naval Facilities Engineering Command (NAVFAC) Southeast
AJAX Street, Building 135N
Code OPDE3/IPT SA
Jacksonville, Florida 32212-0030

Reference: CLEAN Contract Number N62470-08-D-1001
Contract Task Order Number JM55

Subject: Finalization of Tier II Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan) for Munitions Response Program
Remedial Investigation of Former Machine Gun Range Complex
Naval Air Station (NAS) Jacksonville
Jacksonville, Florida

Dear Ms. Wilson:

Tetra Tech, Inc. (Tetra Tech) is pleased to finalize the subject Sampling and Analysis Plan (SAP) following concurrence and signature received from the NAS Jacksonville Partnering Team. Enclosed for your records is an electronic version of the Final SAP (December 2012) on CD. A hard copy of the revised cover, spine, and signature page are also enclosed, as is a new cover sheet that confirms the finalization of the SAP per this transmittal. These items can be inserted directly into the binder that was sent to you in November 2012, which contained the Draft Final version of the SAP. The CD and hard copy items are also being distributed to members of the NAS Jacksonville Partnering Team today, as reflected in your transmittal letters.

If you have any questions regarding the enclosed material, or if I can be of assistance in any way, feel free to contact me by phone at (610) 382-3770, or by e-mail at barb.becker@tetratech.com.

Very Respectfully,

Barb Becker

Barb Becker, PMP®
Sr. Project Manager

BB/pg

Enclosures

c: Mark Peterson (Tetra Tech) (cover letter only)
Garth Glenn (Tetra Tech) (cover letter only)
John Trepanowski (Tetra Tech) (cover letter only)
Project File (Tetra Tech)
NIRIS Regional Data Manager (complete paper copy)

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Tier II Sampling and Analysis Plan
Munitions Response Program

Remedial Investigation
of
Former Machine Gun Range Complex

Naval Air Station Jacksonville
Jacksonville, Florida

Naval Facilities Engineering Command
Southeast

Contract Number N62470-08-D-1001
Contract Task Order JM55

December 2012

TETRA TECH

By inclusion of this cover sheet and the following signature page, which signifies concurrence among the NAS Jacksonville Partnering Team members, the Draft Final Sampling and Analysis Plan (dated November 2012) becomes the Final Sampling and Analysis Plan (dated December 2012).

Title and Approval Page
(UFP-QAPP Manual Section 2.1)

DRAFT FINAL
TIER II SAMPLING AND ANALYSIS PLAN
(Field Sampling Plan and Quality Assurance Project Plan)
November 2012

Munitions Response Program
Remedial Investigation of Former Machine Gun Range Complex
Naval Air Station Jacksonville
Jacksonville, Florida

Prepared for:
Naval Facilities Engineering Command Southeast
NAS Jacksonville, Building 903
Jacksonville, Florida 32212-0030

Prepared by:
Tetra Tech
234 Mall Boulevard, Suite 260
King of Prussia, Pennsylvania 19406-2954

Prepared under:
Comprehensive Long-term Environmental Action Navy
Contract No. N62470-08-D-1001
Contract Task Order JM55

BUREAU OF WASTE CLEANUP
NOV 19 2012
FEDERAL FACILITIES SECTION

Review Signatures:

T.F. Johnston 11-6-12
Tom Johnston, PhD/ Quality Assurance Manager/ Date
Tetra Tech

Barbara Becker / 11/6/12
Barbara Becker, PMP/ Project Manager/ Date
Tetra Tech

Approval Signatures:

-- see next page --
Quality Assurance Officer/ Date
NAVFAC Mid-Atlantic

WILSON.ADRIENNE.TOWNSEL.1228825723

Adrienne Wilson/ Remedial Project Manager/ Date
NAVFAC SE

11/20/12
Peter Dao/ Remedial Project Manager/ Date
USEPA Region 4

David P. Grabka 11/16/12
David Grabka/ Remedial Project Manager/ Date
Florida Department of Environmental Protection

DQD_7_3526

Title and Approval Page
(UFP-QAPP Manual Section 2.1)

INTERNAL DRAFT
TIER II SAMPLING AND ANALYSIS PLAN
(Field Sampling Plan and Quality Assurance Project Plan)
~~October 2011~~February 2012

Munitions Response Program
Remedial Investigation of Former Machine Gun Range Complex
Naval Air Station Jacksonville
Jacksonville, Florida

Prepared for:
Naval Facilities Engineering Command Southeast
NAS Jacksonville, Building 903
Jacksonville, Florida 32212-0030

Prepared by:
Tetra Tech NUS, Inc.
234 Mall Boulevard, Suite 260
King of Prussia, Pennsylvania 19406-2954

Prepared under:
Comprehensive Long-term Environmental Action Navy
Contract No. N62470-08-D-1001
Contract Task Order JM55

Review Signatures:

Tom Johnston, PhD/ Quality Assurance Manager/ Date
Tetra Tech NUS, Inc.

Barbara Becker, PMP/ Project Manager/ Date
Tetra Tech NUS, Inc.

Digitally signed by TUCKER.JONATHAN.P.1239524180
Date: 2012.03.28 02:30:12 -04'00'

Approval Signatures:

Quality Assurance Officer/ Date
NAVFAC Mid-Atlantic

Adrienne Wilson/ Remedial Project Manager/ Date
NAVFAC SE

Peter Dao/ Remedial Project Manager/ Date
USEPA Region 4

David Grabka/ Remedial Project Manager/ Date
Florida Department of Environmental Protection

EXECUTIVE SUMMARY

Tetra Tech has prepared this Tier II Sampling and Analysis Plan (SAP) for the Munitions Response Program (MRP) Remedial Investigation (RI) of the Former Machine Gun Range Complex at Naval Air Station (NAS) Jacksonville, located in Jacksonville, Florida (**Figure ES-1**), under Contract No. N62470-08-D-1001, Comprehensive Long-term Environmental Action Navy (CLEAN), Contract Task Order (CTO) JM55. The Former Machine Gun Range Complex comprises six Unexploded Ordnance (UXO) sites that were formerly identified as Potential Source of Contamination (PSC) sites prior to the discovery of Munitions Constituents (MC) in soil and sediment and the sites' subsequent inclusion in the MRP. The six sites, which are shown on **Figure ES-2,** are as follows:

- Fort Dix Skeet Range (formerly identified as PSC 22, now identified as UXO 1)
- .50 Caliber Range (formerly PSC 23A, now UXO 2)
- Former Skeet Range (formerly PSC 23B, now UXO 3)
- Akron Road Pistol Range (formerly PSC 56, now UXO 4)
- .30 Caliber Range (formerly PSC 57, now UXO 5)
- Trap Ranges (formerly PSC 58, now UXO 6)

Data collected during the RI will be combined with data from previous investigations and used to determine whether, and to what extent, MC contamination is present in surface and subsurface soil, sediment, surface water, and/or groundwater at these six sites. The Conceptual Site Model (CSM) for each site will be revised based on the contaminant nature and extent, and risk assessments will be performed to determine whether the contamination poses potentially unacceptable risks to human health and/or ecological receptors.

The Navy is following the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) process for the investigation of these sites. The initial phase of the CERCLA process, the Preliminary Assessment (PA), was completed in 2007 and recommended further study of the small arms and skeet ranges at the Former Machine Gun Range Complex (Malcolm Pirnie, 2007). The next phase of the CERCLA process, the Site Inspection (SI), was completed in January 2010. The SI considered the background information provided in the PA and focused on the collection of site-specific environmental data to support screening-level human health and ecological risk evaluations to identify contaminants of potential concern (COPCs) in soil and sediment at each of the six sites. The findings, conclusions, and recommendations of the SI are documented in the SI Report for the Former Machine Gun Range Complex (Tetra Tech, 2010).

This SAP governs the next phase of the CERCLA process for the Former Machine Gun Range, the RI, which is being conducted based on recommendations from the SI. The scope of the RI includes the collection and analysis of additional surface and subsurface soil, sediment, surface water, and groundwater samples, as necessary, to delineate the horizontal and vertical boundaries of MC contamination. The RI sampling strategy is designed to fill the data gaps identified in the SI Report to define the nature and extent of COPCs and complete the human health and ecological risk assessments for each site.

This SAP was generated for and complies with applicable United States Department of the Navy (Navy), United States Environmental Protection Agency (USEPA) Region 4, and Florida Department of Environmental Protection (FDEP) requirements, regulations, guidance, and technical standards, as appropriate. This includes the Department of Defense (DoD), Department of Energy (DOE), and USEPA Interagency Data Quality Task Force (IDQTF) environmental requirements regarding federal facilities, as specified in the Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) guidance (USEPA, 2005) and the Navy's guidance for Tier II SAPs (which is the preferred format for use in addressing project sites that are not particularly complex or politically sensitive). A cross-walk indicating the location of information required under the UFP-QAPP guidance is provided in **Appendix G**, along with supplemental worksheets that are not included in the Tier II SAP outline.

This SAP outlines the organization, project management, objectives, planned activities, measurement, data acquisition, assessment, oversight, and data review procedures associated with the planned investigation at the Former Machine Gun Range Complex. Protocols for sample collection, handling, and storage, chain of custody, laboratory and field analyses, data validation, and reporting are also addressed. Field activities conducted under this SAP, which are scheduled to begin in July 2012, will be conducted in accordance with Tetra Tech and FDEP Standard Operating Procedures (SOPs) and will meet the requirements of the Site-Specific Health and Safety Plan, to be submitted under separate cover.

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ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
°F	Degrees Fahrenheit
%D	Percent Difference or Percent Drift
%R	Percent Recovery
ABB-ES	ABB Environmental Services, Inc.
ATV	All-Terrain Vehicle
BaP	Benzo(a)pyrene
BERA	Baseline Ecological Risk Assessment
bgs	Below Ground Surface
BKGD	Site-Specific Background Screening Concentration
BRAC	Base Realignment and Closure
CAS	Chemical Abstracts Service
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
Chemtech	Chemtech Consulting Group, Inc.
CLEAN	Comprehensive Long-term Environmental Action Navy
CLP	Contract Laboratory Program
COPC	Contaminant of Potential Concern
CRREL	Cold Regions Research and Engineering Laboratory
CSM	Conceptual Site Model
CTL	Cleanup Target Level
CTO	Contract Task Order
DAF	Dilution Attenuation Factor
DL	Detection Limit
DO	Dissolved Oxygen
DoD	Department of Defense
DOE	Department of Energy
DPT	Direct-Push Technology
DQI	Data Quality Indicator
DQO	Data Quality Objective
DVM	Data Validation Manager
Eco SSL	Ecological Soil Screening Level
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Accreditation Program

ACRONYMS AND ABBREVIATIONS (Continued)

Empirical	Empirical Laboratories, LLC
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
EU	Exposure Unit
F.A.C.	Florida Administrative Code
FBL	Fixed-base Laboratory
FDEP	Florida Department of Environmental Protection
FDOH	Florida Department of Health
FNAI	Florida Natural Areas Inventory
FOL	Field Operations Leader
FS	Feasibility Study
FTMR	Field Task Modification Request
g	Gram
GC/MS	Gas Chromatography / Mass Spectrometry
GCTL	Groundwater Cleanup Target Level
GIS	Geographic Information System
GPS	Global Positioning System
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HHRA	Human Health Risk Assessment
HI	Hazard Index
HNO_3	Nitric Acid
HPLC	High Performance Liquid Chromatography
HQ	Hazard Quotient
HSM	Health and Safety Manager
ICAL	Initial Calibration
ICP-MS	Inductively Coupled Plasma-Mass Spectroscopy
IDQTF	Intergovernmental Data Quality Task Force
IDW	Investigation-Derived Waste
ILCR	Incremental Lifetime Cancer Risk
IRP	Installation Restoration Program
IS	Internal Standard
ITRC	Interstate Technology and Regulatory Council
L	Liter

ACRONYMS AND ABBREVIATIONS (Continued)

LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LOD	Limit of Detection
LOQ	Limit of Quantitation
LUC	Land Use Control
Malcolm Pirnie	Malcolm Pirnie, Inc.
MC	Munitions Constituents
MCL	Maximum Contaminant Level
MD	Matrix Duplicate
MEC	Munitions and Explosives of Concern
mg/kg	Milligram per Kilogram
mL	Milliliter
mm	Millimeter
MPC	Measurement Performance Criterion
MPPEH	Material Potentially Presenting an Explosive Hazard
MRP	Munitions Response Program
MS	Matrix Spike
MSD	Matrix Spike Duplicate
msl	Mean Sea Level
NA	Not Applicable
NAD83	North American Datum of 1983
NAS	Naval Air Station
NAVD88	North American Vertical Datum of 1988
NAVFAC SE	Naval Facilities Engineering Command Southeast
Navy	United States Department of the Navy
NELAP	National Environmental Laboratory Accreditation Program
NEDD	NIRIS Electronic Data Deliverable
NG	Nitroglycerin
NIRIS	Naval Installation Restoration Information Solution
NOAA	National Oceanic and Atmospheric Administration
NRWQC	National Recommended Water Quality Criterion
NTU	Nephelometric Turbidity Unit
ORP	Oxidation-Reduction Potential
OSHA	Occupational Safety and Health Administration

ACRONYMS AND ABBREVIATIONS (Continued)

OU	Operable Unit
oz	Ounce
PA	Preliminary Assessment
PAH	Polycyclic Aromatic Hydrocarbon
PAL	Project Action Limit
PM	Project Manager
POC	Point of Contact
PPE	Personal Protective Equipment
PQL	Practical Quantitation Limit
PQLG	Practical Quantitation Limit Goal
PSC	Potential Source of Contamination
PVC	Polyvinyl Chloride
PWD	Public Works Department
QA	Quality Assurance
QAM	Quality Assurance Manager
QAO	Quality Assurance Officer
QC	Quality Control
QSM	Quality Systems Manual
R3 BTAG SW	USEPA Region 3 Biological Technical Assistance Group Freshwater Surface Water Screening Benchmark
R4 Eco	USEPA Region 4 Ecological Screening Level
R4 Eco SDSL	USEPA Region 4 Ecological Sediment Screening Level
RAC	Remedial Action Contract
RBSSL	USEPA Regions 3, 6, and 9 Regional Screening Level, Migration to Groundwater (Risk-Based Soil Screening Level)
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RPD	Relative Percent Difference
RPM	Remedial Project Manager
R-RSL	USEPA Regions 3, 6, and 9 Regional Screening Level, Residential Direct Contact
RSD	Relative Standard Deviation
RSL	Regional Screening Level
SAP	Sampling and Analysis Plan

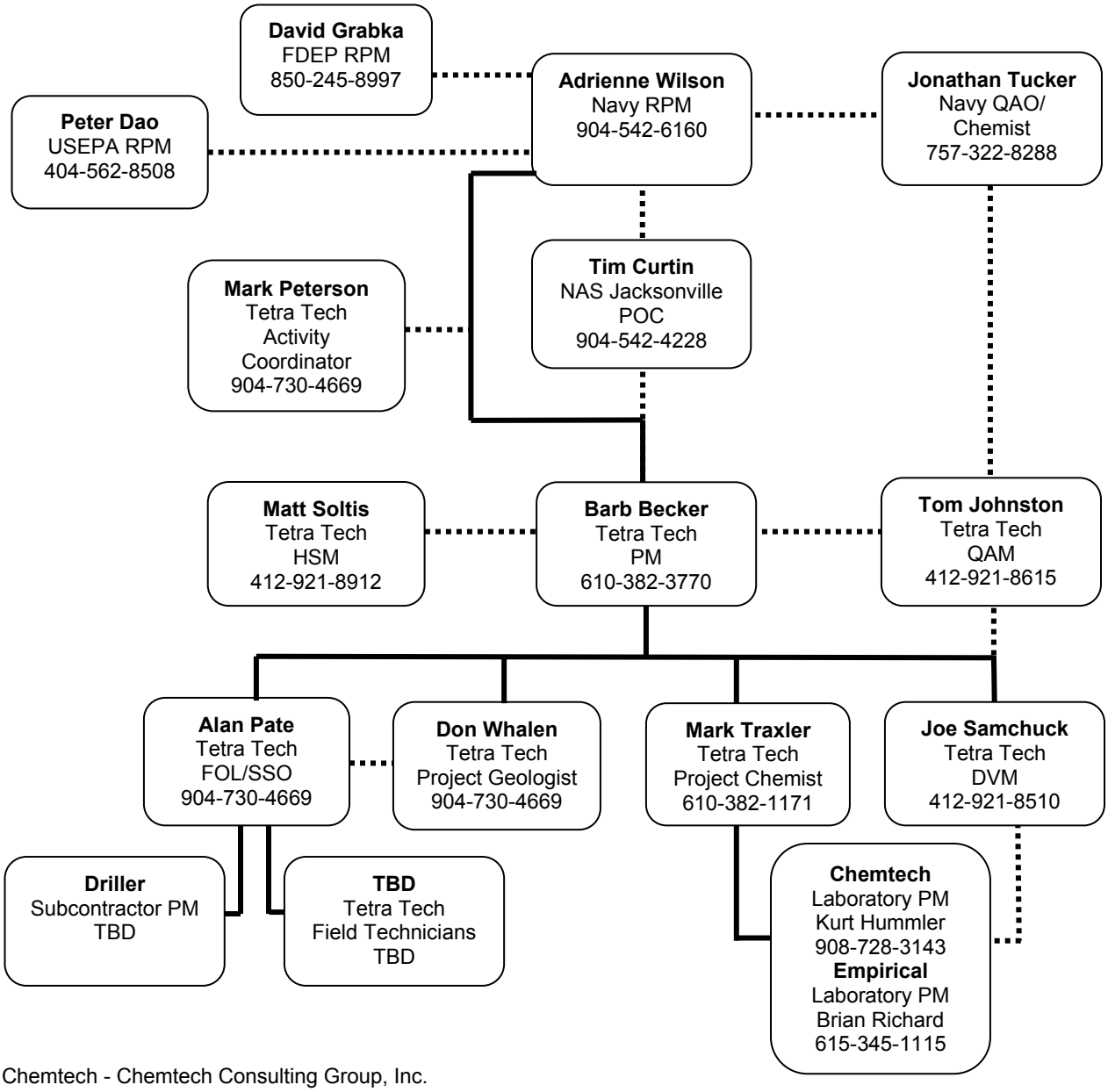
ACRONYMS AND ABBREVIATIONS (Continued)

SCTL	Soil Cleanup Target Level
SCTL-LGW	Soil Cleanup Target Level, Leachability to Groundwater
SCTL-RDE	Soil Cleanup Target Level, Residential Direct Exposure
SLERA	Screening-Level Ecological Risk Assessment
SI	Site Inspection
SIM	Selected Ion Monitoring
SOP	Standard Operating Procedure
SPCS	State Plan Coordinate System
SPLP	Synthetic Precipitation Leaching Procedure
SQL	Structured Query Language
SQuiRT	Screening Quick Reference Table
SSO	Site Safety Officer
SWQS	Surface Water Quality Standards
TBD	To Be Determined
TCLP	Toxicity Characteristic Leaching Procedure
TOC	Top of Casing
T-RSL	USEPA Regions 3, 6, and 9 Regional Screening Level, Tapwater
UCL	Upper Confidence Limit
UFP-SAP	Uniform Federal Policy for Sampling Analysis Plan
UFP-QAPP	Uniform Federal Policy for Quality Assurance Project Plan
µg/kg	Micrograms per Kilogram
µg/L	Micrograms per Liter
U.S.	United States
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UV	Ultraviolet
UXO	Unexploded Ordnance
WWI	World War I
WWII	World War II
XRF	X-ray Fluorescence

1.0 -- Project Organizational Chart

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

Lines of Authority ——— Lines of Communication ·····



Chemtech - Chemtech Consulting Group, Inc.
DVM - Data Validation Manager
Empirical – Empirical Laboratories, LLC
FDEP - Florida Department of Environmental Protection
FOL - Field Operation Leader
HSM - Health and Safety Manager
NAS - Naval Air Station
Navy - United States Department of the Navy
USEPA - United States Environmental Protection Agency
POC - Point of Contact
QAM - Quality Assurance Manager
QAO - Quality Assurance Officer
RPM - Remedial Project Manager
SSO - Site Safety Officer
TBD - To Be Determined
PM - Project Manager

2.0 -- Communication Pathways

(UFP-QAPP Manual Section 2.4.2 – Worksheet #6)

The communication pathways for the Sampling and Analysis Plan (SAP) are shown below.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Regulatory Agency Interface	USEPA RPM FDEP RPM Navy RPM	Peter Dao David Grabka Adrienne Wilson	404-562-8508 850-245-8997 904-542-6160	The Navy RPM will contact each regulatory agency via phone and/or e-mail within 24 hours of recognizing the issue whenever issues arise.
Field Progress Reports	Tetra Tech FOL Tetra Tech PM	Alan Pate Barb Becker	904-730-4669 x214 610-382-3770	The Tetra Tech FOL will contact the Tetra Tech PM on a daily basis via phone, and every 1-2 days summarizing progress via e-mail.
Gaining Site Access	Tetra Tech FOL NAS Jacksonville POC	Alan Pate Tim Curtin	904-730-4669 x214 904-542-4228	The Tetra Tech FOL will contact the Naval Air Station (NAS) Jacksonville POC verbally or via e-mail at least 3 days prior to commencement of field work to arrange for access to the site for all field personnel.
Obtaining Utility Clearances for Intrusive Activities	Tetra Tech FOL NAS Jacksonville POC	Alan Pate Tim Curtin	904-730-4669 x214 904-542-4228	The Tetra Tech FOL will coordinate verbally or via e-mail with NAS Jacksonville POC at least 7 days in advance of site access to initiate the utility clearance process for all well boring locations. The Tetra Tech FOL will contact both the Sunshine State One Call system and NAS Jacksonville infrastructure personnel verbally or via e-mail at least 3 days prior to commencement of field work to complete a utility clearance ticket for the areas under investigation.
Stop Work Due to Safety Issues	Tetra Tech SSO Tetra Tech PM Tetra Tech HSM Navy RPM NAS Jacksonville POC	Alan Pate Barb Becker Matt Soltis Adrienne Wilson Tim Curtin	904-730-4669 x214 610-382-3770 412-921-8612 904-542-6160 904-542-4228	If Tetra Tech is the responsible party for a stop work command, the Tetra Tech SSO will inform onsite personnel, subcontractor(s), the NAS Jacksonville POC, and the identified Partnering Team members within 1 hour (verbally or by e-mail). If a subcontractor is the responsible party, the subcontractor PM must verbally inform the Tetra Tech SSO within 15 minutes, and the Tetra Tech SSO will then follow the procedure listed above.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
SAP Changes Prior to Field/ Laboratory Work	Tetra Tech FOL Tetra Tech PM Navy RPM NAS Jacksonville POC	Alan Pate Barb Becker Adrienne Wilson Tim Curtin	904-730-4669 x214 610-382-3770 904-542-6160 904-542-4228	The Tetra Tech PM will document the proposed changes via a Field Task Modification Request (FTMR) form within 5 days and send the Navy RPM a concurrence letter within 7 days of identifying the need for change if necessary. SAP amendments will be submitted by the Tetra Tech PM to the Navy RPM and NAS Jacksonville POC for review and approval. The Tetra Tech PM will send scope changes to the Partnering Team via e-mail within 1 business day.
SAP Changes in the Field	Tetra Tech FOL Tetra Tech PM Navy RPM NAS Jacksonville POC	Alan Pate Barb Becker Adrienne Wilson Tim Curtin	904-730-4669 x214 610-382-3770 904-542-6160 904-542-4228	The Tetra Tech FOL will verbally inform the Tetra Tech PM on the day that the issue is discovered. The Tetra Tech PM will inform the Navy RPM and the NAS Jacksonville POC (verbally or via e-mail) within 1 business day of discovery. The Navy RPM will issue a scope change (verbally or via e-mail), if warranted. The scope change is to be implemented before further work is executed. The Tetra Tech PM will document the change via an FTMR form within 2 days of identifying the need for change and will obtain required approvals within 5 days of initiating the form.
Field Corrective Actions	Tetra Tech PM Tetra Tech QAM Navy RPM	Barb Becker Tom Johnston Adrienne Wilson	610-382-3770 412-921-8615 904-542-6160	The Tetra Tech QAM will notify the Tetra Tech PM verbally or by e-mail within one business day that the corrective action has been completed. The Tetra Tech PM will then notify the Navy RPM (verbally or by e-mail) within 1 business day.
Sample Receipt Variances	Chemtech Laboratory PM Empirical Laboratory PM Tetra Tech FOL Tetra Tech PM	Kurt Hummler Brian Richard Alan Pate Barb Becker	908-728-3143 615-345-1115 904-730-4669 x214 610-382-3770	The Laboratory PM will notify (verbally or via e-mail) the Tetra Tech FOL immediately upon receipt of any chain of custody/sample receipt variances for clarification or direction from the Tetra Tech FOL. The Tetra Tech FOL will notify (verbally or via e-mail) the Tetra Tech PM within 1 business day, if corrective action is required. The Tetra Tech PM will notify (verbally or via e-mail) the Laboratory PM and the Tetra Tech FOL within 1 business day of any required corrective action.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Reporting Laboratory Quality Variances	Chemtech Laboratory PM Empirical Laboratory PM Tetra Tech Project Chemist Tetra Tech PM Tetra Tech FOL Chemtech Laboratory QAM Empirical Laboratory QAM	Kurt Hummler Brian Richard Mark Traxler Barb Becker Alan Pate Krupa Dubey Marcia McGinitty	908-728-3143 615-345-1115 610-382-1171 610-382-3770 904-730-4669 x214 908-728-3152 615-345-1115	Any planned Standard Operating Procedure (SOP) variances from the quality elements specified in the Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 4.1 (April 2009) are identified in **Section 10.0**. The Laboratory PM will notify (verbally or via e-mail) the Tetra Tech Project Chemist of any variance from the quality limits identified in this SAP on the day that the variance becomes known. The Tetra Tech Project Chemist will notify (verbally or via e-mail) the Tetra Tech PM within 1 business day of the need for corrective action, if the variance is a significant issue. The Tetra Tech PM will notify (verbally or via e-mail) the Laboratory PM and the Tetra Tech FOL and Project Chemist within 1 business day of any required corrective action. The Laboratory QAM will document all quality variances in the Case Narrative of the Analytical Laboratory Report.
Reporting Concerns Involving Laboratory	Tetra Tech Project Chemist Tetra Tech PM Tetra Tech FOL Chemtech Laboratory PM Empirical Laboratory PM	Mark Traxler Barb Becker Alan Pate Kurt Hummler Brian Richard	610-382-1171 610-382-3770 904-730-4669 x214 908-728-3143 615-345-1115	If reported analytical results are inconsistent with the planned details identified in this SAP, the Tetra Tech Project Chemist will notify (verbally or via e-mail) the Tetra Tech PM within 1 business day of identifying a concern to determine if corrective action is needed. The Tetra Tech PM will notify (verbally or via e-mail) the Laboratory PM and the Tetra Tech FOL and Project Chemist within 1 business day of any required corrective action.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Notification of Non-Usable Data	Chemtech Laboratory PM Empirical Laboratory PM Tetra Tech Project Chemist Tetra Tech DVM Tetra Tech PM	Kurt Hummler Brian Richard Mark Traxler Joseph Samchuck Barb Becker	908-728-3143 615-345-1115 610-382-1171 412-921-8510 610-382-3770	If the laboratory determines that any data they have generated is non-usable, the Laboratory PM will notify (verbally or via e-mail) the Tetra Tech Project Chemist within 1 business day of when the issue is discovered. The Tetra Tech Project Chemist will notify (verbally or via e-mail) the Tetra Tech DVM and the Tetra Tech PM within 1 business day of the need for corrective action, if the non-usable data is a significant issue (i.e., critical sample data). Corrective action may include resampling and/or reanalyzing the effected samples. If a Tetra Tech Data Validator identifies non-usable data during the data validation process, the Tetra Tech DVM will notify the Tetra Tech PM verbally or via e-mail within 48 hours of validation completion that a non-routine and significant laboratory quality deficiency has resulted in non-usable data. The Tetra Tech PM will take corrective action appropriate for the identified deficiency to ensure the project objectives are met.
Analytical Corrective Actions and Reporting Data Validation Issues	Chemtech Laboratory PM Empirical Laboratory PM Tetra Tech Project Chemist Tetra Tech DVM Tetra Tech PM Navy RPM	Kurt Hummler Brian Richard Mark Traxler Joseph Samchuck Barb Becker Adrienne Wilson	908-728-3143 615-345-1115 610-382-1171 412-921-8510 610-382-3770 904-542-6160	The Laboratory PM will notify (verbally or via e-mail) the Tetra Tech Project Chemist within 1 business day of when an issue related to laboratory data is discovered. The Tetra Tech Project Chemist will notify (verbally or via e-mail) the DVM and the Tetra Tech PM within 1 business day. Tetra Tech DVM or Project Chemist will notify the Tetra Tech PM verbally or via e-mail within 48 hours of validation completion that a non-routine and significant laboratory quality deficiency has been detected that could affect this project and/or other projects. The Tetra Tech PM will verbally advise the Navy RPM within 24 hours of notification from the Tetra Tech DVM or Project Chemist. The Navy RPM will take corrective action appropriate for the identified deficiency. Examples of significant laboratory deficiencies include data reported that has a corresponding failed mass spectrometer tune or initial calibration verification. Corrective actions may include a consult with the Navy QAO/ Chemist.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Data Validation Corrective Actions	Tetra Tech DVM Tetra Tech PM	Joseph Samchuck Barb Becker	412-921-8510 610-382-3770	See "Notification of Non-Usable Data" procedure above. If a Tetra Tech Data Validator identifies non-usable data during the data validation process that requires corrective action, the Tetra Tech PM will coordinate with the Tetra Tech DVM to take corrective action appropriate for the identified deficiency to ensure the project objectives are met. Corrective action may include resampling and/or reanalyzing the affected samples, as determined by the Tetra Tech PM.

3.0 -- Project Planning Session Participants Sheet

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

Project Name: Remedial Investigation (RI) of Former Machine Gun Range Complex **Projected Date(s) of Sampling**: Spring 2012 **Project Manager**: Barb Becker	**Site Name**: Unexploded Ordnance (UXO) Sites 1 to 6 **Site Location**: NAS Jacksonville, Jacksonville, Florida

Date of Session: June 13, 2011
Scoping Session Purpose: Internal (Tetra Tech) Data Quality Objective (DQO) Scoping Meeting

Name	Title	Affiliation	Phone #	E-Mail Address	Project Role
Barb Becker	PM	Tetra Tech	610-382-3770	barb.becker@tetratech.com	Management/ Oversight
Don Whalen	Project Geologist	Tetra Tech	610-382-1536	don.whalen@tetratech.com	Sampling Strategy Design
Mark Traxler	Project Chemist, SAP Author	Tetra Tech	610-382-1171	mark.traxler@tetratech.com	DQO Facilitator/ Project Chemist
Chris Rumer	Environmental Scientist, SAP Author	Tetra Tech	412-921-7105	chris.rumer@tetratech.com	Technical Writing and Field Support

Comments/Decisions: The internal technical team discussed the historical use of each site, the current Conceptual Site Models (CSMs), and the available data from past studies and investigations. The team also discussed an overall strategy for planning and implementing surface and subsurface soil, sediment, surface water, and groundwater sampling for the RI in accordance with the Navy's Tier II SAP guidance.

Action Items: Prepare the draft Tier II SAP for the RI of the six Munitions Response Program (MRP) sites.

Consensus Decisions: The meeting participants developed a conceptual strategy for identifying sample locations for the surface and subsurface soil, sediment, surface water, and groundwater sampling for the RI, based on the Site Inspection (SI) Report findings and recommendations. Consensus decisions included the following:

- Step-out surface and subsurface soil sampling should be conducted to define the nature and extent of polycyclic aromatic hydrocarbons (PAHs) and/or metals contamination at locations identified during the SI as having concentrations above risk-based screening levels [i.e., the SI Project Action Limits (PALs)].
    - Surface soil samples should be collected from 0 to 6 inches and, where appropriate, 6 to 24 inches below ground surface (bgs) at locations selected based on SI data to ensure sufficient horizontal bounding of contamination.

- Subsurface soil samples should be collected from 2-foot depth intervals below SI sample locations where vertical delineation was not fully achieved during the SI.

- Groundwater sampling should be conducted where recommended in the SI Report to determine whether impacted soil represents a potential source of contamination in underlying groundwater.
  - Groundwater samples should be collected near locations that were identified during the SI as having concentrations exceeding the Synthetic Precipitation Leaching Procedure (SPLP) PALs.
  - Groundwater samples should be collected from the top 5 feet of the surficial aquifer.

- Surface water and collocated sediment samples should be collected from surface ponds that receive runoff from locations where surface soil or sediment sample concentrations exceed PALs.
  - Sediment samples should be collected from the top 6-inch interval of sediment underlying the surface water in the selected ponds to determine whether sediment Contaminants of Potential Concern (COPCs) exceed the PALs.
  - Collocated surface water samples should be collected along with the sediment samples in the selected ponds to determine whether surface water COPCs exceed the PALs.
  - No samples need to be collected from the pond in the northern portion of the Former Trap Ranges, which was recently constructed to support the wastewater reuse project.

Project Name: RI of Former Machine Gun Range Complex **Projected Date(s) of Sampling**: Spring 2012 **Project Manager**: Barb Becker	**Site Name**: UXO Sites 1 to 6 **Site Location**: NAS Jacksonville, Jacksonville, Florida

Date of Session: July 20, 2011
Scoping Session Purpose: Partnering Team DQO Planning Session

Name	Title	Affiliation	Phone #	E-Mail Address	Project Role
Adrienne Wilson	Navy RPM	Naval Facilities Engineering Command Southeast (NAVFAC SE)	(904) 542-6160	adrienne.wilson@ navy.mil	Navy RPM
Robbie Darby	Environmental Department Manager	NAVFAC SE	(904) 542-2684	robbie.darby@ navy.mil	Tier II Link
Tim Curtin	NAS Jacksonville POC	NAVFAC SE	(904) 542-4228	tim.l.curtin@ navy.mil	NAS Jacksonville POC
Peter Dao	USEPA RPM	USEPA	(404) 562-8508	dao.peter@ epa.gov	USEPA RPM
David Grabka	Federal Facilities RPM	FDEP	(850) 245-8997	david.grabka@ dep.state.fl.us	FDEP RPM
Hal Davis	Geologist	United States Geological Society (USGS)	(850) 553-3673	hdavis@usgs.gov	USGS Geologist
Eric Davis	Remedial Action Contract (RAC) Contractor	CH2M Hill	(678) 530-4085	eric.davis@ ch2m.com	RAC Contractor
Mark Peterson	Base Activities Coordinator	Tetra Tech	(904) 730-4669 Ext. 213	mark.peterson@ tetratech.com	Technical Support
Barb Becker	PM	Tetra Tech	(610) 382-3770	barb.becker@ tetratech.com	Management/ Oversight
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Tetra Tech presented informational slides to the NAS Jacksonville Partnering Team and led the DQO planning discussion for the RI to be conducted at the Former Machine Gun Range UXO sites. The following topics were discussed: general site descriptions, SI results, COPCs, DQOs, and proposed sampling designs. The presentation was based on findings documented in the SI Report that was

finalized on September 30, 2010, and on the draft sampling strategy developed by Tetra Tech's technical staff. Both the presentation and meeting minutes are included in **Appendix A**.

Comments/Decisions: During the meeting, significant comments were made regarding the DQOs and sampling strategy. Detailed comments are included in the meeting minutes (**Appendix A**). A summary of the comments is presented below:

- Surface water and groundwater sampling designs should take into account the groundwater divide that runs near the golf course, as well as modifications that have been made to golf course creeks and drainages since the ranges were in operation.

- Calculation of site-specific leachability limit values for metals would help avoid unnecessary groundwater data collection. The groundwater sampling design should take these calculated values into account and an applicable decision rule should be added to the DQOs.

- Recalculation of the correlation between x-ray fluorescence (XRF) results and laboratory data collected during the SI would allow XRF data to be used for decision-making purposes at all six sites. For sites where the SI Report indicated that the correlation of laboratory data to XRF data was not within acceptable limits, Tetra Tech may re-evaluate the data to eliminate the obvious outlier(s). The revised evaluations should be included in the SAP so the Partnering Team can evaluate its applicability to the RI.

- The sampling strategy should consider the potential application of future land use controls (LUCs). Where opportunities arise to place samples in such a way that allows boundaries subject to LUCs to be limited to certain areas (e.g., treed areas where receptors do not frequently access), we should do so. For instance, samples located at site boundaries should be placed on the tree side of cart paths, where possible, rather than in the fairways so that if the data indicate no exceedances of Soil Cleanup Target Levels (SCTLs), the LUC boundaries would fall outside of operational areas.

- There needs to be an additional step in the Decision Rules for the Ecological Risk Assessment (ERA) to make sure that representative ecological receptors are conservative. Example verbiage for this rule: "If a Baseline ERA (BERA) is determined to be necessary, compile a list of receptors and toxicity tests required, and submit to both FDEP and USEPA for approval." This step should be inserted between the screening level ERA (SLERA) and BERA.

The following significant comments and recommendations were made with respect to the site-specific sampling designs proposed for each UXO site:

- UXO 1 – Where possible, boundary samples should be placed between the tree line and the cart path to enable LUC boundaries to be delineated in a manner that would not affect future maintenance activities along the cart path.

- UXO 2 – SPLP exceedances of metals observed during the SI suggest that a well should be installed in the vicinity of the elevated soil sample locations. FDEP noted that the site could possibly be closed by using the 95-percent (%) Upper Confidence Limit (UCL) of the data set (rather than the maximum) for comparison to the published SCTL, in accordance with Florida's risk-based management options [see Florida Administrative Code (F.A.C.) Chapter 62-780 for specific requirements]. In addition, leachability to groundwater may be addressed either through collection of groundwater data or through derivation of alternative site-specific SCTLs for leachability and comparison of soil concentrations to these values.

- UXO 3 – Due to the large size of this site, the sampling approach should allow for shrinking the boundaries of contamination to prevent outlying areas that show only slight contamination from being included in the main exposure area.

- UXO 4 – Spoils from the holding pond excavation are currently stockpiled on the east side of the eastern berm of UXO 4, which could conflict with the sampling locations proposed for that portion of the site. Tetra Tech should obtain current site information regarding whether the proposed sample locations are still accessible in case they need to be altered. Also, site elevation data should be included in the SAP so it is easier to visualize the topography and evaluate the proposed sampling locations. The groundwater well should be installed in front of the backstop on the range floor, where most of the bullets landed, rather than on the other side of the backstop. If there is no groundwater impact in this location (where maximum concentrations would be expected), then no further data would be necessary.

- UXO 5 – SPLP exceedances of metals observed during the SI suggest that a well should be installed in the vicinity of the elevated soil sample locations. Similar to UXO 2, FDEP suggested that the approach of developing and comparing soil data to alternative site-specific SCTLs for leachability be considered for applicability to this site.

- UXO 6 – The proposed sampling approach looked fine – no issues were raised.

(Note: subsequent to this meeting, it was determined that alternative site-specific SCTLs for leachability had already been calculated for antimony, arsenic, copper, lead, tin, and zinc, as presented in Appendix F of the SI Report. For UXO 2, comparison of the SI soil data to site-specific leachability criteria confirmed that groundwater warranted further investigation under the RI. For UXO 5, comparison of the SI soil data to site-specific leachability criteria indicated no exceedances and, thus, a recommendation of no groundwater investigation under the RI.)

Consensus Decisions: Tetra Tech will incorporate the Partnering Team's input in the SAP prior to submittal.

4.0 -- Conceptual Site Models

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

The Former Machine Gun Range Complex at NAS Jacksonville comprises the following six MRP sites, as shown on **Figure 4-1**:

- Fort Dix Skeet Range (UXO 1)
- .50 Caliber Range (UXO 2)
- Former Skeet Range (UXO 3)
- Akron Road Pistol Range (UXO 4)
- .30 Caliber Range (UXO 5)
- Trap Ranges (UXO 6)

This worksheet presents general background information and updated CSMs for the six ranges subject to this RI SAP. The information presented herein provides the basis for the project DQOs (see **Section 5.0**), which have been developed in accordance with USEPA QA/G-4 guidance (USEPA, 2006).

4.1 REGULATORY FRAMEWORK

This RI is being conducted under the regulatory framework of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) in concert with requirements set forth in FDEP F.A.C. 62-780. Prior to this RI, a Preliminary Assessment (PA) was completed in 2007 by Malcolm Pirnie, Inc. (Malcolm Pirnie, 2007), and an SI was completed in 2010 by Tetra Tech (Tetra Tech, 2010). This RI represents the next phase in the CERCLA process, which will be followed until regulatory closure is achieved at each site. A comprehensive discussion of the regulatory framework for the investigation of the MRP sites is provided in Section 2.1.1 of the SI Report (Tetra Tech, 2010).

Based on the information obtained during the PA and SI, data gaps have been identified where more information is needed to adequately define the nature and extent of munitions constituent (MC) contamination at the six MRP sites. This RI is being conducted to address these data gaps and collect sufficient information to conduct both a Human Health Risk Assessment (HHRA) and an ERA. The objective of these assessments is to quantify the risks associated with MC contamination at each site and determine whether contaminants are present in concentrations that pose a potentially unacceptable risk to human and/or ecological receptors. If risks are determined to be unacceptable, a Feasibility Study (FS) will be conducted to evaluate and compare remedial alternatives that may be implemented to reduce risk to acceptable levels.

4.2 BACKGROUND INFORMATION

Detailed background information regarding the history and physical characteristics of the Former Machine Gun Range Complex at NAS Jacksonville is presented in the PA (Malcolm Pirnie, 2007) and in the SI UFP-SAP (Tetra Tech, 2009). This information is summarized below to provide general descriptions of the installation history, the physical setting of the area in which the six MRP sites are located, and site-specific descriptions for each range.

4.2.1 Installation History

NAS Jacksonville was officially commissioned on October 15, 1940. Prior to its establishment, portions of the installation were used as the Black Point Militia Target Range, a state militia training facility. During World War I (WWI), the U.S. Army assumed control of the Black Point Militia Target Range and established Camp Joseph E. Johnson as an infantry training station. After WWI, the facility was turned back over to the state militia and operated as Camp Clifford R. Foster from 1928 until 1939. The Black Point Militia Target Range and Camp Joseph E. Johnson were located in the east central portion of NAS Jacksonville in the area currently referred to as Black Point.

NAS Jacksonville became the first component of the Jacksonville Navy Complex, which would eventually include NAS Cecil Field and Naval Station Mayport. NAS Jacksonville's mission was to train pilots for the Navy. More than 11,000 pilots earned their wings at the air station during World War II (WWII). NAS Jacksonville also provided the war effort with more than 10,000 highly trained air crewmen and 30,000 gunners. Although air field support and ordnance storage for air-to-ground bombing training was provided by NAS Jacksonville, the ranges were located remotely from the installation.

Following WWII, the Navy's Flight Demonstration Team, the Blue Angels, was formed and stationed at NAS Jacksonville until it was reassigned to the aircraft carrier USS Princeton (CV-37) in 1950. The station's mission was changed to include support for patrol squadrons that arrived after the war and are still on duty today. By 1973, helicopter squadrons arrived at NAS Jacksonville, and in 1977, reserve jet squadrons transferred to nearby Cecil Field. Under Base Realignment and Closure (BRAC) operations, Cecil Field closed in 1999 and the last of the S-3 squadrons were transferred to NAS Jacksonville, where they were decommissioned in January 2009.

4.2.2 Physical Setting

NAS Jacksonville is located in southwestern Duval County, Florida, approximately 7 miles southwest of downtown Jacksonville, Florida, and 22 miles west of the Atlantic Ocean (**Figure ES-1**). NAS Jacksonville covers approximately 3,800 acres on the west bank of the St. Johns River and is located

24 miles upstream of the mouth of the St. Johns River and the Atlantic Ocean. The six sites associated with the Former Machine Gun Range Complex cover approximately 65 acres located within the central portion of the installation (**Figure ES-2**).

Climate

NAS Jacksonville is characterized by a humid and semitropical climate. The average annual temperature is 70 degrees Fahrenheit (°F). Average daily temperatures range from 50°F in the winter to 80°F in the summer. Prevailing winds are northeasterly in fall and winter and southwesterly in spring and summer. Average annual rainfall in Duval County is 54 inches, with most rainfall occurring from June through September. Winters are typically mild and dry. During summer, thunderstorms occur at a frequency of every other day and may yield several inches of rainfall. The Jacksonville area is subject to tropical storms and hurricanes, sometimes with tornadic activity, which are likely to occur from June through November.

Topography

NAS Jacksonville is located in the Coastal Plain physiographic province, which is predominantly flat with marshy areas of various sizes scattered among areas of slightly elevated high ground. The station is situated on a gentle rise between the St. Johns River and Ortega River. Elevations at NAS Jacksonville range from sea level to approximately 25 feet above mean sea level (msl). The point of highest elevation is located in the southern portion of the station, and the lowest points lie along the shorelines of the St. Johns River. The six sites comprising the Former Machine Gun Range Complex lie within the boundaries of the present day golf course (**Figure 4-1**), which consists of generally flat to gently sloping terrain, except for the backstop and side berms that were constructed as part of the Akron Road Pistol Range.

Geology

Regional geology is composed of hundreds of feet of marine sediments, which were deposited in terraces during prehistoric fluctuation of sea level. Surficial deposits ranging from 25 to 100 feet thick consist of sediments of Late Miocene to recent age. The sediment is highly variable and includes sand, shelly, sand, coquina, silt, clay, and shell beds. Below these sediments lie several limestone formations, including (from shallowest to deepest) the Hawthorn, Ocala Limestone, Avon Park, and Oldsmar Formations.

Soil and Vegetation Types

Fourteen soil types have been mapped at NAS Jacksonville. The most commonly observed soil types are poorly drained fine sands and loamy soil. Much of the soil in the vicinity of the golf course has been

reworked by earthmoving operations, and consists of a mixture of soil materials. Soil series mapped near the golf course are classified as Arents, Sapelo, and Wesconnett, which are typically poorly drained and have moderately high to high permeability. Natural vegetation consists chiefly of pine, palmetto, live oak, turkey oak, magnolia, and locally adapted shrubs.

Hydrology

NAS Jacksonville is located on a peninsula between the St. Johns River and its tributary, the Ortega River. The St. Johns River, its tributaries, and lakes within the basin are designated as Class III waterways and are used for recreational purposes and the propagation of fish and wildlife. Most of NAS Jacksonville lies within the watershed of the St. Johns River.

NAS Jacksonville contains three dredged lakes (totaling 26 acres), of which only Casa Linda Lake on the golf course is managed as a freshwater fishery (catch and release only). The lake, which spans approximately ten acres, has historically received runoff containing fertilizers and pesticides from the golf course.

The predominant surface drainage features in the vicinity of NAS Jacksonville are the St. Johns River and the Ortega River. NAS Jacksonville is situated on the central and eastern portion of a ridge line between the two rivers. Surface water drainage is directed by topographic features to both the Ortega and St. Johns Rivers. Drainage across most of the installation is generally toward the St. Johns River.

Hydrogeology

Unconsolidated deposits of sand, shell, and clay comprise the surficial aquifer underlying the installation. The direction of the groundwater flow in the surficial aquifer tends to reflect the surface topography of the area, as depicted in **Figure 4-2**. Throughout much of NAS Jacksonville, groundwater flow in the surficial aquifer is generally toward surface water features, including the St. Johns River to the southeast, the Ortega River to the west, and smaller tributaries of these two principal drainage features. The groundwater divide intersects the western portion of the Fort Dix Skeet Range but is situated west of the other Machine Gun Range Complex sites.

The Hawthorn Formation acts as a confining bed to the Floridan aquifer system, which is the principal source of drinking water in the Jacksonville area, and restricts downward percolation of water from the surficial aquifer. The top of the Floridan aquifer in the vicinity of NAS Jacksonville occurs at a depth of approximately 400 feet bgs. Recharge to the aquifer results from downward percolation of precipitation in the sandy uplands west and southwest of Jacksonville.

Wetlands

During the Former Machine Gun Range Complex SI, a site walkover was conducted to identify any obvious surface water drainage pathways potentially leading to adjoining surface water bodies such as ponds or wetlands. Two drainages were identified as wetlands, including a wooded wetlands area with a small stream bordering the southern boundary of the Akron Road Pistol Range, and a wooded wetlands area located north of the .30-Caliber Range. Surface streams also run through the Fort Dix Skeet Range and Former Skeet Range sites, but no wetlands areas were identified within those sites.

Cultural and Natural Resources

There are currently no archeological sites or buildings at NAS Jacksonville listed in the National Register of Historic Places, although more than 75 buildings are deemed eligible for listing. None of these eligible structures are located within the boundaries of the Machine Gun Range Complex sites.

Endangered and Special Status Species

The Florida Natural Areas Inventory (FNAI) conducted a survey for rare animal species on NAS Jacksonville in 1996-1997. According to the survey, several species of threatened or endangered animals have been identified at NAS Jacksonville or in adjacent waters. Protected species that are known to or have the potential to inhabit NAS Jacksonville are listed in **Table 4-1**.

TABLE 4-1
SUMMARY OF KNOWN OR POTENTIAL PROTECTED SPECIES

Ecological Receptor	Species
Federal Endangered	Manatee
Federal Threatened	American Bald Eagle
State Endangered	Manatee
State Threatened	American Bald Eagle
	Least Tern
State Species of Special Concern	Gopher Tortoise
	Little Blue Heron
	Snowy Egret
	Tricolored Heron
	Sherman's Fox Squirrel

Two rare plant species have been documented at NAS Jacksonville. However, neither plant species has been observed at or in the vicinity of the Former Machine Gun Range Complex.

Current Land Use and Anticipated Future Land Use

The six MRP sites associated with the Machine Gun Range Complex are situated within or adjacent to the boundaries of the base golf course. Future land use at these sites is anticipated to be the same as current land use, which is associated with golf course activities.

4.2.3 Site Descriptions

The Former Machine Gun Range Complex at NAS Jacksonville was constructed in the early 1940s for small arms training and recreational trap shooting. It consists of six UXO sites that were formerly identified as Potential Source of Contamination (PSC) sites prior to the discovery of MC in soil and sediment and the sites' subsequent inclusion in the MRP. The six sites are as follows: Fort Dix Skeet Range (formerly identified as PSC 22, now identified as UXO 1); .50 Caliber Range (formerly PSC 23A, now UXO 2); Former Skeet Range (formerly PSC 23B, now UXO 3); Akron Road Pistol Range (formerly PSC 56, now UXO 4); .30 Caliber Range (formerly PSC 57, now UXO 5); and Trap Ranges (formerly PSC 58, now UXO 6). The approximate sizes, uses, and dates of use of each range are summarized in **Table 4-2**. The ranges are no longer operational, and the sites they once occupied now lie within the boundaries of the Base Golf Course (**Figure 4-1**).

TABLE 4-2
SUMMARY OF FORMER MACHINE GUN RANGE COMPLEX SITES

Site Name	Current UXO Site No.	Former PSC Site No.	Estimated Size (acres)	Use	Dates of Use
Fort Dix Skeet Range	1	22	31.4	Skeet and Trap Range	1943 - mid 1950s
.50-Caliber Range	2	23a	2.2	Machine Gun Range	~1941-1978
Former Skeet Range	3	23b	18.4	Skeet Range	~1941-1978
Akron Road Pistol Range	4	56	2.5	Pistol Range	1941-2002
.30-Caliber Range	5	57	1.3	Machine Gun Range	1941-1978
Trap Ranges	6	58	9.6	Trap Ranges	1941-1978

The six ranges were used for small arms training only; thus, no Munitions and Explosives of Concern (MEC) or materially potentially presenting an explosive hazard (MPPEH) are known or suspected to be present at any of the sites. Based on the information obtained during the PA data collection process, no other munitions types, including special consideration munitions (e.g., chemical warfare materiel-filled munitions, electrically fuzed munitions, and/or depleted uranium associated munitions) are known or suspected to have been used at these sites. The total number of rounds deployed or fired at these sites is unknown, and there are no available records or defensible methods for determining the exact quantity.

The Interstate Technology and Regulatory Council (ITRC) has prepared a document entitled, "Characterization and Remediation of Soils at Closed Small Arms Ranges" (ITRC, 2003), to provide information relevant to the investigation and cleanup of typical small arms ranges, including rifle ranges, pistol ranges, and shotgun (e.g., trap and skeet) ranges. The document provides details regarding the general layout of different types of ranges, characteristics of the ammunition used, expected penetration depths and dispersal patterns of spent ammunition, contaminant fate and transport, and risk assessment considerations. Information contained in this document provides much of the basis for the sampling strategies employed in the previous SI and planned for this RI.

According to the ITRC guidance, the typical penetration depth of ammunition on the floor of small arms ranges is 1 foot or less. For trap and skeet ranges, the spent ammunition is typically dispersed as pellets in a fan-shaped pattern in the direction of fire. Shell fragments and pellets dispersed from a shotgun are deposited on the ground surface without significantly penetrating the ground unless disturbed. Clay targets and target fragments that fall to the ground after use are also dispersed in a fan-shaped pattern, although they typically fall closer to the firing points than the shotgun pellets do. The fan-shaped dispersal pattern is generally wider at skeet ranges than at trap ranges because in skeet shooting, targets are launched across the line of fire, whereas in trap shooting, targets are launched in a downrange direction. Typical contaminants at trap and skeet ranges are metals (e.g., lead, antimony, arsenic, copper, tin, and zinc) from the shotgun shells and PAHs from the clay targets.

Rifle and pistol ranges are designed such that small arms ammunition is fired toward targets and retained by the backstop berm directly behind the targets. The backstop berm receives most of the impact, with bullets penetrating a foot or more into the berm (depending on soil type, size of ammunition, angle of impact, velocity at impact, etc.) before they lose energy. Side berms, if present, provide lateral containment for stray bullets and ricochets, with rounds typically penetrating to a maximum depth of one foot. Bullets that impact the range floor typically do so because they fall short or miss the target, or as a result of ricochet. The resulting bullet fragments are usually found within the top 6 inches of soil on the range floor. Spent rounds are not expected to penetrate deeper than the depths specified or to

accumulate beyond the backstop berm. Typical contaminants at rifle and pistol ranges are metals (e.g., lead, antimony, arsenic, copper, tin, and zinc) from the bullets.

Additional research conducted by USACE at the Cold Regions Research and Engineering Laboratory (CRREL) subsequent to the publication of the ITRC document has shown that nitroglycerin (NG) may also be of concern at small arms ranges due to its use as a propellant in small arms ammunition. Results of tests conducted in 2007 (USACE, 2007) indicated that the percentage of unburned energetics (NG) compared to the original constituent load in small arms ammunition ranged from 0.56% for 7.62-mm machine guns to 5.4% for 9-mm pistols. Although machine guns and higher caliber weapons were found to have a relatively high propellant consumption efficiency (i.e., low percent of unburned energetics), the 9-mm pistol was less efficient in its consumption of NG. The amount of residue emitted with each round fired was low; however, the cumulative effect of firing large numbers of rounds could result in the deposition of a significant mass of energetic residue over a small area, particularly on ranges where small caliber, non-automatic weapons are fired repeatedly from the same locations over a long period of time.

The following paragraphs provide site-specific details for each of the six sites.

UXO 1 - Fort Dix Skeet Range (formerly PSC 22)

The Fort Dix Skeet Range (UXO 1) is located directly northwest of the Former Machine Gun Range Complex (**Figure 4-1**). The range was constructed and became operational in 1943, and it stayed active until the mid-1950s. The range consisted of eight skeet ranges, which originally encompassed approximately 8 acres (**Figure 4-3**). The firing positions were located in a line that ran northwest-to-southeast, and the firing direction was to the northeast. The range structures and features were demolished and removed in the late 1990s, and portions of the land were used in the expansion of the base golf course. The central portion of the range is now a wooded area, which is bordered on all sides by golf course fairways. Lake Scotlis is located northeast of the site, and small golf course ponds are located along the northern and southeastern boundaries of the site.

Munitions use at the Fort Dix Skeet Range was limited to 12-gauge shotgun ammunition. The predominant MC associated with shotgun ammunition and clay targets include lead from shot pellets used in the ammunition and PAHs from the pitch tar used in clay pigeons. Other associated MC expected to be present but less likely to be of concern include antimony, arsenic, copper, tin, and zinc. According to ITRC guidance, propellants in shotgun ammunition are rapidly burning compounds that are completely combusted when rounds are fired; however, the metal components are not consumed when the rounds function as designed. Therefore, these MC may still exist at the site.

UXO 2 - .50-Caliber Range (formerly PSC 23A)

The .50-Caliber Range (UXO 2) is located directly southeast of the former Fort Dix Skeet Range (UXO 1), west of the Former Skeet Range (UXO 3), and north of the Trap Ranges (UXO 6) (**Figure 4-1**). The .50-Caliber Range was constructed and became operational in approximately 1941. It consisted of a machine gun range that encompassed approximately 2.25 acres (**Figure 4-4**). The firing positions were located on the south side of the range, and the firing direction was to the north. The .50-Caliber Range was adjacent to the Air Blast Range and Synchronized Gun Range, and the three ranges shared a common backstop berm. The range features were demolished in the late 1990s, and portions of the land were used for the expansion of the base golf course. The site now lies almost entirely within a golf course fairway. There are no surface water bodies or wetlands within the site perimeter, although golf course ponds are located north and south of the site.

Munitions use at the .50 Caliber Range was limited to .50-caliber ammunition. The predominant MC of concern at this site is lead from bullets. Other associated MC expected to be present but less likely to be of concern include antimony, arsenic, copper, tin, and zinc. These MC are not consumed when small arms ammunition function as they are designed. Therefore, they may still exist at the site. NG is not expected at this site due to the relatively high propellant consumption efficiency of machine guns reported by CRREL (USACE, 2007).

UXO 3 - Former Skeet Range (formerly PSC 23B)

The Former Skeet Range (UXO 3) is located directly east of the .50-Caliber Range (UXO 2) (**Figure 4-1**). The range was constructed and became operational in approximately 1941, and it ceased operation in 1978. It consisted of two trap and skeet firing areas, which originally encompassed approximately 9.2 acres (**Figure 4-5**). The firing positions were located in a line that ran northwest to southeast, and the firing direction was to the northeast. The range structures and features remained in place until the late 1990s when they were removed for the expansion of the present-day golf course. The area of the range closest to the former firing positions is now a wooded area, and the remainder of the site contains portions of several golf course fairways. Lake Scotlis is located north of the site and several golf course ponds lie within or adjacent to the site.

Munitions use at the former Skeet Range was limited to 12-gauge shotgun ammunition. The predominant MC associated with shotgun ammunition and clay targets include lead from shot pellets used in the ammunition and PAHs from the pitch tar used in clay pigeons. Other associated MC expected to be present but less likely to be of concern include antimony, arsenic, copper, tin, and zinc. According to ITRC guidance (ITRC, 2003), propellants in shotgun ammunition are rapidly burning compounds that are

completely combusted when rounds are fired; however, the metal components are not consumed when the rounds function as designed. Therefore, these MC may still exist at the site.

UXO 4 - Akron Road Pistol Range (formerly PSC 56)

The Akron Road Pistol Range (UXO 4) is located directly south of the .30-Caliber Range (UXO 5) and west of the Trap Ranges (UXO 6) (**Figure 4-1**). This range was constructed and became operational in 1941, and it was closed in 1997. Property records indicate that the pistol range consisted of 40 bulls' eye targets and two firing lines located at 25 and 50 yards from the targets. The range encompassed approximately 2.3 acres and was oriented north-to-south (**Figure 4-6**). The firing positions were on the north side of the range, and the firing direction was to the south. The backstop berm, which is approximately 300 feet long and 25 feet high, still exists on the south side of the range. Two wing berms, which were added some time after the range became operational, still exist on the east and west sides of the range. There are no surface water bodies within the perimeter of this site, although a drainage that flows west-to-east is located directly south of the site and a golf course pond lies directly east of the site.

In August 1994, soil samples were collected from the backstop berm and eastern wing berm for toxicity characteristic leaching procedure (TCLP) metals analysis. Results for several samples exceeded the Resource Conservation and Recovery Act (RCRA) limit for leachable lead (5 mg/L). In June 1995, lead-impacted soil was removed from six locations on the face of the backstop berm to a depth of 1 foot bgs, as well as from the northern and southern tips of the eastern wing berm. In addition, lime was applied to the ground surface at the range to reduce the leachability of metals contaminants. During a range condition inspection in 1997, it was ascertained that the range's overhead baffles were damaged beyond economical repairs, and that there was encroachment of the golf course; therefore, a decision was made at that time to close the range. Bullet removal and additional lime application occurred in 2000, and a letter dated August 19, 2002 noted the formal closure of the range.

Munitions use at the Akron Road Pistol Range was limited to small arms ammunition (primarily .22-, .38-, and .45-caliber and 9-millimeter [mm] pistol ammunition); 12-gauge shotgun ammunition; and .50-caliber ammunition. The predominant MC of concern at this site is lead from bullets. Other associated MC expected to be present but less likely to be of concern include antimony, arsenic, copper, tin, and zinc. These MC are not consumed when small arms ammunition function as they are designed. Therefore, they may still exist at the site. In addition, NG may be present in surface soil at the two firing lines due to its use as an energetic compound in smalls arms ammunition propellants, the long duration of concentrated firing activities at this range, and the lack of any significant soil disturbance at this site that could have diluted or displaced energetic compounds from the firing line areas.

UXO 5 - .30-Caliber Range (formerly PSC 57)

The 0.30-Caliber Range (UXO 5) is a former machine gun range located directly south of the Fort Dix Skeet Range (UXO 1), west of the .50-Caliber Range (UXO 2), and north of the Akron Road Pistol Range (UXO 4) (**Figure 4-1**). The .30-Caliber Range was constructed and became operational in 1941. It encompassed approximately 1.3 acres and was oriented south-to-north (**Figure 4-7**). Property records indicate that the range consisted of eight fixed firing positions and four targets located approximately 50 feet downrange. The firing positions were located on the south side of the range, and the firing direction was to the north. A backstop berm approximately 220 feet long and 25 feet high was in place on the north side of the range, but it has been removed and there is no longer any evidence of the berm. The site now lies almost entirely within a golf course fairway. A wooden wetlands area is located directly beyond the northern boundary of UXO 5, and a small golf course pond lies directly west of the site.

Munitions use at the .30-Caliber Range was limited to .30-caliber ammunition. The predominant MC of concern at this site is lead from bullets. Other associated MC expected to be present but less likely to be of concern include antimony, arsenic, copper, tin, and zinc. These MC are not consumed when small arms ammunition function as they are designed. Therefore, they may still exist at the site. NG is not expected at this site due to the relatively high propellant consumption efficiency of machine guns reported by CRREL (USACE, 2007).

UXO 6 - Trap Ranges (formerly PSC 58)

The Trap Ranges (UXO 6) are located directly south of the .50-Caliber Range (UXO 2) and east of the Akron Road Pistol Range (UXO 4) (**Figure 4-1)**. The Trap Ranges were constructed in 1941 and encompassed approximately 10.5 acres (**Figure 4-8**). They were used for recreational trap shooting until they were closed in 1978. Property records indicate that the site contained four trap shooting fields with five firing points on each firing arc. The firing points were spaced 15 feet apart along the firing arc and were located 49 feet from the trap houses. The ranges were oriented in a north-to-south direction, with the firing points located in the northern portion of the Trap Ranges and the firing direction toward to the south. A golf course pond now covers the former firing points, and a second pond lies in the southeastern portion of the site. The target field is now covered half by woods and half by golf course fairway.

Munitions use at the Trap Ranges was limited to 12-gauge shotgun ammunition. The predominant MC associated with shotgun ammunition and clay targets include lead from shot pellets used in the ammunition and PAHs from the pitch tar used in clay pigeons. Other associated MC expected to be present but less likely to be of concern include antimony, arsenic, copper, tin, and zinc. According to ITRC guidance (ITRC, 2003), propellants in shotgun ammunition are rapidly burning compounds that are

completely combusted when rounds are fired; however, the metal components are not consumed when the rounds function as designed. Therefore, these MC may still exist at the site.

4.3 SUMMARY OF PREVIOUS INVESTIGATIONS

4.3.1 Preliminary Assessment

The PA, which was the initial investigative phase under the CERCLA process, was completed in 2007 (Malcolm Pirnie, 2007). The PA identified five "other than operational" range sites associated with the Former Machine Gun Range Complex. These sites were designated as PSC sites under the Installation Restoration Program (IRP), but are now designated as UXO sites under the MRP. In addition, the .50-Caliber Range is now considered a separate site rather than a part of the Former Skeet Range; thus, there are six sites subject to this SAP.

The PA used five primary sources of information to support the data collection effort. Those sources include historical archives, personal interviews, installation data repositories, visual surveys, and off-facility data sources and repositories such as libraries and museums. The PA summarized the historical usage and physical characteristics of the each range under investigation including features such as vegetation, topography, geology, hydrogeology, climate, endangered species, and cultural and natural resources. Based on the detailed information collected, the PA presented an initial CSM for each site.

4.3.2 Site Inspection

In January 2010, Tetra Tech implemented the sampling and analysis activities outlined in the SI SAP (Tetra Tech, 2009) to determine whether MC were present at the six sites associated with the Former Machine Gun Range Complex in concentrations that exceeded ecological and/or human health screening criteria. Samples of the following media were collected and analyzed: surface soils (0 to 6 inches bgs and 6 to 24 inches bgs), drainageway sediments (0 to 6 inches bgs), and subsurface soils (2 to 4 feet bgs). At sampling locations within the golf course fairways, where fill material was known to have been placed, soil samples were collected from two depth intervals: one foot above the native ground surface and one foot below the native ground surface, as determined by the Field Geologist. Soil and sediment samples were analyzed for select metals (antimony, arsenic, copper, lead, and zinc) and/or PAHs, as appropriate for the type of range and particular location within the range from which they were collected. Three to four samples from each range were also analyzed by the SPLP to evaluate the leachability of metals under normal environmental conditions.

Samples collected during the SI were evaluated in the field for lead using XRF technology. A subset of the samples was also selected for analytical testing at a fixed-base laboratory (FBL). The correlation

between XRF and FBL lead results for each site was estimated by performing statistical comparisons (i.e., regression analyses) of the data sets to evaluate the usability of XRF data in predicting actual lead concentrations. The correlation analysis presented in the SI Report, which is contained in **Appendix B**, demonstrated an acceptable correlation between XRF and FBL data for five of the six sites.

A review of the correlation analysis for the site where lead data did not appear to correlate well (Fort Dix Skeet Range) identified one sample location (JAX-22-SBSS033) where the metals concentrations reported by the FBL were unusually high. Copper alone accounted for more than 18% of the soil sample, by weight; zinc accounted for more than 3%; and lead and tin each accounted for more than 1%. The high metals concentrations reported for this soil sample are likely due to the presence of metal fragments in the sample fraction analyzed at the FBL. Inherent heterogeneity in the sample matrix (i.e., metal fragments present in the sample analyzed at the FBL but not in the sample evaluated by XRF) provides a plausible explanation for why the lead concentration reported by the FBL was several orders of magnitude higher than the onsite XRF result. Thus, the data couple for this sample location is considered a statistical outlier which, when disregarded, allows for an acceptable correlation between the two data sets for the Fort Dix Skeet Range (see revised correlation analysis in **Appendix B**).

The data collected during the SI were used to conduct screening level risk evaluations for each site. Data were compared to risk-based screening benchmarks, identified in the SI as PALs, to determine whether concentrations of contaminants at each site posed a potential human health and/or ecological risk. As a result of identifying MC at concentrations that exceeded PALs, some metals and PAHs were determined to be COPCs that required further investigation under a RI to more thoroughly define their nature and extent and to provide the necessary data to complete an HHRA and ERA. In addition, the confirmed presence of MC resulted in the re-designation of the six “PSC” sites investigated during the SI as “UXO” sites to be investigated under the MRP.

The SI Report (Tetra Tech, 2010) contains a complete description of the field investigations and laboratory tests that were performed, data that were generated, and risk evaluations that were conducted under the SI. Table ES-1 of the SI Report summarizes the conclusions and recommendations of the SI (see **Appendix C**). The remainder of this section provides an overview of the contamination observed during the SI and recommendations that were made for each of the six UXO sites under investigation. **Appendix C** contains the tag maps from the SI Report that are referenced in the discussions below.

UXO 1 - Fort Dix Skeet Range

The SI analytical program for the Fort Dix Skeet Range consisted of the collection of soil and sediment samples from the locations shown on **Figure 4-9** for analysis of select metals (lead, antimony, arsenic, copper, tin, and zinc) and/or PAHs. As detailed below, results of the analyses indicated widespread lead

contamination in surface soil, subsurface soil, and drainage sediments. PAL exceedances for metals other than lead (antimony, arsenic, copper, tin, and zinc) were also observed, typically collocated with the lead PAL exceedances. PAH concentrations exceeded their respective PALs at numerous locations throughout the site, as well.

Fifty-six surface soil samples were analyzed in the field using XRF. Eighteen of those samples exceeded the lead field screening level [300 milligrams per kilogram (mg/kg)], with concentrations ranging from 406 to 6,053 mg/kg. One of seven subsurface samples analyzed using XRF exceeded the field screening level.

Nineteen surface soil, one subsurface soil, and ten sediment samples were analyzed for select metals at the FBL. Seventeen soil and nine sediment samples exceeded the tiered select ecological PAL for lead (11 mg/kg); and seven soil and five sediment samples exceeded the human health PAL for lead (400 mg/kg). Human health and/or ecological PALs were also exceeded in a large number of soil samples for antimony (12 samples exceeded the ecological PAL and two samples also exceeded the human health PAL), arsenic (five samples exceeded the human health PAL and one sample also exceeded the ecological PAL), copper (three samples exceeded the ecological PAL and one sample also exceeded the human health PAL), tin (one sample exceeded the ecological PAL), and zinc (two samples exceeded the ecological PAL and one sample also exceeded the human health PAL).

Fifty-eight surface soil, five subsurface soil, and ten sediment samples were analyzed for PAHs at the FBL. Benzo(a)pyrene (BaP) equivalents were calculated, which indicated exceedances of the human health PAL (100 micrograms per kilogram [µg/kg]) in twenty-eight surface soil, five subsurface soil, and five sediment samples. In addition, concentrations of one or more individual PAHs exceeded their respective ecological screening values in ten surface soil and five sediment samples.

Four samples underwent SPLP analysis, and results indicated the potential for antimony, arsenic, and lead to leach from soil to groundwater at predicted concentrations exceeding their respective groundwater PALs. To further evaluate the potential leachability of metals, alternative SCTLs were calculated using site-specific data. Comparisons of the soil results to these levels confirmed the potential for antimony, arsenic, and lead to impact groundwater.

A 6- to 12-inch layer of skeet fragments was observed at sampling locations JAX-22-SBSS001 through JAX-22-SBSS006. Therefore, no samples were collected at these locations from the planned 0 to 6-inch bgs depth interval. Instead, samples were collected from the interval beneath the layer of skeet, between 1 and 2 feet bgs.

Tag maps depicting the respective PAL exceedances reported during the SI for the Fort Dix Skeet Range (**SI Report Figures 4-2 through 4-6**) are presented in **Appendix C**. These data are summarized on **Figure 4-9**, which illustrates all sampling locations where PALs were exceeded at this site.

Based on the analytical results for the Fort Dix Skeet Range, the SI Report recommended proceeding to a RI to delineate the horizontal and vertical extent of metals and PAH contamination in soil and sediment. Groundwater sampling was also recommended because of the potential for antimony, arsenic, and lead to leach from soil to groundwater.

UXO 2 - .50-Caliber Range

The SI analytical program for the .50-Caliber Range consisted of the collection of surface and subsurface soil samples from the locations shown on **Figure 4-10** for analysis of select metals (lead, antimony, arsenic, copper, tin, and zinc). Sample depths were chosen to reflect “surface” and “subsurface” depth intervals relative to the native ground surface prior to fill emplacement (i.e., during golf course construction). As detailed below, analytical results for three subsurface samples (from two locations) indicated exceedances of one or more human health screening criteria.

Three of the thirty soil samples analyzed in the field using XRF exceeded the lead field screening level (300 mg/kg), with concentrations ranging from 687 to 1,179 mg/kg. Results for ten samples analyzed for select metals at the FBL indicated that two samples (from one location) exceeded the human health PAL for copper (150 mg/kg), and three samples (from two locations) exceeded the human health PAL for lead (400 mg/kg). There were no exceedances of PALs reported for antimony, arsenic, tin, or zinc.

SPLP analysis was performed for the three samples that exceeded PALs, and results indicated the potential for lead and antimony to leach from soil to groundwater at predicted concentrations exceeding their respective groundwater PALs. To further evaluate the potential leachability of metals, alternative SCTLs were calculated using site-specific data. Comparisons of the soil results to these levels confirmed the potential for antimony, but not lead, to impact groundwater.

Tag maps depicting the PAL exceedances reported during the SI for the .50-Caliber Range (**SI Report Figures 5-2 and 5-3**) are presented in **Appendix C**. These data are summarized on **Figure 4-10,** which illustrates all sampling locations where PALs were exceeded at this site.

Based on the analytical results for the .50-Caliber Range, the SI Report recommended proceeding to a RI to complete the delineation of metals in soils. Groundwater sampling was also recommended because of the potential for antimony to leach from soil to groundwater.

UXO 3 - Former Skeet Range

The SI analytical program for the Former Skeet Range consisted of the collection of soil and sediment samples from the locations shown on **Figure 4-11** for analysis of select metals (lead, antimony, arsenic, copper, tin, and zinc) and/or PAHs. As detailed below, results of the analyses indicated widespread lead and PAH contamination in surface soil, subsurface soil, and drainage sediments. PAL exceedances for metals other than lead (antimony, arsenic, copper, and zinc) were observed, typically collocated with the lead PAL exceedances. The majority of contamination was found in the wooded areas; however, contamination was also detected in soil beneath the golf course fairway.

Thirty-four surface soil samples were analyzed in the field using XRF. Three of those samples exceeded the lead field screening level (300 mg/kg), with concentrations ranging from 364 to 645 mg/kg. One of thirteen subsurface samples analyzed using XRF exceeded the field screening level.

Eighteen surface soil, two subsurface soil, and ten sediment samples were analyzed for select metals at the FBL. Sixteen surface soil samples exceeded the ecological PAL for lead (11 mg/kg); and two of those exceeded the human health PAL for lead (400 mg/kg), as well. Eight surface soil and five sediment samples exceeded the ecological PAL for antimony. Five surface soil and five sediment samples exceeded the human health PAL for arsenic; and two sediment samples also exceeded the ecological PAL for arsenic. Five sediment samples exceeded the ecological PAL for copper, and one surface soil sample exceeded the ecological PAL for zinc.

Eighteen surface soil and ten sediment samples were analyzed for PAHs at the FBL. BaP equivalents were calculated, which indicated exceedances of the human health PAL[(100 µg/kg) in nine surface soil and six sediment samples. In addition, concentrations of one or more individual PAHs exceeded their respective ecological screening values in two surface soil and six sediment samples.

Three soil samples underwent SPLP analysis, and results indicated the potential for lead and antimony to leach from soil to groundwater at predicted concentrations exceeding their respective groundwater PALs. To further evaluate the potential leachability of metals, alternative leachability-based SCTLs were calculated using site-specific data. Comparisons of the soil results to these levels indicated that neither lead nor antimony were present at high enough concentrations in the soil to impact groundwater.

Tag maps depicting the respective PAL exceedances reported during the SI for the Former Skeet Range (**SI Report Figures 6-2 through 6-6**) are presented in **Appendix C**. These data are summarized on **Figure 4-11**, which illustrates all sampling locations where PALs were exceeded at this site.

Based on the analytical results for the Former Skeet Range, the SI Report recommended proceeding to a RI to delineate the horizontal and vertical extent of metals and PAH contamination in soil and sediment. Although SPLP data suggested the need for groundwater sampling, it was not recommended for this site based on comparisons of soil data to site-specific leachability-based SCTLs.

UXO 4 - Akron Road Pistol Range

The SI analytical program for the Akron Road Pistol Range consisted of the collection of soil and sediment samples from the locations shown on **Figure 4-12** for analysis of select metals (lead, antimony, arsenic, copper, tin, and zinc). As detailed below, results of the analyses indicated widespread lead contamination in surface and subsurface soil, and in the sediment, as well. Lead exceeded the ecological screening criteria at all but one sampling location (soil and sediment). Antimony, arsenic, copper, and zinc exceeded their respective PALs at numerous surface soil sampling locations; and antimony, arsenic, and copper exceeded their respective PALs in all of the sediment samples.

Thirty-four of 138 surface soil samples analyzed in the field using XRF exceeded the lead field screening level (300 mg/kg), with concentrations ranging from 302 to 6,619 mg/kg. Forty-two of the sixty-three subsurface soil samples analyzed using XRF exceeded the field screening level, with concentrations ranging from 450 to 2,572 mg/kg.

Twenty-seven surface soil, three subsurface soil, and four sediment samples were analyzed for select metals at the FBL. Twenty-two surface soil and all four sediment samples exceeded the ecological PAL for lead (11 mg/kg). Eleven surface soil and three sediment samples also exceeded the human health PAL for lead (400 mg/kg), as well. Exceedances of the ecological and/or human health PALs were reported for antimony (17 surface soil and two sediment samples exceeded the ecological PAL and one surface soil sample also exceeded the human health PAL), for arsenic (four surface soil and one sediment samples exceeded the human health PAL and two surface soil samples also exceeded the ecological PAL), copper (nine surface soil and three sediment samples exceeded the ecological PAL and seven of the surface soil and three of the sediment samples also exceeded the human health PAL), and zinc (four surface soil samples exceeded the ecological PAL).

Three surface soil samples underwent SPLP analysis, and results indicated the potential for lead to leach from soil to groundwater at predicted concentrations exceeding the PAL. To further evaluate the potential leachability of lead, an alternative leachability-based SCTL was calculated using site-specific data. Comparisons of the soil results to these levels confirmed the potential for lead to impact groundwater.

Tag maps depicting the respective PAL exceedances reported during the SI for the Akron Road Pistol Range (**SI Report Figures 7-2a through 7-4**) are presented in **Appendix C**. These data are

summarized on **Figure 4-12**, which illustrates all sampling locations where PALs were exceeded at this site.

Based on the analytical results for the Akron Road Pistol Range, the SI Report recommended proceeding to a RI to complete the delineation of metals in surface and subsurface soils. Groundwater sampling was also recommended because of the potential for lead to leach from soil to groundwater.

UXO 5 - .30-Caliber Range

The SI analytical program for the .30-Caliber Range consisted of the collection of surface and subsurface soil samples from the locations shown on **Figure 4-13** for analysis of select metals (lead, antimony, arsenic, copper, tin, and zinc). Sample depths were chosen to reflect "surface" and "subsurface" depth intervals relative to the native ground surface prior to fill emplacement (i.e., during golf course construction). As detailed below, analytical results indicated two sampling locations that exceeded the ecological PAL for lead, and one sampling location that exceeded the human health PAL for arsenic.

None of the forty soil samples analyzed in the field using XRF exceeded the lead field screening level (300 mg/kg). Results for twenty samples that were analyzed for select metals at the FBL indicated that two surface soil samples exceeded the ecological PAL for lead (11 mg/kg), and one subsurface soil sample exceeded the human health PAL for arsenic.

Three soil samples underwent SPLP analysis, and results indicated the potential for lead and antimony to leach from soil to groundwater at predicted concentrations exceeding their respective groundwater PALs. To further evaluate the potential leachability of metals, alternative leachability-based SCTLs were calculated using site-specific data. Comparisons of the soil results to these levels indicated that neither lead nor antimony were present at high enough concentrations in the soil to impact groundwater.

Tag maps depicting the PAL exceedances reported during the SI for the .30-Caliber Range (**SI Report Figures 8-2 and 8-3**) are presented in **Appendix C**. These data are summarized on **Figure 4-13**, which illustrates all sampling locations where PALs were exceeded at this site.

Based on the analytical results for the .30-Caliber Range, the SI Report recommended proceeding to a RI to delineate the extent of lead and arsenic in the soil. It was noted, however, that the arsenic exceedance was marginal and that the locations that exceeded ecological screening criteria for lead are in the middle of the golf course fairway, which is not considered to be an ecological habitat. Although SPLP data suggested the need for groundwater sampling, it was not recommended for this site, based on comparisons of soil data to site-specific leachability-based SCTLs.

UXO 6 - Trap Ranges

The SI analytical program for the Trap Ranges consisted of the collection of soil and sediment samples from the locations shown on **Figure 4-14** for analysis of select metals (lead, antimony, arsenic, copper, tin, and zinc) and PAHs. As detailed below, results of the analyses indicated widespread metals and PAH contamination in the surface soil, subsurface soil, and drainage sediment. Antimony, arsenic, lead, and PAHs exceeded screening criteria in numerous surface and subsurface soil samples; and lead, copper, zinc, and PAHs exceeded screening criteria in sediment samples.

Thirty-three surface soil samples were analyzed in the field using XRF. Six of those samples exceeded the lead field screening level (300 mg/kg), with concentrations ranging from 364 to 645 mg/kg. The one subsurface sample analyzed using XRF also exceeded the field screening level.

Nineteen surface soil, one subsurface soil, and ten sediment samples were analyzed for select metals at the FBL. Fourteen surface soil and six sediment samples exceeded the ecological PAL for lead (11 mg/kg); and five of the sediment samples exceeded the human health PAL for lead (400 mg/kg), as well. Nine surface soil, one subsurface soil, and two sediment samples exceeded the ecological PAL for antimony. Four surface soil, one subsurface soil, and two sediment samples exceeded the human health PAL for arsenic; and both sediment samples also exceeded the ecological PAL for arsenic. One sediment sample exceeded the ecological PAL for copper, and one sediment sample exceeded the ecological PAL for zinc.

Fifteen surface soil and ten sediment samples were analyzed for PAHs at the FBL. BaP equivalents were calculated, which indicated exceedances of the human health PAL (100 µg/kg) in five surface soil and eight sediment samples. In addition, concentrations of one or more individual PAHs exceeded their respective ecological screening values in five surface soil and seven sediment samples.

Three surface soil and one subsurface soil samples underwent SPLP analysis, and results indicated the potential for antimony, arsenic, and lead to leach from soil to groundwater at predicted concentrations exceeding their respective groundwater PALs. To further evaluate the potential leachability of metals, alternative leachability-based SCTLs were calculated using site-specific data. Comparisons of the soil results to these levels confirmed the potential for antimony, arsenic, and lead to impact groundwater.

Tag maps depicting the respective PAL exceedances reported during the SI for the Trap Ranges (**SI Report Figures 9-2 through 9-6**) are presented in **Appendix C**. These data are summarized on **Figure 4-14**, which illustrates all sampling locations where PALs were exceeded at this site.

Based on the analytical results for the Trap Ranges, the SI Report recommended proceeding to a RI to delineate the horizontal and vertical extent of metals and PAH contamination in soil and sediment. Groundwater sampling was also recommended because of the potential for antimony, arsenic, and lead to leach from soil to groundwater. Surface water sampling was recommended to investigate the possible impact of soil and sediment contaminant migration through the site drainages into nearby surface ponds, where contaminants could leach into the surface water, or through the underlying groundwater, which could seep into the ponds.

4.3.3 Sampling to Support Construction of Water Reuse Holding Pond

In March 2011, the Navy began planning for the excavation of soil within the boundaries of the Former Skeet Range and Trap Ranges sites to construct a wastewater reuse holding pond and pumping station. Prior to the excavation, Tetra Tech collected and analyzed samples to characterize the soil to be removed so that decisions could be made regarding the appropriate disposition and possible reuse of the excavated material. Soil and sediment sampling locations were selected to provide for sufficient delineation of lead and PAH contamination to allow the excavation spoils to be segregated according to whether they required special consideration as contaminated material or could be reused onsite. Highlights from the Partnering Team meeting where the analytical data were presented and the proposed disposition of excavation spoils was discussed are included in **Appendix A**.

The boundaries of the "Proposed Unlined Holding Pond" shown on the **Appendix A** figures represent the actual limits of excavation, as constructed in April-May 2011. Analytical data for samples previously collected from within these boundaries (i.e., during this sampling event or during the 2010 SI) are no longer relevant because the material that was sampled is no longer in place. The excavated area, which is shown on figures in this SAP as the "Wastewater Reuse Holding Pond," is now a functioning component of the installation's wastewater reuse system.

4.4 CONCEPTUAL SITE MODELS

Information regarding the description and background of each site has been considered along with data collected during previous environmental investigations to develop a conceptual understanding of how previous range activities have impacted each site. As reflected on the Exposure Pathway Analysis diagrams (**Figures 4-15 and 4-16**), the fundamental source of contamination at the Former Machine Gun Range Complex sites is impacted soil. Over time, contaminants in the soil may have migrated laterally (via surface runoff) to nearby drainages and surface ponds, or vertically (via leaching or infiltration) to underlying subsurface soil and groundwater.

The exposure pathway analyses are key components of the CSMs discussed in this section. For MC, a complete exposure pathway must include the following components: 1) a contaminant source (e.g., locations where contaminants are expected to be found); 2) an exposure medium (e.g., surface soil, etc.); 3) an exposure route (e.g., dermal contact, etc.); and 4) receptors (e.g., human and/or ecological). If the point of exposure is not at the same location as the source, the pathway may also include a release mechanism (e.g., surface runoff) and a transport medium (e.g., surface water).

Currently, both human and ecological receptors have the potential to contact contaminated site media at the six former Machine Gun Range Complex sites. As shown on **Figure 4-15**, current human receptors include recreational users, trespassers, maintenance workers, and construction workers. In the event of future land use changes (i.e., the base is closed and the golf course area is redeveloped for industrial or residential use), potential human receptors could also include onsite industrial workers and/or residents. Human receptors may be exposed to contaminated media through dermal contact, ingestion, or inhalation.

As shown on **Figure 4-16**, potential ecological receptors include common flora and fauna. Terrestrial plants and invertebrates may exist in areas currently covered by golf course fairways; and terrestrial plants and invertebrates, birds, and mammals may exist in wooded areas. Benthic organisms, fish, and other aquatic organisms may be present in surface water features such as drainages, ponds, and wetlands. Ecological receptors may be exposed through direct contact with or ingestion of contaminated media, as well as through the food chain (i.e., by ingesting plants and animals that have been impacted through uptake of soil contaminants).

The six sites that comprise the former Machine Gun Range Complex share most elements of the CSM in common, with only a few exceptions at each site. The following paragraphs describe site-specific aspects of the CSMs that differ from the general CSM described above.

4.4.1 UXO 1 - Fort Dix Skeet Range

Metals and PAH contamination have been deposited in surface soil due to accumulations of shotgun shell residue (e.g., lead shot) and clay skeet fragments. Contaminants have also leached to subsurface soil and been transported through runoff to drainageway sediment. It is possible that additional contaminant migration may have impacted groundwater underlying the site or surface water and sediment in the three onsite ponds.

This site contains golf course fairway areas, wooded areas, and surface ponds. Therefore, the full range of exposure pathways depicted in **Figures 4-15 and 4-16** are potentially complete. A three-dimensional

CSM diagram illustrating how contaminated media at this site may result in exposure to ecological and/or human receptors is presented in **Figure 4-17**.

4.4.2 UXO 2 - .50-Caliber Range

Metals contamination has been deposited in surface soil due to accumulations of bullet residue, and has also leached to subsurface soil. In addition, it is possible that contaminant migration may have impacted groundwater underlying the site, as well.

This site is located predominately within a golf course fairway. It also contains a wooded area along the north side, but there are no surface ponds onsite. Therefore, the exposure pathways depicted in **Figures 4-15 and 4-16** are all potentially complete except for the surface water and sediment pathways. A three-dimensional CSM diagram illustrating how contaminated media at this site may result in exposure to ecological and/or human receptors is presented in **Figure 4-18**.

4.4.3 UXO 3 - Former Skeet Range

Metals and PAH contamination have been deposited in surface soil due to accumulations of shotgun shell residue (e.g., lead shot) and clay skeet fragments. Contaminants have also leached to subsurface soil and been transported through runoff to drainageway sediment. Although it is possible that additional contaminant migration may have impacted groundwater underlying the site, the data obtained during the SI did not warrant further consideration of groundwater as a source of unacceptable risk.

This site contains golf course fairway areas, wooded areas, and surface ponds. However, the surface ponds are not adjacent to areas of significant soil contamination and do not warrant further consideration as exposure media. Considering the contaminant concentrations reported during the SI, the only complete exposure pathways depicted in **Figures 4-15 and 4-16** are the surface and subsurface soil pathways. A three-dimensional CSM diagram illustrating how contaminated media at this site may result in exposure to ecological and/or human receptors is presented in **Figure 4-19**.

4.4.4 UXO 4 - Akron Road Pistol Range

Metals contamination has been deposited in surface soil due to accumulations of bullet residue. Contaminants have also leached to subsurface soil and been transported through runoff to drainageway sediment. In addition, it is possible that contaminant migration may have impacted groundwater underlying the site, as well. At the two firing line areas, NG from unburned propellants may have been deposited in the surface soil. Since the firing line areas at UXO 4 do not appear to have been covered by fill or reworked since it was used as a firing range, exposure to NG in these areas are still possible.

This site still contains the backstop and wing berms associated with the former pistol range. Most of the berms and areas south of the berms are wooded, but there are no surface ponds onsite. Therefore, the exposure pathways depicted in **Figures 4-15 and 4-16** are all potentially complete except for the surface water and sediment pathways. A three-dimensional CSM diagram illustrating how contaminated media at this site may result in exposure to ecological and/or human receptors is presented in **Figure 4-20**.

4.4.5 UXO 5 - .30-Caliber Range

Metals contamination has been deposited in surface soil due to accumulations of bullet residue, and has also leached to subsurface soil. Although it is possible that additional contaminant migration may have impacted groundwater underlying the site, the data obtained during the SI did not warrant further consideration of groundwater as a source of unacceptable risk.

This site lies completely within a golf course fairway. There are no wooded areas or surface ponds onsite. Considering the contaminant concentrations reported during the SI, the only complete exposure pathways depicted in **Figures 4-15 and 4-16** are the surface and subsurface soil pathways. A three-dimensional CSM diagram illustrating how contaminated media at this site may result in exposure to ecological and/or human receptors is presented in **Figure 4-21.**

4.4.6 UXO 6 - Trap Ranges

Metals and PAH contamination have been deposited in surface soil due to accumulations of shot gun shell residue (e.g., lead shot) and clay trap fragments. Contaminants have also leached to subsurface soil and been transported through runoff to drainageway sediment. In addition, it is possible that additional contaminant migration may have impacted groundwater underlying the site or surface water and sediment in the onsite pond.

This site contains golf course fairway areas, wooded areas, and surface ponds. Therefore, the full range of exposure pathways depicted in **Figures 4-15 and 4-16** are potentially complete. A three-dimensional CSM diagram illustrating how contaminated media at this site may result in exposure to ecological and/or human receptors is presented in **Figure 4-22**.

5.0 -- Data Quality Objectives/Systematic Planning Process Statements

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

The following text describes the development of DQOs using USEPA's DQO Systematic Planning Process (USEPA, 2006).

5.1 PROBLEM STATEMENT

During the SI, MC (PAH and metals) concentrations that exceed site-specific leachability criteria, risk-based screening criteria, and/or site-specific background concentrations (for metals only) were measured in soil and sediment at UXO Sites 1 to 6 and were, therefore, identified as COPCs. Because COPCs are present at these UXO sites, a RI is required to determine whether these COPCs have migrated from soil and drainageway sediments to surface water, underlying sediment, or groundwater and/or whether they pose an unacceptable risk to human and ecological receptors. The possibility that NG may be an additional COPC in surface soil at the two firing line areas of UXO 4 must also be investigated. As agreed upon in the SI UFP-SAP, groundwater will only be investigated for analytes that exceeded the site-specific leachability criteria for soil during the SI investigation. Additionally, surface water and underlying sediment will only be investigated for analytes that were identified as soil or sediment COPCs during the SI. Once the extent of COPCs within all media has been defined at these sites, a human health and ecological risk assessment must be conducted. If unacceptable risks from exposure to COPCs at any particular site are identified, then remedial alternatives will be developed by the Project Team and presented in an FS Report; otherwise, no further action will be recommended.

5.2 INFORMATION INPUTS

Data that are required to resolve the problem described in **Section 5.1** are as follows:

1. Chemical data: Surface soil, subsurface soil, surface water and underlying sediment, and/or groundwater concentrations of MC are needed to determine the nature and extent of COPC contamination at UXOs 1-6 and to conduct risk assessments at each site. The field sampling program and associated analysis for each sample is presented in **Section 8.5**. The complete list of target analytes in each analytical group is presented in **Section 9.0**.

2. Physical data: Field investigation parameters for surface water and groundwater, including pH, specific conductance, turbidity, temperature, oxidation-reduction potential (ORP), and dissolved oxygen (DO), must be collected in the field to ensure the representativeness of surface water and groundwater samples collected and assist with characterization of the surface ponds and the surficial aquifer, respectively.

3. Groundwater level measurements: Temporary well casing elevations (via land survey) and synoptic groundwater level measurements (via water level meter) are needed to provide information regarding the potentiometric surface (i.e., elevation) of the water table at sampling locations and to determine the direction(s) of groundwater flow. Temporary wells allow for the collection of sufficiently accurate groundwater level measurements to meet this objective. These data also provide a point of reference if continued groundwater investigation is required.

4. Dissolved metals data (provisional): Surface water and groundwater concentrations of dissolved metals are needed to provide additional data at locations where the sample matrix is highly turbid [i.e., turbidity measurements are greater than 10 nephelometric turbidity units (NTUs)]. Total metals data are generally used for risk screening. However, the proximity of the six UXO sites to the St. Johns River might result in turbidity issues that could limit the ability of total metals data to represent actual groundwater conditions. In addition, the use of temporary wells, while sufficient for collecting organic parameter concentration data in groundwater, may not be optimal for metals because of a potential for increased turbidity compared to groundwater collected from permanent wells. The increased turbidity is caused by entrained soil, which contains relatively high concentrations of metals. Nevertheless, the speed and reduced cost associated with installation of temporary wells is considered to be an acceptable compromise. In anticipation of turbidity issues during this investigation, dissolved metals concentrations must be measured, in addition to total metals concentrations, to provide a deeper understanding of the nature of contamination and to support site-specific human health risk calculations. The dissolved metals concentrations may be used by the Partnering Team in a “lines of evidence” approach to estimate the degree of partitioning of metals between aqueous and particulate phases for a variety of reasons, such as:

   - Estimating bioavailability of metals;
   - Qualifying the degree of risk as estimated based on total metal concentrations; and
   - Other uses within the context of an updated CSM that provide a more complete or accurate picture of risks than would be possible using total metals concentrations alone.

5. Sample location data: Sample location horizontal coordinates and vertical depths must be measured for use in mapping each location so that data can be analyzed and presented in a spatial context. Horizontal coordinates may be measured with equal effectiveness using a hand-held global positioning system (GPS) or by land survey techniques. Top of well casings and ground surface elevations must be measured using land survey instruments to obtain elevation data of sufficient accuracy to establish the potentiometric surface and infer groundwater flow directions. Depth intervals are best measured using a tape measure or other device with similar accuracy and precision

(e.g., water level meter). Location coordinates must be documented in the datums identified in **Section 8.2.12**.

6. Background concentrations of metals derived for NAS Jacksonville: Because metals occur naturally in environmental media, the Navy considers naturally occurring constituents in the background concentration range as not representing contamination and will not remediate sites where the background concentrations are greater than the risk based or regulatory criteria. Therefore, site metals concentrations that are greater than the risk based screening criteria but less than applicable background values will not be carried through the risk assessment or identified as COCs. These values are identified as the NAS Jacksonville Basewide Background values, which were derived during the Remedial Investigation/Feasibility Study (RI/FS) for Operable Unit (OU) 1 [ABB Environmental Services (ABB-ES), March 1996].

7. Human health and ecological risk based or regulatory screening criteria: Chemical data must be compared against current USEPA and FDEP surface soil, subsurface soil, sediment, surface water, and groundwater human health and ecological risk-based or regulatory screening criteria to delineate COPCs and conduct the risk assessments at each UXO site. In order to ensure that the laboratory can measure to the lowest human health or ecological criteria that will be used to achieve the RI project objectives, the criteria and associated quantitation limits are presented in **Section 9.0**. Supporting documentation for the selection of screening criteria are provided in **Appendix D**.

   To conduct comparisons of site data to screening criteria, the selected laboratory must be able to achieve Limits of Quantitation (LOQs) that are low enough to measure constituent concentrations less than the criteria. In cases where conventional test methods are not able to achieve LOQs that are lower than the criteria (such as for arsenic), rules for evaluating the data are required that help the Partnering Team determine with reasonable satisfaction whether the constituent poses a potentially unacceptable risk. Analytical data reported by the laboratory must use the following reporting conventions:

   - All concentrations less than Detection Limits (DLs) will be considered non-detects and will be reported as DL values with a "U" qualifier - this reporting convention is generally preferred by FDEP.
   - Concentrations between the DL and LOQ will be reported as estimated values with a “J” qualifier.

   If the associated criterion for a COPC is between the DL and LOQ, the “J” flagged data will be accepted to achieve project goals. The inability to quantifiably compare individual analytes to

screening criteria with confidence must be addressed in the risk evaluation uncertainty analysis in each risk assessment.

8. Project Action Limits (PALs): PALs are necessary to make decisions regarding the appropriate next step in the CERCLA process based on risk to identified receptors from exposure to surface soil, subsurface soil, sediment, surface water, and groundwater data. The selected human health and ecological PALs for this RI are as follows:

   - Human Health Risk: An incremental lifetime cancer risk (ILCR) greater than 1 x 10^{-6} or a non-cancer Hazard Index (HI) greater than 1 (based on common target organs or effects) is considered to be unacceptable and indicative of the need to make risk management decisions.
   - Ecological Risk: A Hazard Quotient (HQ) greater than 1 for any receptor in any medium is considered to be unacceptable.

9. Risk Assessments: Previously collected SI data will be used along with the newly collected RI data to determine the nature and extent of COPCs and to assess risk to human and ecological receptors at UXO Sites 1 to 6. These risk assessments will be conducted in accordance with USEPA protocols and Navy guidance documents for HHRAs and ERAs, as well as with the FDEP risk management processes described in F.A.C. Chapter 62-780 (FDEP, 2007).

5.3 STUDY AREA BOUNDARIES

The RI study area boundaries are based on the evaluation of soil and drainageway sediment data from the SI Report for UXO Sites 1 to 6. Study area boundaries are described below for each environmental medium of interest as it applies to each of the sites being investigated. In general, the investigations must be biased toward areas of each site that have the greatest potential for being contaminated to ensure that contamination has the greatest chance of being detected and delineated. To delineate contamination, however, some data collection must include areas thought not to be contaminated so that the boundary of contamination can be delineated. The following paragraphs address the horizontal, vertical, and temporal boundaries for the RI.

5.3.1 Surface and Subsurface Soil

The populations of interest for soil are the soils that have been contaminated either directly (by site operations) or indirectly (by subsequent migration of contaminants), as documented in the SI Report.

The horizontal study boundary for the RI will encompass each area that, based on the SI Report, was impacted by site activities. Lateral expansion of this horizontal study boundary is necessary where

COPCs were identified. However, lateral expansion by step-outs beyond the edges of the wooded areas into the golf course fairways are not deemed necessary because the fairways are not viable ecological habitats and the contaminants located within the fairways have been covered by clean fill to contour the golf course; therefore, any residual MC (i.e., COPCs) have been made unavailable to human and ecological exposure in those areas under the existing land use. The following sub-areas are areas of interest within each study boundary for the two types of ranges comprising UXO Sites 1 to 6:

- UXO Sites 1, 3, and 6 (Trap/Skeet Ranges): An area downrange of the firing line where clay target fragments and spent lead shot (resulting from targets being hit by shotgun shells) would have accumulated; an area downrange of the target fragments where used/weathered targets not hit by shotgun shells (i.e., missed targets) would have accumulated; an area downrange of the firing line, the target fragments, and the used/weathered target fragments where the greatest concentrations of lead shot would accumulate as a result of shotgun shells missing their intended targets (targets and target fragments are unlikely to be within this area). For purposes of Exposure Unit (EU) definition during the risk assessment, the site may be further divided horizontally if analytical data suggest that "hot spot" zones are present at the site.

- UXO Sites 2, 4, and 5 (Machine Gun/Pistol Ranges): The area where the former backstop berm was located, where the greatest concentrations of expended bullets would have accumulated; the area where the former firing line was located, which may contain discarded bullets; the areas where the two former firing lines were located at UXO Site 4, which may contain NG from unburned propellant; and the range floor immediately in front of the former target embankments, which may contain stray or ricocheted bullets.

The vertical study boundary for soil in the SI was limited to 4 feet bgs. Vertical expansion of this study boundary during the RI is necessary where COPCs were identified in the samples collected along this boundary during the SI.

The surface soil depth of interest is 0 to 6 inches and 6 to 24 inches bgs, as this is the interval most likely to contain contamination, if present. Non-saturated subsurface soil from 4 to 6 feet bgs will be investigated to determine whether any vertical (downward) migration of surface contamination has occurred or whether lateral migration of groundwater contamination has impacted subsurface soil.

Temporal boundaries of MC COPC concentrations are anticipated to be relatively unchanged (stable) over the course of time needed to conduct the environmental investigations and into the foreseeable future; therefore, no temporal constraints exist. Sampling events will need to be coordinated with

installation personnel to coincide with times when the affected portions of the golf course are not in operation.

5.3.2 Surface Water and Collocated Underlying Sediment

The populations of interest for surface water and collocated underlying sediment include surface ponds that may be contaminated due to receipt of shotgun pellets and/or skeet fragments during range operations or due to subsequent migration of nearby surface soil and/or drainageway sediment COPCs, as documented in the SI Report.

Horizontal and vertical boundaries – Surface water and collocated underlying sediment potentially impacted by site operations must be investigated at surface ponds within UXO 1 and UXO 6. The horizontal boundaries of the surface water and collocated underlying sediment are within 6 feet of the shoreline of each pond as they exist at the time of sample collection. The sediment depth of interest at each site is 0 to 6 inches below the sediment surface, as this is the sediment interval that relates to ecological exposure. Surface water in locations collocated with the sediment population of interest will be investigated at a depth of 6 to 12 inches below the water surface.

Temporal boundaries – Surface water and sediment COPC concentrations are not expected to change significantly during the course of this investigation; therefore, no temporal constraints exist.

5.3.3 Groundwater

The groundwater of interest for this investigation is the top 5 feet of the surficial aquifer at each site where the SI Report concluded that migration of soil leachability COPCs may impact groundwater. Although not currently used for drinking water production, this shallow formation contains the groundwater most likely to have been impacted by migration from soil contaminants deposited during range operations. In general, groundwater samples must be collected from the surficial aquifer at the locations of greatest COPC (i.e., lead or other metals) concentrations in the soil and sediment based on SI results (Tetra Tech, 2010) to ensure that the data generated represent worst-case site conditions.

Horizontal and vertical boundaries - The groundwater population that is representative of any impacted groundwater will be investigated at UXO 1, UXO 2, UXO 4, and UXO 6. The horizontal boundaries of the groundwater investigation coincide with the locations where leachability COPCs at UXO 1, UXO 2, UXO 4, and UXO 6, were identified, as shown on **Figure 4-3, Figure 4-4, Figure 4-6,** and **Figure 4-8,** respectively. The water table is anticipated to be encountered at approximately 3 to 7 feet bgs at UXO Sites 1 to 6. Water level measurements are required at a minimum of three locations to establish

groundwater flow directions. Due to the proximity of the sites, all of the water level measurements collected during the RI can be evaluated together for this purpose.

Temporal boundaries – Groundwater COPC concentrations are not expected to change significantly during the course of this investigation; therefore, no temporal constraints exist.

5.4 ANALYTIC APPROACH

The analytic approach described below explains how the Partnering Team will use the chemical data for decision making at UXO Sites 1 to 6.

COPC Delineation

The decision rules presented in the SI SAP were used to develop the sampling plan presented in this RI SAP. Those rules stated that sampling and analysis would be conducted to define the nature and extent of COPCs in soil at each site, as well as in groundwater at sites where leachability data indicated the potential for COPCs to migrate to groundwater at unacceptable concentrations. Additionally, surface water and collocated underlying sediment need to be analyzed at surface ponds that receive runoff from areas represented by soil and drainageway sample locations where soil COPCs indicate a potential for migration into surface water at unacceptable concentrations.

If the Partnering Team determines, based on a combination of the SI and RI data, that the presence of COPCs has been adequately delineated in all environmental media of concern at each site, then proceed with completing the human health and ecological risk assessments; otherwise, convene the Partnering Team to decide whether additional data collection is warranted to characterize the nature and extent of soil, sediment, and/or groundwater COPCs and address any data gaps. At a minimum, this evaluation must consider the following factors relative to the existing CSM in each environmental medium:

- Frequency of detection for each constituent
- Frequency and magnitude of screening criteria exceedance for each constituent
- Background concentrations of metals that exceed screening criteria
- Magnitude of concentrations within, and on the perimeter of, the investigated areas
- Identities of COPCs and their estimated contributions to unacceptable levels of risk

Note: The tendency to collect more data will increase as spatial concentration patterns indicate that a potentially unacceptable risk exists outside the investigated areas, that the levels or distribution of contaminants are not known to a satisfactory degree of confidence, or that the data indicate that the CSM is in significant error.

Human Health Risk Assessment

A human health risk assessment will be conducted in accordance with EPA and FDEP (i.e., F.A.C. Chapter 62.780) regulatory requirements, based on the COPCs identified for each site. The following decision rules will apply:

Step 1 (all media):

- All media: If hazard quotients or hazard indices are less than 1 and ILCRs are less than 1 x 10-6, then recommend no further investigation and no further action for that site. Otherwise, proceed to Step 2.

Step 2 (Applicable Separately to Each Environmental Medium):

- Soil: If risks are unacceptable from soil [i.e., hazard quotients or hazard indices are greater than 1, and/or incremental lifetime cancer risks (ILCRs) are greater than 1 x 10-6], then the Partnering Team will make risk management decisions for the site on a case-by-case basis. The decision process may include proceeding to an FS to evaluate remedial alternatives for soil at the site.

- Sediment: If risks are unacceptable from sediment [i.e., hazard quotients or hazard indices are greater than 1, and/or ILCRs are greater than 1 x 10-6], then the Partnering Team will make risk management decisions for the site on a case-by-case basis. The decision process may include proceeding to an FS to evaluate remedial alternatives for sediment at the site.

- Groundwater: If target analyte concentrations in groundwater are greater than the MCL or present a human health risk (i.e., hazard quotients or hazard indices are greater than 1, and/or ILCRs are greater than 1 x 10-6), then the Partnering Team will make risk management decisions for the site on a case-by-case basis. The decision process may include proceeding to an FS to evaluate remedial alternatives for groundwater at the site.

Ecological Risk Assessment

The goal of the ERA is to determine whether adverse ecological impacts are present as a result of exposure to chemicals released to the environment through historical activities. The ERA will be conducted in accordance with guidance presented in the following documents:

- Final Guidelines for Ecological Risk Assessment (USEPA, 1998).
- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (USEPA, 1997).
- Navy Policy for Conducting Ecological Risk Assessments (Navy, 1999).

The ERA will consist of Steps 1, 2, and 3a of the eight step ERA process. The first two steps comprise the screening-level ecological risk assessment (SLERA), where conservative exposure estimates are compared to screening-level and threshold toxicity values. Step 3a is the first step of a baseline ecological risk assessment (BERA) and consists of refining the conservative assumptions (e.g., number of exceedances of screening criteria, magnitude of the exceedances of screening criteria, spatial distribution of data, home range, background concentrations, alternate benchmarks, etc.), following Steps 1 and 2 to further focus the ERA process on the chemicals of greatest concern at a site. The remaining steps of the ERA process beyond Step 3a would require a decision by the Partnering Team to develop an addendum to the RI SAP or a separate SAP prior to initiation and, therefore, are not included in this ERA methodology.

Ecological receptor EUs will be defined in the ERA based on the combined data from the SI and the RI. If, after completing an ERA through Step 3a, risks are determined to be acceptable, then no further investigation or action is needed to protect ecological receptors. Otherwise, continue the ERA process past Step 3a.

5.5 PERFORMANCE OR ACCEPTANCE CRITERIA

Surface and subsurface soil, sediment, surface water, and groundwater RI sample locations were selected to define the nature and extent of COPCs in areas most likely to be contaminated, based on the SI results, as well as in presumably clean areas outside the impacted areas. The data will be used to verify the boundaries of contamination and to support the HHRA and ERA.

The biased selection of sample locations does not support the use of quantitative statistics to estimate decision performance as specified in the DQO guidance (USEPA, 2006). Instead, the Partnering Team will use the results of this investigation to determine whether the quality of data collected is sufficient to support the attainment of project objectives and to decide whether further investigation is required. Performance criteria for laboratory-generated data are normal laboratory quality assurance (QA) limits and pre-established detection limits for target analytes, as listed in **Section 9.0**. The data quality will be reviewed to ensure that performance criteria have been met and that the data are sufficient for decision-making purposes.

The only performance criterion applicable to this project is a need to collect all planned data with no significant quality deficiencies. If this is achieved, the data collected will be considered sufficient to support the planned remediation. To evaluate data quality, the processes and criteria described in **Section 12.0** will be used. Data quality deficiencies must be brought to the attention of all Partnering Team members for their consideration as to how the deficiencies effect attainment of project objectives (see also **Section 5.4**).

The data set generated by the laboratory will be reviewed to ensure that the intended samples were collected and that usable data was reported for all samples submitted. If all data are collected as planned and no data points are missing or rejected for quality reasons, then the investigation completeness will be considered satisfactory. If any data gaps are identified, including missing or rejected data, the Partnering Team will assess whether a claim of having obtained project objectives is reasonable based on the quantity and types of data gaps. All Partnering Team members will be involved in rendering the final conclusion by consensus regarding adequacy of the data.

5.6 SAMPLING DESIGN AND RATIONALE

The plans for obtaining data along with the sampling designs and rationales are described in detail in **Sections 7.0** and **8.5**.

6.0 -- Field Quality Control Samples

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

Quality Control (QC) Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria (MPCs)	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Equipment Rinsate Blank	All analytical groups	One per 20 samples per matrix per sampling equipment(1)	Bias/ Contamination	No analytes ≥ ½ LOQ, except common laboratory contaminants, which must be < LOQ.	S & A
Filtered Rinsate Blank	Dissolved metals (if necessary due to high turbidity)	One per filter brand(2)	Bias/ Contamination	No analytes ≥ ½ LOQ, except common laboratory contaminants, which must be < LOQ.	S & A
Field Duplicate	All analytical groups	One per 10 field samples	Precision	Values > 5X LOQ: Relative Percent Difference (RPD) must be ≤30 (aqueous) (3)(4); ≤50 (solids)(3)(4).	S & A
Cooler Temperature Indicator	All analytical groups	One per cooler	Representativeness	Temperature must be above freezing and less than or equal to 6 degrees Celsius (°C).	S

Notes:

1 Equipment rinsate blanks will be collected if non-dedicated submersible pumps or other equipment are used.
2 A filtered rinsate blank will be collected if filtered samples (e.g., dissolved metals) are collected.
3 If duplicate values for non-metals are less than five times the LOQ, the absolute difference should be less than or equal to two times the LOQ.
4 If duplicate values for metals are less than five times the LOQ, the absolute difference should be less than or equal to four times the LOQ.

7.0 -- Sampling Design and Rationale

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

The sampling strategy for UXO Sites 1 to 6 is designed to: fill the data gaps identified in the SI Report to define the nature and extent of COPCs in the surface and subsurface soil; provide surface water, collocated underlying sediment, and groundwater data to determine whether potentially unacceptable levels of COPCs have migrated from the soil to other media; provide surface soil data to determine whether potentially unacceptable concentrations of NG are present at the two firing lines at UXO 4; and provide data necessary to complete the HHRA and ERA. As described in the SI Report, there are locations where the existing analytical data is not sufficient to define the extent of COPCs or support a risk assessment. This RI SAP describes the supplemental sampling and analysis necessary to address these data gaps.

Metals (primarily lead) and specific PAH COPCs were identified in soil and drainageway sediment at concentrations exceeding their respective human health and/or ecological PALs. Based on review by the Tetra Tech Risk Assessor, additional data are needed to complete the risk assessment and better delineate the extent of contamination at each site. This worksheet presents the design and rationale of the sampling and analysis program to be conducted under this RI. Sampling locations planned for each site are illustrated on **Figures 7-1 through 7-6**, and a table listing all planned sampling locations is provided in **Section 8.5.**

MC target analytes that are present in soil at the six UXO sites at concentrations exceeding soil PALs (and site-specific background levels for metals) were identified in the SI Report as COPCs. These contaminants have the highest potential to impact groundwater and include the following:

- PAHs: Multiple PAHs associated with clay targets were documented at elevated levels in soil within certain areas near the firing points of the three skeet/trap ranges (UXO Sites 1, 3, and 6), which is consistent with their operational histories.

- Metals: Metals associated with expended munitions were documented at elevated levels in soil within certain areas of all six UXO sites, predominantly in the target areas, which is consistent with their operational histories. Lead is typically the most significant metals contaminant because it is present in the greatest concentrations and poses the greatest risk to receptors. However, other metals that are target analytes in this investigation, based on levels detected in soil at various locations, include antimony, arsenic, and copper. (Note: At many locations, arsenic and/or antimony results were determined to be consistent with background levels and, thus, PAL exceedances are not of concern.)

In addition to the MC target analytes that were identified in the SI Report as COPCs, NG is an MC target analyte that may also be present at concentrations above screening levels near the two firing lines of UXO 4.

The proposed biased sampling approach is based on assumptions regarding potential contaminant distribution, knowledge of historical site activities, the CSMs (including expected groundwater flow directions), and previous soil sampling investigation results. The sample locations were selected to provide sufficient data to bound the contamination present in site soils and determine whether contaminants have migrated to the underlying surficial groundwater, nearby surface ponds, or submerged sediment in the surface ponds.

Samples collected during the RI will be submitted to Chemtech and Empirical for chemical analyses. The analytical methods and laboratory SOPs used by Chemtech and Empirical are identified in **Section 10.0**. The total numbers of sample analyses to be performed for each target analyte or analytical group are identified in **Sections 8.5** and **8.7**. **Section 8.6** presents a summary of the sample analyses, container types and volumes, preservation requirements, and holding times for the samples to be collected. All groundwater samples collected for metals analysis will be analyzed for total metals. If the groundwater at a particular location is turbid (i.e., turbidity greater than 10 NTUs), then the groundwater will be filtered in the field and a sample will be collected for the analysis of dissolved metals.

Field QC samples will be collected as part of the investigation, including field duplicates and equipment rinsate blanks. **Section 6.0** presents the field QC sample summary. Also, additional sample volume will be collected as necessary for laboratory QC analysis of matrix spike (MS) and matrix spike duplicate (MSD) samples (low-level PAHs and NG) or MS and matrix duplicate (MD) samples (total, and if required, dissolved metals).

Sample locations will be marked in the field using a wooden stake or brightly colored pin flag. Coordinates of each sample location will be determined by GPS, which will allow for future reacquisition of the locations if further investigation or remedial action is necessary. All sample location markers will be removed prior to final demobilization.

7.1 FIELD SAMPLING PROGRAM FOR UXO 1

Soil sample locations have been placed at UXO 1 based on the results of the SI to delineate the horizontal extent of lead, other select metals (antimony, arsenic, copper, and zinc), and PAH contamination. The focus of this sampling event is to bound contamination to the wooded areas, if possible, as well as to collect data from surface water and sediment in the 3 ponds located within the site boundary. A total of 50 soil samples will be collected from 37 locations at UXO 1. Surface soil samples

will be collected at 34 locations from 0 to 6 inches bgs, and at 13 locations from 6 to 24 inches bgs. Subsurface soil samples will be collected at two locations from 2 to 4 feet bgs. Eight collocated surface water and sediment samples will be collected from the three ponds. In addition, three temporary groundwater wells will be installed at locations where SPLP analyses and SCTL comparisons showed a potential for soil contamination to leach to groundwater, and one temporary groundwater well will be installed in the vicinity of the skeet debris layer. Groundwater samples collected from the first three wells will be shipped to the fixed base laboratory for antimony, arsenic, and lead analysis, and a sample from the fourth well will be shipped to the laboratory for low-level PAH analysis. Field measurements of the following groundwater monitoring parameters will be recorded: water level, temperature, pH, specific conductance, ORP, DO, and turbidity.

To delineate the skeet debris layer observed during the SI in the south-central portion of the site, a visual inspection and shovel-aided investigation of the area will be conducted. Working outward from the known locations of debris (e.g., SI sample locations JAX-22-SBSS001 through JAX-22-SBSS006), surface material will be removed manually at discrete locations (to be determined by field personnel), as necessary, to define the boundaries of the debris. The horizontal extent of the debris will be marked using handheld GPS units, and the depth of the debris will be measured using a shovel and ruler or measuring tape. It is estimated that approximately 20 to 30 discrete locations will need to be investigated to sufficiently define the horizontal and vertical boundaries of the debris layer. The FOL will ensure that the groundwater and collocated soil samples intended to monitor the impacts of this debris layer are installed at an appropriate location.

Figure 7-1 depicts the layout of UXO 1 along with the planned sampling locations. These locations may be adjusted, if necessary, based on actual field conditions at the time of sampling. **Section 8.5** provides a detailed description of each sample, including its identification number, location description, sample depth, relevant SOPs, and applicable laboratory and field analyses. Soil samples, sediment samples, surface water samples, and groundwater samples will be collected in accordance with FDEP SOPs FS 3000, FS 4000, FS 2100, and FS 2220, respectively.

7.2 FIELD SAMPLING PROGRAM FOR UXO 2

Soil sample locations have been placed at UXO 2 based on the results of the SI to delineate the horizontal extent of lead and copper contamination. The focus of this sampling event is to isolate the previous sampling locations where lead and copper exceeded human health screening criteria. A total of 14 soil samples will be collected from 9 locations at UXO 2. Four samples at locations X2SB001 through X2SB004 will be collected from 4 to 5 feet bgs and shipped to the fixed-base laboratory for lead analysis. Ten samples at locations X2SB005 through X2SB009 will be collected from 3 to 4 feet bgs and 4 to 5 feet bgs and shipped to the fixed-base laboratory for lead and copper analysis. In addition, one temporary

groundwater well will be installed due to SPLP analyses and/or SCTL comparisons showing a potential for lead and antimony contamination in soil to leach to groundwater. The groundwater sample will be shipped to the fixed base laboratory for lead and antimony analysis. Field measurements of the following groundwater monitoring parameters will be recorded: water level, temperature, pH, specific conductance, ORP, DO, and turbidity.

Figure 7-2 depicts the layout of UXO 2 along with the planned sampling locations. These locations may be adjusted, if necessary, based on actual field conditions at the time of sampling. **Section 8.5** provides a detailed description of each sample, including its identification number, location description, sample depth, relevant SOPs, and applicable laboratory and field analyses. Soil and groundwater samples will be collected in accordance with FDEP SOPs FS 3000 and FS 2220, respectively.

7.3 FIELD SAMPLING PROGRAM FOR UXO 3

Soil sample locations have been placed at UXO 3 based on the results of the SI to delineate the horizontal extent of lead, arsenic, and PAH contamination. The focus of this sampling event is to bound contamination to the wooded areas, if possible. A total of 15 soil samples will be collected from 15 locations at UXO 3. All samples will be surface soil samples collected from 0 to 6 inches bgs. Seven of the samples will be analyzed for PAHs, eight will be analyzed for lead, and five of the lead samples will also be analyzed for arsenic.

Figure 7-3 depicts the layout of UXO 3 along with the planned sample locations. These locations may be adjusted, if necessary, based on actual field conditions at the time of sampling. **Section 8.5** provides a detailed description of each sample, including its identification number, location description, sample depth, relevant SOPs, and applicable laboratory and field analyses. Soil samples will be collected in accordance with FDEP SOPs FS 3000.

7.4 FIELD SAMPLING PROGRAM FOR UXO 4

Soil sample locations have been placed at UXO 4 based on the results of the SI to delineate the horizontal and vertical extent of lead and other select metals contamination. Lead is the primary contaminant that exceeded both ecological and human health screening criteria during the SI. Ecological screening criteria were exceeded at 68 of the 69 sample locations. As a result, 15 soil sample locations have been placed around the boundary of UXO 4 for horizontal delineation. In addition to these perimeter sample locations, 5 previous sample locations SB040 (now X4SB016), SB042 (now X4SB017), SB044 (now X4SB018), SB045 (now X4SB019), and SB046 (now X4SB020) will be sampled at a greater depth interval (4 to 6 feet bgs) to delineate the vertical extent of lead contamination.

A total of 35 soil samples are proposed at 20 locations at UXO 4 for metals. Thirty of those will be collected as surface soil samples (15 from 0 to 6 inches bgs, and 15 from 6 to 24 inches bgs). The laboratory will analyze the 15 samples collected from 0 to 6 inches bgs and, if there are any metals exceedances in those samples, they will analyze the deeper sample collected from 6 to 24 inches bgs at the corresponding location. All samples will be analyzed for lead and one or more of the other select metals (antimony, arsenic, copper, and zinc), as indicated for each location. In addition, one temporary groundwater well will be installed on the range floor in front of the center section of the target berm, where SPLP analyses and SCTL comparisons showed a potential for soil contamination to leach to groundwater. The groundwater sample from this well will be analyzed for lead. Field measurements of the following groundwater monitoring parameters will be recorded: water level, temperature, pH, specific conductance, ORP, DO, and turbidity.

Additionally, two soil sample locations have been placed at UXO 4 to investigate the potential presence of elevated levels of NG at the two firing line areas. At each firing line, ten surface soil sample aliquots (from 0 to 6 inches bgs) will be collected and combined to form a 10-point composite sample to represent that firing line. The two 10-point composite samples (one for the 25-yard firing line and one for the 50-yard firing line) will be submitted to the laboratory for analysis of NG.

Figure 7-4 depicts the layout of UXO 4 along with the planned sample locations. These locations may be adjusted, if necessary, based on actual field conditions at the time of sampling. **Section 8.5** provides a detailed description of each sample, including its identification number, location description, sample depth, relevant SOPs, and applicable laboratory and field analyses. Soil and groundwater samples will be collected in accordance with FDEP SOPs FS 3000 and FS 2220, respectively.

7.5 FIELD SAMPLING PROGRAM FOR UXO 5

No additional data collection is necessary at UXO 5 because the data collected during the SI were sufficient to define the nature and extent of COPCs in surface and subsurface soil at this site. In addition, there are no surface water features within the site boundaries. The evaluation of SPLP data and comparisons of soil data to alternative SCTLs indicate that there is not a strong potential for soil contaminants to leach to the underlying groundwater. Therefore, no surface water, sediment, or groundwater sampling is necessary. Instead, soil sample data collected during the SI will be used to complete the risk screening evaluation and, if necessary, the HHRA and ERA for presentation in the RI Report.

7.6 FIELD SAMPLING PROGRAM FOR UXO 6

Soil sample locations have been placed at UXO 6 based on the results of the SI to delineate the horizontal extent of select metals (primarily lead) contamination. PAH contamination in the northern part of the range was previously delineated through sampling to support the construction of the wastewater reuse holding pond (see **Section 4.3.3**). The focus of the RI sampling is to delineate the horizontal extent of lead, antimony, and arsenic contamination, as well as to collect data from surface water and sediment in the pond located in the southeastern corner of the range. A total of 11 soil samples will be collected from UXO 6. Ten surface soil samples will be collected from a depth of 0 to 6 inches bgs. One subsurface soil sample will be collected from a location sampled during the SI (SB028), now X6SB001, which exhibited high concentrations of lead, antimony, and arsenic. This soil sample will be collected from 4 to 6 feet bgs. In addition, three collocated surface water and sediment samples will be collected from the southern pond, and a temporary groundwater well will be installed where SPLP analyses and SCTL comparisons showed a potential for soil contamination to leach to groundwater. The groundwater sample will be analyzed for lead, antimony, and arsenic. Field measurements of the following groundwater monitoring parameters will be recorded: water level, temperature, pH, specific conductance, ORP, DO, and turbidity.

Figure 7-5 depicts the layout of UXO 6 along with the planned sample locations. These locations may be adjusted, if necessary, based on actual field conditions at the time of sampling. **Section 8.5** provides a detailed description of each sample, including its identification number, location description, sample depth, relevant SOPs, and applicable laboratory and field analyses. Soil samples, sediment samples, surface water samples, and groundwater samples will be collected in accordance with FDEP SOPs FS 3000, FS 4000, FS 2100, and FS 2220, respectively.

7.7 GROUNDWATER SAMPLING PROGRAM

Figure 7-6 summarizes all temporary well locations planned for this RI, relative to their respective MRP site boundaries. To obtain representative groundwater elevation data for use in evaluating flow direction in the vicinity of the Machine Gun Range Complex, all wells will be installed, developed, and allowed to stabilize prior measuring depth to water or collecting groundwater samples. Synoptic groundwater level measurements will be recorded in all six wells at least 24 hours following the development of the last well installed to minimize the temporal variability in groundwater levels so that the potentiometric surface can be evaluated holistically.

8.0 -- Field Project Implementation (Field Project Instructions)

(UFP-QAPP Manual Section 5.2.3 – Worksheets #14, 18, 19, 20, 21, and 30)

8.1 PROJECT AND FIELD OBJECTIVES

The objective of the field work is to obtain the soil, collocated surface water and underlying sediment, and groundwater data that are needed to meet the project objectives. Soil and surface sediment data will be used to determine the nature and extent of COPCs that are present at UXO Sites 1 to 6 as a result of historical operations. The surface water, collocated underlying sediment, and groundwater data will be used to determine whether there has been any significant migration of COPCs into these secondary media. An HHRA and/or an ERA will be conducted at each site where risk screening results determine that there is a potential unacceptable risk for human or ecological receptors from a particular medium at a particular site. Project objectives are described in more detail in **Section 5.1**.

8.2 FIELD PROJECT TASKS

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

Project-specific SOPs and Field Forms for field tasks referenced in this worksheet are identified by title in **Section 8.4** and copies of each SOP are provided in **Appendix E**. The RI field tasks are as follows:

- Mobilization/Demobilization
- Utility Clearance
- Site-Specific Health and Safety Training
- Sample Collection and Sample Handling Tasks
- Monitoring Equipment Calibration
- Surface and Subsurface Soil Sampling
- Surface Water and Sediment Sampling
- Well Borings and Lithologic Soil Sampling
- Temporary Well Installation and Development
- Groundwater Level Measurements
- Temporary Well Groundwater Sampling
- GPS Locating
- Land Surveying
- Investigation-Derived Waste (IDW) Management
- Field Decontamination Procedures
- Field Documentation Procedures
- Quality Control Tasks

8.2.1 Mobilization/Demobilization

Mobilization will consist of the delivery of all equipment, materials, and supplies to the site, complete assembly (in satisfactory working order) of all such equipment at the site, and secure storage at the site of all such materials and supplies, along with the acquisition of personnel and vehicle base access badges. The Tetra Tech FOL or designee will coordinate with the NAS Jacksonville POC to identify appropriate locations for the temporary storage of equipment and supplies. Site-specific health and safety training for all Tetra Tech field personnel and subcontractors will be conducted as part of site mobilization.

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

8.2.2 Utility Clearance

One week prior to the commencement of any intrusive activities, Tetra Tech will coordinate utility clearance with the NAS Jacksonville POC and with Sunshine State One Call. The NAS Jacksonville personnel and Utility Companies subscribed to Sunshine State One Call will identify and mark-out utilities that may be present near the soil boring locations. The Tetra Tech FOL will coordinate with the Public Works Department (PWD) and Golf Course Superintendent at NAS Jacksonville to document the utility clearance process and obtain approval for conducting intrusive activities.

Utilities that are identified in the field, but not shown or incorrectly located on the work approval documentation, will be marked directly on the document and returned to the NAS Jacksonville POC for inclusion in the Geographic Information System (GIS) database.

8.2.3 Site-Specific Health and Safety Training

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

8.2.4 Sample Collection and Sample Handling Tasks

The sampling and analysis program is outlined in **Section 7.0** and **8.5**. Sample collection and handling will be in accordance with the SOPs listed in **Section 8.4**. Sample labeling will be in accordance with **Tetra Tech SOP-01**, and the sample numbering scheme will be in accordance with **Tetra Tech SOP-02** and as described in **Section 8.5**. Methods for sample handling will be in accordance with **Tetra Tech SOP-03**. Sample containers will be provided in "certified-clean" condition (I-Chem 300 or equivalent) from the analytical laboratory. The selection of sample containers, sample preservation, packaging, and shipping will be in accordance with **Tetra Tech SOP-04** and **Section 8.6**. Field and laboratory QC samples will be collected as outlined in **Section 8.7**.

8.2.5 Monitoring Equipment Calibration

Field equipment will be calibrated in accordance with FDEP SOP FT 1000 and associated field testing FDEP SOPs and with manufacturer's guidance by the Tetra Tech FOL or designee. Documentation of the field equipment calibration is required. Field equipment should be calibrated at the beginning and end of each day, unless otherwise stated by the equipment manufacturer.

8.2.6 Surface and Subsurface Soil Sampling

Surface soil samples will be collected by trowel, and subsurface soil samples will be collected by hand auger or corer in accordance with FDEP SOP FS 3000. All soil samples will be collected as discrete grab samples, except the surface soil samples that will be collected for NG analysis from the two firing lines at UXO 4. Each NG sample will be collected from 10 discrete locations within the designated firing line and combined to form one composite sample to represent that firing line. The soil borings will be described by the field personnel in accordance with **Tetra Tech SOP-05**. Any visual signs of potential contamination (such as the presence of bullet or skeet fragments or soil staining) will be noted on the soil boring log.

The areas to be sampled will be cleared of any surface debris (i.e., leaves, twigs). A properly decontaminated stainless steel trowel will be used to remove the surface soil sample material from 0 to 6 inches bgs and transfer it to the appropriate sample container.

Soil samples from below 6 inches bgs will be collected using a hand auger in accordance with FDEP SOP FS 3000. The area to be sampled will be cleared of any surface debris (i.e., leaves, twigs). The hand auger system consists of a stainless steel bucket bit (i.e., cylinder 6.5-inches long and 2.75-inches in diameter), a 3- or 4-foot extension rod, and a cross handle. A properly decontaminated bucket bit is attached to a clean extension rod, and then onto the cross handle. The hand auger is turned into the ground and the sample material is removed and placed onto clean aluminum foil until reaching the final

desired depth. Larger debris items such as twigs, roots, or stones are removed from the sample prior to transfer to the appropriate sample container.

The sample ID, date, and time will be marked on the container with an indelible marker. Required information will be entered on the Soil Sample Log Sheet and the Chain-of-Custody Form. Excess soil core material will be returned to the hole, and the hand auger assembly will be decontaminated between discrete sample locations in accordance with FDEP SOP FC 1000.

8.2.7 Surface Water and Sediment Sampling

The surface water sampling procedures discussed in FDEP SOP FS 2100 and the sediment sampling procedures discussed in FDEP SOP 4000 will be followed for the collection of surface water and underlying sediment samples in ponds that may have been impacted by historical operations.

FDEP SOP FS 2100 establishes the procedure for standard grab surface water sampling in ponds. Surface grab samples will be collected from the top 12 inches of the water column above the sediment most likely to be impacted by inflow of surface runoff or drainage.

FDEP SOP FS 4000 establishes the procedure for sediment sampling in streams, ponds, and other waterways. Vegetative matter or debris, if present, will be avoided when selecting precise sample locations. Sample material will be collected from the top 6 inches of sediment using a clean petite Ponar dredge sampler. Material will be transferred directly to an appropriate sample container that has been marked with the sample ID, date, and time. Required information will be entered on the Sediment Sample Log Sheet and the Chain-of-Custody Form.

8.2.8 Well Borings and Lithologic Soil Sampling

Soil samples will be obtained for lithologic logging purposes from the well borings using a combination of hand auger and direct-push technology (DPT) dual-tube methods. The proposed well boring locations are presented on **Figures 7-1, 7-2, 7-4, 7-5, and 7-6**. The top 5 feet of soil at each boring location will be removed using a hand auger to avoid any potential utility interference. The remainder of the soil core (i.e., below 5 feet bgs) will be collected continuously at each location by advancing a macrocore sampler (in 4- to 5-foot long segments) mounted on an all-terrain vehicle (ATV) to the target depth (i.e., approximately 8 feet below the top of the first water-bearing zone encountered). The macrocore sampler will be withdrawn, and the soils will be described in accordance with **Tetra Tech SOP-05**. When lithologic logging is completed, each boring will be converted into a temporary well to facilitate the collection of groundwater samples for chemical analyses.

8.2.9 Temporary Well Installation and Development

Temporary wells will be installed across the first (i.e., shallowest) water-bearing zone encountered. The wells are located to provide data that can be used to determine whether contaminants are migrating from the ground surface to underlying groundwater. Proposed locations are shown on **Figures 7-1, 7-2, 7-4, 7-5, and 7-6**. The temporary wells will be installed using DPT dual-tube drilling methods, and constructed with nominal 1-inch inside diameter polyvinyl chloride (PVC) pre-packed screens. The wells will be abandoned in accordance with **Tetra Tech SOP-06** within 3 days of sample collection. Each of the temporary wells will be developed in accordance with **Tetra Tech SOP-07** and FDEP SOP FS 2200. If there is any conflict between these two SOPs, the FDEP method will be followed.

8.2.10 Groundwater Level Measurements

Prior to the start of sampling, the depth to the static water level will be measured in all wells using an electronic water level meter in accordance with **Tetra Tech SOP-08**. The depth will be measured in units of feet (to the nearest 0.01 foot) with respect to the top of the PVC well riser. The stick-up length of the PVC well riser will be measured from the ground surface to the reference measuring point to determine the depth-to-water below the ground surface. Water levels will be recorded on a Tetra Tech water level measurement form. The water level meter will be decontaminated prior to use and between each monitoring well.

8.2.11 Groundwater Sampling

All temporary wells will be purged prior to sampling using low-flow sampling techniques in accordance with FDEP SOP FS 2212. Groundwater samples will be collected in accordance with FDEP SOP FS 2220.

Section 7.0 and **8.5** specify the sample locations and target analytes for this investigation, and **Section 10.0** specifies the analytical methods to be used. After collection, the samples will be placed in a cooler, chilled with ice, and shipped under chain-of-custody protocol to Chemtech for analysis.

8.2.12 Global Positioning System Locating

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 in accordance with **Tetra Tech SOP-09**. The GPS coordinate system will be set up so that horizontal coordinates are collected and documented in the field using the Florida State Plane Coordinate System (SPCS) North Sheet, North American Datum of 1983 (NAD83) in United States U.S. survey feet for easting and northing. Vertical coordinates must be documented by land

surveying (see below) referenced to msl, North American Vertical Datum, 1988 Adjustment (NAVD88) to map the ground surface and groundwater elevations to the accuracy required to properly determine groundwater flow direction.

The GPS survey will utilize third order monument data, if available. Select monuments or markers (such as surveyed permanent monitoring wells) will be visited at the start and end of each day. Prior to the start of fieldwork, Tetra Tech will load site boundaries, known cultural or terrain features that may affect surveys, and background maps into the GPS unit. In addition, coordinates of the planned sampling locations will be loaded into the unit so that the field team can reacquire and mark each location in the field. Field personnel will have the flexibility to adjust sampling locations up to 10 feet in any direction, as necessary, to avoid physical obstructions or safety hazards (e.g., pavement, utility lines, sprinkler heads, etc.) or otherwise ensure proper placement of samples. If the Tetra Tech FOL determines that moving a sampling location more than 10 feet is appropriate, he will contact the Tetra Tech PM, who will engage the NAVFAC RPM and other Partnering Team members, as necessary, at the discretion of the RPM.

Following sample collection, each location will be resurveyed using GPS to obtain the coordinates of the actual soil, sediment, and groundwater sampling locations. GPS data collected during the survey will be stored in the GPS unit and downloaded to a computer daily or as soon as possible after acquisition. Data will also be manually entered into a field log as it is collected. Once downloaded from the GPS unit, the data will then be uploaded for processing by Tetra Tech GIS personnel. Certain spatial data acquired during the RI fieldwork will be uploaded as well, to ensure that significant site features are appropriately documented in the NAS Jacksonville spatial database files.

To ensure sub-meter accuracy, the GPS SOP requires a minimum of six satellites to capture a position.
If GPS accuracy is not sub-meter, data will not be collected until more satellites become available and the accuracy criteria specified in **Tetra Tech SOP-09** are met. In locations where the overhead canopy interferes with satellite lines-of-sight and GPS accuracy cannot be reasonably established, an alternative positioning technique will be employed (e.g., compass and tape measure, fiducials, or total station) to ensure that anomaly locations can be reacquired at a later date, if necessary.

8.2.13 Land Surveying

After the temporary wells are installed, well locations will be surveyed by Tetra Tech personnel or by a professional surveyor licensed in the State of Florida. The Tetra Tech FOL or designee will provide the surveyor with the coordinate designation nomenclature, and all coordinate systems will be pre-approved prior to commencement of the survey. All measurements will be reported and recorded in U.S. Survey Feet. The surveyor will establish the horizontal location and vertical elevation for each temporary well. One horizontal measurement and two vertical measurements will be required per well. The two vertical

measurements are: (1) the top of the PVC riser pipe (herein referred to as "top of casing [TOC]"), and (2) the top of ground adjacent to the pipe. All of the vertical measurements should be taken from marked positions on each temporary well or, if missing a mark, on the north side of the riser pipe.

The surveyor will find and use existing survey control. It is anticipated that adequate control is located within one mile of the site. Horizontal locations will be referenced to the Florida SPCS North Sheet, NAD 83. As appropriate, the control will be referenced to the appropriate SPCS Zone and/or other State Adjustments. Elevations shall be referenced to Mean Sea Level, NAVD 88. All survey data will be determined to the nearest 0.03 meter horizontally (equivalent of 0.1 foot) and the nearest 0.003 meter vertically (equivalent of 0.01 foot).

The surveyor will record all fieldwork in a clear, legible, and complete manner. The field record will contain a complete description of the nature and location of the new and existing points. The record will also include a sketch of the point locations and the benchmark witness points for both Project Control and Local Control.

Tetra Tech will use the survey data, along with groundwater level measurements to determine the direction of groundwater flow. A potentiometric surface map will be included in the RI Report.

8.2.14 Investigation-Derived Waste Management

Solid or semi-solid IDW in the form of soil will be generated during field activities such as the installation of temporary wells and/or collection of subsurface soil samples using DPT. To the extent possible, soil removed during sampling activities but not included in the sample volume shipped to the laboratory for analysis will be replaced into the boring from which it was removed.

Liquid IDW generated during sampling, including decontamination fluids, will be handled in accordance with **Tetra Tech SOP-10**. Waste water will be generated during DPT grab groundwater sampling, temporary well development, well purging and sampling, and decontamination procedures. All aqueous IDW will be containerized in drums provided by the NAS Jacksonville PWD Part B facility. The facility will pick up the filled drums and stage them at the designated waste accumulation area to await waste characterization analyses. Based on waste characterization results, the drummed water will be transported and appropriately disposed at a Navy-approved off-site disposal facility by the IDW subcontractor.

Used personal protective equipment (PPE) will be bagged and disposed of as regular trash in an appropriate facility waste container.

8.2.15 Field Decontamination Procedures

Decontamination of sampling equipment will not be necessary for dedicated and disposable hand trowels. Decontamination of reusable sampling equipment (e.g., non-disposable hand trowels, hand augers, and DPT sampling equipment) will be conducted prior to sampling and between samples at each location. Decontamination of major equipment and sampling equipment will be in general accordance with FDEP SOP FC 1000.

8.2.16 Field Documentation Procedures

Field documentation will be performed in accordance with **Tetra Tech SOP-03** and FDEP SOP FD 1000.

Matrix-specific sample log sheets will be maintained for each sample collected. In addition, sample collection information will be recorded in bound field notebooks or specific field forms. Samples will be packaged and shipped according to **Tetra Tech SOP-01** and FDEP SOP FS 1000.

A summary of field activities will be properly recorded in indelible ink in a bound logbook with consecutively numbered pages that cannot be removed. Logbooks will be assigned to field personnel and stored in a secured area when not in use.

All entries will be written in indelible ink, and no erasures will be made. If an incorrect entry is made, striking a single line through the incorrect information will make the correction; and the person making the correction will initial and date the change. Boring logs, sampling forms, and other field forms will also be used to document field activities.

8.2.17 Quality Control Tasks

QC samples will be collected at frequencies listed in **Worksheet #6.0**.

8.3 ADDITIONAL PROJECT-RELATED TASKS

Additional project-related tasks include:

- Analytical Tasks
- Data Management
- Data Review
- Project Reports

8.3.1 Analytical Tasks

Chemical analyses for low level PAHs and metals will be performed by Chemtech, which is a current DoD Environmental Laboratory Accreditation Program (ELAP)-accredited laboratory for these analyses. In addition, Chemtech holds National Environmental Laboratory Accreditation Program (NELAP) accreditation with the State of Florida Department of Health (FDOH). Chemical analysis for NG will be performed by Empirical, which is a current DoD ELAP-accredited laboratory for NG. Copies of the pertinent laboratory accreditations are included in **Appendix F**. Analyses will be performed in accordance with the analytical methods identified in **Section 8.6**. Chemtech and Empirical will meet the screening criteria specified in **Section 9.0** and will perform the chemical analyses following the laboratory-specific SOPs identified in **Section 10.0**. Copies of the Laboratory SOPs are available to the Partnering Team upon request.

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

The analytical data packages provided by Chemtech and Empirical will be in a Contract Laboratory Program (CLP)-like format and will be fully validatable and contain raw data, summary forms for all sample and laboratory method blank data, and summary forms containing all method-specific QC information (results, percent recoveries [%Rs], RPDs, relative standard deviations [RSDs], percent differences or percent drifts [%Ds], etc.).

8.3.2 Data Management

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

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

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

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

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

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

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

8.3.3 Data Review

This review comprises data verification, validation, and usability assessment. The data verification and validation processes and requirements are described in **Section 12.0**. The data usability assessment will, at a minimum, constitute evaluation of the following characteristics to ensure that the amount, type, and quality of data are sufficient to achieve project objectives. The means of conducting these evaluations will vary depending on the nature of the data. For example, soil borings and well construction logs will generally be evaluated qualitatively or semi-quantitatively, whereas precision, accuracy, and sensitivity of analytical data will generally be evaluated quantitatively and may be based on, or may supplement, data validation findings. Examples include:

- Comparing actual to intended sampling locations and verifying that the correct datum was used to delineate contamination.
- Evaluating trends across sample delivery groups or sampling events.
- Assessing quantitative relationships between parameters (e.g., relative magnitudes of lead and other MC metals).
- Identifying potential errant or outlier data points.
- Assessing planning assumption validity.
- Evaluating the potential for contamination of samples by samplers.

DQIs to be evaluated during this assessment include:

1. **Precision.** A semi-quantitative estimate of the uncertainty in contaminant concentrations as a function of location will be made.

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

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

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

5. **Comparability.** This will be accomplished by comparing overall precision and bias among data sets for each matrix and analytical fraction for each sampled area. This will not require quantitative comparisons unless the Tetra Tech Project Chemist indicates that such quantitative analysis is beneficial to the project and the Tetra Tech PM agrees.

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

7. **Other quantitative characteristics.** These may include quantities such as verification of soil volume calculations, soil disposal cost estimates, etc., that are used to determine whether the contaminants are sufficiently well delineated to estimate remediation costs.

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

8.3.4 Project Reports

A Draft RI Report will be prepared and submitted to the Partnering Team for review. The report will include a summary of the work performed in accordance with the approved SAP; field modifications as documented by the Tetra Tech FOL; summary and analysis of analytical results; updated CSMs, HHRAs and ERAs, as appropriate, based on the risk screening evaluations, decision rules; and conclusions and recommendations for each site. Tetra Tech will respond to comments received on the Draft RI Report, and submit a final version of the report that incorporates the agreed-upon responses to comments. The final version of the RI Report will be submitted in hardcopy and electronic format to the Partnering Team and the Administrative Record.

8.4 - Field SOPs Reference Table

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

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
FC 1000	Cleaning/Decontamination Procedures, December 2008	FDEP	Decontamination equipment (scrub brushes, phosphate free detergent, de-ionized water)	N	See footnote.
FD 1000	Documentation Procedures, December 2008	FDEP	Documentation of all sampling activities (log book, sampling logs, chain-of-custodies)	N	See footnote.
FS 1000	General Sampling Procedures, December 2008	FDEP	Not Applicable (NA)	N	See footnote.
FS 2200	Groundwater Sampling, December 2008	FDEP	NA	N	See footnote.
FS 2212	Well Purging Techniques, December 2008	FDEP	Multi-parameter water quality meter, such as a Horiba U-22	N	See footnote.
FS 2220	Groundwater Sampling Techniques, December 2008	FDEP	Multi-parameter water quality meter, such as a Horiba U-22	N	See footnote.
FS 3000	Soil Sampling, December 2008	FDEP	Soil sampling equipment	N	See footnote.
FS 4000	Sediment Sampling, December 2008	FDEP	Stainless steel or disposable trowel	N	See footnote.
FT 1000	Field Testing General, December 2008	FDEP	Multi-parameter water quality meter, such as a Horiba U-22	N	See footnote.
FT 1100	Field pH, December 2008	FDEP	Multi-parameter water quality meter, such as a Horiba U-22	N	See footnote.
FT 1200	Field Specific Conductance, December 2008	FDEP	Multi-parameter water quality meter, such as a Horiba U-22	N	See footnote.
FT 1400	Field Temperature, December 2008	FDEP	Multi-parameter water quality meter, such as a Horiba U-22	N	See footnote.
FT 1500	Field DO, December 2008	FDEP	Multi-parameter water quality meter, such as a Horiba U-22	N	See footnote.
FT 1600	Field Turbidity, December 2008	FDEP	Turbidity meter, such as LaMotte Model 2008, or similar	N	See footnote.
SOP-01	Sample Labeling (Revision 0, September 2011)	Tetra Tech	NA	Y	Contained in **Appendix E**.
SOP-02	Sample Identification Nomenclature (Revision 0, September 2011)	Tetra Tech	NA	Y	Contained in **Appendix E**.

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP-03	Sample Custody and Documentation of Field Activities (Revision 0, September 2011)	Tetra Tech	Field logbook, sample log sheets, boring logs	Y	Contained in **Appendix E**.
SOP-04	Sample Preservation, Packaging, and Shipping (Revision 0, September 2011)	Tetra Tech	NA	Y	Contained in **Appendix E**.
SOP-05	Lithologic Soil Sample Logging (Revision 0, September 2011)	Tetra Tech	General field supplies	Y	Contained in **Appendix E**.
SOP-06	Temporary Monitoring Well Installation and Abandonment (Revision 0, September 2011)	Tetra Tech	Health and safety equipment, well drilling and installation equipment, hydrogeologic equipment	Y	Contained in **Appendix E**.
SOP-07	Temporary Well Development (Revision 0, September 2011)	Tetra Tech	NA	Y	Contained in **Appendix E**.
SOP-08	Measurement of Water Levels (Revision 0, September 2011)	Tetra Tech	NA	Y	Contained in **Appendix E**.
SOP-09	Global Positioning System (Revision 0, September 2011)	Tetra Tech	GPS unit	Y	Contained in **Appendix E**.
SOP-10	Management of Investigation-Derived Waste (Revision 0, September 2011)	Tetra Tech	NA	Y	Contained in **Appendix E**.

Notes:

FDEP Field SOPs can be obtained at the following website: www.dep.state.fl.us/water/sas/sop/sops.htm

8.5 - Sample Details Table

(UFP-QAPP Manual Section 3.1.1 and 3.5.2.3 – Worksheet #18)

Sample Location	Sample ID	Sample Location Rationale[1]	Sample Depth[2] (feet bgs)	Sampling SOP[3]	Laboratory Analyses							Field Analyses						
					Antimony	Arsenic	Copper	Lead	Zinc	Low-Level PAHs	NG	Water Level	Temperature	pH	Spec. Cond.	ORP	DO	Turbidity
PSC 22 - Fort Dix Skeet Range (UXO Site 1)																		
Surface and Subsurface Soil																		
X1SB001	X1SS0010006	Horizontal delineation south of JAX-22-SB004 (plus field duplicate)	0.0-0.5	FS 3000						•								
X1SB002	X1SS0020624	Horizontal delineation south of JAX-22-SB003 (plus field duplicate)	0.5-2.0	FS 3000						•								
X1SB003	X1SB0030204	Horizontal delineation south of JAX-22-SB002 (plus field duplicate)	2.0-4.0	FS 3000						•								
X1SB004	X1SS0040624	Horizontal delineation south of JAX-22-SB001	0.5-2.0	FS 3000						•								
X1SB005	X1SS0050006	Horizontal delineation south of JAX-22-SB015	0.0-0.5	FS 3000						•								
X1SB006	X1SS0060006	Horizontal delineation south of JAX-22-SB012	0.0-0.5	FS 3000						•								
X1SB006	X1SS0060624	Horizontal delineation south of JAX-22-SB012	0.5-2.0	FS 3000						•								
X1SB007	X1SS0070006	Horizontal delineation north of JAX-22-SB012	0.0-0.5	FS 3000						•								
X1SB007	X1SS0070624	Horizontal delineation north of JAX-22-SB012	0.5-2.0	FS 3000						•								
X1SB008	X1SS0080006	Horizontal delineation west of JAX-22-SB015	0.0-0.5	FS 3000						•								
X1SB009	X1SS0090006	Horizontal delineation west of JAX-22-SB016	0.0-0.5	FS 3000				•		•								

Sample Location	Sample ID	Sample Location Rationale[1]	Sample Depth[2] (feet bgs)	Sampling SOP[3]	Laboratory Analyses							Field Analyses						
					Antimony	Arsenic	Copper	Lead	Zinc	Low-Level PAHs	NG	Water Level	Temperature	pH	Spec. Cond.	ORP	DO	Turbidity
X1SB009	X1SS0090624	Horizontal delineation west of JAX-22-SB016	0.5-2.0	FS 3000						•								
X1SB010	X1SS0100006	Horizontal delineation west of JAX-22-SB017	0.0-0.5	FS 3000						•								
X1SB011	X1SS0110006	Horizontal delineation south of JAX-22-SB018 (plus field duplicate)	0.0-0.5	FS 3000		•		•										
X1SB012	X1SS0120006	Horizontal delineation east of JAX-22-SB018 (plus field duplicate)	0.0-0.5	FS 3000		•		•										
X1SB013	X1SS0130006	Horizontal delineation west of JAX-22-SB018	0.0-0.5	FS 3000		•		•										
X1SB014	X1SS0140006	Horizontal delineation north of JAX-22-SB019	0.0-0.5	FS 3000				•										
X1SB014	X1SS0140624	Vertical delineation north of JAX-22-SB019	0.5-2.0	FS 3000				•										
X1SB015	X1SS0150006	Horizontal delineation north of JAX-22-SB024	0.0-0.5	FS 3000				•		•								
X1SB015	X1SS0150624	Horizontal delineation north of JAX-22-SB024	0.5-2.0	FS 3000				•		•								
X1SB015	X1SB0150204	Horizontal delineation north of JAX-22-SB024	2.0-4.0	FS 3000				•		•								
X1SB016	X1SS0160006	Horizontal delineation north of JAX-22-SB027	0.0-0.5	FS 3000				•		•								
X1SB016	X1SS0160624	Horizontal delineation north of JAX-22-SB027	0.5-2.0	FS 3000				•		•								
X1SB017	X1SS0170006	Horizontal delineation further north of JAX-22-SB027	0.0-0.5	FS 3000				•		•								

Sample Location	Sample ID	Sample Location Rationale[1]	Sample Depth[2] (feet bgs)	Sampling SOP[3]	Laboratory Analyses							Field Analyses						
					Antimony	Arsenic	Copper	Lead	Zinc	Low-Level PAHs	NG	Water Level	Temperature	pH	Spec. Cond.	ORP	DO	Turbidity
X1SB017	X1SS0170624	Horizontal delineation further north of JAX-22-SB027	0.5-2.0	FS 3000				•		•								
X1SB018	X1SS0180006	Horizontal delineation northeast of JAX-22-SB028	0.0-0.5	FS 3000				•		•								
X1SB019	X1SS0190006	Horizontal delineation further northeast of JAX-22-SB028	0.0-0.5	FS 3000				•		•								
X1SB020	X1SS0200006	Horizontal delineation northeast of JAX-22-SB041	0.0-0.5	FS 3000				•		•								
X1SB021	X1SS0210006	Horizontal delineation northeast of JAX-22-SB037	0.0-0.5	FS 3000				•		•								
X1SB022	X1SS0220006	Horizontal delineation west of JAX-22-SB035 (plus field duplicate)	0.0-0.5	FS 3000						•								
X1SB023	X1SS0230006	Horizontal delineation south of JAX-22-SB035	0.0-0.5	FS 3000						•								
X1SB024	X1SS0240006	Horizontal delineation east of JAX-22-SB035	0.0-0.5	FS 3000						•								
X1SB025	X1SS0250006	Horizontal delineation north of JAX-22-SB035	0.0-0.5	FS 3000						•								
X1SB026	X1SS0260006	Horizontal delineation north of JAX-22-SB033 (plus field duplicate)	0.0-0.5	FS 3000	•	•	•	•	•									
X1SB026	X1SS0260624	Horizontal delineation north of JAX-22-SB033 (plus field duplicate)	0.5-2.0	FS 3000	•	•	•	•	•									
X1SB027	X1SS0270006	Horizontal delineation southeast of JAX-22-SB033	0.0-0.5	FS 3000	•	•	•	•	•									
X1SB027	X1SS0270624	Horizontal delineation southeast of JAX-22-SB033	0.5-2.0	FS 3000	•	•	•	•	•									

Sample Location	Sample ID	Sample Location Rationale[1]	Sample Depth[2] (feet bgs)	Sampling SOP[3]	Laboratory Analyses							Field Analyses						
					Antimony	Arsenic	Copper	Lead	Zinc	Low-Level PAHs	NG	Water Level	Temperature	pH	Spec. Cond.	ORP	DO	Turbidity
X1SB028	X1SS0280006	Horizontal delineation south of JAX-22-SB034	0.0-0.5	FS 3000						•								
X1SB029	X1SS0290006	Horizontal delineation east of JAX-22-SB034	0.0-0.5	FS 3000						•								
X1SB030	X1SS0300006	Horizontal delineation south of JAX-22-SB032	0.0-0.5	FS 3000		•		•		•								
X1SB031	X1SS0310006	Horizontal delineation north of JAX-22-SB032	0.0-0.5	FS 3000		•		•		•								
X1SB032	X1SS0320006	Horizontal delineation south of JAX-22-SB008 (plus field duplicate)	0.0-0.5	FS 3000						•								
X1SB032	X1SS0320624	Horizontal delineation south of JAX-22-SB008	0.5-2.0	FS 3000						•								
X1SB033	X1SS0330006	Horizontal delineation south of JAX-22-SB036	0.0-0.5	FS 3000						•								
X1SB033	X1SS0330624	Vertical delineation south of JAX-22-SB036	0.5-2.0	FS 3000						•								
X1SB034	X1SS0340006	Horizontal delineation south of JAX-22-SB007	0.0-0.5	FS 3000				•		•								
X1SB035	X1SS0350006	Horizontal delineation south of JAX-22-SB010	0.0-0.5	FS 3000		•		•										
X1SB036	X1SS0360006	Horizontal delineation north of JAX-22-SB010	0.0-0.5	FS 3000		•		•										
X1SB037	X1SS0370006	Horizontal delineation south of skeet debris layer	0.0-0.5	FS 3000						•								
X1SB037	X1SS0370624	Vertical delineation south of skeet debris layer	0.5-2.0	FS 3000						•								
Sediment																		
X1SD001	X1SD0010006	Sample 1 in North Pond (plus field duplicate)	0.0-0.5	FS 4000	•	•		•										

Sample Location	Sample ID	Sample Location Rationale[1]	Sample Depth[2] (feet bgs)	Sampling SOP[3]	Laboratory Analyses							Field Analyses						
					Antimony	Arsenic	Copper	Lead	Zinc	Low-Level PAHs	NG	Water Level	Temperature	pH	Spec. Cond.	ORP	DO	Turbidity
X1SD002	X1SD0020006	Sample 2 in North Pond	0.0-0.5	FS 4000	•	•		•										
X1SD003	X1SD0030006	Sample 3 in North Pond	0.0-0.5	FS 4000	•	•		•										
X1SD004	X1SD0040006	Sample 1 in East Pond	0.0-0.5	FS 4000	•	•		•		•								
X1SD005	X1SD0050006	Sample 2 in East Pond	0.0-0.5	FS 4000	•	•		•		•								
X1SD006	X1SD0060006	Sample 1 in South Pond	0.0-0.5	FS 4000	•	•		•		•								
X1SD007	X1SD0070006	Sample 2 in South Pond	0.0-0.5	FS 4000	•	•		•		•								
X1SD008	X1SD0080006	Sample 3 in South Pond	0.0-0.5	FS 4000	•	•		•		•								
Surface Water																		
X1SW001	X1SW0010006	Sample 1 in North Pond (plus field duplicate)	0.0-0.5	FS 2100, FT 1000 to 1600	•	•		•				•	•	•	•	•	•	•
X1SW002	X1SW0020006	Sample 2 in North Pond	0.0-0.5	FS 2100, FT 1000 to 1600	•	•		•				•	•	•	•	•	•	•
X1SW003	X1SW0030006	Sample 3 in North Pond	0.0-0.5	FS 2100, FT 1000 to 1600	•	•		•				•	•	•	•	•	•	•
X1SW004	X1SW0040006	Sample 1 in East Pond	0.0-0.5	FS 2100, FT 1000 to 1600	•	•		•		•		•	•	•	•	•	•	•
X1SW005	X1SW0050006	Sample 2 in East Pond	0.0-0.5	FS 2100, FT 1000 to 1600	•	•		•		•		•	•	•	•	•	•	•
X1SW006	X1SW0060006	Sample 1 in South Pond	0.0-0.5	FS 2100, FT 1000 to 1600	•	•		•		•		•	•	•	•	•	•	•
X1SW007	X1SW0070006	Sample 2 in South Pond	0.0-0.5	FS 2100, FT 1000 to 1600	•	•		•		•		•	•	•	•	•	•	•

Sample Location	Sample ID	Sample Location Rationale[1]	Sample Depth[2] (feet bgs)	Sampling SOP[3]	Laboratory Analyses							Field Analyses						
					Antimony	Arsenic	Copper	Lead	Zinc	Low-Level PAHs	NG	Water Level	Temperature	pH	Spec. Cond.	ORP	DO	Turbidity
X1SW008	X1SW0080006	Sample 3 in South Pond	0.0-0.5	FS 2100, FT 1000 to 1600	•	•		•		•		•	•	•	•	•	•	•
Groundwater																		
TW01	X1TW01	DPT temporary well TW-01 underlying X1SB007 (plus field duplicate)	6-12	FS 2212, FT 1000 to 1600	•	•		•				•	•	•	•	•	•	•
TW02	X1TW02	DPT temporary well TW-02 underlying X1SB016	6-12	FS 2212, FS 2200, FT 1000 to 1600	•	•		•				•	•	•	•	•	•	•
TW03	X1TW03	DPT temporary well TW-03 underlying X1SB026	6-12	FS 2212, FS 2200, FT 1000 to 1600	•	•		•				•	•	•	•	•	•	•
TW07	X1TW07	DPT temporary well TW-07 near skeet debris layer, underlying X1SB037	6-12	FS 2212, FS 2200, FT 1000 to 1600						•		•	•	•	•	•	•	•
PSC 23A - .50 Caliber Range (UXO Site 2)																		
Surface and Subsurface Soil																		
X2SB001	X2SB0010405	Horizontal delineation south of JAX-23A-SBSS008 (plus field duplicate)	4.0-5.0	FS 3000				•										
X2SB002	X2SB0020405	Horizontal delineation west of JAX-23A-SBSS008	4.0-5.0	FS 3000				•										
X2SB003	X2SB0030405	Horizontal delineation north of JAX-23A-SBSS008	4.0-5.0	FS 3000				•										
X2SB004	X2SB0040405	Horizontal delineation east of JAX-23A-SBSS008	4.0-5.0	FS 3000				•										

Sample Location	Sample ID	Sample Location Rationale[1]	Sample Depth[2] (feet bgs)	Sampling SOP[3]	Laboratory Analyses							Field Analyses						
					Antimony	Arsenic	Copper	Lead	Zinc	Low-Level PAHs	NG	Water Level	Temperature	pH	Spec. Cond.	ORP	DO	Turbidity
X2SB005	X2SB0050304	Horizontal delineation west of JAX-23A-SBSS012 (plus field duplicate)	3.0-4.0	FS 3000			•	•										
X2SB005	X2SB0050405	Horizontal delineation west of JAX-23A-SBSS012	4.0-5.0	FS 3000			•	•										
X2SB006	X2SB0060304	Horizontal delineation south-west of JAX-23A-SBSS012	3.0-4.0	FS 3000			•	•										
X2SB006	X2SB0060405	Horizontal delineation south-west of JAX-23A-SBSS012	4.0-5.0	FS 3000			•	•										
X2SB007	X2SB0070304	Horizontal delineation south of JAX-23A-SBSS012	3.0-4.0	FS 3000			•	•										
X2SB007	X2SB0070405	Horizontal delineation south of JAX-23A-SBSS012	4.0-5.0	FS 3000			•	•										
X2SB008	X2SB0080304	Horizontal delineation north of JAX-23A-SBSS012	3.0-4.0	FS 3000			•	•										
X2SB008	X2SB0080405	Horizontal delineation north of JAX-23A-SBSS012	4.0-5.0	FS 3000			•	•										
X2SB009	X2SB0090304	Horizontal delineation east of JAX-23A-SBSS012	3.0-4.0	FS 3000			•	•										
X2SB009	X2SB0090405	Horizontal delineation east of JAX-23A-SBSS012	4.0-5.0	FS 3000			•	•										
Groundwater																		
TW04	X2TW04	DPT temporary well TW-04 underlying X2SB006	6-12	FS 2212, FS 2200, FT 1000 to 1600	•			•				•	•	•	•	•	•	•
PSC 23B - Former Skeet Range (UXO Site 3)																		
Surface and Subsurface Soil																		
X3SB001	X3SS0010006	Horizontal delineation west of JAX-23B-SBSS012	0.0-0.5	FS 3000				•										

Sample Location	Sample ID	Sample Location Rationale[1]	Sample Depth[2] (feet bgs)	Sampling SOP[3]	Laboratory Analyses							Field Analyses						
					Antimony	Arsenic	Copper	Lead	Zinc	Low-Level PAHs	NG	Water Level	Temperature	pH	Spec. Cond.	ORP	DO	Turbidity
X3SB002	X3SS0020006	Horizontal delineation north of JAX-23B-SBSS012	0.0-0.5	FS 3000				•										
X3SB003	X3SS0030006	Horizontal delineation east of JAX-23B-SBSS012	0.0-0.5	FS 3000				•										
X3SB004	X3SS0040006	Horizontal delineation south of JAX-23B-SBSS006 (plus field duplicate)	0.0-0.5	FS 3000		•		•										
X3SB005	X3SS0050006	Horizontal delineation west of JAX-23B-SBSS007	0.0-0.5	FS 3000		•		•										
X3SB006	X3SS0060006	Horizontal delineation north of JAX-23B-SBSS002	0.0-0.5	FS 3000		•		•		•								
X3SB007	X3SS0070006	Horizontal delineation north of JAX-23B-SBSS008	0.0-0.5	FS 3000		•		•		•								
X3SB008	X3SS0080006	Horizontal delineation east of JAX-23B-SBSS032	0.0-0.5	FS 3000	•	•		•										
X3SB009	X3SS0090006	Horizontal delineation south of JAX-23B-SBSS004 (plus field duplicate)	0.0-0.5	FS 3000						•								
X3SB010	X3SS0100006	Horizontal delineation east of JAX-23B-SBSS004	0.0-0.5	FS 3000						•								
X3SB011	X3SS0110006	Horizontal delineation east of JAX-23B-SBSS015	0.0-0.5	FS 3000						•								
X3SB012	X3SS0120006	Horizontal delineation north of JAX-23B-SBSS038	0.0-0.5	FS 3000						•								
X3SB013	X3SS0130006	Horizontal delineation south-west of JAX-23B-SBSS003	0.0-0.5	FS 3000						•								
X3SB014	X3SS0140006	Horizontal delineation north-west of JAX-23B-SBSS001	0.0-0.5	FS 3000						•								
X3SB015	X3SS0150006	Horizontal delineation north-east of JAX-23B-SBSS001	0.0-0.5	FS 3000						•								

Sample Location	Sample ID	Sample Location Rationale[1]	Sample Depth[2] (feet bgs)	Sampling SOP[3]	Laboratory Analyses							Field Analyses						
					Antimony	Arsenic	Copper	Lead	Zinc	Low-Level PAHs	NG	Water Level	Temperature	pH	Spec. Cond.	ORP	DO	Turbidity
PSC 56 - Akron Road Pistol Range (UXO Site 4)																		
Surface and Subsurface Soil																		
X4SB001	X4SS0010006	Horizontal delineation north of JAX-56-SBSS028 (plus field duplicate)	0.0-0.5	FS 3000	•	•	•	•	•									
X4SB001	X4SS0010624	Horizontal delineation north of JAX-56-SBSS028 (plus field duplicate)	0.5-2.0	FS 3000		•		•										
X4SB002	X4SS0020006	Horizontal delineation north of JAX-56-SBSS032	0.0-0.5	FS 3000	•	•	•	•	•									
X4SB002	X4SS0020624	Horizontal delineation north of JAX-56-SBSS032	0.5-2.0	FS 3000		•		•										
X4SB003	X4SS0030006	Horizontal delineation north of JAX-56-SBSS033	0.0-0.5	FS 3000	•	•	•	•	•									
X4SB003	X4SS0030624	Horizontal delineation north of JAX-56-SBSS033	0.5-2.0	FS 3000		•		•										
X4SB004	X4SS0040006	Horizontal delineation north-east of JAX-56-SBSS027, east of floor of eastern berm (in native soil)	0.0-0.5	FS 3000	•	•	•	•	•									
X4SB004	X4SS0040624	Horizontal delineation north-east of JAX-56-SBSS027, east of floor of eastern berm (in native soil)	0.5-2.0	FS 3000		•		•										
X4SB005	X4SS0050006	Horizontal delineation east of JAX-56-SBSS031, east of floor of eastern berm (in native soil)	0.0-0.5	FS 3000	•	•	•	•	•									

Sample Location	Sample ID	Sample Location Rationale[1]	Sample Depth[2] (feet bgs)	Sampling SOP[3]	Laboratory Analyses							Field Analyses						
					Antimony	Arsenic	Copper	Lead	Zinc	Low-Level PAHs	NG	Water Level	Temperature	pH	Spec. Cond.	ORP	DO	Turbidity
X4SB005	X4SS0050624	Horizontal delineation east of JAX-56-SBSS031, east of floor of eastern berm (in native soil)	0.5-2.0	FS 3000		•		•										
X4SB006	X4SS0060006	Horizontal delineation east of JAX-56-SBSS034, east of floor of eastern berm (in native soil)	0.0-0.5	FS 3000	•	•	•	•	•									
X4SB006	X4SS0060624	Horizontal delineation east of JAX-56-SBSS034, east of floor of eastern berm (in native soil)	0.5-2.0	FS 3000		•		•										
X4SB007	X4SS0070006	Horizontal delineation east of JAX-56-SBSS039, east of floor of eastern berm (in native soil)	0.0-0.5	FS 3000	•	•	•	•	•									
X4SB007	X4SS0070624	Horizontal delineation east of JAX-56-SBSS039, east of floor of eastern berm (in native soil)	0.5-2.0	FS 3000		•		•										
X4SB008	X4SS0080006	Horizontal delineation east of JAX-56-SBSS038	0.0-0.5	FS 3000	•	•	•	•	•									
X4SB008	X4SS0080624	Horizontal delineation east of JAX-56-SBSS038	0.5-2.0	FS 3000		•		•										
X4SB009	X4SS0090006	Horizontal delineation south of JAX-56-SBSS037	0.0-0.5	FS 3000	•	•	•	•	•									
X4SB009	X4SS0090624	Horizontal delineation south of JAX-56-SBSS037	0.5-2.0	FS 3000		•		•										
X4SB010	X4SS0100006	Horizontal delineation south of JAX-56-SBSS035	0.0-0.5	FS 3000	•	•	•	•	•									

Sample Location	Sample ID	Sample Location Rationale[1]	Sample Depth[2] (feet bgs)	Sampling SOP[3]	Laboratory Analyses							Field Analyses						
					Antimony	Arsenic	Copper	Lead	Zinc	Low-Level PAHs	NG	Water Level	Temperature	pH	Spec. Cond.	ORP	DO	Turbidity
X4SB010	X4SS0100624	Horizontal delineation south of JAX-56-SBSS035	0.5-2.0	FS 3000		•		•										
X4SB011	X4SS0110006	Horizontal delineation south of JAX-56-SBSS026 (plus field duplicate)	0.0-0.5	FS 3000	•	•	•	•	•									
X4SB011	X4SS0110624	Horizontal delineation south of JAX-56-SBSS026 (plus field duplicate)	0.5-2.0	FS 3000		•		•										
X4SB012	X4SS0120006	Horizontal delineation north-west of JAX-56-SBSS026, west of floor of western berm (in native soil)	0.0-0.5	FS 3000	•	•	•	•	•									
X4SB012	X4SS0120624	Horizontal delineation north-west of JAX-56-SBSS026, west of floor of western berm (in native soil)	0.5-2.0	FS 3000		•		•										
X4SB013	X4SS0130006	Horizontal delineation west of JAX-56-SBSS014, west of floor of western berm (in native soil)	0.0-0.5	FS 3000	•	•	•	•	•									
X4SB013	X4SS0130624	Horizontal delineation west of JAX-56-SBSS014, west of floor of western berm (in native soil)	0.5-2.0	FS 3000		•		•										
X4SB014	X4SS0140006	Horizontal delineation west of JAX-56-SBSS008, west of floor of western berm (in native soil)	0.0-0.5	FS 3000	•	•	•	•	•									

Sample Location	Sample ID	Sample Location Rationale[1]	Sample Depth[2] (feet bgs)	Sampling SOP[3]	Laboratory Analyses							Field Analyses						
					Antimony	Arsenic	Copper	Lead	Zinc	Low-Level PAHs	NG	Water Level	Temperature	pH	Spec. Cond.	ORP	DO	Turbidity
X4SB014	X4SS0140624	Horizontal delineation west of JAX-56-SBSS008, west of floor of western berm (in native soil)	0.5-2.0	FS 3000		•		•										
X4SB015	X4SS0150006	Horizontal delineation west of JAX-56-SBSS002, west of floor of western berm (in native soil)	0.0-0.5	FS 3000	•	•	•	•	•									
X4SB015	X4SS0150624	Horizontal delineation west of JAX-56-SBSS002, west of floor of western berm (in native soil)	0.5-2.0	FS 3000		•		•										
X4SB016	X4SB0160406	Vertical delineation below JAX-56-SBSS040 (plus field duplicate)	4.0-6.0	FS 3000	•			•										
X4SB017	X4SB0170406	Vertical delineation below JAX-56-SBSS042	4.0-6.0	FS 3000	•	•	•	•										
X4SB018	X4SB0180406	Vertical delineation below JAX-56-SBSS044	4.0-6.0	FS 3000				•										
X4SB019	X4SB0190406	Vertical delineation below JAX-56-SBSS045	4.0-6.0	FS 3000				•										
X4SB020	X4SB0200406	Vertical delineation below JAX-56-SBSS046	4.0-6.0	FS 3000				•										
X4SB021C	X4SB0210006C	Composite of 10 sample locations from within the 25-yard firing line area	0.0-0.5	FS 3000							•							
X4SB022C	X4SB0220006C	Composite of 10 sample locations from within the 50-yard firing line area	0.0-0.5	FS 3000							•							

Sample Location	Sample ID	Sample Location Rationale[1]	Sample Depth[2] (feet bgs)	Sampling SOP[3]	Laboratory Analyses							Field Analyses						
					Antimony	Arsenic	Copper	Lead	Zinc	Low-Level PAHs	NG	Water Level	Temperature	pH	Spec. Cond.	ORP	DO	Turbidity
Groundwater																		
TW05	X4TW05	DPT temporary well TW-05 north of JAX-56-SBSS044, at the center of the range floor at the base of the backstop berm	6-12	FS 2212, FS 2200, FT 1000 to 1600				•				•	•	•	•	•	•	•
PSC 57 - .30 Caliber Range (UXO Site 5)																		
No RI Samples																		
PSC 58 - Trap Ranges (UXO Site 6)																		
Surface and Subsurface Soil																		
X6SB001	X6SB0010406	Vertical delineation below JAX-58-SBSS028 (plus field duplicate)	4.0-6.0	FS 3000	•	•		•										
X6SB002	X6SS0020006	Horizontal delineation south-west of JAX-58-SBSS028 (plus field duplicate)	0.0-0.5	FS 3000	•	•		•										
X6SB003	X6SS0030006	Horizontal delineation south-east of JAX-58-SBSS025	0.0-0.5	FS 3000	•	•		•										
X6SB004	X6SS0040006	Horizontal delineation south-west of JAX-58-SBSS025	0.0-0.5	FS 3000	•	•		•										
X6SB005	X6SS0050006	Horizontal delineation west of JAX-58-SBSS019	0.0-0.5	FS 3000	•	•		•										
X6SB006	X6SS0060006	Horizontal delineation west of JAX-58-SBSS007	0.0-0.5	FS 3000	•	•		•										
X6SB007	X6SS0070006	Horizontal delineation north of JAX-58-SBSS008	0.0-0.5	FS 3000	•	•		•										
X6SB008	X6SS0080006	Horizontal delineation north of JAX-58-SBSS010	0.0-0.5	FS 3000	•	•		•										
X6SB009	X6SS0090006	Horizontal delineation north of JAX-58-SBSS012	0.0-0.5	FS 3000	•	•		•										

Sample Location	Sample ID	Sample Location Rationale[1]	Sample Depth[2] (feet bgs)	Sampling SOP[3]	Laboratory Analyses							Field Analyses						
					Antimony	Arsenic	Copper	Lead	Zinc	Low-Level PAHs	NG	Water Level	Temperature	pH	Spec. Cond.	ORP	DO	Turbidity
X6SB010	X6SS0100006	Horizontal delineation east of JAX-58-SBSS024	0.0-0.5	FS 3000	•	•		•										
X6SB011	X6SB0110006	Horizontal delineation east of JAX-58-SBSS029	0.0-0.5	FS 3000	•	•		•										
Sediment																		
X6SD001	X6SD0010006	Sample 1 in Center Pond (plus field duplicate)	0.0-0.5	FS 4000	•	•		•										
X6SD002	X6SD0020006	Sample 2 in Center Pond	0.0-0.5	FS 4000	•	•		•										
X6SD003	X6SD0030006	Sample 3 in Center Pond	0.0-0.5	FS 4000	•	•		•										
Surface Water																		
X6SW001	X6SW0010006	Sample 1 in Center Pond (plus field duplicate)	0.0-0.5	FS 2100, FT 1000 to 1600	•	•		•				•	•	•	•	•	•	•
X6SW002	X6SW0020006	Sample 2 in Center Pond	0.0-0.5	FS 2100, FT 1000 to 1600	•	•		•				•	•	•	•	•	•	•
X6SW003	X6SW0030006	Sample 3 in Center Pond	0.0-0.5	FS 2100, FT 1000 to 1600	•	•		•				•	•	•	•	•	•	•
Groundwater																		
TW06	X6TW06	DPT temporary well TW-06 underlying X6SB001	6-12	FS 2212, FS 2200, FT 1000 to 1600	•	•		•				•	•	•	•	•	•	•

1 Sample rationale is based on the recommendations provided in the SI Report (Tetra Tech, 2010).
2 Depths are estimated for proposed wells. Actual depths may vary based on site conditions. Well screens will be placed across the first water-bearing zone.
3 SOP or worksheet that describes the sample collection procedures (**Worksheet #8.4**).

8.6 - Analytical SOP Requirements and Analytical Services Table

(UFP-QAPP Manual Section 3.1.1 - Worksheets #19 and 30)

Laboratory point of contact, e-mail address, and phone number: Kurt Hummler, khummler@chemtech.net, 908-728-3143
Laboratory Name and Address: Chemtech, 284 Sheffield Street, Mountainside, NJ 07092
Laboratory point of contact, e-mail address, and phone number: Brian Richard, brichard@empirlabs.com, (615) 345-1115
Laboratory Name and Address: Empirical Laboratories, LLC, 621 Mainstream Drive, Suite 270, Nashville, TN 37228
Data Package Turnaround time: 21 days
Tentative Sampling Dates: Spring 2012

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference[1]	Containers (number, size, and type)	Sample Volume (units)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation / analysis)
Surface and subsurface soil	Low- Level PAHs	SW-846 3541/8270D Selected Ion Monitoring (SIM) Chemtech SOP M8270C/D-BNA-16	One 4-ounce (oz) glass jar	30 grams (g)	Cool to ≤6 °C. Do not freeze.	14 days for preparation; 40 days to analysis
	NG	SW-846 8330B Empirical SOP-327	One 4-oz glass jar with a Teflon-lined lid	30 g	Cool to ≤6 °C. Do not freeze.	14 days for preparation; 40 days to analysis
	Metals	SW-846 3050B/6020A/ 7471B Chemtech SOP M6020/6020A-Metals ICPMS-13	One 4-oz glass jar	1 to 2 g	Cool to ≤6 °C. Do not freeze.	180 days to analysis
Sediment	Low- Level PAHs	SW-846 3541/8270D SIM Chemtech SOP M8270C/D-BNA-16	One 4-oz glass jar	30 g	Cool to ≤6 °C. Do not freeze.	14 days for preparation; 40 days to analysis
	Metals	SW-846 3050B/6020A/ 7471B Chemtech SOP M6020/6020A-Metals ICPMS-13	One 4-oz glass jar	1 to 2 g	Cool to ≤6 °C. Do not freeze.	180 days to analysis
Surface water, groundwater, and aqueous field QC samples	Low- Level PAHs	SW-846 3510C/8270D SIM Chemtech SOP M8270C/D-BNA-16	Two 1-liter (L) amber glass bottles	1,000 milliliter (mL)	Cool to ≤6 °C. Do not freeze.	7 days for preparation; 40 days to analysis
	Metals (Total, and if required, Dissolved)	SW-846 3010A/6020A/ 7470A Chemtech SOP M6020/6020A-Metals ICPMS-13	One 500-mL polyethylene bottle (one for total, one more for dissolved if necessary)	50 mL	Nitric acid (HNO_3) to pH < 2; Cool to ≤6 °C. Do not freeze.	180 days to analysis

Notes:
1 Specify the appropriate reference letter or number from the Analytical SOP References table (**Worksheet #10.0**).

8.7 - Field Quality Control Sample Summary Table

(UFP-QAPP Manual Section 3.1.1 - Worksheet #20)

Matrix	Analytical Group	No. of Sampling Locations	No. of Field Duplicates	No. of MS/MSDs(1)	No. of Equip. Blanks	Total No. of Samples to Lab
Surface Soil	Low Level PAHs	44	5	3/3	0	49
	NG	2	1	1/1	0	3
	Total Metals	73	8	4/4	0	81
Subsurface Soil	Low Level PAHs	2	1	1/1	1	4
	Total Metals	21	3	2/2	2	26
Sediment	Total Metals	11	2	1/1	0	13
	Low Level PAHs	5	1	1/1	1	7
Surface Water	Total Metals	11	2	1/1	0	13
	Dissolved Metals	0 minimum; 11 maximum	2	1/1	1(2)	0 minimum; 14 maximum
	Low Level PAHs	5	1	1/1	0	6
Groundwater	Low Level PAHs	1	1	1/1	0	2
	Total Metals	6	1	1/1	0	7
	Dissolved Metals	0 minimum; 6 maximum	1	1/1	1(2)	0 minimum; 8 maximum

1 Although MS/MSD samples are not typically considered field QC samples, they are included here because location determination is often established in the field. MS/MSD samples are not included in the total number of samples sent to the laboratory. For total (and dissolved if required) metals, an MD will be collected in place of an MSD.
2 The equipment blank for dissolved metals, if collected, will be obtained by passing rinse water through a 0.45-micron filter.

9.0 -- Reference Limits and Evaluation Tables

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

Matrix: Soil
Analytical Group: Low-Level PAHs (SW-846 Method 8270D SIM)

Analyte	CAS Number	Screening Criteria (mg/kg)		Criteria References[1]	PQLG (mg/kg)	Chemtech		
		HHRA	ERA	HHRA / ERA		LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
Acenaphthene	83-32-9	2.1	29	SCTL-LGW / Eco SSL	0.70	0.0067	0.006	0.0013
Acenaphthylene	208-96-8	27	29	SCTL-LGW / Eco SSL	9.0	0.0067	0.006	0.00079
Anthracene	120-12-7	1,700	29	R-RSL / Eco SSL	9.7	0.0067	0.006	0.0012
Benzo(a)anthracene	56-55-3	0.15	1.1	R-RSL / Eco SSL	0.050	0.0067	0.006	0.0013
Benzo(a)pyrene	50-32-8	0.015	1.1	R-RSL / Eco SSL	0.0050	0.0067	0.006	0.0015
Benzo(b)fluoranthene	205-99-2	0.15	1.1	R-RSL / Eco SSL	0.050	0.0067	0.006	0.0016
Benzo(g,h,i)perylene	191-24-2	170	1.1	R-RSL / Eco SSL	0.37	0.0067	0.006	0.0017
Benzo(k)fluoranthene	207-08-9	1.5	1.1	R-RSL / Eco SSL	0.37	0.0067	0.006	0.0017
Chrysene	218-01-9	15	1.1	R-RSL / Eco SSL	0.37	0.0067	0.006	0.0019
Dibenzo(a,h)anthracene	53-70-3	0.015	1.1	R-RSL / Eco SSL	0.0050	0.0067	0.006	0.0019
Fluoranthene	206-44-0	230	29	R-RSL / Eco SSL	9.7	0.0067	0.006	0.001
Fluorene	86-73-7	80	29	RBSSL / Eco SSL	9.7	0.0067	0.006	0.00083
Indeno(1,2,3-c,d)pyrene	193-39-5	0.15	1.1	R-RSL / Eco SSL	0.050	0.0067	0.006	0.0026
Naphthalene	91-20-3	1.2	29	R-RSL / Eco SSL	0.0031	0.0067	0.006	0.00086
Phenanthrene	85-01-8	170	29	R-RSL / Eco SSL	9.7	0.0067	0.006	0.00079
Pyrene	129-00-0	170	1.1	R-RSL / Eco SSL	0.37	0.0067	0.006	0.0024
Benzo(a)pyrene (BaP) Equivalents	NA	0.1	NC	SCTL-LGW / None	NA	---	---	---

CAS – Chemical Abstracts Service
PQLG – Practical Quantitation Limit Goal
LOD – Limit of Detection

(1) The references for surface and subsurface soil are: SCTL-LGW – FDEP Soil Cleanup Target Level, Leachability to Groundwater (FDEP, 2005); R-RSL – Regions 3, 6, and 9 Regional Screening Level, Direct Contact Residential, adjusted to 1/10 of value for noncarcinogens (USEPA, 2012a); RBSSL – Regions 3, 6, and 9 Regional Screening Level, Migration to Groundwater, Dilution Attenuation Factor (DAF) = 20 (USEPA, 2012a); Eco SSL – USEPA Ecological Soil Screening Level (USEPA, 2008). Refer to **Appendix D** for further explanation and justification of screening criteria.

Matrix: Soil
Analytical Group: NG (SW-846 Method 8330B)

Analyte	CAS Number	Screening Criteria (mg/kg)		References[1]	PQLG (mg/kg)	Empirical		
		HHRA	ERA	HHRA / ERA		LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
Nitroglycerin	55-63-0	0.61	NC	R-RSL / None	0.20	0.4	0.2	0.1

(1) The references for surface and subsurface soil are: R-RSL – Regions 3, 6, and 9 Regional Screening Level, Direct Contact Residential, adjusted to 1/10 of value for noncarcinogens (USEPA, 2012a). Refer to **Appendix D** for further explanation and justification of screening criteria.

Matrix: Soil
Analytical Group: Metals (SW-846 Method 6020A)

Analyte	CAS Number	Screening Criteria (mg/kg)		References[1]	PQLG (mg/kg)	Chemtech		
		HHRA	ERA	HHRA / ERA		LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
Antimony	7440-36-0	3.1	0.27	R-RSL / Eco SSL	0.090	0.2	0.1	0.026
Arsenic	7440-38-2	0.8	18	BKGD / Eco SSL	0.23	0.1	0.05	0.022
Copper	7440-50-8	150	28	SCTL-RDE / Eco SSL	9.3	0.2	0.1	0.006
Lead	7439-92-1	400	11	R-RSL / Eco SSL	3.7	0.1	0.05	0.004
Tin	7440-31-5	4,700	53	R-RSL / R4 Eco	18	0.5	0.25	0.024
Zinc	7440-66-6	2,300	46	R-RSL / Eco SSL	15	0.2	0.1	0.011

(1) The references for surface and subsurface soil are: R-RSL – Regions 3, 6, and 9 Regional Screening Level, Direct Contact Residential, adjusted to 1/10 of value for noncarcinogens (USEPA, 2012a); BKGD – Site-Specific Background Screening Concentration, lowest of surface and subsurface values (ABB-ES, 1996); SCTL-RDE – FDEP Soil Cleanup Target Level, Residential Direct Exposure (FDEP, 2005); SCTL-LGW – FDEP Soil Cleanup Target Level, Leachability to Groundwater (FDEP, 2005); Eco SSL – USEPA Ecological Soil Screening Level (USEPA, 2008); R4 Eco – Region 4 Ecological Soil Screening Level (USEPA, 2001). Refer to **Appendix D** for further explanation and justification of screening criteria.

Matrix: Sediment
Analytical Group: Low-Level PAHs (SW-846 Method 8270D SIM)

Analyte	CAS Number	Screening Criteria (mg/kg)		References[1]	PQLG (mg/kg)	Chemtech		
		HHRA	ERA	HHRA / ERA		LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
Acenaphthene	83-32-9	340	0.00671	R-RSL / R4 Eco SDSL	0.0023	0.0067	0.006	0.0013
Acenaphthylene	**208-96-8**	340	**0.00587**	R-RSL / **R4 Eco SDSL**	**0.0020**	**0.0067**	**0.006**	**0.00079**
Anthracene	120-12-7	1,700	0.0469	R-RSL / R4 Eco SDSL	0.016	0.0067	0.006	0.0012
Benzo(a)anthracene	56-55-3	0.15	0.0748	R-RSL / R4 Eco SDSL	0.025	0.0067	0.006	0.0013
Benzo(a)pyrene	50-32-8	0.015	0.0888	R-RSL / R4 Eco SDSL	0.0050	0.0067	0.006	0.0015
Benzo(b)fluoranthene	205-99-2	0.15	0.312	R-RSL / R4 Eco SDSL	0.050	0.0067	0.006	0.0016
Benzo(g,h,i)perylene	191-24-2	170	0.655	R-RSL / R4 Eco SDSL	0.22	0.0067	0.006	0.0017
Benzo(k)fluoranthene	207-08-9	1.5	0.312	R-RSL / R4 Eco SDSL	0.10	0.0067	0.006	0.0017
Chrysene	218-01-9	15	0.108	R-RSL / R4 Eco SDSL	0.036	0.0067	0.006	0.0019
Dibenzo(a,h)anthracene	**53-70-3**	0.015	**0.00622**	R-RSL / **R4 Eco SDSL**	**0.0021**	**0.0067**	**0.006**	**0.0019**
Fluoranthene	206-44-0	230	0.113	R-RSL / R4 Eco SDSL	0.038	0.0067	0.006	0.001
Fluorene	86-73-7	230	0.0212	R-RSL / R4 Eco SDSL	0.0071	0.0067	0.006	0.00083
Indeno(1,2,3-c,d)pyrene	193-39-5	0.15	0.312	R-RSL / R4 Eco SDSL	0.050	0.0067	0.006	0.0026
Naphthalene	91-20-3	3.6	0.0346	R-RSL / R4 Eco SDSL	0.012	0.0067	0.006	0.00086
Phenanthrene	85-01-8	170	0.0867	R-RSL / R4 Eco SDSL	0.029	0.0067	0.006	0.00079
Pyrene	129-00-0	170	0.153	R-RSL / R4 Eco SDSL	0.051	0.0067	0.006	0.0024
BaP Equivalents	NA	NC	NC	None / None	NA	---	---	---

(1) The references for sediment are: R-RSL – Regions 3, 6, and 9 Regional Screening Level, Direct Contact Residential, adjusted to 1/10 of value for noncarcinogens (USEPA, 2012a); R4 Eco SDSL – Region 4 Ecological Sediment Screening Level (USEPA, 2001). Refer to **Appendix D** for further explanation and justification of screening criteria.

Bolded rows indicate that the screening criterion is between the laboratory LOQ and DL. The Partnering Team has agreed to accept this data for decision making as long as results below the LOQ are "J" qualified and discussed in the uncertainties section of the RI Report.

Matrix: Sediment
Analytical Group: Metals (SW-846 Method 6020A)

Analyte	CAS Number	Screening Criteria (mg/kg)		References[1]	PQLG (mg/kg)	Chemtech		
		HHRA	ERA	HHRA / ERA		LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
Antimony	7440-36-0	9.2	2	BKGD / R4 Eco SDSL	0.67	0.2	0.1	0.026
Arsenic	7440-38-2	1.26	7.24	BKGD / R4 Eco SDSL	0.42	0.1	0.05	0.022
Copper	7440-50-8	150	18.7	SCTL-RDE / R4 Eco SDSL	6.2	0.2	0.1	0.006
Lead	7439-92-1	400	30.2	R-RSL / R4 Eco SDSL	10	0.1	0.05	0.004
Tin	7440-31-5	4,700	NC	R-RSL / None	1,600	0.5	0.25	0.024
Zinc	7440-66-6	2,300	124	R-RSL / R4 Eco SDSL	41	0.2	0.1	0.011

(1) The references for sediment are: R-RSL – Regions 3, 6, and 9 Regional Screening Level, Direct Contact Residential, adjusted to 1/10 of value for noncarcinogens (USEPA, 2012a); BKGD – Site-Specific Background Screening Concentration, Sediment (ABB-ES, 1996); SCTL-RDE – FDEP Soil Cleanup Target Level, Residential Direct Exposure (FDEP, 2005); R4 Eco SDSL – Region 4 Ecological Sediment Screening Level (USEPA, 2001). Refer to **Appendix D** for further explanation and justification of screening criteria.

Matrix: Surface Water
Analytical Group: Low-Level PAHs (SW-846 Method 8270D SIM)

Analyte	CAS Number	Screening Criteria (µg/L)		References[1]	PQLG (µg/L)	Chemtech		
		HHRA	ERA	HHRA / ERA		LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
Acenaphthene	83-32-9	3	17	GCTL / R4 Eco	1.0	0.20	0.18	0.054
Acenaphthylene	208-96-8	40	4,840	T-RSL / NOAA	13	0.20	0.18	0.034
Anthracene	**120-12-7**	0.3	**0.012**	GCTL / **R3 BTAG SW**	**0.0040**	**0.20**	**0.18**	**0.047**
Benzo(a)anthracene	**56-55-3**	**0.029**	**0.018**	**T-RSL / R3 BTAG SW**	**0.0060**	**0.20**	**0.18**	**0.049**
Benzo(a)pyrene	**50-32-8**	**0.0029**	**0.015**	**T-RSL / R3 BTAG SW**	**0.00097**	**0.20**	**0.18**	**0.053**
Benzo(b)fluoranthene	**205-99-2**	**0.029**	9.07	**T-RSL** / NOAA	**0.0097**	**0.20**	**0.18**	**0.065**
Benzo(g,h,i)perylene	191-24-2	8.7	7.64	T-RSL / NOAA	2.5	0.20	0.18	0.038
Benzo(k)fluoranthene	207-08-9	0.29	NC	T-RSL / None	0.097	0.20	0.18	0.054
Chrysene	218-01-9	2.9	NC	T-RSL / None	0.97	0.20	0.18	0.040
Dibenzo(a,h)anthracene	**53-70-3**	**0.0029**	NC	**T-RSL** / None	**0.00097**	**0.20**	**0.18**	**0.065**
Fluoranthene	206-44-0	0.3	39.8	GCTL / R4 Eco	0.10	0.20	0.18	0.038
Fluorene	86-73-7	22	3	T-RSL / R3 BTAG SW	1.0	0.20	0.18	0.034
Indeno(1,2,3-c,d)pyrene	**193-39-5**	**0.029**	4.31	**T-RSL** / NOAA	**0.0097**	**0.20**	**0.18**	**0.070**
Naphthalene	91-20-3	0.14	62	T-RSL / R4 Eco	0.047	0.20	0.18	0.025
Phenanthrene	85-01-8	8.7	0.4	T-RSL / R3 BTAG SW	0.13	0.20	0.18	0.036
Pyrene	**129-00-0**	0.3	**0.025**	GCTL / **R3 BTAG SW**	**0.0083**	**0.20**	**0.18**	**0.022**
BaP Equivalents	NA	0.1	NC	GCTL / None	0.033	---	---	---

µg/L – micrograms per liter
(1) The references for surface water are: GCTL – FDEP Groundwater Cleanup Target Level (FDEP, 2005); T-RSL – Regions 3, 6, and 9 Regional Screening Level for Tapwater, adjusted to 1/10 of value for noncarcinogens (USEPA, 2012a); R4 Eco – Region 4 Ecological Freshwater Surface Water Screening Level (USEPA, 2001); NOAA – National Oceanographic and Atmospheric Administration Screening Quick Reference Tables (SQuiRTs), freshwater chronic surface water benchmarks (NOAA, 2008); R3 BTAG SW – Region 3 Biological Technical Assistance Group Freshwater Surface Water Screening Benchmarks (USEPA, 2006). Refer to **Appendix D** for further explanation and justification of screening criteria.

Bolded rows indicate that the value is between the laboratory LOQ and DL. The Partnering Team has agreed to accept this data for decision making as long as results below the LOQ are "J" qualified and discussed in the uncertainties section of the RI Report.

Shaded and Bold row indicate the screening criterion is less than the DL; therefore, the Partnering Team has agreed to replace the criteria with the laboratory LOQs for decision making purposes, as suggested in "Guidance for the Selection of Analytical Methods for the Evaluation of Practical Quantitation Limits" (FDEP, October 2004).

Matrix: Surface Water
Analytical Group: Metals (SW-846 Method 6020A)

Analyte	CAS Number	Screening Criteria (µg/L)		References[1]	PQLG (µg/L)	Chemtech		
		HHRA	ERA	HHRA / ERA		LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
Antimony	7440-36-0	0.6	160	T-RSL / R4 Eco	0.50	2	1	0.14
Arsenic	7440-38-2	3.2	150	BKGD / NRWQC	0.015	1	0.5	0.18
Copper	7440-50-8	7.6	6.54	BKGD / R4 Eco	1.2	2	1	0.04
Lead	7439-92-1	8.5	2.5	GCTL / NRWQC	0.83	1	0.5	0.04
Tin	7440-31-5	930	73	T-RSL / R3 BTAG SW	24	5	2.5	0.15
Zinc	7440-66-6	86	120	GCTL / NRWQC	29	2	1	0.09

(1) The references for surface water are: T-RSL – Regions 3, 6, and 9 Regional Screening Level for Tapwater, adjusted to 1/10 of value for noncarcinogens (USEPA, 2012a); BKGD – Site-Specific Background Screening Concentration, Surface Water (ABB-ES, 1996); GCTL – FDEP Groundwater Cleanup Target Level (FDEP, 2005); R4 Eco – Region 4 Ecological Freshwater Surface Water Screening Level (USEPA, 2001); NRWQC - National Recommended Water Quality Criteria USEPA, 2009); R3 BTAG SW - Region 3 BTAG Freshwater Surface Water Screening Benchmark (USEPA, 2006). Refer to **Appendix D** for further explanation and justification of screening criteria.

Matrix: Groundwater
Analytical Group: Low-Level PAHs (SW-846 Method 8270D SIM)

Analyte	CAS Number	Screening Criteria (µg/L)	References[1]	PQLG (µg/L)	Chemtech		
		HHRA	HHRA		LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
Acenaphthene	83-32-9	20	GCTL	6.7	0.20	0.18	0.054
Acenaphthylene	208-96-8	40	T-RSL	13	0.20	0.18	0.034
Anthracene	120-12-7	130	T-RSL	43	0.20	0.18	0.047
Benzo(a)anthracene	**56-55-3**	**0.029**	**T-RSL**	**0.0097**	**0.20**	**0.18**	**0.049**
Benzo(a)pyrene	50-32-8	0.2	MCL	0.067	0.20	0.18	0.053
Benzo(b)fluoranthene	**205-99-2**	**0.029**	**T-RSL**	**0.0097**	**0.20**	**0.18**	**0.065**
Benzo(g,h,i)perylene	191-24-2	8.7	T-RSL	2.9	0.20	0.18	0.038
Benzo(k)fluoranthene	207-08-9	0.29	T-RSL	0.097	0.20	0.18	0.054
Chrysene	18-01-9	2.9	T-RSL	0.97	0.20	0.18	0.040
Dibenzo(a,h)anthracene	**53-70-3**	**0.0029**	**T-RSL**	**0.00097**	**0.20**	**0.18**	**0.065**
Fluoranthene	206-44-0	63	T-RSL	21	0.20	0.18	0.038
Fluorene	86-73-7	22	T-RSL	7.3	0.20	0.18	0.034
Indeno(1,2,3-c,d)pyrene	**193-39-5**	**0.029**	**T-RSL**	**0.0097**	**0.20**	**0.18**	**0.070**
Naphthalene	**91-20-3**	**0.14**	**T-RSL**	**0.047**	**0.20**	**0.18**	**0.025**
Phenanthrene	85-01-8	8.7	T-RSL	2.9	0.20	0.18	0.036
Pyrene	129-00-0	8.7	T-RSL	2.9	0.20	0.18	0.022
BaP Equivalents	NA	NC	None	NA	---	---	---

(1) The references for groundwater are: GCTL – FDEP Groundwater Cleanup Target Level (FDEP, 2005); T-RSL – Regions 3, 6, and 9 Regional Screening Level for Tapwater, adjusted to 1/10 of value for noncarcinogens (USEPA, 2012a); MCL – USEPA Maximum Contaminant Level (USEPA, 2012b). Refer to **Appendix D** for further explanation and justification of screening criteria.

Bolded rows indicate that the value is between the laboratory LOQ and DL. The Partnering Team has agreed to accept this data for decision making as long as results below the LOQ are "J" qualified and discussed in the uncertainties section of the RI Report.

Shaded and Bold row indicate the screening criterion is less than the DL; therefore, the Partnering Team has agreed to replace the criteria with the laboratory LOQs for decision making purposes, as suggested in "Guidance for the Selection of Analytical Methods for the Evaluation of Practical Quantitation Limits" (FDEP, October 2004).

Matrix: Groundwater
Analytical Group: Metals (SW-846 Method 6020A)

Analyte	CAS Number	Screening Criteria (µg/L)	References[1]	PQLG (µg/L)	Chemtech		
		HHRA	HHRA		LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
Antimony	7440-36-0	43	BKGD	2.0	2	1	0.14
Arsenic	7440-38-2	13.2	BKGD	3.3	1	0.5	0.18
Copper	7440-50-8	1,300	MCL	50	2	1	0.04
Lead	7439-92-1	45.8	BKGD	5.0	1	0.5	0.04
Tin	7440-31-5	930	T-RSL	310	5	2.5	0.15
Zinc	7440-66-6	470	T-RSL	160	2	1	0.09

(1) The references for groundwater are: BKGD – Site-Specific Background Screening Concentration, Groundwater (ABB-ES, 1996); MCL – USEPA Maximum Contaminant Level (USEPA, 2012b); T-RSL – Regions 3, 6, and 9 Regional Screening Level for Tapwater, adjusted to 1/10 of value for noncarcinogens (USEPA, 2012a). Refer to **Appendix D** for further explanation and justification of screening criteria.

10.0 -- Analytical SOP References Table

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

Lab SOP Number	Title, Revision Date, and / or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance to DOD QSM? (Y/N)	Modified for Project Work? (Y/N)
M3510C3580A-Extraction SVOC-11	Extraction Preparation for Semi-volatile Organic Compounds (Revision 11, 09/30/09)	Definitive	Surface water, groundwater, and aqueous field QC samples – Low- Level PAHs	NA/ Extraction	Chemtech	N	N
M3541-ASE Extraction-04	Automated Soxhlet Extraction Procedure by Method SW 3541 Modified (Revision 04, 09/30/09)	Definitive	Soil and sediment samples – Low- Level PAHs	NA/ Extraction	Chemtech	N	N
M8270C/D-BNA-16	Determination of Extractable Semi-Volatile Organic Compounds by SW-846 Method 8270C/D (Revision 16, 12/25/10)	Definitive	Soil, sediment, surface water, groundwater, and aqueous field QC samples – Low- Level PAHs	Gas Chromatograph/ Mass Spectrometer (GC/MS)	Chemtech	Y - See Section 11 for Surrogate %Rs	N
SOP-327	Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC) Method 8330, 8330A, 8330B and 8332 (Revision 14, 09/07/10)	Definitive	Soil, Explosives	HPLC/ Ultraviolet (UV)	Empirical	N	N
M3010A-Digestion-10	Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by ICP Spectroscopy (Revision 10, 05/23/11)	Definitive	Groundwater and aqueous field QC samples – Metals	NA/ Digestion	Chemtech	N	N
M3050B-Digestion-13	Acid Digestion of Sediments, Sludges, and Soils for Total Metals Analysis by ICP Spectroscopy (Revision 13, 05/23/11)	Definitive	Soil and sediment samples – Metals	NA/ Digestion	Chemtech	N	N
M6020/6020A-Metals ICPMS-13	Trace Elemental Analysis by Inductively Coupled Plasma-Mass Spectrometric Method (Revision 13, 05/23/11)	Definitive	Soil, sediment, surface water, groundwater, and aqueous field QC samples – Metals	Inductively Coupled Plasma - Mass Spectroscopy (ICP-MS)	Chemtech	N	N

QSM – DoD Quality Systems Manual for Environmental Laboratories, Version 4.1 (April, 2009), or more current.

11.0 -- Laboratory QC Samples Tables

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

Matrix	Soil, sediment, surface water, groundwater, and aqueous field QC samples
Analytical Group	Low-level PAHs
Analytical Method/SOP Reference	SW-846 8270D SIM Chemtech M8270C/D-BNA-16

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	MPC
Method Blank	One per batch of 20 or fewer samples per matrix.	No analytes ≥½ LOQ.	Re-extract and reanalyze, except when the analysis resulted in a non-detect. If not enough sample exists for a re-extraction, then flag the effected sample results.	Analyst, Supervisor	Bias/ Contamination	Same as QC Acceptance Limits.
Surrogate	All field and QC samples. Two per sample for SIM: 2-Fluorobiphenyl Terphenyl-d_{14}	%Rs must be within the following laboratory statistically-derived control limits. Water Soil 50-110 45-105 50-135 30-125	Check integrations for errors, check calculations for errors, and check instrument performance. Re-extract and re-analyze the samples if the above show no problems or flag the data if sample matrix interference is present. Laboratory PM will contact the Tetra Tech Project Chemist to determine the course of action.	Analyst, Supervisor	Accuracy/Bias	Same as QC Acceptance Limits.
Internal Standards(IS)	Every field sample, standard, and QC sample. Five per sample – Naphthalene-d_8 Acenaphthene-d_{10} Phenanthrene-d_{10} Chrysene-d_{12} Perylene-d_{12}	Retention times for IS must be within $\pm$ 30 seconds and the response areas must be within -50% to +100% of Initial Calibration (ICAL) mid-point standard.	Inspect MS or GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.	Analyst, Supervisor	Accuracy/Bias	Same as QC Acceptance Limits.

Matrix	Soil, sediment, surface water, groundwater, and aqueous field QC samples
Analytical Group	Low-level PAHs
Analytical Method/SOP Reference	SW-846 8270D SIM Chemtech M8270C/D-BNA-16

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	MPC
Laboratory Control Sample (LCS)	One per batch of 20 or fewer samples per matrix.	%Rs must meet the DoD QSM Version 4.1 limits as per **Appendix G**.	If LCS %R exceeds the acceptance range and there are no positive findings for that compound, no further action is taken. If there are positive findings, reanalyze the LCS and all effected samples or flag the results. If %R is below the acceptance range, reanalyze the LCS and all effected samples.	Analyst, Supervisor	Accuracy / Bias	Same as QC Acceptance Limits.
MS/MSD	One per batch of 20 or fewer samples per matrix.	%Rs should meet the DoD QSM Version 4.1 limits as per **Appendix G**. RPD between MS and MSD should be ≤30%.	Evaluate the sample spiked for matrix interference and flag the data as necessary. Examine the project DQOs and the Laboratory PM will contact the Tetra Tech Project Chemist to determine the course of action.	Analyst, Supervisor	Accuracy / Bias Precision	Same as QC Acceptance Limits.
Results between the DL and LOQ	NA.	Apply “J” qualifier to results detected between DL and LOQ.	None.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits.

Matrix	Soil samples
Analytical Group	NG
Analytical Method/SOP Reference	SW-846 8330B Empirical SOP-327

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

Matrix	Soil, sediment, surface water, groundwater, and aqueous field QC samples
Analytical Group	Metals
Analytical Method/ SOP Reference	SW-846 6020A Chemtech M6020/6020A-Metals ICPMS-13

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	MPC
Method Blank	One per batch of 20 or fewer samples per matrix.	No analytes ≥½ LOQ.	Repeat analysis. Evaluate systems for contamination sources and repeat the batch as necessary.	Analyst, Supervisor	Bias / Contamination	Same as QC Acceptance Limits.
LCS	One per batch of 20 or fewer samples per matrix.	%Rs must be 80-120%.	Investigate source of problem. Redigest and reanalyze all associated samples.	Analyst, Supervisor, Data Validator	Accuracy / Bias	Same as QC Acceptance Limits.
MS	One per batch of 20 or fewer samples per matrix.	The %R should be within 80-120%, if sample < 4x spike added. RPD between MS and MSD should be ≤20%.	Dilute and re-spike/re-analyze to determine if interferences can be overcome by sample dilution. Prepare post-digestion spike for analytes outside limits. Flag data as possible matrix interference.	Analyst, Supervisor	Accuracy / Bias	Same as QC Acceptance Limits.
Duplicate Sample	One per batch of 20 or fewer samples per matrix (if MSD is not included).	RPD between duplicate samples should be ≤20%, if both results are >5x LOQ.	Evaluate sample homogeneity and flag as necessary.	Analyst, Supervisor	Precision	Same as QC Acceptance Limits.
Serial Dilution	One per batch of 20 or fewer samples per matrix on failure of MS/MSD.	The 5-fold dilution result must agree within ± 10%D of the original sample result.	Flag result or dilute and reanalyze sample to eliminate interference. Applicable when the concentration is >50x the LOQ. If the %D is >10%, then perform post-digestion spike solution.	Analyst, Supervisor	Precision	Same as QC Acceptance Limits.

Matrix	Soil, sediment, surface water, groundwater, and aqueous field QC samples
Analytical Group	Metals
Analytical Method/ SOP Reference	SW-846 6020A Chemtech M6020/6020A-Metals ICPMS-13

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	MPC
Post-Digestion Spike	When serial dilution test fails or when all analyte concentrations are <50 x LOD.	The %R must be within 75-125% of expected value to verify the absence of an interference. Spike addition should produce a concentration of 10-100x LOQ.	Narrate.	Analyst, Supervisor	Accuracy / Bias	Same as QC Acceptance Limits.
IS	Every sample.	IS intensity must recover within 70-130% of intensity of the IS in the original calibration blank.	Reanalyze sample at two-fold dilution with addition of appropriate amounts of IS; repeat until the IS intensities recover above 70%.	Analyst, Supervisor	Precision	Same as QC Acceptance Limits.
Results between the DL and LOQ	NA.	Apply “J” qualifier to results detected between DL and LOQ.	None.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits.

12.0 -- Data Verification and Validation (Steps I and IIa/IIb) Process Table

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

Data Review Input	Description	Responsible for Verification (name, organization)	Internal/ External
Chain of Custody Forms	The Tetra Tech FOL or designee will review and sign the chain-of-custody form to verify that all samples listed are included in the shipment to the laboratory and the sample information is accurate. The forms will be signed by the sampler and a copy will be retained for the project file, the Tetra Tech PM, and the Tetra Tech Data Validators. The Tetra Tech FOL or designee will review the chain-of-custody form to verify that all samples listed in the SAP have been collected. All deviations should be documented in the report.	Sampler and FOL, Tetra Tech	Internal
Chain of Custody Forms	1 - The Laboratory Sample Custodian will review the sample shipment for completeness and integrity, and sign accepting the shipment. 2- The Tetra Tech Data Validators will check that the chain-of-custody form was signed and dated by the Tetra Tech FOL or designee relinquishing the samples and also by the Laboratory Sample Custodian receiving the samples for analyses.	1 - Laboratory Sample Custodian, Chemtech and Empirical 2 - Data Validators, Tetra Tech	External
Chain of Custody Forms and SAP	Ensure that the custody and integrity of the samples was maintained from collection to analysis and the custody records are complete and any deviations are recorded. Review that the samples were shipped and stored at the required temperature and preservation conditions for chemically-preserved samples meet the requirements listed in the SAP. Ensure that the analyses were performed within the holding times listed in the SAP.	Data Validators, Tetra Tech	External
Sample Log Sheets, Chain of Custody Forms, SAP, and Laboratory Sample Login Documentation	Verify that information recorded in the log sheets is accurate and complete. Verify that samples were correctly identified, that sampling location coordinates are accurate, and that documentation establishes an unbroken trail of documented chain-of-custody from sample collection to report generation. Verify that the correct sampling and analytical methods/SOPs were applied. Verify that the sampling plan was implemented and carried out as written and that any deviations are documented. Document any discrepancies in the final report.	PM, FOL, or designee, Tetra Tech	Internal
SAP, Analytical SOPs, and Analytical Data Packages	Ensure that all laboratory SOPs were followed. Verify that the correct analytical methods/SOPs were applied. Establish that all method QC samples were analyzed and in control as listed in the analytical SOPs. If method QA is not in control, the Laboratory QAM will contact the Tetra Tech PM verbally or via e-mail for guidance prior to report preparation.	Laboratory QAM, Chemtech and Empirical	Internal

Data Review Input	Description	Responsible for Verification (name, organization)	Internal/ External
SAP/ Chain-of-Custody Forms	Check that all field QC samples determined necessary were collected as required.	FOL or designee, Tetra Tech	Internal
Analytical Data Packages	Verify all analytical data packages for completeness. The Laboratory QAM will sign the case narrative for each data package.	Laboratory QAM, Chemtech and Empirical	Internal
EDDs/ Analytical Data Packages	Check each EDD against the chain-of-custody and hard copy data package for accuracy and completeness. Compare laboratory analytical results to the electronic analytical results to verify accuracy. Evaluate sample results for laboratory contamination and qualify false detections using the laboratory method/preparation blank summaries. Qualify analyte concentrations between the DL and the LOQ as estimated. Remove extraneous laboratory qualifiers from the validation qualifier.	Data Validators, Tetra Tech	External
Analytical Data Packages	Verify each data package for completeness. Request missing information from the Laboratory PM.	Data Validators, Tetra Tech	External
SAP/ Laboratory Data Packages/ EDDs	Ensure that the laboratory QC samples were analyzed and that the MPCs listed in were met for all field samples and QC analyses. Check that specified field QC samples were collected and analyzed and that the analytical QC criteria set up for this project were met.	Data Validators, Tetra Tech	External
SAP/ Laboratory Data Packages/ EDDs	Check the field sampling precision by calculating RPDs for field duplicate samples. Check laboratory precision by reviewing the RPD or percent difference values from laboratory duplicate analyses; MS/MSDs; and LCS/Laboratory Control Sample Duplicate (LCSD), if available. Ensure compliance with the methods and project MPCs accuracy goals listed in the SAP.	Data Validators, Tetra Tech	External
SAP/ Laboratory Data Packages/ EDDs	Check that the laboratory recorded the temperature at sample receipt and the pH of samples preserved with acid or base to ensure sample integrity from sample collection to analysis.	Data Validators, Tetra Tech	External
SAP/ Laboratory Data Packages/ EDDs	Review the chain-of-custody forms generated in the field to ensure that the required analytical samples have been collected, appropriate sample identifications have been used, and correct analytical methods have been applied. The Tetra Tech Data Validator will verify that elements of the data package required for validation are present, and if not, the laboratory will be contacted and the missing information will be requested. Check that all data have been transferred correctly and completely to the project Structured Query Language (SQL) database.	Data Validators, Tetra Tech	External
SAP/ Laboratory Data Packages/ EDDs	Ensure that the project LOQs listed in SAP were achieved.	Data Validators, Tetra Tech	External

Data Review Input	Description	Responsible for Verification (name, organization)	Internal/ External
SAP/ Laboratory Data Packages/ EDDs	Discuss the impact on DLs that are elevated because of matrix interferences. Be especially cognizant of and evaluate the impact of sample dilutions on low-concentration analytes when the dilution was performed because of the high concentration of one or more other contaminants. Document this usability issue and inform the Tetra Tech PM. Review and add screening criteria to the laboratory EDDs. Flag samples and notify the Tetra Tech PM of samples that exceed criteria listed in SAP.	Data Validators, Tetra Tech	External
SAP/ Laboratory Data Packages/ EDDs	Ensure that all QC samples specified in the SAP were collected and analyzed and that the associated results were within prescribed SAP acceptance limits. Ensure that QC samples and standards prescribed in analytical SOPs were analyzed and within the prescribed control limits. If any significant QC deviations occur, the Laboratory QAM shall have contacted the Tetra Tech PM.	Data Validators, Tetra Tech	External
SAP/ Laboratory Data Packages/ EDDs	Summarize deviations from methods, procedures, or contracts in the Data Validation Report. Determine the impact of any deviation from sampling or analytical methods and SOPs requirements and matrix interferences effect on the analytical results. Qualify data results based on method or QC deviation and explain all the data qualifications. Print a copy of qualified data stored the project database to depict data qualifiers and data qualifier codes that summarize the reason for data qualifications. Determine if the data met the MPCs and determine the impact of any deviations on the technical usability of the data.	Data Validators, Tetra Tech	External

12.1 VALIDATION SUMMARY

Analytical Group	Validation Criteria	Data Validator (title and organizational affiliation)
Low-Level PAHs and NG	Full data validation will be performed on 100% of the data using criteria for SW-846 Methods 8270D SIM and 8330B listed in this SAP and the current DoD QSM. The logic outlined in USEPA CLP National Functional Guidelines for Organic Data Review USEPA-540/R-99-008, (USEPA, October 1999) will be used to apply qualifiers to data to the extent possible.	Data Validation Specialist, Tetra Tech
Metals	Full data validation will be performed on 100% of the data using criteria for SW-846 Method 6020A listed in this SAP and the current DoD QSM. The logic outlined in USEPA CLP National Functional Guidelines for Inorganic Data Review (USEPA, October 2004) will be used to apply qualifiers to data to the extent possible.	Data Validation Specialist, Tetra Tech

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FIGURES

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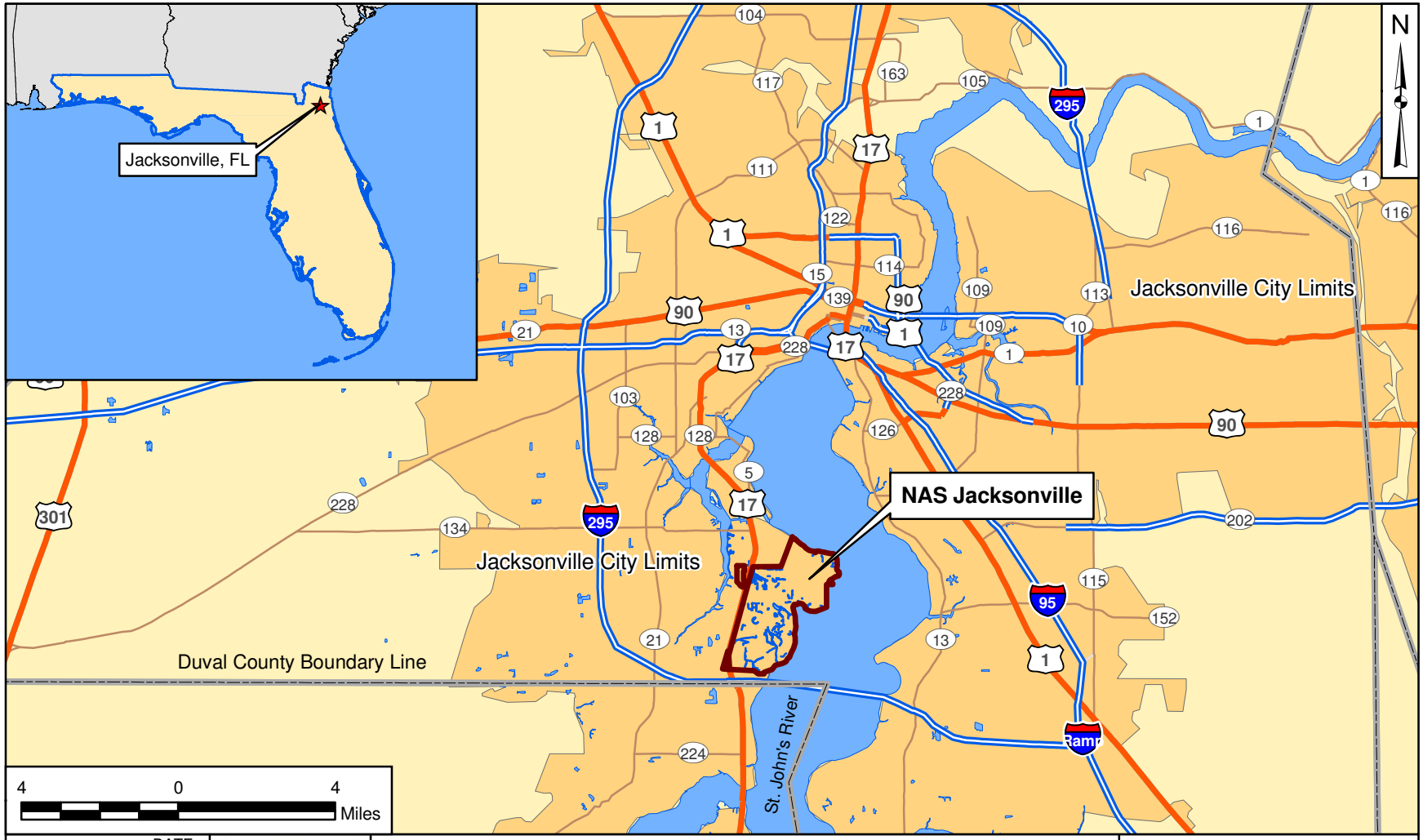

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CHECKED BY B. BECKER	DATE 08/30/11		APPROVED BY ___ DATE ___
COST/SCHEDULE AREA			APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE ES-1 / REV 0

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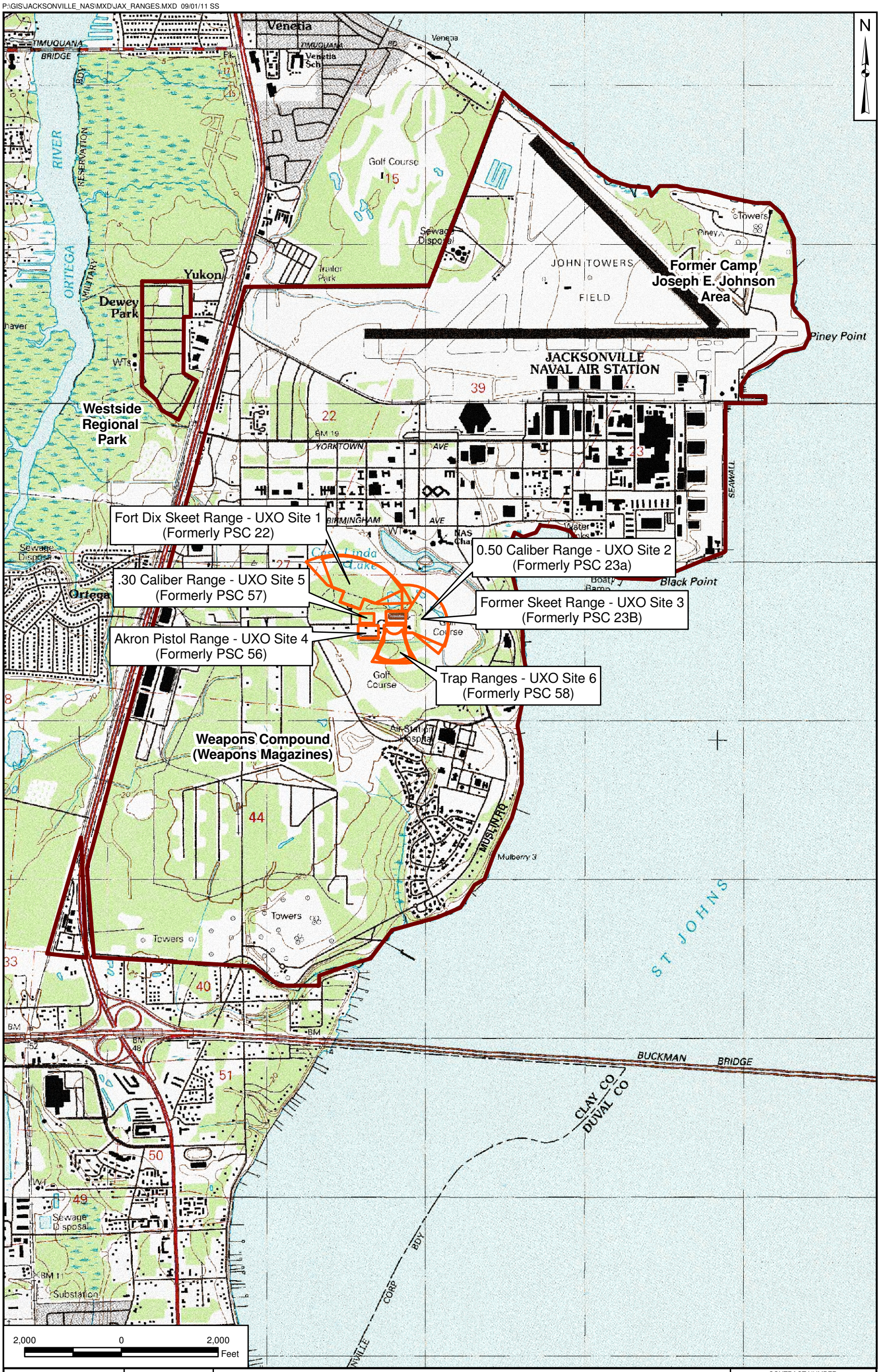

DRAWN BY	DATE
T. WHEATON	06/15/10
CHECKED BY	DATE
B. BECKER	09/01/11
REVISED BY	DATE
___	___
SCALE	
AS NOTED	

NAVFAC

RANGES ASSOCIATED WITH THE
FORMER MACHINE GUN COMPLEX
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NUMBER	
CTO JM55	
APPROVED BY	DATE
___	___
APPROVED BY	DATE
___	___
FIGURE NO.	REV
FIGURE ES-2	0

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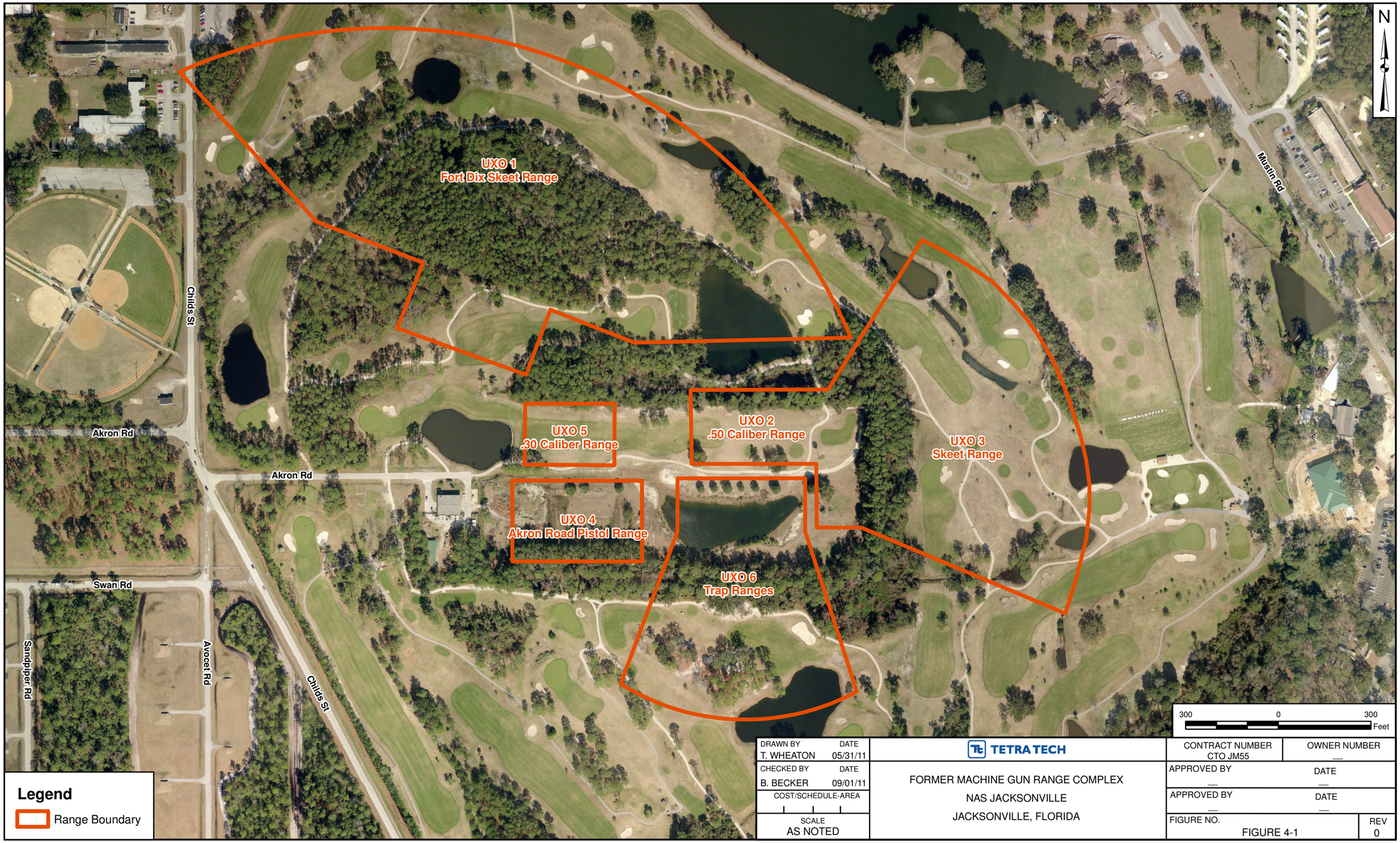

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CHECKED BY B. BECKER	DATE 09/01/11	FORMER MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY — / DATE —
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 4-1 / REV 0

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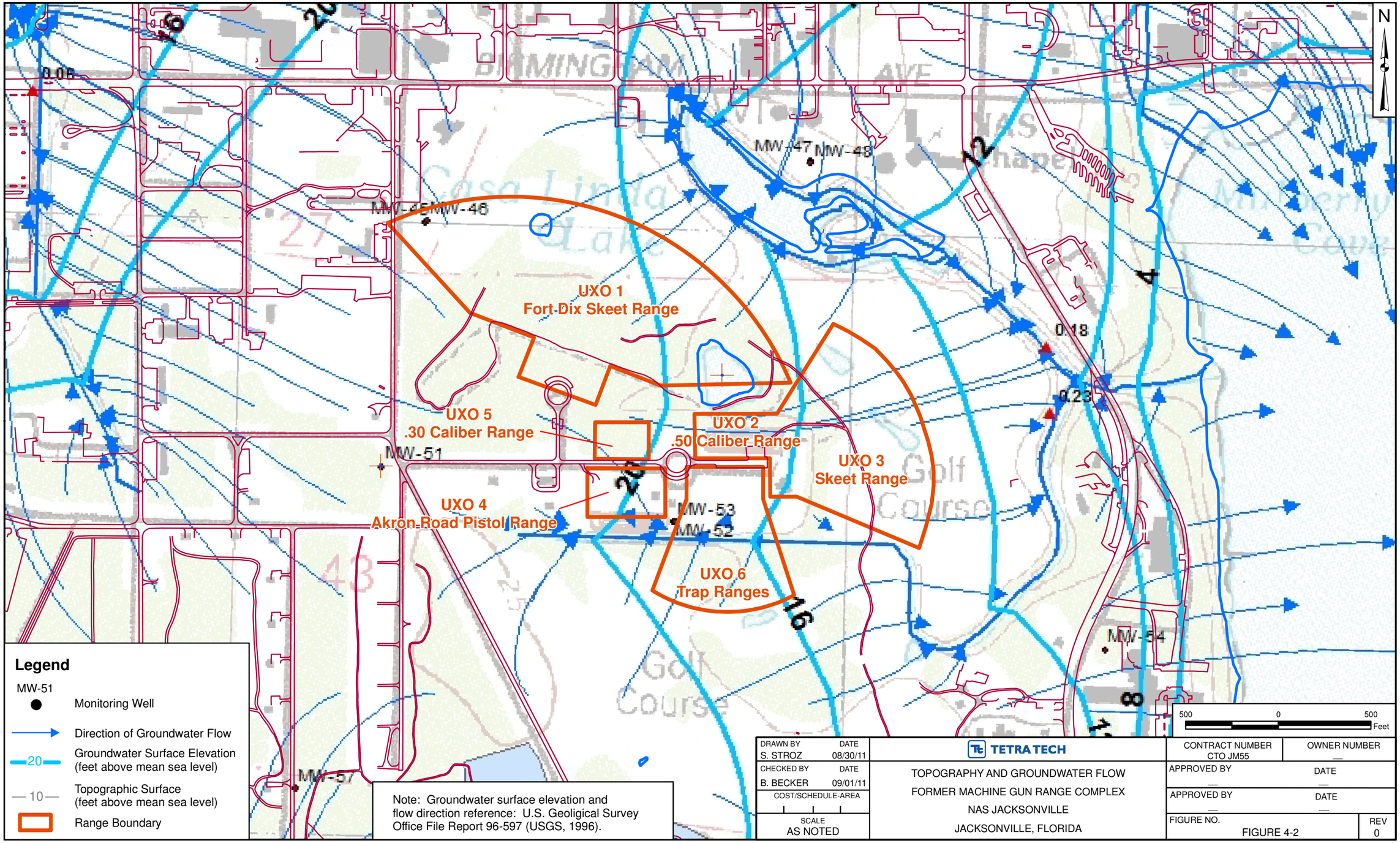

Note: Groundwater surface elevation and flow direction reference: U.S. Geological Survey Office File Report 96-597 (USGS, 1996).

DRAWN BY S. STROZ	DATE 08/30/11	TETRA TECH	CONTRACT NUMBER CTO JM55 / OWNER NUMBER —
CHECKED BY B. BECKER	DATE 09/01/11	TOPOGRAPHY AND GROUNDWATER FLOW FORMER MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY — / DATE —
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 4-2 / REV 0

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Legend

Firing Lines

Range Boundary

DRAWN BY T. WHEATON	DATE 06/15/10	TETRA TECH	CONTRACT NUMBER CTO JM55	OWNER NUMBER —
CHECKED BY B. BECKER	DATE 08/30/11	SITE LAYOUT UXO 1 - FORT DIX SKEET RANGE MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY —	DATE —
COST/SCHEDULE-AREA			APPROVED BY —	DATE —
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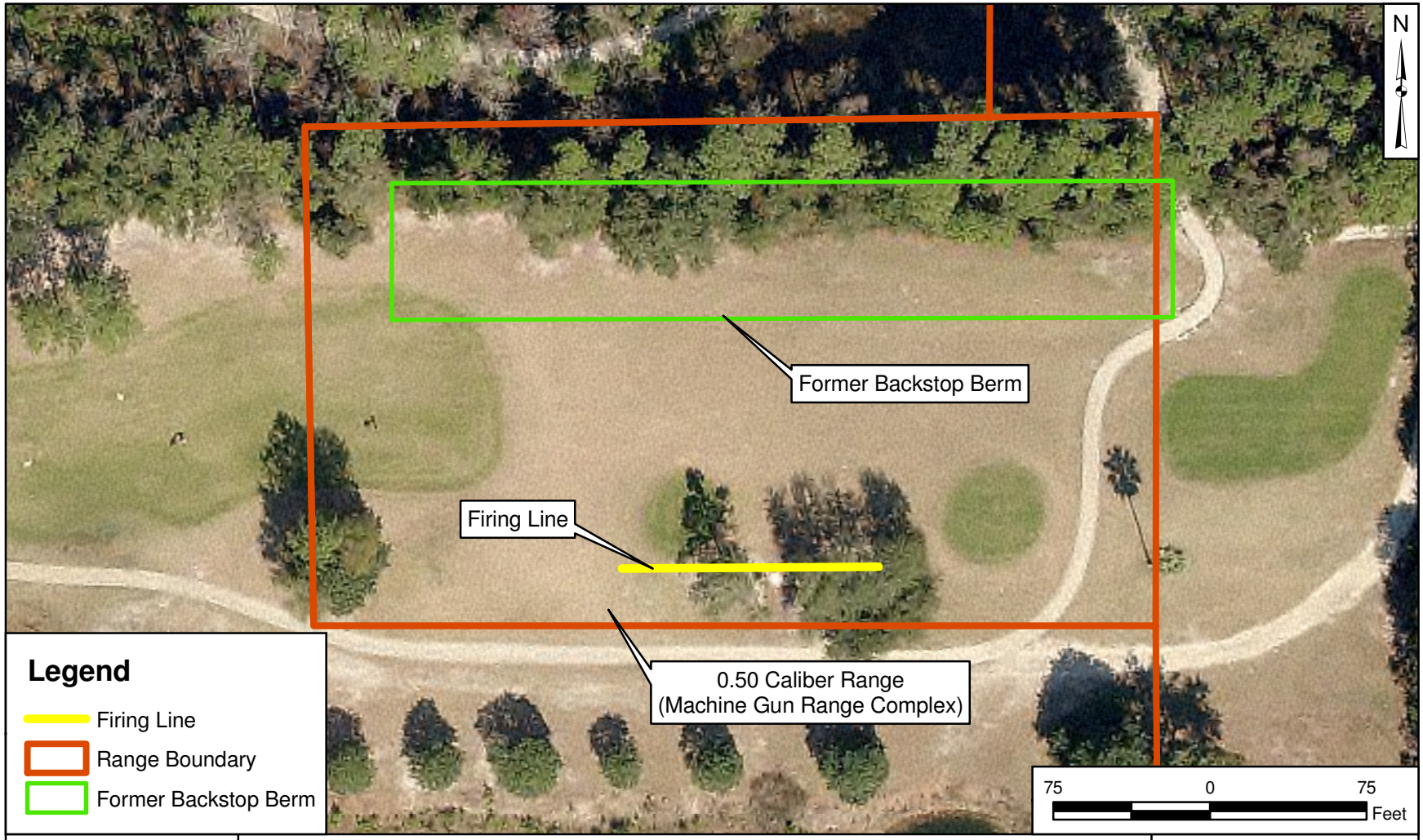

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CHECKED BY B. BECKER	DATE 10/07/11	SITE LAYOUT UXO 2 - .50 CALIBER RANGE MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY ___ DATE ___
COST/SCHEDULE AREA			APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 4-4 / REV 0

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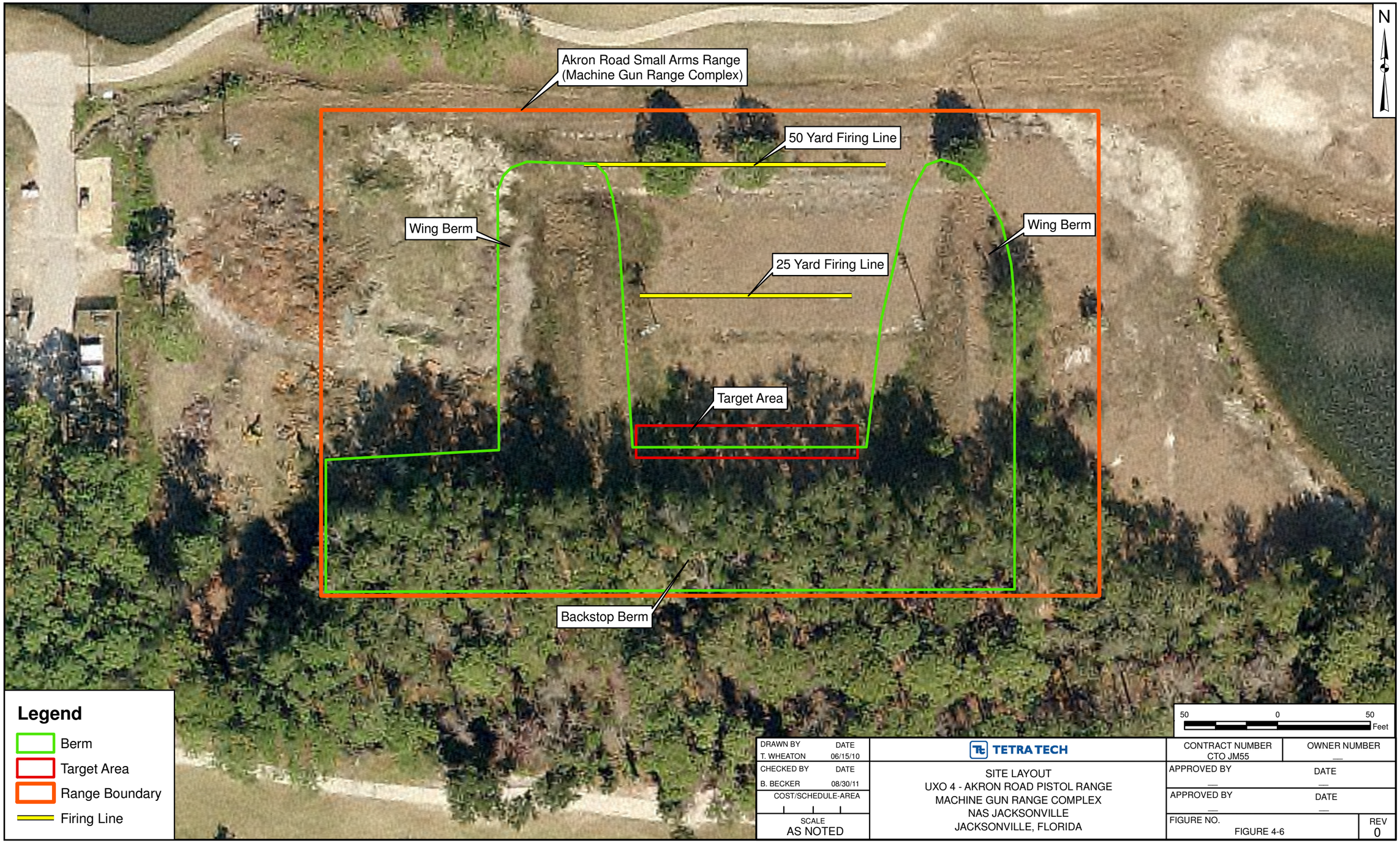
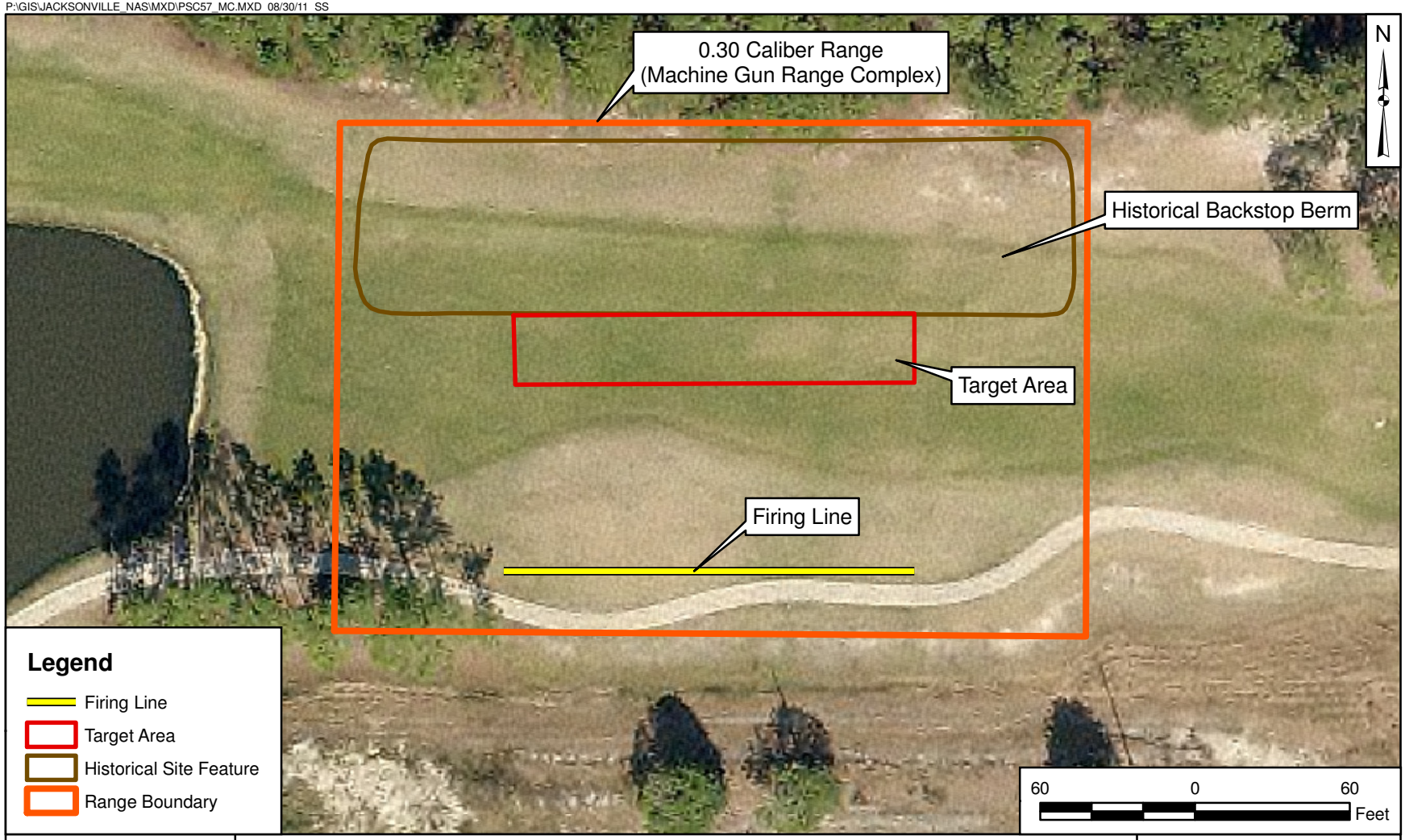
DRAWN BY T. WHEATON	DATE 06/15/10	TETRA TECH	CONTRACT NUMBER CTO JM55	OWNER NUMBER —
CHECKED BY B. BECKER	DATE 08/30/11	SITE LAYOUT UXO 3 - FORMER SKEET RANGE MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY —	DATE —
COST/SCHEDULE-AREA			APPROVED BY —	DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 4-5	REV 0

P:\GIS\JACKSONVILLE_NAS\MXD\PSC56_MC.MXD 08/30/11 SS



DRAWN BY T. WHEATON	DATE 06/15/10	TETRA TECH	CONTRACT NUMBER CTO JM55	OWNER NUMBER —
CHECKED BY B. BECKER	DATE 08/30/11	SITE LAYOUT UXO 4 - AKRON ROAD PISTOL RANGE MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY —	DATE —
COST/SCHEDULE-AREA			APPROVED BY —	DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 4-6	REV 0

P:\GIS\JACKSONVILLE_NAS\MXD\PSC57_MC.MXD 08/30/11 SS

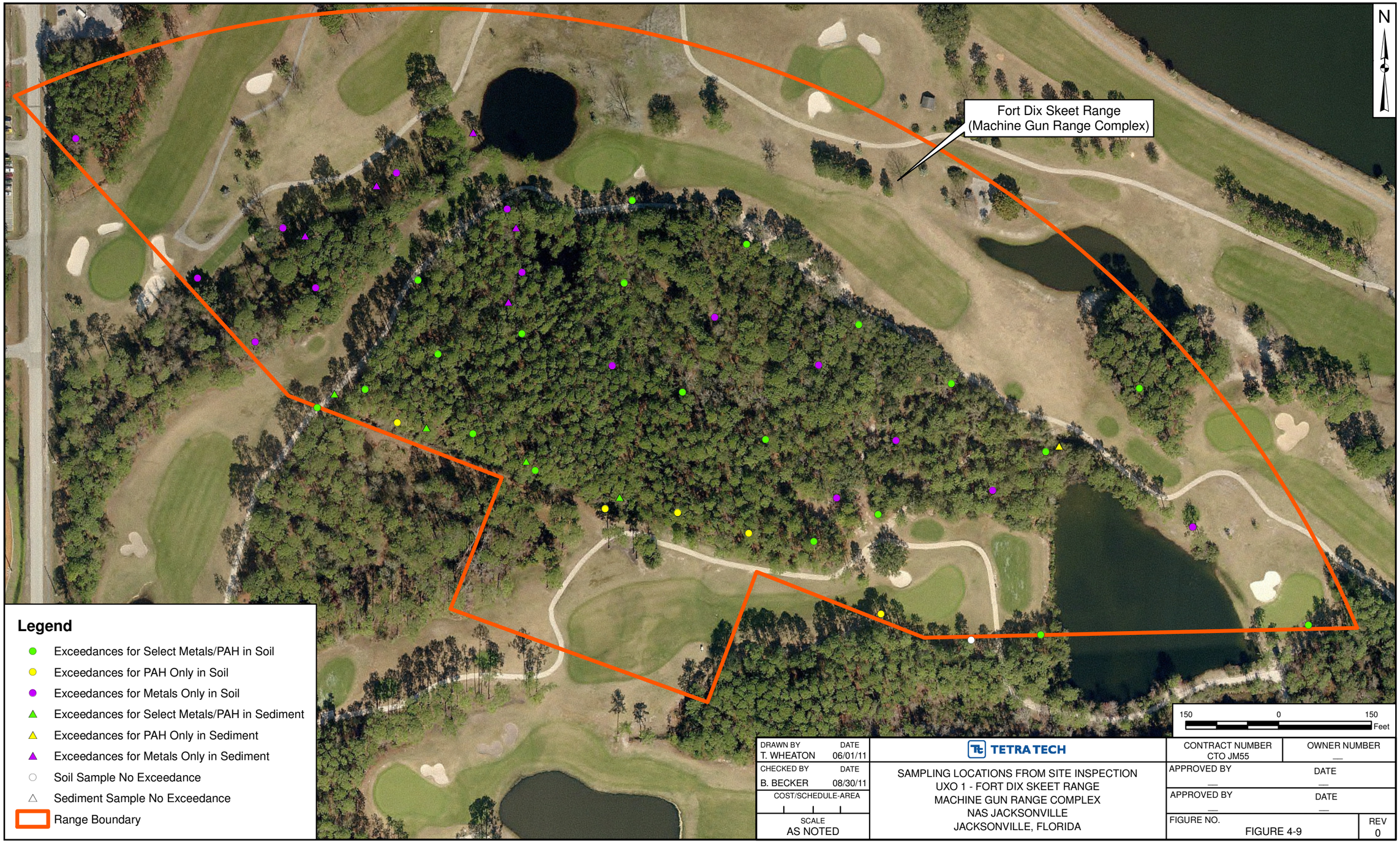


DRAWN BY T. WHEATON	DATE 06/15/10	TETRA TECH	CONTRACT NUMBER CTO JM55
CHECKED BY B. BECKER	DATE 08/30/11	SITE LAYOUT UXO 5 - .30 CALIBER RANGE MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY ___ DATE ___
COST/SCHEDULE AREA			APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 4-7 / REV 0

P:\GIS\JACKSONVILLE_NAS\MXD\PSC58_MC.MXD 08/30/11 SS

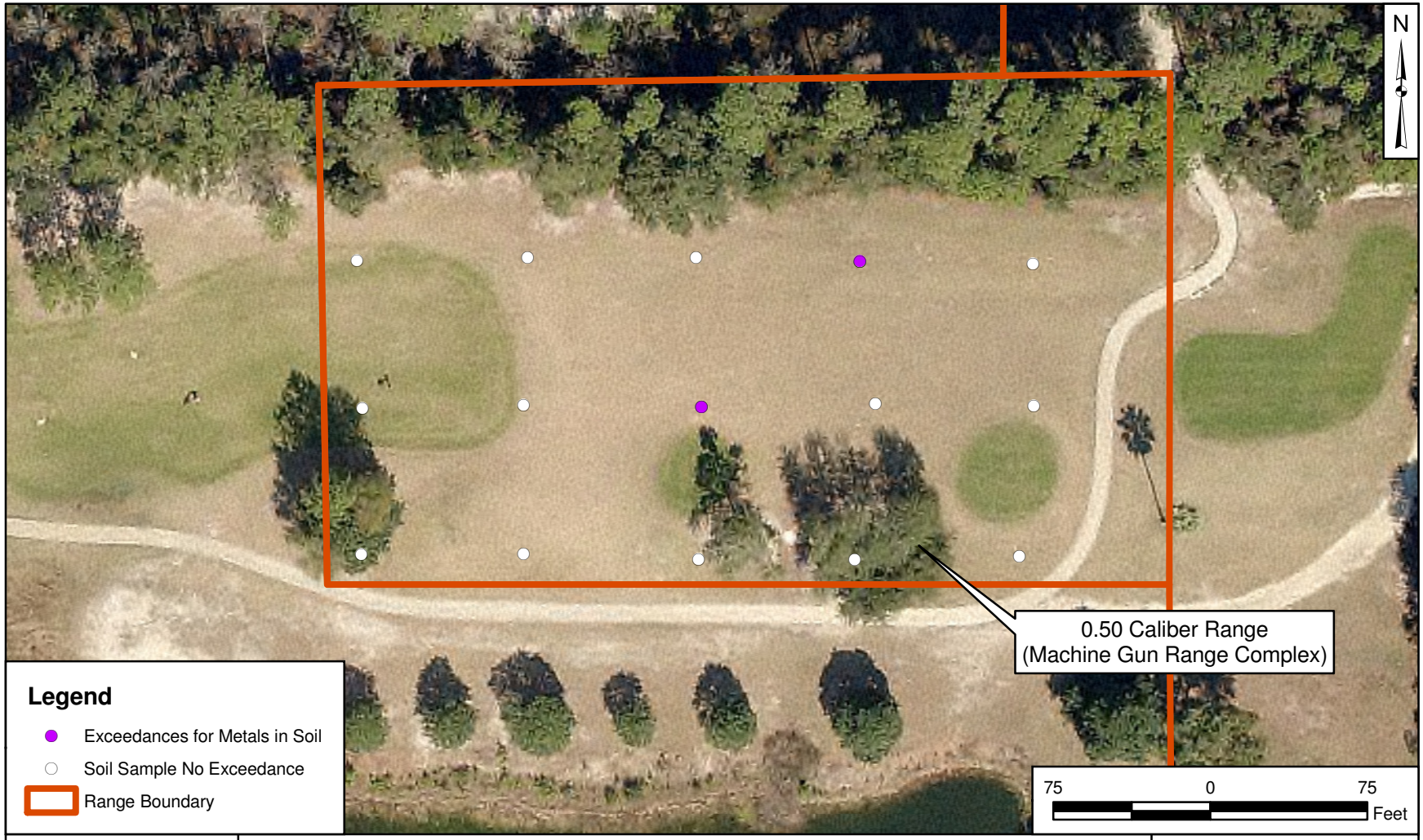
DRAWN BY T. WHEATON	DATE 06/15/10	TETRA TECH	CONTRACT NUMBER CTO JM55
CHECKED BY B. BECKER	DATE 08/30/11	SITE LAYOUT UXO 6 - TRAP RANGES MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY ___ DATE ___
REVISED BY ___	DATE ___		APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 4-8 / REV 0

P:\GIS\JACKSONVILLE_NAS\MXD\PSC22_ALL_SAMPLES.MXD 08/30/11 SS



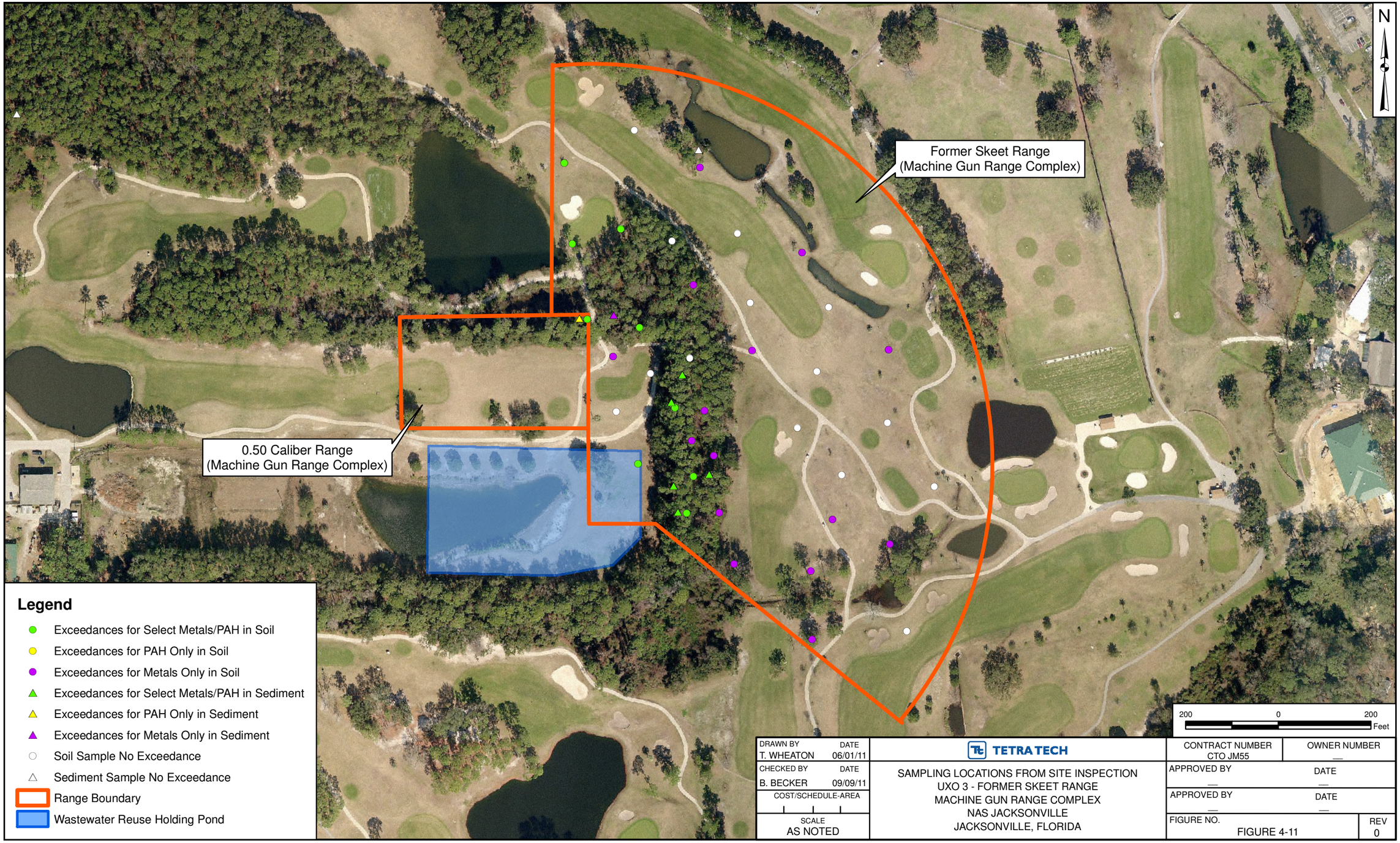
DRAWN BY T. WHEATON	DATE 06/01/11	TETRA TECH	CONTRACT NUMBER CTO JM55 / OWNER NUMBER —
CHECKED BY B. BECKER	DATE 08/30/11	SAMPLING LOCATIONS FROM SITE INSPECTION UXO 1 - FORT DIX SKEET RANGE MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY — / DATE —
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 4-9 / REV 0

P:\GIS\JACKSONVILLE_NAS\MXD\PSC23A_ALL_SAMPLES.MXD 08/30/11 SS



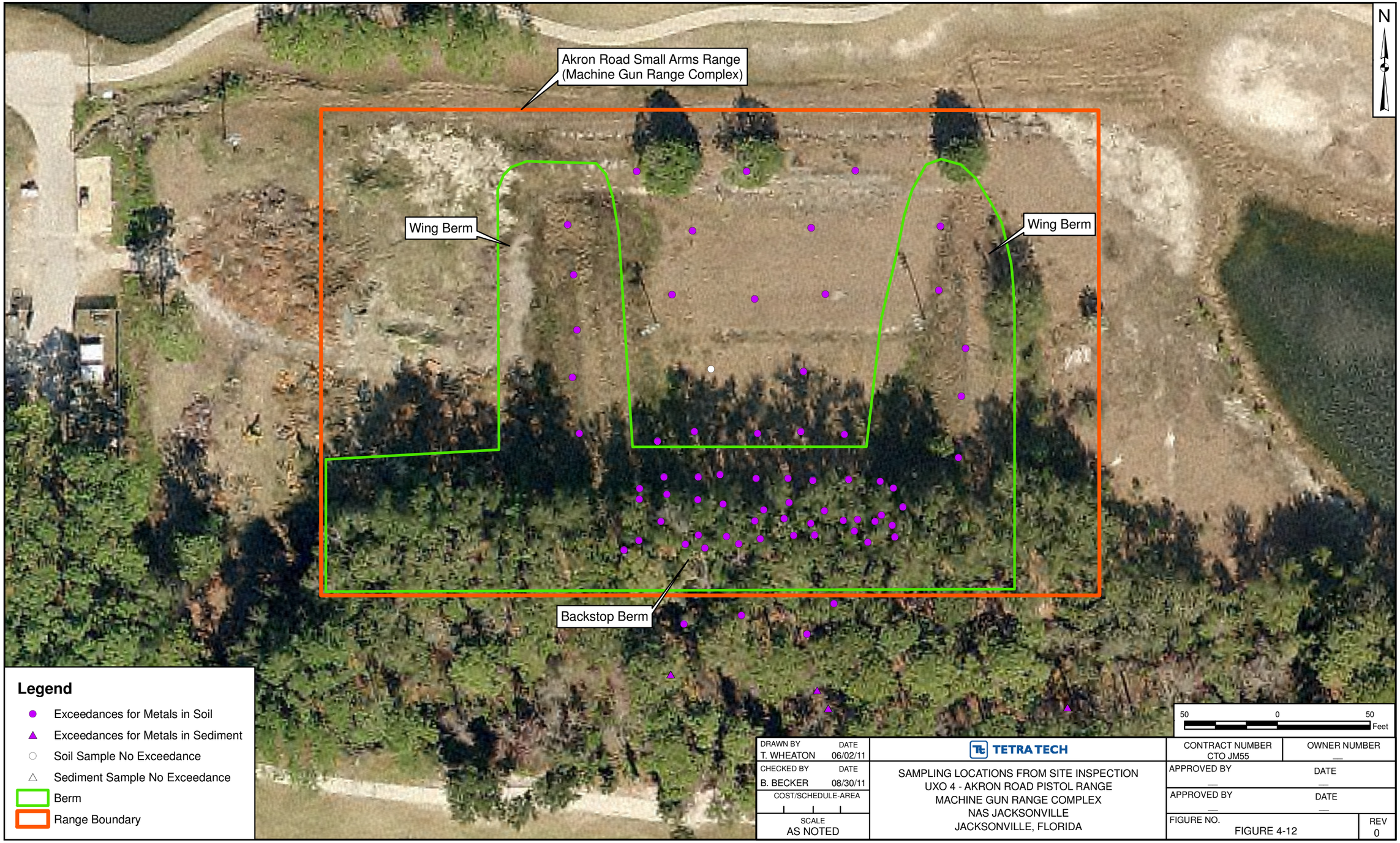
DRAWN BY T. WHEATON	DATE 06/01/11	TETRA TECH	CONTRACT NUMBER CTO JM55
CHECKED BY B. BECKER	DATE 08/30/11	SAMPLING LOCATIONS FROM SITE INSPECTION UXO 2 - .50 CALIBER RANGE MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY ___ DATE ___
COST/SCHEDULE AREA			APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 4-10 / REV 0

P:\GIS\JACKSONVILLE_NAS\MXD\PSC23B_ALL_SAMPLES.MXD 09/09/11 SS



DRAWN BY T. WHEATON	DATE 06/01/11	TETRA TECH	CONTRACT NUMBER CTO JM55 / OWNER NUMBER —
CHECKED BY B. BECKER	DATE 09/09/11	SAMPLING LOCATIONS FROM SITE INSPECTION UXO 3 - FORMER SKEET RANGE MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY — / DATE —
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 4-11 / REV 0

P:\GIS\JACKSONVILLE_NAS\MXD\PSC56_ALL_SAMPLES.MXD 08/30/11 SS

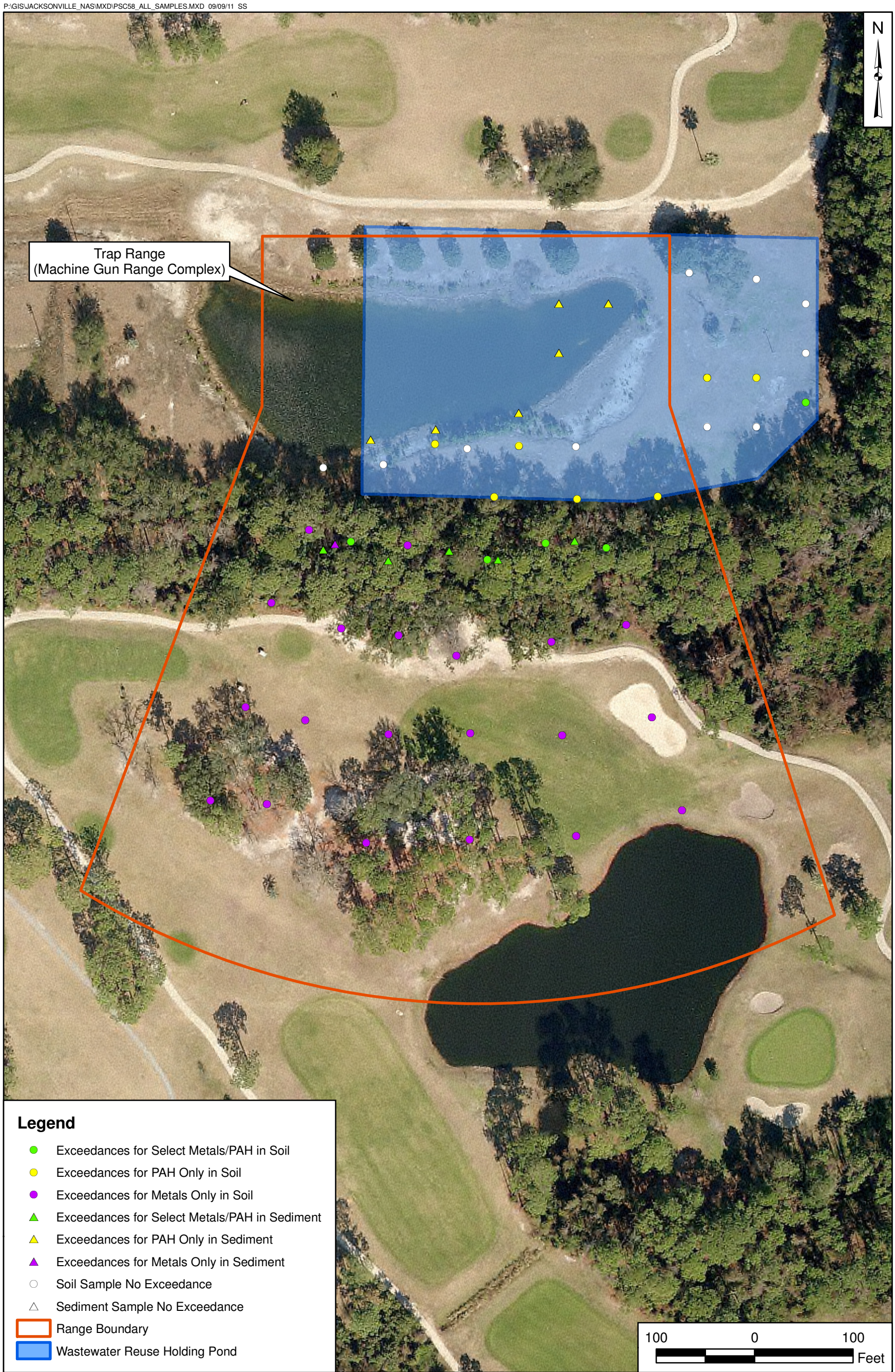


DRAWN BY T. WHEATON	DATE 06/02/11	TETRA TECH	CONTRACT NUMBER CTO JM55 / OWNER NUMBER —
CHECKED BY B. BECKER	DATE 08/30/11	SAMPLING LOCATIONS FROM SITE INSPECTION UXO 4 - AKRON ROAD PISTOL RANGE MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY — / DATE —
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 4-12 / REV 0

P:\GIS\JACKSONVILLE_NAS\MXD\PSC57_ALL_SAMPLES.MXD 08/30/11 SS

DRAWN BY T. WHEATON	DATE 06/01/11	TETRA TECH	CONTRACT NUMBER CTO JM55
CHECKED BY B. BECKER	DATE 08/30/11	SAMPLING LOCATIONS FROM SITE INSPECTION UXO 5 - .30 CALIBER RANGE MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY ___ DATE ___
COST/SCHEDULE AREA			APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 4-13 / REV 0

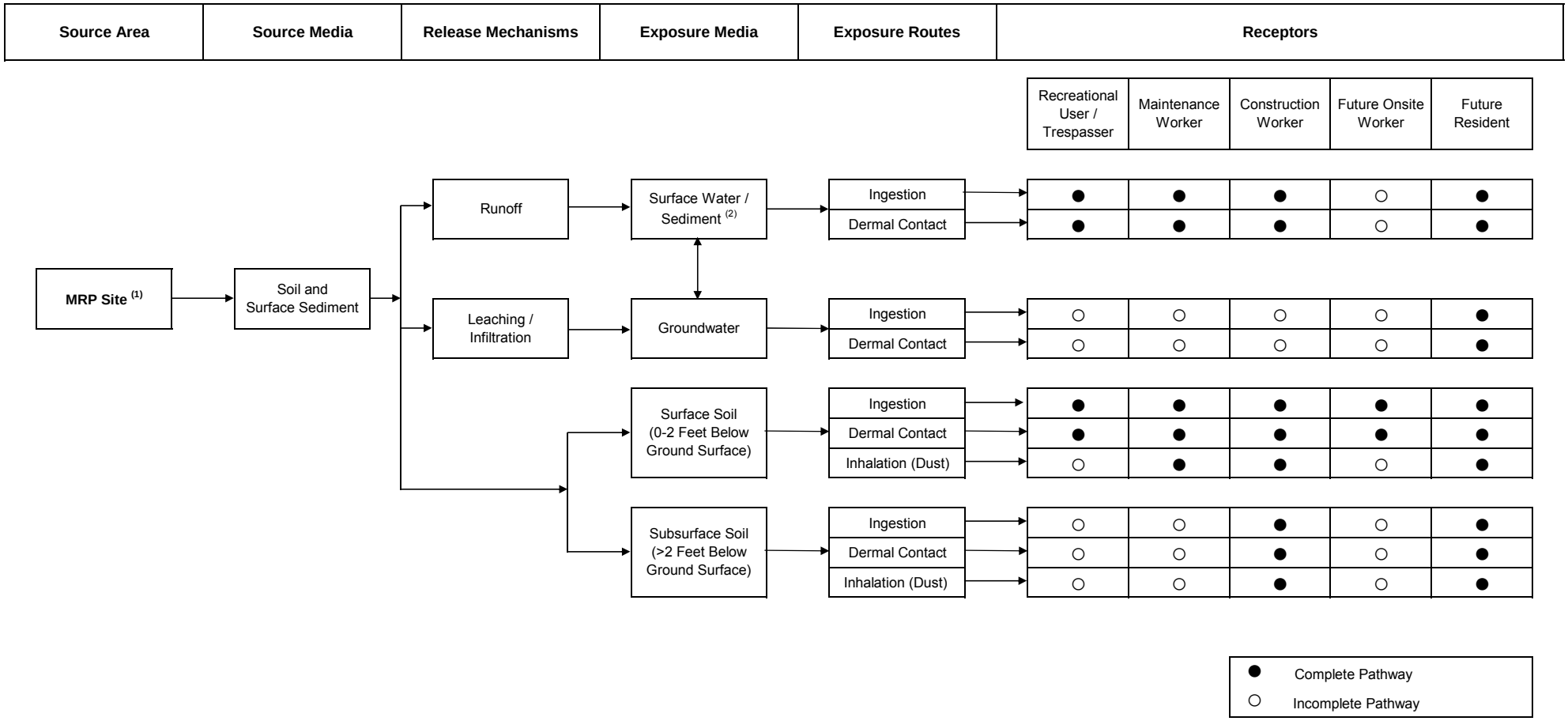
P:\GIS\JACKSONVILLE_NAS\MXD\PSC58_ALL_SAMPLES.MXD 09/09/11 SS



DRAWN BY T. WHEATON	DATE 06/02/11	TETRA TECH	CONTRACT NUMBER CTO JM55
CHECKED BY B. BECKER	DATE 09/09/11	SAMPLING LOCATIONS FROM SITE INSPECTION UXO 6 - TRAP RANGES MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY ___ DATE ___
REVISED BY ___	DATE ___		APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 4-14 / REV 0

FIGURE 4-15

HUMAN HEALTH EXPOSURE PATHWAY ANALYSIS
MACHINE GUN RANGE COMPLEX
NAS JACKSONVILLE, JACKSONVILLE, FLORIDA

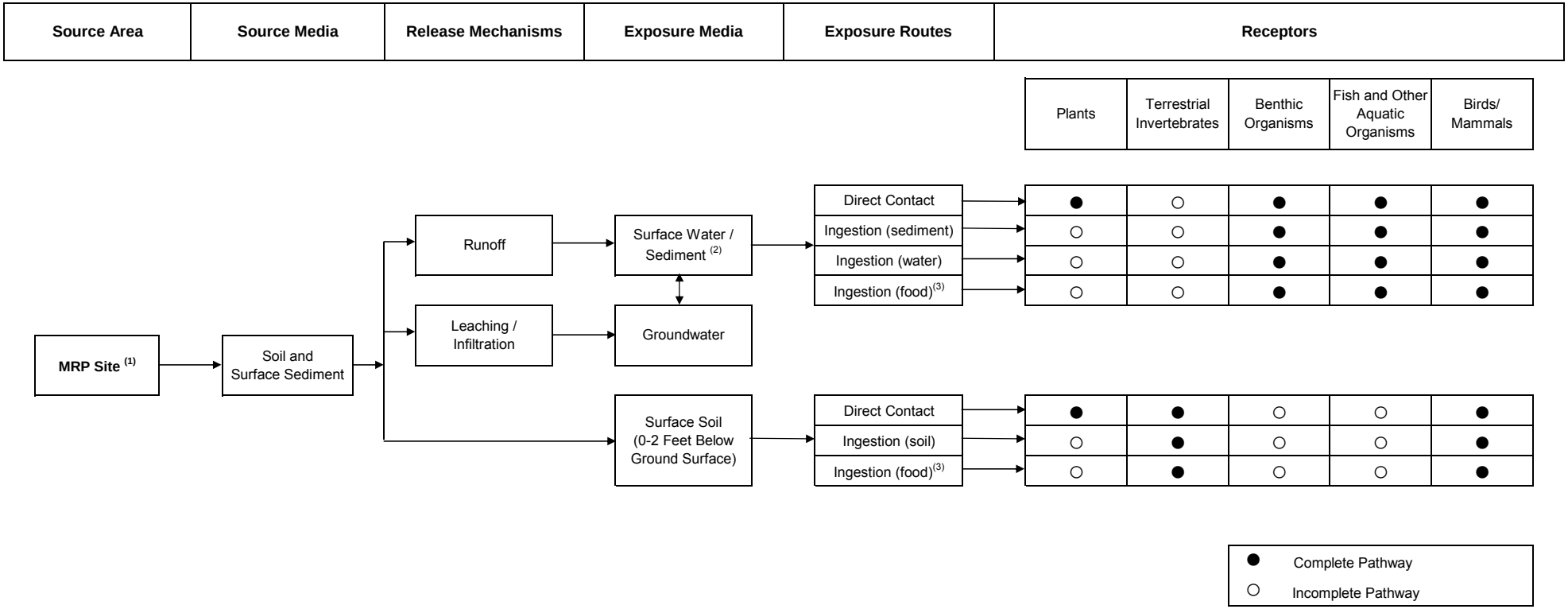


(1) Includes three Small Arms Range sites (.30 Caliber, .50 Caliber, and Akron Road Pistol Ranges) and three Trap/Skeet Range sites (Fort Dix Skeet, Former Skeet, and Trap Ranges).

(2) No surface water or submerged sediment exists within the boundaries of the three Small Arms Range sites; therefore, surface water/sediment exposure pathway is only applicable to the three Trap/Skeet Range sites.

FIGURE 4-16

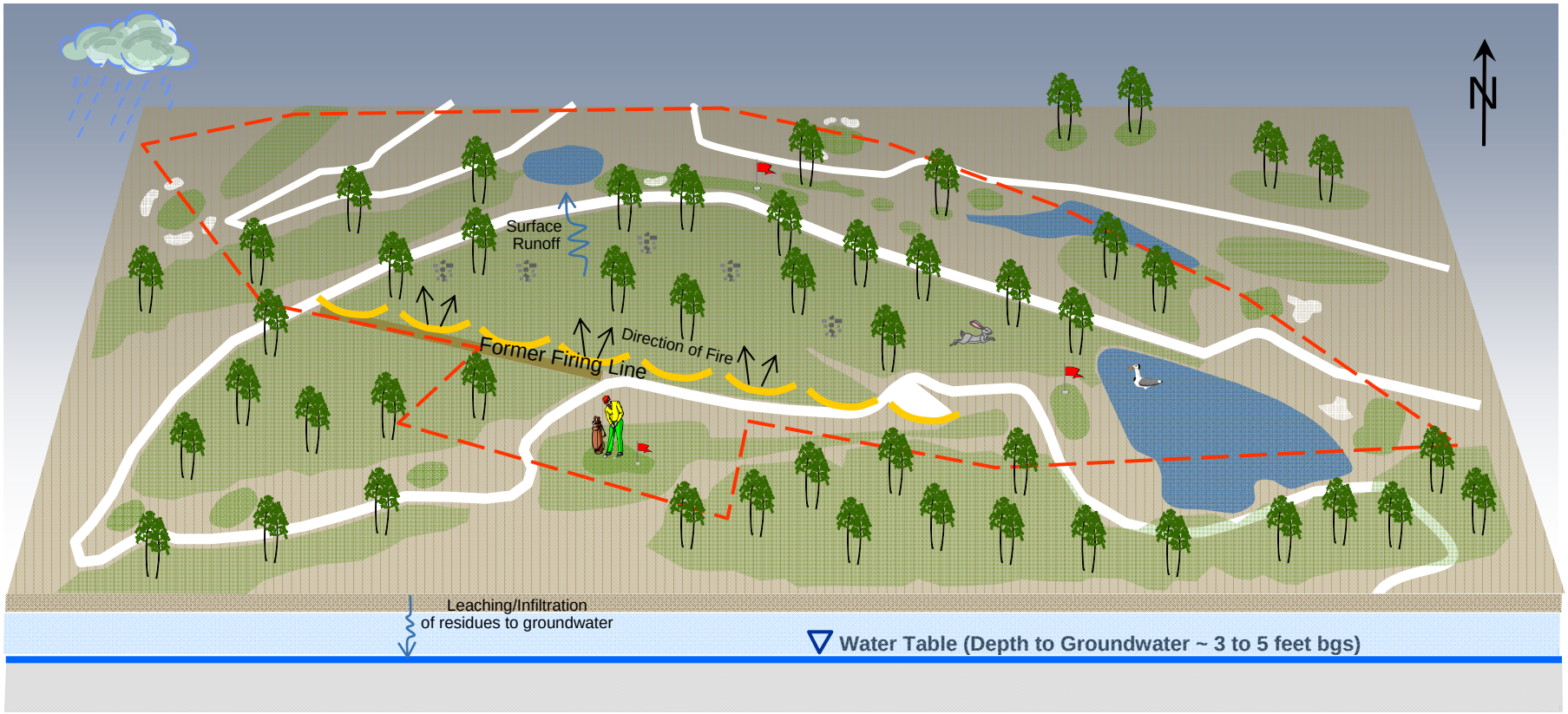
ECOLOGICAL EXPOSURE PATHWAY ANALYSIS
MACHINE GUN RANGE COMPLEX
NAS JACKSONVILLE, JACKSONVILLE, FLORIDA



(1) Includes three Small Arms Range sites (.30 Caliber, .50 Caliber, and Akron Road Pistol Ranges) and three Trap/Skeet Range sites (Fort Dix Skeet, Former Skeet, and Trap Ranges).

(2) No surface water or submerged sediment exists within the boundaries of the three Small Arms Range sites; therefore, surface water/sediment exposure pathway is only applicable to the three Trap/Skeet Range sites.

(3) Ingestion of food chain plants/animals affected by uptake of contaminated soil and sediment.



LEGEND

- Shot Gun Shell Residue and/or Skeet Fragments
- Wooded Area
- Firing Line
- Surface Water
- Range Boundary
- Water Table

Potential Receptors and Exposure Pathways

Human Receptors
- Site worker, maintenance worker, construction worker, recreational user, hypothetical resident

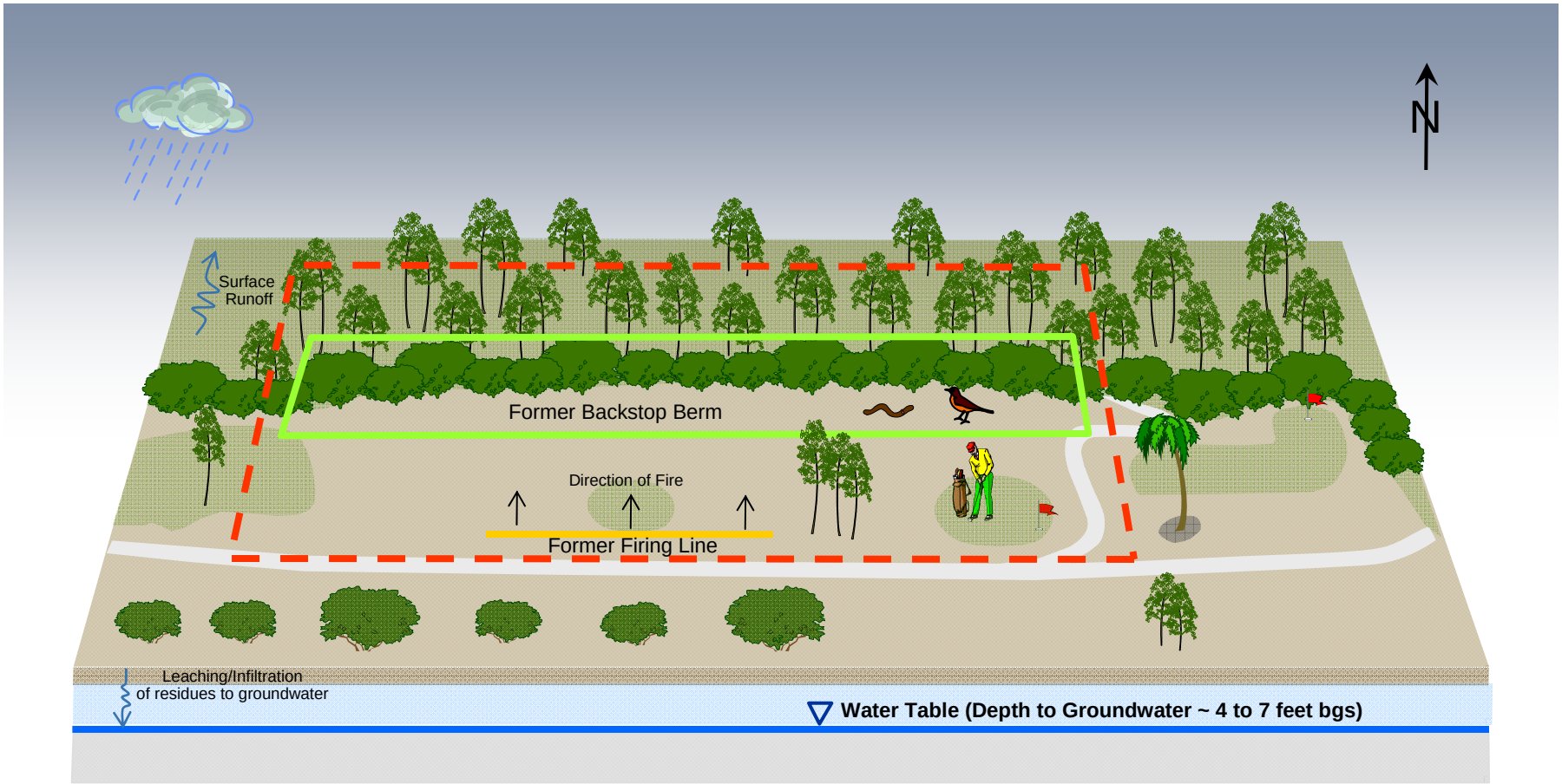
Ecological Receptors
- Plants, terrestrial invertebrates, benthic/aquatic species, birds, mammals

Surface Water/Sediment
- Dermal contact, ingestion

Groundwater
- Direct contact, ingestion

Surface/Subsurface Soil
- Dermal contact, ingestion, inhalation

DRAWN BY C. Pennington 9-11	DATE	CONCEPTUAL SITE MODEL UXO1-FORT DIX SKEET RANGE MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	CONTRACT NO. CTO JM55
CHECKED BY B. Becker 9-11	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE NOT TO SCALE			DRAWING NO. FIGURE 4-17 / REV.



LEGEND

- Backstop Berm
- Firing Line
- Range Boundary
- Water Table
- Wooded Areas

Potential Receptors and Exposure Pathways

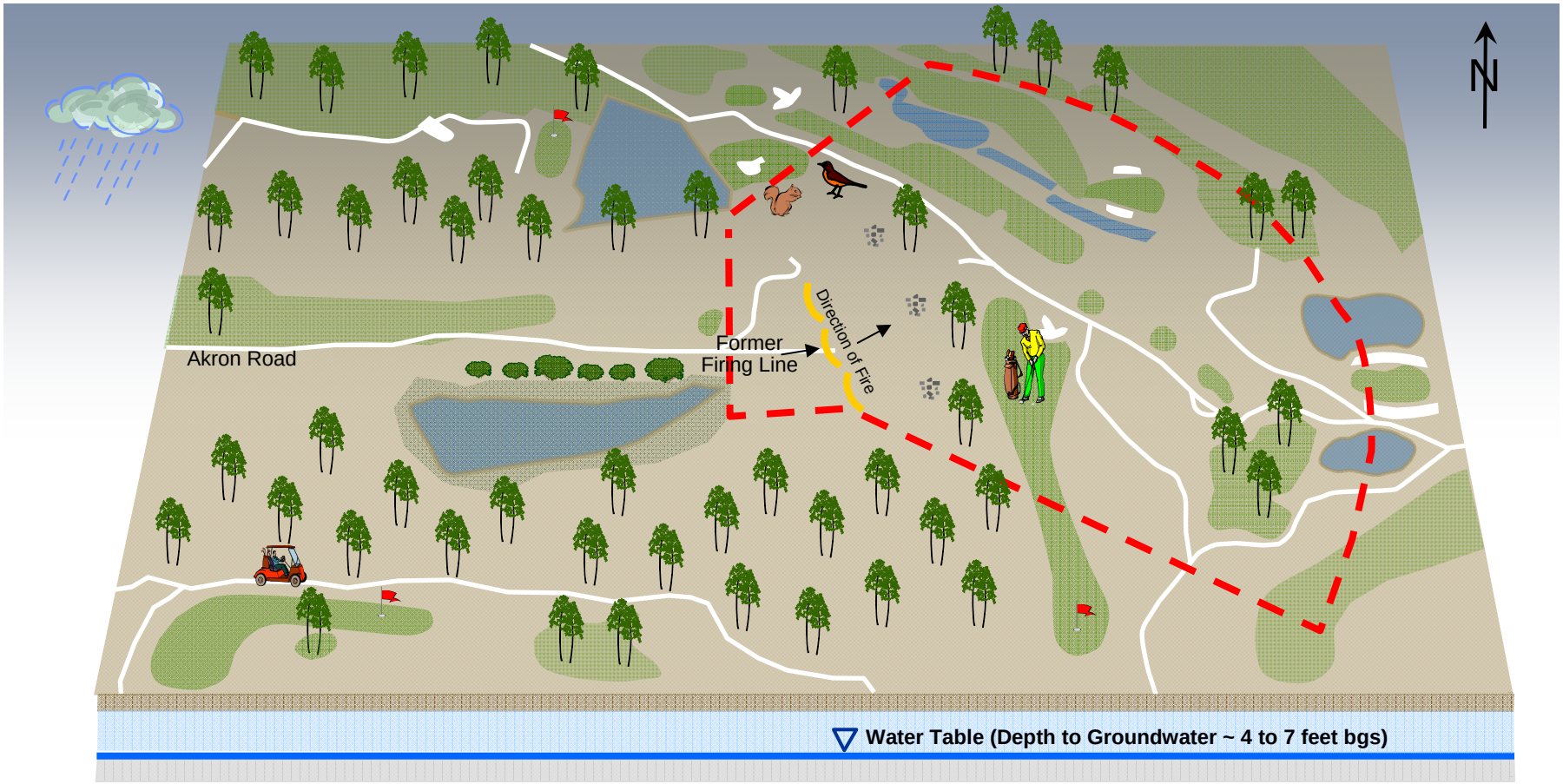
Human Receptors
- Site worker, maintenance worker, construction worker, recreational user, hypothetical resident

Ecological Receptors
- Plants, terrestrial invertebrates, birds, mammals

Groundwater
- Direct contact, ingestion

Surface/Subsurface Soil
- Dermal contact, ingestion, inhalation

DRAWN BY C. Pennington 9-11 DATE	NAVFAC	CONCEPTUAL SITE MODEL UXO2-0.50 CALIBER RANGE MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	CONTRACT NO. CTO JM55
CHECKED BY DATE			OWNER NO.
REVISED BY B. Becker 9-11 DATE			APPROVED BY DATE
SCALE NOT TO SCALE			DRAWING NO. FIGURE 4-18 REV.



LEGEND

- Shot Gun Shell Residue and/or Skeet Fragments
- Firing Line
- Range Boundary
- Wooded Area
- Surface Water
- Water Table

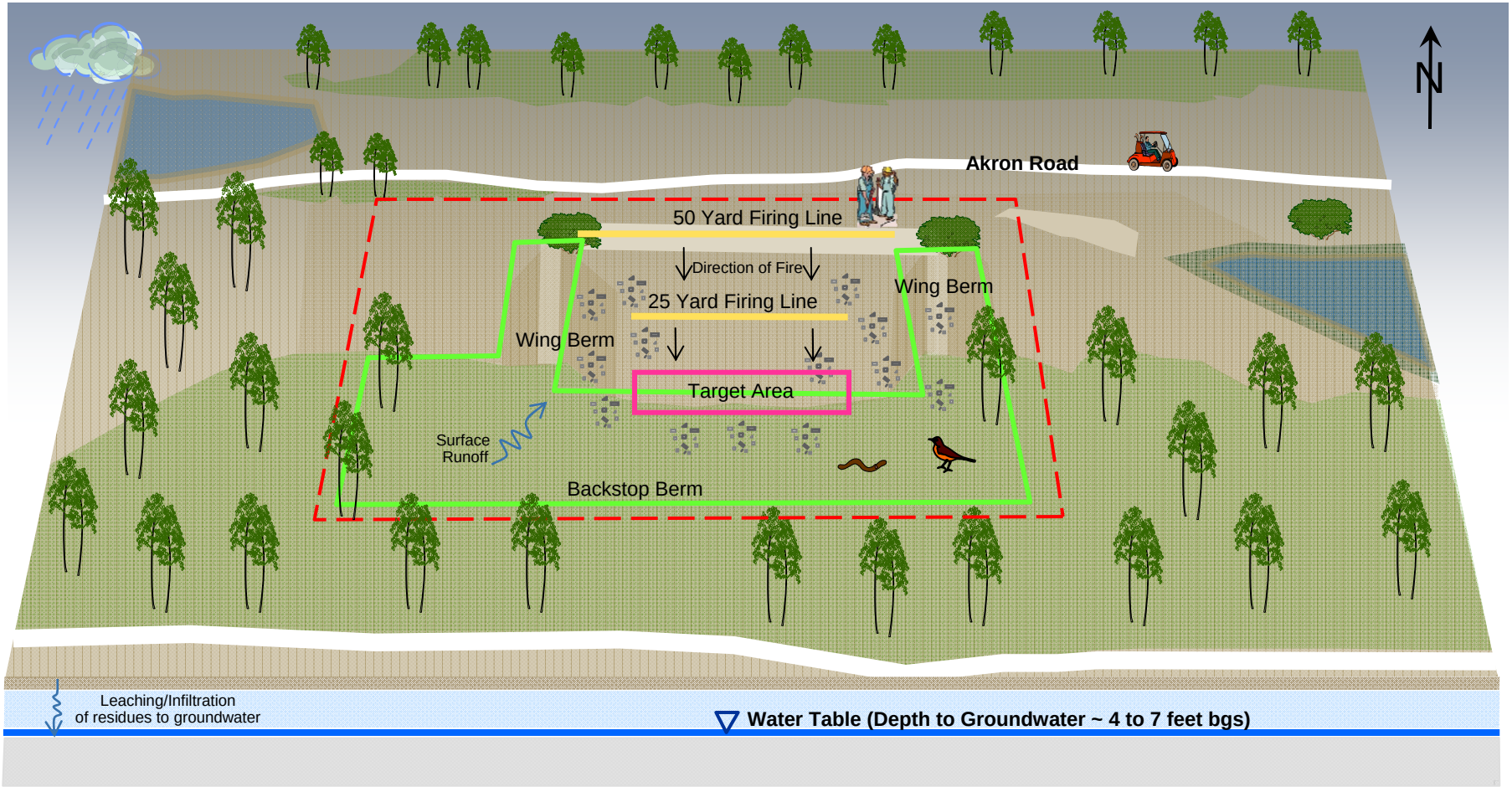
Potential Receptors and Exposure Pathways

Human Receptors
- Site worker, maintenance worker, construction worker, recreational user, hypothetical resident

Ecological Receptors
- Plants, terrestrial invertebrates, benthic/aquatic species, birds, mammals

Surface/Subsurface Soil
- Dermal contact, ingestion, inhalation

DRAWN BY C. Pennington 9-11	DATE	CONCEPTUAL SITE MODEL UXO3-FORMER SKEET RANGE MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	CONTRACT NO. CTO JM55
CHECKED BY B. Becker 9-11	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE NOT TO SCALE			DRAWING NO. FIGURE 4-19 / REV.



LEGEND

- Bullet Residue
- Range Boundary
- Backstop Berm
- Water Table
- Firing Line
- Wooded Areas

Potential Receptors and Exposure Pathways

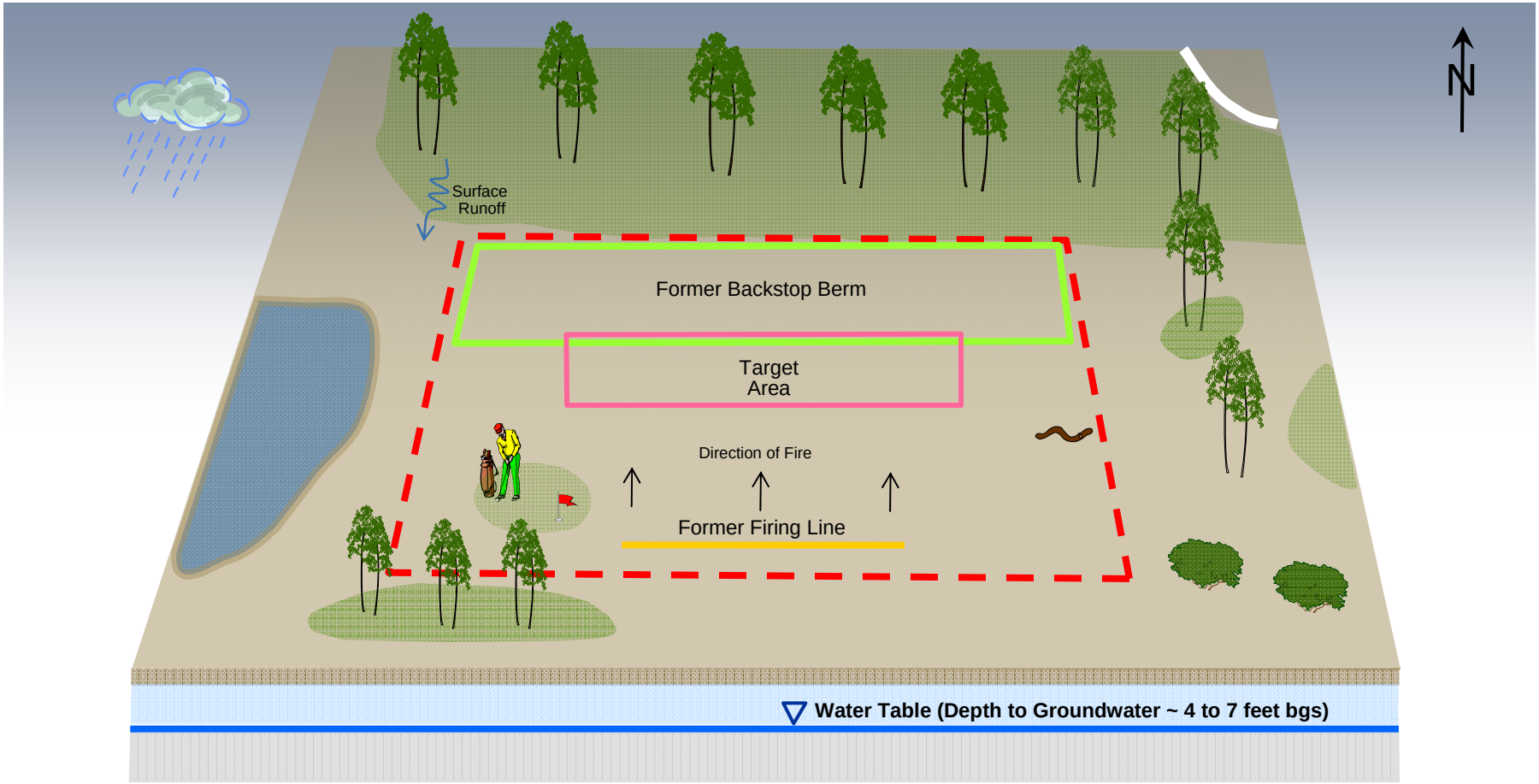
Human Receptors
- Site worker, maintenance worker, construction worker, recreational user, hypothetical resident

Ecological Receptors
- Plants, terrestrial invertebrates, birds, mammals

Groundwater
- Direct contact, ingestion

Surface/Subsurface Soil
- Dermal contact, ingestion, inhalation

DRAWN BY	DATE	CONCEPTUAL SITE MODEL UXO4-AKRON ROAD PISTOL RANGE MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	CONTRACT NO.	
C. Pennington	9-11		CTO JM55	
CHECKED BY	DATE		OWNER NO.	
B. Becker	9-11			
REVISED BY	DATE		APPROVED BY	DATE
SCALE			DRAWING NO.	REV.
NOT TO SCALE			FIGURE 4-20	



LEGEND

- Backstop Berm
- Firing Line
- Range Boundary
- Water Table
- Wooded Areas

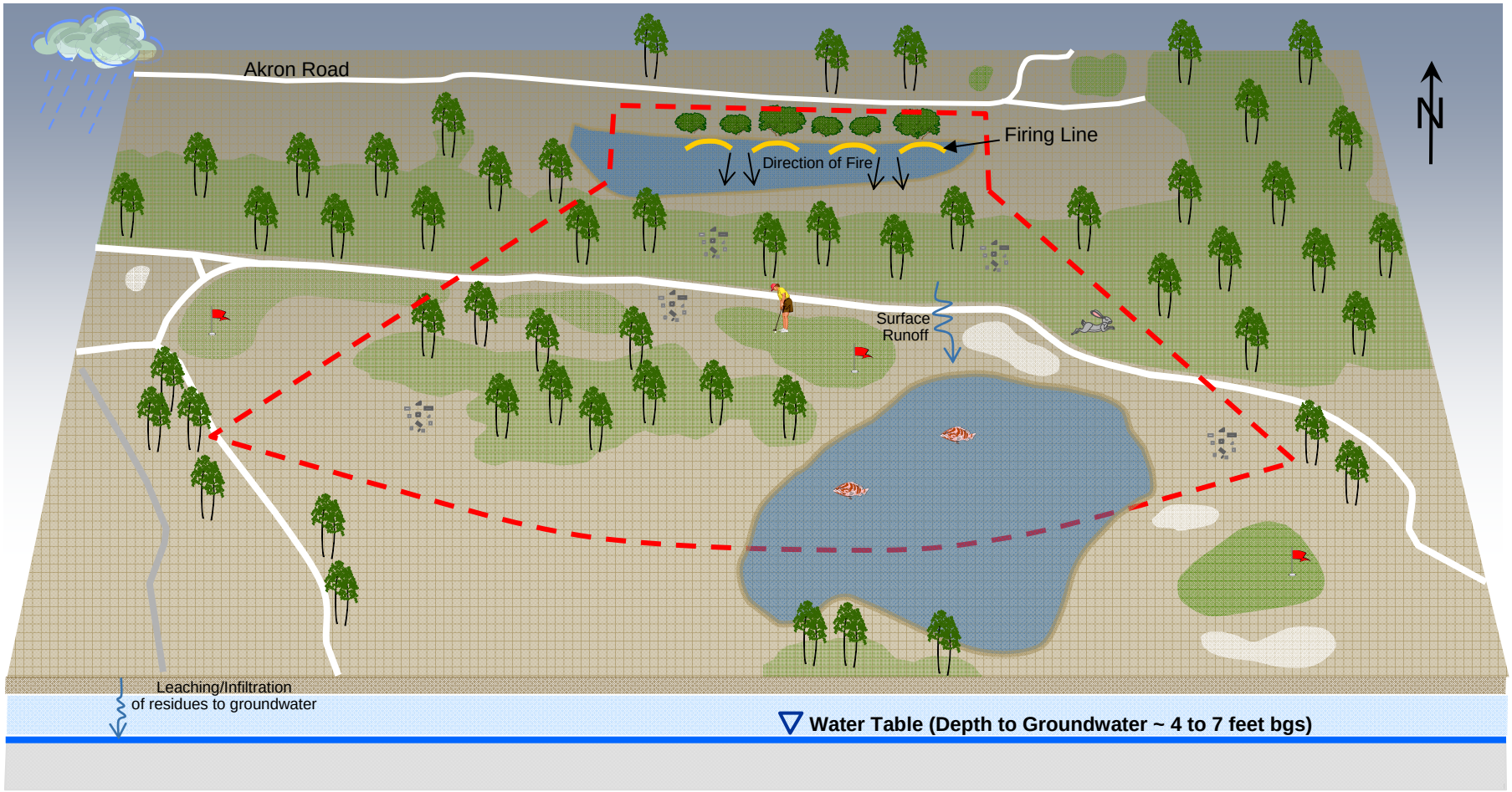
Potential Receptors and Exposure Pathways

Human Receptors
- Site worker, maintenance worker, construction worker, recreational user, hypothetical resident

Ecological Receptors
- Plants, terrestrial invertebrates

Surface/Subsurface Soil
- Dermal contact, ingestion, inhalation

DRAWN BY C. Pennington DATE 9-11	NAVFAC	CONCEPTUAL SITE MODEL UXO5- .30 CALIBER RANGE MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	CONTRACT NO. CTO JM55
CHECKED BY B. Becker DATE 9-11			OWNER NO.
REVISED BY DATE			APPROVED BY DATE
SCALE NOT TO SCALE			DRAWING NO. FIGURE 4-21 REV.



LEGEND

- Shot Gun Shell Residue and/or Skeet Fragments
- Wooded Area
- Firing Line
- Surface Water
- Range Boundary
- Water Table

Potential Receptors and Exposure Pathways

Human Receptors
- Site worker, maintenance worker, construction worker, recreational user, hypothetical resident

Ecological Receptors
- Plants, terrestrial invertebrates, benthic/aquatic species, birds, mammals

Surface Water/Sediment
- Dermal contact, ingestion

Groundwater
- Direct contact, ingestion

Surface/Subsurface Soil
- Dermal contact, ingestion, inhalation

DRAWN BY C. Pennington 9-11 DATE	NAVFAC	CONCEPTUAL SITE MODEL UXO6-TRAP RANGES MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	CONTRACT NO. CTO JM55
CHECKED BY B. Becker 9-11 DATE			OWNER NO.
REVISED BY DATE			APPROVED BY DATE
SCALE NOT TO SCALE			DRAWING NO. FIGURE 4-22 REV.

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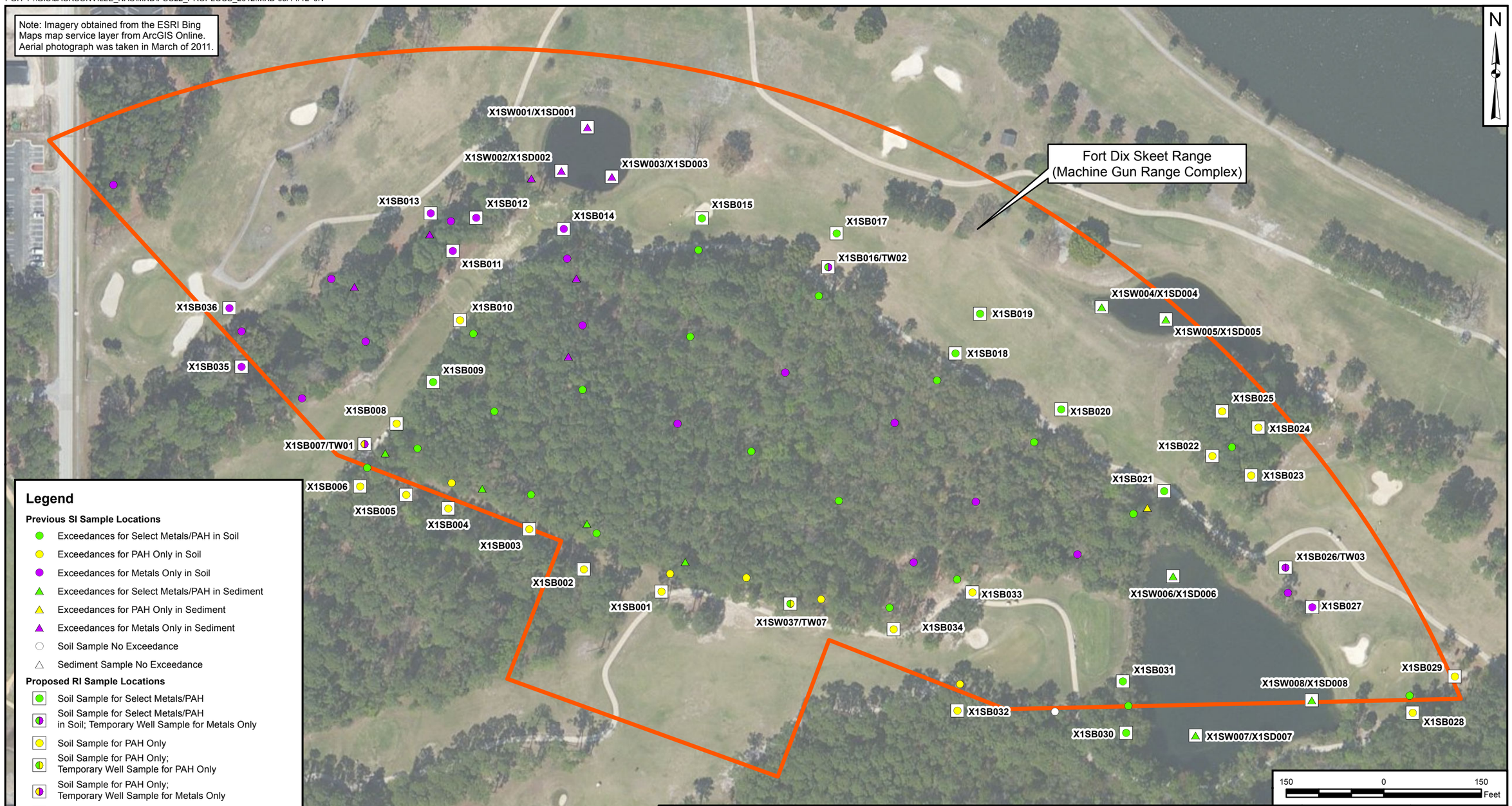
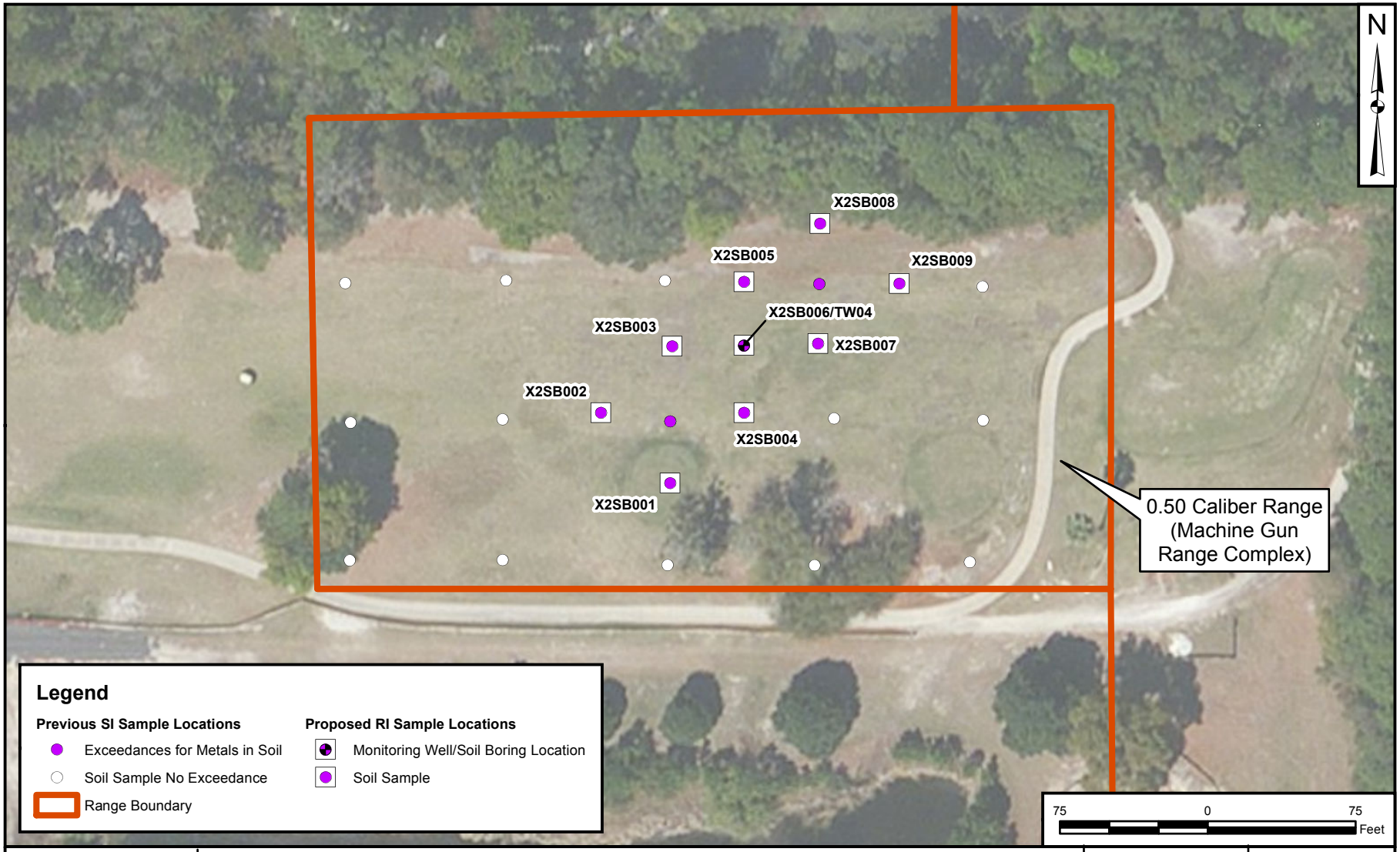


DRAWN BY	DATE	TETRA TECH	CONTRACT NUMBER	CTO NUMBER
J. ENGLISH	07/17/12		3621	JM55
CHECKED BY	DATE	PROPOSED SAMPLE LOCATIONS UXO 1 - FORT DIX SKEET RANGE MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY	DATE
B. BECKER	09/14/12		—	—
REVISED BY	DATE		APPROVED BY	DATE
J. NOVAK	09/14/12		—	—
SCALE			FIGURE NO.	REV
AS NOTED			FIGURE 7-1	0

PGH P:\GIS\JACKSONVILLE_NAS\MXD\PSC23A_PROPLOCS_2012.MXD 09/14/12 JN



DRAWN BY J. ENGLISH	DATE 07/17/12	TETRA TECH	CONTRACT NUMBER 3621 / CTO NUMBER JM55
CHECKED BY M. TRAXLER	DATE 09/14/12	PROPOSED SAMPLING LOCATIONS UXO 2 - .50 CALIBER RANGE MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY — / DATE —
REVISED BY J. NOVAK	DATE 09/14/12		APPROVED BY — / DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 7-2 / REV 0

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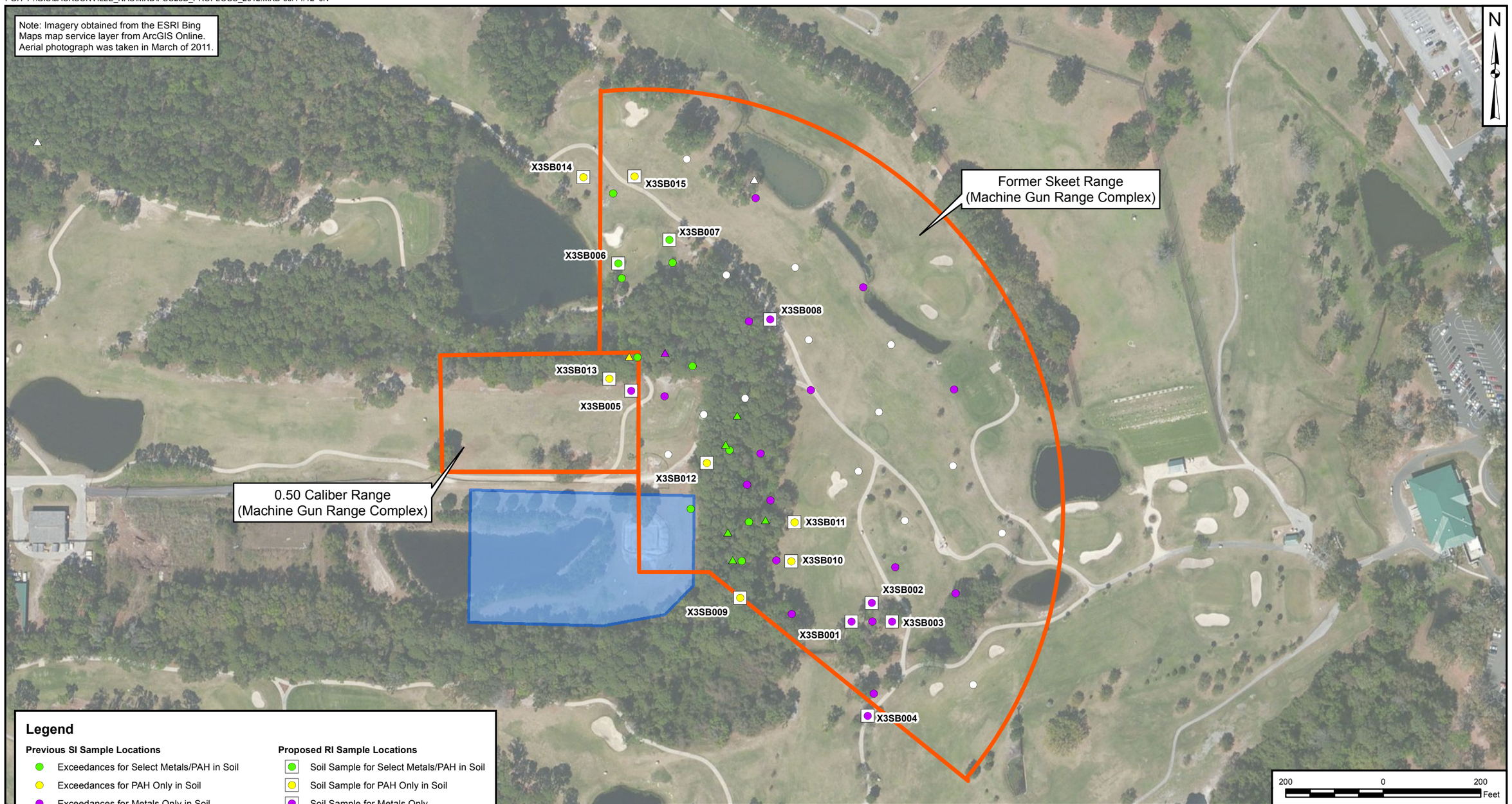

Legend

Previous SI Sample Locations

- Exceedances for Select Metals/PAH in Soil
- Exceedances for PAH Only in Soil
- Exceedances for Metals Only in Soil
- Exceedances for Select Metals/PAH in Sediment
- Exceedances for PAH Only in Sediment
- Exceedances for Metals Only in Sediment
- Soil Sample No Exceedance
- Sediment Sample No Exceedance

Proposed RI Sample Locations

- Soil Sample for Select Metals/PAH in Soil
- Soil Sample for PAH Only in Soil
- Soil Sample for Metals Only
- Range Boundary
- Wastewater Reuse Area

DRAWN BY J. ENGLISH	DATE 07/17/12	TETRA TECH	CONTRACT NUMBER 3621 / CTO NUMBER JM55
CHECKED BY B. BECKER	DATE 09/14/12	PROPOSED SAMPLING LOCATIONS UXO 3 - FORMER SKEET RANGE MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY — / DATE —
REVISED BY J. NOVAK	DATE 09/14/12		APPROVED BY — / DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 7-3 / REV 0

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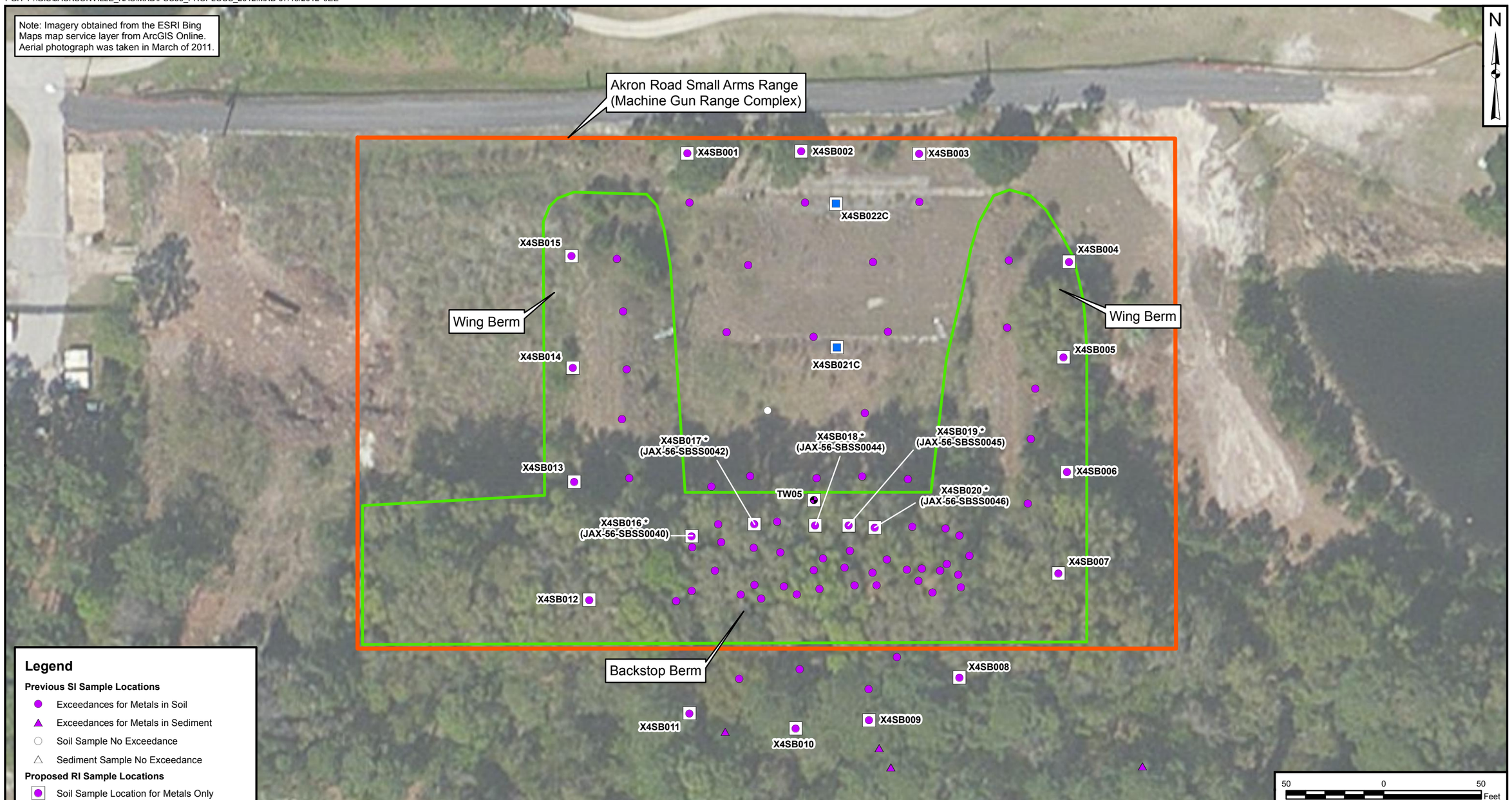

Legend

Previous SI Sample Locations

- Exceedances for Metals in Soil
- Exceedances for Metals in Sediment
- Soil Sample No Exceedance
- Sediment Sample No Exceedance

Proposed RI Sample Locations

- Soil Sample Location for Metals Only
- Temporary Well Location for Metals Only
- Composite Sample for Nitroglycerin Only
- Berm
- Range Boundary

* Vertical Delineation of Previous SI Sample Location (Previous Location ID in Parentheses)

DRAWN BY	DATE	TETRA TECH	CONTRACT NUMBER	CTO NUMBER
J. ENGLISH	07/17/12		3621	JM55
CHECKED BY	DATE	PROPOSED SAMPLING LOCATIONS UXO 4 - AKRON ROAD PISTOL RANGE MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY	DATE
M. TREXLER	07/18/12		—	—
REVISED BY	DATE		APPROVED BY	DATE
—	—		—	—
SCALE AS NOTED			FIGURE NO. FIGURE 7-4	REV 0

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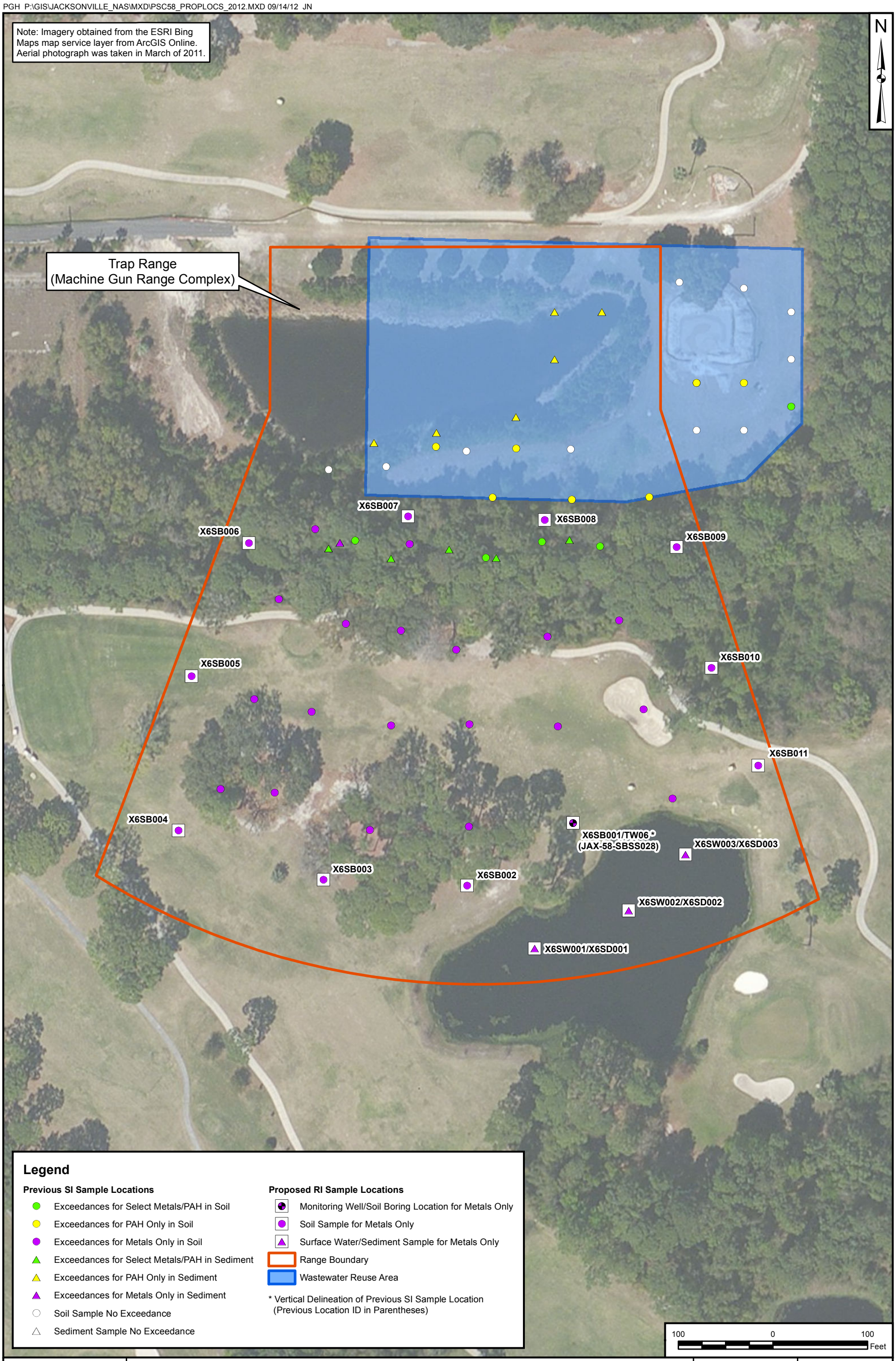

DRAWN BY J. ENGLISH	DATE 07/16/12	TETRA TECH	CONTRACT NUMBER 3621	CTO NUMBER JM55
CHECKED BY B. BECKER	DATE 09/14/12	PROPOSED SAMPLE LOCATIONS UXO 6 - TRAP RANGES MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY —	DATE —
REVISED BY J. NOVAK	DATE 09/14/12		APPROVED BY —	DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 7-5	REV 0

PGH P:\GIS\JACKSONVILLE_NAS\MXD\MACH_GUN_COMPLEX_TW_LOCS.MXD 09/14/12 JN

Legend

- Temporary Well Location
- Range Boundary

DRAWN BY	DATE
S. STROZ	09/01/11
CHECKED BY	DATE
B. BECKER	09/14/12
REVISED BY	DATE
J. NOVAK	09/14/12
SCALE	
AS NOTED	

TETRA TECH

TEMPORARY WELL LOCATIONS
MACHINE GUN RANGE COMPLEX
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NUMBER	CTO NUMBER
—	JM55
APPROVED BY	DATE
—	—
APPROVED BY	DATE
—	—
FIGURE NO.	REV
FIGURE 7-6	0

APPENDIX A

PARTNERING TEAM MEETING PRESENTATIONS AND MINUTES

NAS JACKSONVILLE PARTNERING TEAM MEETING MINUTES

March 22nd & 23rd, 2011

Jacksonville, Florida

Attendees:
David Grabka
Adrienne Wilson- Gate/Timekeeper
Eric Davis
Gus Campana, Facilitator
Julie Johnson – Scribe
Mark Peterson
Tim Curtin
Hal Davis, USGS
Casey Hudson - Chair

Guests: Mike Maughon, TtNUS; Alan Pate, TtNUS

1.0 Team Meeting and Introduction

1.1 Team member greeting, introductions, and check in – Done
1.2 Assignment of Team Roles: Gate/Timekeeper – Adrienne Wilson; Chair – Casey Hudson; Scribe – Julie Johnson
1.3 Read Team Ground Rules – Ground rules were read

2.0 Initial Agenda Items

2.1 Review, submit revisions to, and reach consensus on previous meeting minutes. Done

Understanding: Team members approved the minutes from the January 2011 meeting.

2.2 Report on Assigned Actions Items and Parking Lot Items. Done.

NAVFAC SE presents current budget execution plan – Adrienne discussed the funding schedule: BOA funded for Monitoring PCA 25, CH2MHill funded for Gas Hill, PSC 47, VI Phase III, and 106 decommission. Yet to be funded is an RD for Site 38 and Hangar 1000 monitoring.

3.0 Agenda

3.1 Schedules/SCAP/Exit Strategy/FDEP Document Tracker: Mark provided the team with a copy of the TtNUS and CH2MHill Document Review status list and Casey, Eric and Mark reviewed the status of report reviews.

Adrienne reminded everyone when working on projects to keep the FFA SMP dates in mind.

Dave briefly reviewed his document tracker and has some BOA reports on his list of things to do. Everything on the document schedule appears to correspond to Dave's document tracker. Dave said he has a final SI report to sign off on for the MRP sites.

3.1.1 Team Development – Gus Campana – Leadership Principles of Dwight D. Eisenhower leadership principles.

3.2 OU 1– Tim Curtin – Tim asked Dave if he received the report from Aerostar, Dave said he doesn't see it on his tracker. Tim said they sampled in November.

3.2.1 LTM Update and Landfill Maintenance – OU 1 will be mowed by a grounds keeper. New signs at all of the IR sites that needed signs.

3.3 OU 3 – Discussion regarding the SMP dates for the RI Addendum and the FS Addendum.

Mark said Tetra Tech is out in the field conducting sampling.

Tim said he doesn't understand why soil sampling is being conducted only on the boundary of OU 3 when there are no soil results within OU 3. Mark proposes to table the soil sampling until the team revisits this concern and come up with a soil sampling strategy to present to Pete and Dave at the next team meeting. Mark said, looking at the data we have, a lot of the source areas are groundwater plumes at below 2 feet bgs (at depth). Mark said the team will be looking at Area G and the locations where EE/CA removal actions were conducted. Tim said he had results from Building 106 and the samples were clean.

3.3.1 OU 3 Preliminary Groundwater Results Discussion – Donald came in from field work Day 2 to discuss preliminary results of the trident probe event being conducted in Areas F and G. So far all non-detect for the first two proposed sampling grid points. Conductivity is running around 2 -3 microSiemens per centimeter (µS/cm). Moved closer to the shoreline and definitely getting groundwater. Hal said he would expect the groundwater would come up along the shoreline since the clay layer is thin there. Tim questioned if they had found where the water was bubbling up approximately 100 feet out. Donald said he is not sure where that is. Donald suggested only sampling two additional locations on the proposed grid on the last two grid points. Asked the team if they thought they should increase the data density closer to shore. Mark agreed and said also, locate the pipe and sample a few points further offshore. Mark said that we are also collecting surface water samples. Dave asked if just conductivity is being used. Donald said temperature is also being taken. The probe goes in a maximum depth of 2 feet and measures temperature and conductivity. Donald said there are two different probes, but they have three different probes. Mainly using the one to measure conductivity and temperature above and below. Donald said they think they can complete the task in two weeks, 1 week ahead of schedule.

The team agrees to increase density. Also, suggested sampling where the seawall ends.

3.3.2 Storm Sewer Outfalls Discussion/Review. Mark Peterson – Mark presented a figure from the Area E RI/FS Addendum showing DPT points and storm sewer samples with relatively low contamination at the east/west transect – Enterprise Avenue. Cis-1,2-DCE at 1.2 and PCE at 3.2 ppb.

3.3.3 Vapor Intrusion Discussion – Casey Hudson - Waiting for comments from Pete and Dave on Phase I (identified AOCs) screening study, just were funded for Phase II (concurrent indoor air, sub slab, and outdoor air sampling). Looking to see if the pathway is complete and if it is significant. Determine site specific attenuation factors. There will be a work plan with conceptual model, site ranking, and discussion of the investigation approach, and then the UFP-SAP will follow that. Looking at getting in the field in September to collect samples.

Will set up a DQO conference call to discuss CSM and strategy.

Action Item: Adrienne to get with Mike Singletary regarding the Geosyntec Presentation for next meeting.

3.4 OU 6 (PSC 52) Hangar 1000 – In the process of responding to regulator comments for the Annual Report for Hangar 1000.

Action Item: Dave/Tim to look for Ensafe Monitoring report January 2005 report for Alan to incorporate into the Annual Report.

3.5 OU 7 PSC 46 Update – DRMO – Casey – After 3 ½ years (stopped work) and 2 ½ years for ESS there is an interim approval to proceed. Not closing Hwy 17 for unintentional detonation. Hoping to get started in May.

3.6 OU 8 PSC 47 – Eric – Going to conduct the final sampling event under that task order next week. Should have the event completed in 8 days. A tech memo will be issued sometime in May. A new task order will be active in September or October. Eric said they are going to survey a well and sample some perimeter wells to address some of the FDEP concerns/comments for the 2009 Annual Report.

Tim said he just purchased 400 Dolphin locks for the wells with rusted locks. Tim said some of the stick up wells have rusty hinges. Tim would like to be made aware of any wells in need of repair so he can add them to the list.

3.7 Petroleum Sites
3/22/11 - Dave said there is still no petroleum SMP, Tier II working on this.
Dave said this will be separate from the Exit Strategy.

3.7.1 Gas Hill (PCA 4)– Eric Davis – Waiting on Dave G.'s approval for the Annual Monitoring Report. A new task order will be started in September or October with Semi-Annual Monitoring and installation of two new compliance point/data gap wells (35 feet at terminal depth).

3.7.2 Hawkin's Property –
With regards to last meeting action item: Dave to determine the states position and the path forward for the Hawkins' Property. Dave said since wells on the property show signs of contamination, and it is likely coming from another property, the Navy is quite likely not responsible. But the data is too old.

Action Item: Mark to contact Eileen M. at the COJ to determine the status of the Kerr-McGee site.

Action Item: Mark to see about reconstructing the information regarding the 2003-2004 removal action. Find the Oculus number for the Kerr-McGee site.

3.7.3 PCA 25- Boat House Area – Mike M. is working on the SAR and the MNA plan will be appended to it.

3.7.4 NEX Gas Station (PSC 56)– SAR has been completed and in internal review. Will be sending out by the end of April. Tim C. said the NEX have been discussing moving the NEX Gas Station and proposed USTs; however, the skipper said no USTs only ASTs, so at this time they are not going to move it. Tankers refill every day.

This site is going to be closed out as a petroleum site and moving to the IR program.

3.7.5 Kemen Test Cell – Nothing new to report.

3.7.6 PSC 57 - S-3 High Power Turn up Pad – This site is closed out as a petroleum site and is part of the IR program. The site is going to be demolished and the blast deflector will be hauled out to Cecil for disposal. The concrete will be tested for contamination and disposed of offsite. New number is PSC 57.

3.8 MRP Sites Update– Mark reviewed preliminary results of PSC 58 pond sampling event conducted March 17 and 18, 2011. The contractor installing the new pond for the water reuse project. All effluent will go to this pond. There will be two sections, one is stormwater and the other side will receive reclaimed water. A berm will separate the two sections. The dirt 22,000 cy and place ½ on the property to west of the site and some portion and use it for fill at demo sites, and the remainder will be stock piled. The initial test results report benzo(a)pyrene (BAP). Mark and Alan discussed the initial SI and results. The deepest samples were to 2 feet and results showed PAHs and lead. Comparing to residential and industrial, lead is below residential and industrial and does not appear to be an issue.

PAHs – Collected three sediment grab samples. Currently the pond is approximately 3 to 9 feet and will be dug to 14 feet deep. Mark said that the PAHs exceeding the ecological screening

values. One residential exceedance for BAP (but below industrial) in the sediment sample location SD12.

Dave G. a potential solution for the sediments would be to take the top 1-foot off the bottom and put in a separate pile and assume below that is clean. Test it once the dewatering is complete and determine the proper handling at that time.

Samples were taken from the slurry pond. There were 3 locations they were unable to sample, due to the construction of the pond. There are two points of concern, SS043 and SS040. Mark thinks there is delineation within 2 feet. Dave pointed out there is no tag on one SS point. Alan will check on that label. Mark suggests segregating and stockpiling the soils.

Action Item: Alan to check on tag missing label on the PAH figure and also check the depth intervals.

Mark reviewed the area showing 0-6 inches, 1 – 2 feet and 2 – 3 feet samples taken. Alan said the samples were taken outside of the silt fencing barrier or the proposed excavation area. Mark reviewed the figure from the SI and discussed that there were hot areas in the drainage ditch. Mark said that the ecological screening criteria are exceeded in locations SS033 to 3 feet and SS034 to 2 feet. Mark asked if 3 feet will be sufficient for segregating out. Mark said that at the proposed edge of the pond, exceedances to 3 feet are right on the edge. Casey said they possibly stockpiled soil from excavation 10 years ago to that area of deeper exceedances. Mark asked what limits are we going to for the stockpiling. Mark said, at the trouble spot, you're at 3 feet and still above industrial.

Tim said that the contours for the pond design looks pretty steep. The drawings show max slope 4:1. Bottom elevation 8 feet and top of bank elevation is 22 feet. Tim said it would be a good idea to use the dirt from the area with contamination to 3 feet to build the berm, the remainder of the dirt will be stockpiled at the antenna area.

The contractors need to be given a map showing where to excavate and where to stockpile. Doing that during this meeting.

3.9 PSC Sites with LUCs and no RODs – Pete Dao's comments are being addressed and the final will be submitted after his approval of the response to comments.

3.10 PSC 45-Building 200 Wash Rack – Mark – The UFP-SAP is completed. The soil removal action is being conducted by CH2MHill and they will conduct the confirmatory sampling at that time. Mark asked if EPA is going to require an EE/CA.

Action Item: Adrienne to determine whether an EE/CA or an Action Memo is needed for PSC 45 and add to scope of work.

3.11 PSC 55-UFP SAP review/comment- Incorporating comments from the Navy and regulatory review. Have not received comments from EPA. The berms are too high for DPT equipment, Alan asked Dave if it was acceptable to hand auger and install temp wells instead of DPT for screening. Dave said he will still require one permanent well if the temp wells show no contamination. Dave G. said he would allow grab samples for screening only. If they all come up clean, install a single groundwater well in the area most likely to be impacted. Mark said use pre-packed well screens for the grab samples.

Action Item: Mark to follow up with Pete Dao and get his consensus on Dave's agreement to allow grab samples for screening only. If they all come up clean, install a single groundwater well in the area most likely to be impacted.

3.12 PSC 38 – UFP SAP review/comment – UFP-SAP in the process of being internally reviewed.

3.13 Five-Year Review – Draft-Final Five Year Review and response to comments for the Draft Five Year Review were sent out to the regulators and the Navy on February 25, 2011. Comments were received from HQ via Pete Dao on March 3, 2011. Tetra Tech will address comments and

prepare another response to comments letter once the rest of the reviewer comments are received.

4.0 Miscellaneous

4.1 Proposed Construction Update – Tim Curtin – Tim gave an update of proposed construction and current construction projects.

- Looking at installing a geothermal HVAC system at the post office.
- Looking to demolish Buildings 103 and 105 in several years.
- Modifying the P3 hangars for P8 jets.
- New air traffic control tower will be in the area of Buildings 103 and 105.
- A slab at Building 160 near Building 106 is going to be demolished.
- Child Development center is moving along, may be completed by the end of June 2011.
- Looking to demolish Building 11, was a BOQ.
- Looking to replace the mooring field and a lot of piers in the marina.
- The hospital is close to completion.
- The reuse project has started.
- Grading projects and shoreline stabilization projects.
- Replacing the deluge sprinklers in the FRC area.
- Designing new windows in Building 101.
- Putting up a lead wall.
- Repaving Sea King Alley, between the helicopter hangers and FRC.

4.2 Tier II Update – Tier II is meeting now. The team looked at an example SMP for Cecil Field that Dave Grabka emailed. The team reviewed the Petroleum Program Schedule in the appendices of the SMP. Also the team looked at Submittals and Time Frames for Person Responsible for Site Rehabilitation (PRSR). This form shows Type of report or activity and PRSR Action or Submittal Time Frames from Chapter 62-770, FAC.

4.3 Institutional Controls Implementation Plans Update – Tim reported that new signs have been installed at the IR Sites. Tim has been doing his inspections.

4.4 NIRIS Update – Nothing new to report.

4.5 RCRA Activities – Dave reported that the RCRA department at FDEP just completed their review of the PSC 42 report and submitted comments for the Five-Year Review. Jane B. is on medical leave.

4.6 Exit Strategy Review – reviewed for each site as meeting progressed. **BOLD ALL CHANGES.** Adrienne provided Mark with the Exit Strategy with the SMP column added. Adrienne and Mark are updating the Exit Strategy after the partnering meeting closes. Mark and Adrienne will be working on incorporating the Petroleum SMP into the Exit Strategy after the meeting.

4.7 BOA Contracts Update and Schedule – Nothing new to report. BFA and Aerostar are the two BOA contractors. BFA was out in January or February sampling Areas B and G. Aerostar will be sampling PSC 51 in a month or two. Most events are annual events, Areas B and G are every two years.

4.8 RAB Presentation Review. The team went through the RAB Presentation and prepared it for the RAB meeting. Day 2 check in: The team felt the RAB meeting went well. Approximately 5 community members were in attendance. The team said good questions were asked.

4.9 OLF Whitehouse Discussion – Tim Curtin. Dave said they found an Environmental Baseline Survey in 1995 and ranked the sites at OLF Whitehouse. Dave said there has to be a petroleum site out there. Other sites were ranked as gray, unknown. Dave said OLF Whitehouse stands out since nothing is being done there.

Action Item: Dave to send the OLF Whitehouse EBS to Tim Curtin (the team), by next meeting.

5.0 Meeting Closing

5.1 Review Meeting Consensus Items – None

5.2 Review Meeting Understandings – Done

5.3 Review Action Items – Done

5.4 Next Meeting Proposed Agenda Changes

5.5 Set the future meeting dates in advance.

Meeting Date	Meeting Time	Location	Meeting Chairman
5/10/11	8:00 a.m. to 5:00 p.m.	Jacksonville – Tetra Tech Office	Adrienne Wilson
7/19/11 7/20/11	11:00 a.m. to 5:00 p.m. 8:00 a.m. to 11:00 a.m.	Jacksonville – Tetra Tech Office	Tim Curtin
10/11/11 10/12/11	11:00 a.m. to 5:00 p.m. 8:00 a.m. to 11:00 a.m.	Jacksonville – Tetra Tech Office	Pete Dao
1/10/12 1/11/12	1 p.m. to 5:00 p.m. 8:00 a.m. to 12:00 noon	Tallahassee – Tetra Tech Office	Dave Grabka

5.6 Set the next meeting location, duration, and roles

- Location –Jacksonville, FL – Tetra Tech Office
- Dates – May 10, 2011
- Duration – One Day
- Chair – Adrienne Wilson
- Gate/Timekeeper – Tim Curtin
- Scribe – Julie Johnson

5.7 Facilitator Plus/Deltas – Done

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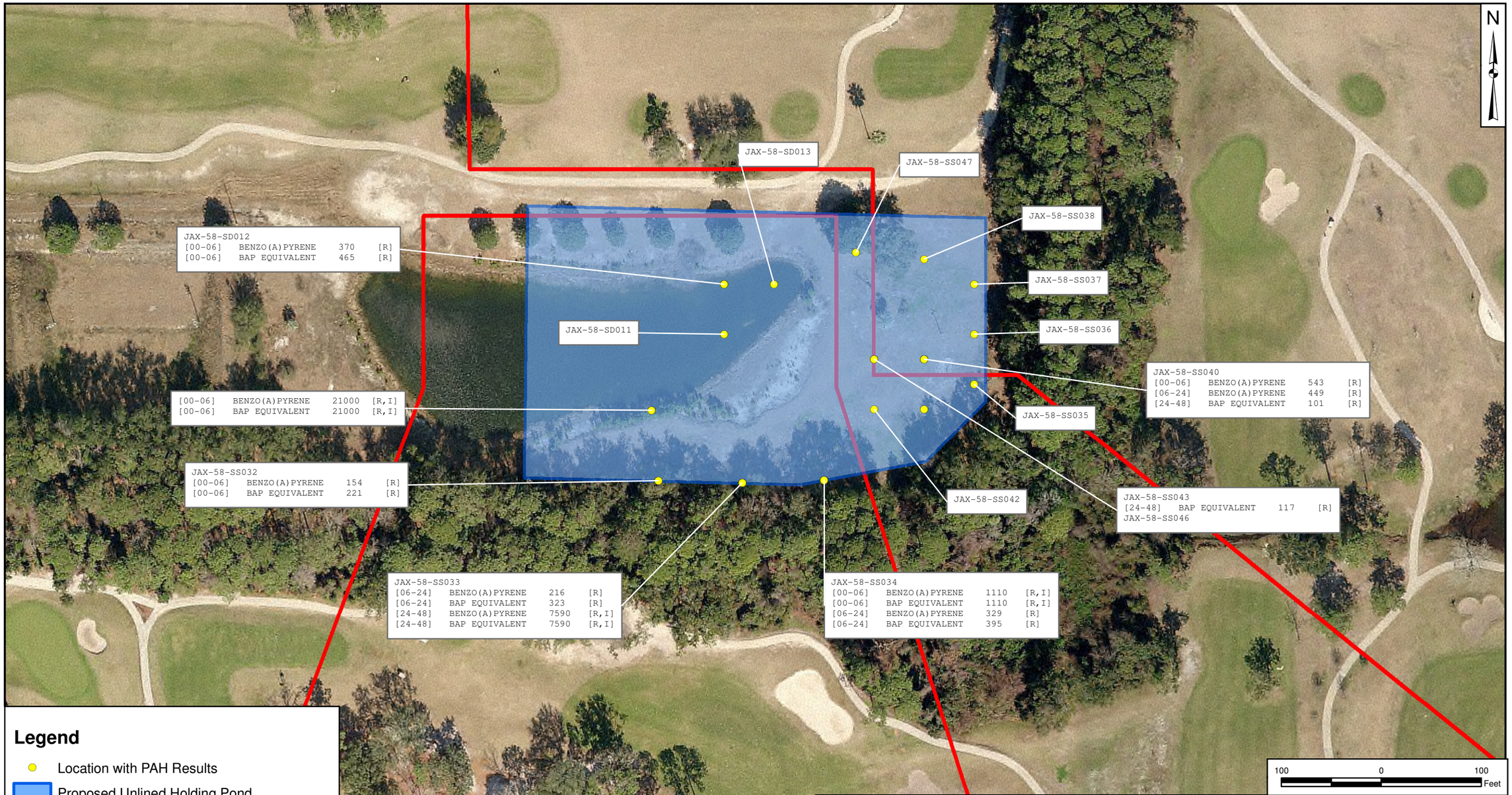
Legend

- Location with Lead Results
- Proposed Unlined Holding Pond
- Range Boundary

Notes:
Lead Residential SCTL = 400 mg/kg
Lead Industrial SCTL = 1400 mg/kg
Results in mg/kg

DRAWN BY S. STROZ	DATE 03/22/11	TETRA TECH	CONTRACT NUMBER CTO 0086 / OWNER NUMBER —
CHECKED BY A. PATE	DATE 03/22/11	LEAD RESULTS PROPOSED UNLINED HOLDING POND NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY — / DATE —
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 1 / REV 0

P:\GIS\JACKSONVILLE_NAS\MXD\PSC23B_58_PAH_RESULTS.MXD 03/22/11 SS



Legend

- Location with PAH Results
- Proposed Unlined Holding Pond
- Range Boundary

Notes:
Benzo(a)pyrene - Residential = 100, Industrial = 700
Bap Equivalent - Residential = 100, Industiral = 700
Results in ug/kg

DRAWN BY S. STROZ	DATE 03/22/11	TETRA TECH	CONTRACT NUMBER CTO 0086 / OWNER NUMBER —
CHECKED BY A. PATE	DATE 03/22/11	PAH RESULTS PROPOSED UNLINED HOLDING POND NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY — / DATE —
COST/SCHEDULE-AREA —			APPROVED BY — / DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 1 / REV 0

NAS JACKSONVILLE PARTNERING TEAM MEETING MINUTES

July 19th & 20th, 2011

Jacksonville, Florida

Attendees:	David Grabka	Mark Peterson
	Adrienne Wilson	Tim Curtin- Chair
	Eric Davis	Hal Davis, USGS
	Tim Flood, Facilitator	Julie Johnson – Scribe
	Pete Dao - Gate/Timekeeper	Robbie Darby, NAVFAC SE

Guests: Mike Maughon, TtNUS; Donald Hardison, TtNUS; Barb Becker, TtNUS (Day 2)

1.0 Team Meeting and Introduction

1.1 Team member greeting, introductions, and check in – Done
1.2 Assignment of Team Roles: Gate/Timekeeper – Pete Dao;
Chair – Tim Curtin; Scribe – Julie Johnson
1.3 Read Team Ground Rules – Ground rules were read

2.0 Initial Agenda Items

2.1 Review, submit revisions to, and reach consensus on previous meeting minutes. Done

2.2 Report on Assigned Action Items and Parking Lot Items. Done.

2.3 NAVFAC presents current budget execution plan. Adrienne reported that everything is completed.

3.0 Agenda

3.1 Schedules/SCAP/Exit Strategy/FDEP Document Tracker: Mark provided the team with a copy of the TtNUS and CH2MHill Document Review status list.

Adrienne said that she believes the petroleum SMP is due in August. She will verify with Robbie Darby.

Mark and Eric reviewed the Document Review Status document (see attachment).

3.1.1 Team Development – Tim Flood – Self Assessment

Goals:
Start: Send petroleum SMP to DEP at the same time as upstairs.

Roles:
Continue: to be as straight forward as possible with changes in home organizations as they occur.

Plus/deltas:
Goals +; Process-delta x 6; Roles –delta x 2; interaction +++++++

Interactions
Start with permission that all communication among team members is allowed with notification to others (Trust).

Dave said there are teams that would not want the regulator to go directly to the contractor, but would rather have them go through the Navy, who in turn would contact the contractor. Adrienne and Tim said that they have no problem with the regulators going directly to the contractor for information, but would expect that they be copied on all emails, or informed with a phone call.

Continue: our good work here.

Processes
Start: Using Tier II UFP SAP review.
Start: attending to confirmation that a document to be reviewed is current revision.
Start: referring to and reviewing charter documents.
Start: be sure we follow FFA specified procedures.

3.2 OU 1– Tim Curtin

3.2.1 LTM Update and Landfill Maintenance – Tim reported No monitoring until December or January. OU 1 has been mowed and will continue under a maintenance contract all year long. Having the maintenance contract is much less expensive.

Adrienne said the BOA contractor sampled OU 1 and Area A in November 2010 and sent the report to the regulators July 20, 2011.

Action Item: Adrienne to get the dates for the Annual Sampling Report from Aerostar for 2011 sampling event and compare to the SMP dates. Done; the reports went out July 8, 2011.

Pete asked about the LUCs at OU 2, there is no LUC RD for OU 2 because it was completed prior to the LUC RD process. It was done under a MOA between the Navy and EPA.

3.3 OU 3 –

3.3.1 Groundwater Model Update – Donald Hardison
Donald presented models for TCE, PCE, cis-1,2,-DCE, trans-1,2-DCE and vinyl chloride.
For TCE, the mass of the plume is at 30 feet. Donald showed slices from 10 to 60 feet.

Tim is willing to take the contaminant figures and try to get FRCSE to approve the sampling at Area A to delineate the plume in that area. This would involve getting permission to cut through the concrete and hand auger to sample. Pete Dao said he believes that additional data needs to be obtained. Adrienne asked even if it was classified as a low-yield aquifer. Pete said that decisions were made on the site that was outside of the RPMs expertise. Now the classification approvals have to be reviewed by a technical expert at EPA.

Action Item: Dave G to search historical records for the approval that OU 3 Area A was classified as a low-yield aquifer.

Action Item: Tim is to meet with FRCSE to try to get approval for additional sampling at Area A to complete the data set for the model.

Action Item: Donald to send the team the OU 3 Groundwater model data package/figures for their review.

Mark said a determination needs to be made by the team regarding whether the data presented will be used in the RI Addendum and whether the team is willing to go with this model. Mark thinks that the team needs to review the model carefully and determine if additional samples need to be taken for the model. Tim said he would like to define the plume as accurately as possible to reduce the size so that the minimal number of contractors have to have HAZWOPER training. Mark pointed out this will be helpful information for the VI sampling as well. Donald indicated he will also work with Suzanne Paxton in GIS to tighten the geostatistics 3-D search radius in EVS to minimize inappropriate extrapolation and interpolation of data in the horizontal and vertical directions.

If approval is given to take additional samples in the Area A buildings, Mark said you will have to use ground penetrating radar to locate utilities.

Consensus: The team agrees and wants the samples collected within Building 101 at OU 3, Area A if it is permitted/possible.

3.3.2 Well Install/Soil Sampling.
Donald reviewed previous DPT sample locations and discussed locations for permanent monitoring wells. Clay layers are at 16 to 25 feet below land surface. Hal said how big should the screen interval be below the clay that would be representative. Dave said usually a 5-foot screen, multi-chamber 1 to 2 foot intervals. Mark said he suggests screening just below the clay. Hal said maybe use 10 foot screens immediately below the clay 30 to 40 feet and 50 to 60 feet; this would cover a good bit of the aquifer. Mark asked what is needed to get Pete and Dave's approval; well design, tag maps, cross sections with all the data for the locations discussed. Dave said show the lithology and data horizontally and vertically. Dave said he wants the model for the cross sections. Hal asked how good is the precision of the data? Mark and Donald said there is pretty good data density and they both feel certain that they could locate the hottest location of the plume. Hal said the goal is to put a sampling point in the hottest part of the plume.

Action Item: Donald and Mark will consult with Hal and they will pull cross sections from the model from locations with highest concentrations, and create a horizontal tag map with TCE, DCE, PCE, and vinyl chloride to provide to Pete, Dave, and Hal with recommendations for well placement and design.

Soil Samples – Donald/Mark – Mark said that he and Adrienne discussed offline about going forward with the soil samples of the boundary of OU 3. The Navy wanted to get additional funding to shrink the LUC boundary at a later date. Dave said that you could choose areas and concentrate sampling in locations in order to eliminate LUCs for soil over large portions of the site.

Tim asked if there could be funding for OU 3 for soil sampling when someone needs to dig. Adrienne said funding is for specific sites. Tim is talking about contractors that need to dig and remove excess soils, mainly in FRC/OU 3. He doesn't think they are being tested to suit the CTLs, etc. The construction contractors are more concerned about how to dispose of excess soil.

3.3.3 Vapor Intrusion Discussion – Eric Davis - DQOs teleconferences were successful. Eric said they are working through the DQOs for the UFP SAP. Adrienne said a Fact Sheet is being completed in order to give to the employees of the buildings that are going to be investigated. Adrienne sent the information from the presentations to the Navy and Marine Corps Public Health Center to prepare the Fact Sheet and Adrienne will provide it to Casey and Eric for review once it is complete. Adrienne said that we need to be as open as possible to the concerns of the employees, especially in the 12 buildings that are going to be investigated.

3.3.4 Building 106 AS/SVE decommissioning – Eric said they plan on being in the field in August 2011. Hill will also be abandoning 11 AS wells. Eric asked the team to look at the Work Plan and provide input.

3.4 PSC 45 – Building 200 Wash Rack – Alan Pate: Summary of RI Analytical Results
Alan said installation of shallow and deep cluster wells were completed in the wash rack area. Only VOCs were the contaminants exceeding GCTLs. Step out DPT samples were taken in an attempt to delineate the VOCs. TCE was reported to exceed CTLs in sample DPT17. Area of concern is to the northeast side of the site, Building 115, Building 175A, and Building 168. It is suspected that this contamination is from OU 3 and not from Building 200. Groundwater flow is east-southeast toward the St. Johns River. Alan said he believes they are bounded to the west, north-west, but not to the southeast. Hal asked what is going on with some of the constituents that are showing up, i.e., chloroform, methylene chloride, etc.

Action Item: Tim to check on the use of Buildings 168, 175A, and 115 and report back to Alan by August 3, 2011.

Once Tim reports back to Alan the uses of Buildings 168, 175, and 115 a recommendation for next steps will be presented to the team for approval.

Soil sample results show no exceedances. Alan said he still has to calculate the BAP equivalents.

Dave wants to see the data on the figure zoomed in and out of the shadow. Mark and Alan said once the data is in NIRIS a data package will be provided to the team at the next meeting.

Dave said you could delineate to the residential SCTL and then put a LUC on the site. He would like the SCTL leachability number added to the table.

Eric D. said that Ch2MHill is scoped to dig out the area (removal action) and will take some samples. Eric and Alan discussed the utility locations in the area. Eric asked if they could get in there with an excavator or will they have to hand dig. Alan said the oil/water separator is approximately 4 to 5 feet deep. He said it is possible if the operator was very experienced. Alan said the only utilities and structures that are in the area proposed for the removal action is the oil/water separator and the water line for the fire hydrant. The water table is at 4 to 4.5 feet. Alan will send the team a complete data package.

Pete asked if there will be an FS and ROD after the removal action, Adrienne said this is a removal action to remove the source point/hot spots. There will still be an FS and a ROD because there is uncertainty whether this removal will complete the action. Pete said that his management has concerns that the station is trying to circumvent the CERCLA process by doing the removal action and not evaluating other alternatives. Adrienne said that the site is funded and the RI/FS is being completed by Tetra Tech. Adrienne said that Hill is only removing the hot spots, the RI and FS will continue. Eric and Adrienne said there will be an EE/CA prepared. Robbie said that the CERCLA process will be conducted.

Dave G. has concerns that the removal action may influence the subsequent risk assessment being compromised because the area is so tight and not spread out and that data from other areas would not be considered. Mark said surficial soil samples were taken around the source area and found to be clean. The concern is that there is going to be a risk assessment conducted and the risk assessors are going to say the area is too small to calculate worker exposure. Mark asked if Dave needed to take the data package to his risk assessors to make sure they approve of the process chosen. Mark P. said that Tetra Tech's risk assessor was involved with the UFP SAP process. Dave indicated he would like to see all data on a CADD map that also shows which areas are impervious.

Robbie said that if there are any concerns after Pete reviews the data with the EPA management, the team can come together and address any additional concerns they have.

Action Item: Alan will send the team a combined (SI and RI) data package prior to the next team meeting.

Action Item: Pete to talk with his management and fill them in on the removal process and RI/FS that are being conducted at PSC 45.

Action Item: Dave and Pete to provide the combined data package to their risk assessors.

3.4.1 EE/CA - Eric Davis: CH2MHill conducted a remedial alternative (document tracker) action. which was submitted on July 14, 2011 to the Navy.

3.5 OU 6 (PSC 52) Hangar 1000 – Mark – funding has been obtained and Donald Hardison will be running CTO.

3.6 OU 7 PSC 46 Update – DRMO – Adrienne – Been in the field since late May and found 2 practice MK 2.75 rocket warheads. Adrienne said they are trying to get the Army portion funded so they containers can be removed. They started night operations on Sunday July 17, 2011. The southwestern ditch has some radiological contamination. Eric said they are tracking to complete around August 15, 2011. Once the completion report is done, groundwater monitoring should continue. Then the draft LUC RD can be finalized.

3.7 OU 8 PSC 47 – Eric – A work plan revision for continued monitoring will go out to the team for review sometime next week. MW30S will be redeveloped by the drillers using a surge block to hopefully increase the yield on this well.

3.8 Petroleum Sites

3.8.1 Gas Hill (PCA 4)– Eric Davis – Plan to install two compliance point wells. Work planned for mid- to late-September. A work plan revision was issued June 20, 2011.

3.8.2 Hawkin's Property – Mark Peterson – Nothing new to report.

3.8.3 PCA 25- Boat House Area – The Draft SAR went out to the team July 18, 2011 and the MNA Work Plan for Groundwater is attached as an appendix to the SAR.

3.8.4 NEX Gas Station (PSC 56)– Once the SAR is approved, the site will transfer to CERCLA. Dave asked if the RCRA people need to be notified when a site moves from the petroleum program.

Action Item: Tim to inform Jane Beason that PCA 1/PSC 33 Base Service Station (NEX Gas Station) will be transferred from petroleum program to CERCLA.

Mark is looking for a SRCO for NEX Gas Station. He asked if the request can be done with the SAR and title it as a Site Rehab Completion Report. Mark said he believes the petroleum constituents are below CTLs and will verify that information from the SAR data.

Action Item: Dave will check with the Department to see if a Site Rehab Completion Order can be made on NEX Gas Station since there are constituents other than petroleum.

3.8.5 Kemen Test Cell – Nothing new to report.

3.9 MRP Sites RI DQO Planning – Barb Becker

Barb Becker presented the following information regarding the six sites that comprise the former machine gun range complex. The presentation, which is included in the meeting attachments, was based on findings documented in the Site Inspection Report that was finalized on September 30, 2010.

UXO Site 1 – Fort Dix Skeet Range: Barb showed the exceedances of Metals and PAHs in soil, sediment and groundwater. Barb said at the firing line area there is a layer of skeet particles, which makes her suspect there was some scraping and reworking done to prepare the site for the construction of the golf course. The site-specific COPCs are listed in the attached presentation. Barb said that the data gaps will be addressed in the RI.

UXO Site 2 – Former 50 Cal Range: two locations at this site with metals exceedances in the native soil underlying the fairway. The COPCs for human health are lead in soils and antimony in groundwater.

UXO Site 3 – Former Skeet Range: In the tree line there are metals and PAH exceedances in soil. Barb said there is a little more bounding to be done on the outlying areas where there were a few exceedances of metals. COPCs include arsenic, lead, and PAHs for Human Health. Antimony, lead, zinc, PAHs for Ecological in soil and sediment.

UXO Site 4 – Akron Road Pistol Range: Concentrated exceedances for metals are present in soil and sediment in the ditches. COPCs metals in soil, sediment and groundwater. Ecological COPCs are metals in soil and sediment.

UXO Site 5 - .30 Caliber Range: COPCs are due to ecological risk only and are limited to lead in soil.

UXO Site 6 – Former Trap Ranges: There are a number of PAH exceedances near the firing line and metals at the opposite end of the range. Both metals and PAH exceedances are present between the firing line and the opposite end of the range. COPCs include metals and PAHs. See attachment for specifics.

Problem Statement

- SI results indicate the presence of munitions constituents (MC) in soil and sediment in concentrations that may pose an unacceptable human health and/or ecological risk.
- Additional data (soil, sediment, surface water, groundwater) are necessary to characterize the nature and horizontal/vertical extent of MC.
- The conceptual site model (CSM) for each site must be refined based on the additional data collected.
- Potential risks to site receptors from MC exposure must be assessed so the need for possible response actions can be evaluated.

Information Inputs

- Chemical Data: concentrations of COPCs (select metals and PAHs)
- Physical Data: water quality data (pH, ORP, DO, temp, spec. conductivity, turbidity)
- Groundwater Level Measurements: depth to water
- Dissolved Metals Data (provisional)
- Sample Location Data: horizontal coordinates and depth
- Project Action Limits (PALs) based on lowest of EPA and FDEP criteria, using base-wide background for metals if higher than EPA/FDEP values.

Mark asked Hal about the groundwater flow in the golf course area with respect to the model. Hal said there is a groundwater divide that runs very close to OU 1. One side flows to the east toward the St. Johns River and the other side flows toward the Ortega River. Hal said some of the drainage has been modified at the golf course and could affect how the creeks interconnect and drain now as compared to the historical information.

Hal asked if there were going to be additional wells installed; Barb said yes there will be additional wells installed where SPLP results dictate. Pete requested that we calculate a site-specific leachability limit value for metals. He said that recently he has run into problems with SPLP data for VOCs. Barb said VOCs are not COPCs for these sites. Mark said that we can calculate the site specific leachability values for the ranges fairly easily. Pete said to be sure we collect sufficient data to support site-specific leachability limit calculations.

Action Item: Mark said that he will look at the SI and determine whether there is sufficient data or identify additional data that would need to be collected to complete the site-specific leachability calculations.

Barb asked the team if they would allow Tetra Tech to recalculate the correlation between XRF result and laboratory data collected during the SI so that the XRF data can be used for decision making purposes. In the SI, at a couple of the sites the correlation of lab data to XRF was determined to not be within acceptable levels, but that was caused by one or two outliers in each data set. If those outliers had been removed, there would be a strong correlation in the data.

Study Area Boundaries

- Population of interest
  - Surface and subsurface soil
  - Groundwater (surficial aquifer, expected at 4 to 10 feet bgs.
  - Ponds (surface water and sediment at end of drainages)
- Horizontal boundaries
  - Initial: within boundaries established in PA; refined to reflect exceedances observed during SI.
  - Expanded: Step out as necessary, to bound exceedances by “clean” sample locations and follow drainages to endpoints.
- Vertical boundaries
  - Initial: Soil to 4 feet bgs; top 5 feet of groundwater
  - Expanded: Step down as necessary to bound soil exceedances by “clean” sample locations

Mark said the sampling strategy should include evaluation of the potential for future land use controls (LUCs). Where opportunities arise to place samples in such a way that allows boundaries subject to LUCs to be limited to tree areas where most receptors would not need frequent access we should do so. Samples located at site boundaries should be placed on the tree side of the cart paths for instance, rather than in the fairways so that if the data does indicate no exceedances of SCTLs, the boundaries would fall outside of operational areas.

Barb said that in most cases, boundary samples are planned for outside the tree line to show clean points outside the tree line because we expect these locations to be clean. This will also enable us to separate the receptor exposure scenarios in the risk assessment.

Decision Rules – COPCs

- Collect Data for COPC delineation
  - If all COPCs in all media are less than PALs, then no further delineation necessary. Use SI data as basis for HHRA/ERA.
  - If any COPCs in surface/subsurface soil are greater than PALs, then confer with Team on need for additional step-out samples, and evaluate soil in HHRA/ERA.
  - If any COPCs in groundwater are greater than PALs, then confer with Team on installation of permanent wells to collect additional data and evaluate groundwater in HHRA.
  - If any COPCs in SW/SD are greater than PALs, then evaluate SW/SD in HHRA/ERA.

Mark said we would add a decision rule to address the calculation of site-specific leachability values.

- Use UCL-95 of COPC data for HHRA
  - IF ILCR < $1x10^{-6}$ and HQ <1, then recommend NFA with respect to the human health risk.
  - IF ILCR > $1x10^{-6}$ > or HQ >, the team will proceed to the FS to evaluate remedial alternatives.
- Use Arithmetic Mean of COPC Data for ERA
  - If SERA HQ <1, then recommend NFA with respect to the ERA
  - If SERA HQ >1, confer with Team on need for further evaluation, and proceed to either BERA or NFA.
  - If BERA shows unacceptable risk to ECO receptors based on multiple lines of evidence, then proceed to FS.

Dave said he believes that there needs to be an additional step in the ERA slide to make sure representative ecological receptors are conservative. Example verbiage: If a Baseline ERA is determined to be necessary, compile a list of receptors and toxicity tests required, and submit to both FDEP and EPA for approval. Dave said this should be conducted between the SERA and BERA.

Eric asked if the "arithmetic mean" to be calculated for eco-risk is conservative enough and why the 95% UCL of the mean is not calculated for eco-risk as it is for human health. Barb said she will verify the appropriateness of the arithmetic mean with the eco-risk assessor.

Performance/Acceptance Criteria

- Collect all planned data with no significant quality deficiencies.
- Collect additional step-out data, as necessary, to delineate the horizontal and vertical extent of MC contamination at each site.

Sampling Design (see presentation) Barb reviewed the proposed sample types and locations for each UXO site.

UXO 1 – Most samples are planned around wooded area to delineate clean areas from contaminated area (woods). Mark said he would place the boundary-samples between the tree line and the cart path so that if maintenance needs to be done on the cart path it would be outside the LUC boundary.

UXO 2 – since there was one SPLP exceedance, a well is proposed to be installed in the middle of the soil sample locations. Dave said if there is sufficient soil data, the site could possibly be closed (NFA) without a lot of additional sampling by using the 95% UCL for comparison to the SCTL. However, we would also need to assess leachability to groundwater. Dave also suggested it might be beneficial just to resample the specific locations where the exceedances occurred. Barb said the contamination was below surface in the native soil and that both exceedances were pretty significant. Dave said that if the soil results were less than 3X residential SCTL, and you have the coverage (typical 1/4 acre residential exposure domain), the 95% UCL could be used if EPA agrees. Minimum requirement is 10 samples per ¼ acre, and it is depth specific.

UXO 3 – Mark asked about shrinking the site down by ¼ acre portions and eliminating or shrinking the boundary. Mark said there are a lot of PAH exceedances and it would be difficult to get below 3X residential. Dave said the area is very large. May need LUCs at least. The ¼ acre sampling density (10 samples per ¼ acre) may not be of value at UXO 3. Mark was trying to eliminate the outlying area that shows little contamination from being included in the main exposure area. Dave said he thinks it can be done.

UXO 4 – the pond to the east of this site was excavated, and the contaminated sediments were placed in a berm between the two sides of the hold pond. Clean sediments were stockpiled outside the pond, adjacent to the east berm of UXO 4. Dave requested some topographic detail so he could better visualize the site. Mark said that this might not be readily available and could require a topographic survey. Mark said that would be very expensive. Hal said he thinks USGS may have some topo information available. Barb said she would be sure that the CSM presented in the SAP indicates the general elevation differences within the site. Tim said that the sample locations along the eastern side of the east berm might have to be adjusted if they fall within the footprint of the holding pond spoils pile. Dave would like to see a well installed on the range floor, in front of the backstop, where most of the bullets landed, rather than on the other side of the backstop. If there is no groundwater impact in this location, where maximum concentrations would be expected, then FDEP would say the groundwater investigation is complete.

Action Item: Barb/Mark/Alan/Hal to determine what topographic information that is available for Akron Road Pistol Range.

Action Item: Tim to determine whether location of spoils berm allows for sampling east of side berm.

UXO Site 5: No exceedances other than SPLP. One well installation is proposed only in the fairway. Mark asked if the calculated SCTL for another area could be used in this area. Pete said if the constituents are the same, he saw no reason why not. Dave said there could be possibility that you couldn't use another area SCTLs. Since the SPLP exceedances you will need a well there.

UXO Site 6: the proposed approach looked fine to team members – no issues were raised.

Barb said that the UFP SAP (Tier II) will be submitted to the Navy in mid-August.

3.10 PSC Sites with LUCs and no RODs – Mark said nothing to report. Going to the field soon.

Tim said that the air field people want to cut down invasive species trees and scrub vegetation in PSCs 8 and 9. Tim said no problem as long as they stay out of the dirt. Tim doesn't know when they are going to do it.

3.11 PSC 55- Nothing new to report. Going to the field soon.

3.12 PSC 38 – UFP SAP review/comment – Mark said the UFP SAP has been reviewed by the Navy chemist and the comments are being addressed. Once the Navy chemist approves the document, it will be sent out to the team for review.

3.13 PSC 57 S-3 High Power Turn-up Pad – blast deflector has been removed

3.14 Five-Year Review – Pete said that HQ has to be briefed and signed off (this is new) before the division director signs off on the Five Year Review.

Pete said Interim Remedial Action cannot be done in the future because a ROD has to be written first. He said a removal action can be done, however. No remedial action pre-ROD only "removal action."

4.0 Miscellaneous

4.1 Proposed Construction Update – Tim Curtin – Tim gave an update of proposed construction and current construction projects.

- New Golf Course Maintenance Building is going to be constructed.
- Mike McCool will be Tim's new contact at the Golf Course.
- Waste water reuse – the pond is complete and they need to sod/seed. The pipes are installed and still need to install the pumps.
- DRMO fuel tank is going to be replaced by smaller AST. They are going to put up another fence between DRMO and Mucho Mulch.
- NECE is getting new wiring and new roof, and 10 new parking spots.
- Building 103 got a new roof.
- Buildings 919 and 1122 installing photovoltaic.
- MWR wants to put a few more cottages along the golf course.
- Building 101 looking at getting new windows.
- Completed directional borings for the copper phone lines at FRC.

4.2 Tier II Update – Robbie Darby

Provided a Meeting summary from the last Tier II meeting.

- BRAC PMO will become a part of NAVFAC in the next couple of years.
- Robbie said that funding is stable for now.
- FDEP had a new secretary appointed in January.
- There has been a Navy CLEAN Contract update. New contractor.
- FFA Workshop/Training to be held at a Tier II level first.
- Florida Petroleum SMP – status of sites needs to be tracked on the Exit Strategy.
- Had more discussions on commitment to partnering. Tool to aid in meeting regulatory requirements.

- Discussed Exit Strategies
- Cecil Field Tier I Team presentation.
- Air Force Cleanup Program team provided information to Tier II
- Cape Patrick Presentation
- Five Year Reviews
- Basics of Partnering Workshop Dates
- Next meeting August 30, 31, and September 1, 2011 in Orlando, FL. Jacksonville Tier I Team is invited to have two presenters at the Tier II meeting.
- Next Exit Strategy due 8/10/11
- FY12 Petroleum SMP input is due to the Navy 7/27/11

4.3 Institutional Controls Implementation Plans Update – Nothing new to report

4.4 NIRIS Update – Nothing new to report.

4.5 RCRA Activities – Still waiting to hear from FDEP regarding the results of last inspection. Issues with light bulbs at the bowling alley and wash water rolling off planes going out the door and into the ditch.

4.6 Exit Strategy Review – reviewed for each site as meeting progressed. **BOLD ALL CHANGES.**

4.7 BOA Contracts Update and Schedule – Nothing new to report. Aerostar is sampled PSC 51 June 14, 2011.

4.8 FFA Review – Adrienne sent the team the Draft FFA SMP for their review.

5.0 Meeting Closing

5.1 Review Meeting Consensus Items – Done

5.2 Review Meeting Understandings – None

5.3 Review Action Items – Done

5.4 Next Meeting Proposed Agenda Changes

5.5 Set the future meeting dates in advance.

Meeting Date	Meeting Time	Location	Meeting Chairman
10/11/11 10/12/11	1 p.m. to 5:00 p.m. 8:00 a.m. to 12:00 noon	Jacksonville – Tetra Tech Office	Pete Dao
1/10/12 1/11/12	1 p.m. to 5:00 p.m. 8:00 a.m. to 12:00 noon	Tallahassee – Tetra Tech Office	Dave Grabka

Meeting Date	Meeting Time	Location	Meeting Chairman
3/6/12 3/7/12	1 p.m. to 5:00 p.m. 8:00 a.m. to 12:00 noon	Jacksonville – Tetra Tech Office	Casey Hudson

5.6 Set the next meeting location, duration, and roles

- Location –Jacksonville, FL – Tetra Tech Office
- Dates – October 11th & 12th, 2011
- Duration – two days
- Chair – Pete Dao
- Gate/Timekeeper – Dave Grabka
- Scribe – Julie Johnson

5.7 Facilitator Plus/Deltas – Done

Plus

Boat Trip
Barb Becker MRP DQOs
Caught up on training
Lot of information in this meeting
Good looking forward in the conversations
Big picture maintained during detailed discussions

Deltas

No Casey
No Mike Singletary
Starting at 11 am

5.8 Facilitator Evaluation – offline

Site	**CONSENSUS ITEMS**
OU 3	The team agrees and wants the samples collected within Building 101 at OU 3, Area A if it is permitted/possible.
Agenda Item No.	**PARKING LOT**
PSC 46, DRMO	CH2M Hill will complete the RA Completion Report which, according to Pete Dao, needs to include a reference to completion of the LUCRD, the removal action, and the groundwater monitoring annual report and engineer certified for PSC 46, DRMO. Revisit this in 2011.
Hawkins Property	The team needs to reach a consensus on a path forward for the disposition of the Hawkins Property, and whether additional monitoring is required for the submission of a FOST. There is no FDEP order for this property. Matt Schelhorn (Community Planning and Liaison Officer for the region) is also looking into this.
Review FFA	The team to review the FFA. Waiting to see where Tier II is taking the FFA training. Sara reported Tier II member Harold, FFA training was conducted internally at EPA and should present to the Tier II team in June.
	Dave G. asked that we consider conducting another Monitoring Well Inventory.

ACTION ITEMS					
Action Item No.	**Responsible Party**	**Status**	**Due Date**	**Site**	**Action Item**
Action Items from January 11th & 12th, 2011 Meeting					
A-90111	Dave G.	Working	Ongoing	Hawkins Property	Dave to determine the states position and the path forward for the Hawkins' Property. *Since wells on the property show signs of contamination, and it is likely coming from another property, the Navy is quite likely not responsible. But the data is too old. The contamination doesn't support JP5, but is mostly naphthalene.* *10/11/11: Dave said the Navy can transfer the cleanup responsibility to a new property owner. Mark P. asked what the city said regarding this. Mark said the city is going after an adjacent property.*
Action Items from May 10, 2011 Meeting					
A-40511	Mike Singletary	Working	7/20/11	OU 3 ASU data	Mike Singletary to get the complete data set from ASU and provide to Tetra Tech for the RI Addendum for OU 3.
A-60511	Mike Singletary	Working	By next meeting	OU 3 MNA sampling	Mike S. to send the USGS report from Frank Chapelle to the team by next meeting.
A-120511	Mark Peterson	Done	5/13/11	Exit Strategy	Mark Peterson to check the dates for PSCs 5, 8, 9, 18, 29, 31, 32, and 50 in the exit strategy. They do not match the FFA SMP dates.
Action Items from July 19-20, 2011 Meeting					
A-10711	Adrienne	Done	7/20/11	OU 1	Adrienne to get the dates for the Annual Sampling Report from Aerostar for 2011 sampling event and compare to the SMP dates. *Email: 7/19/11 from*

ACTION ITEMS					
Action Item No.	**Responsible Party**	**Status**	**Due Date**	**Site**	**Action Item**
					Adrienne: OU1 & Area A were sampled in November 2010 and was sent out to regulators 7/8/11.
A-20711	Dave	Done	7/28/11	OU 3, Area A	Dave G to search historical records for the approval that OU 3 Area A was classified as a low-yield aquifer.
A-30711	Tim	Done	7/30/11	OU 3, Area A	Tim is to meet with FRCSE to try to get approval for additional sampling within Building 101 at Area A to complete the data set for the model. *Email from Tim: In response to my Action Item A-30711, I spoke with Peter Gallant at FRC regarding drilling holes through the floors in FRC. Peter says it can probably be done but needs to see a map of where we want to drill.*
A-40711	Donald	Done	8/15/11	OU 3 Groundwater Model	Donald to send the team the OU 3 Groundwater model data package/figures for their review. Providing CDs to the team at October meeting.
A-50711	Donald/Mark	Done	8/15/11	OU 3 Well placement	Donald and Mark will consult with Hal and they will pull cross sections from the model from locations with highest concentrations, and a horizontal tag map with TCE, DCE, PCE, and vinyl chloride to provide to Pete, Dave, and Hal with recommendations for well placement and design.
A-60711	Tim Curtin	Done	10/11/11	NEX Gas Station	Tim to inform Jane Beason that PCA 1/PSC 33 Base Service Station

ACTION ITEMS					
Action Item No.	**Responsible Party**	**Status**	**Due Date**	**Site**	**Action Item**
					(NEX Gas Station) will be transferred from the petroleum program to CERCLA.

ACTION ITEMS					
Action Item No.	**Responsible Party**	**Status**	**Due Date**	**Site**	**Action Item**
A-70711	Tim Curtin	Done	8/3/2011	Building 200 Wash Rack	Tim to check on the use of Buildings 168, 175A, and 115 and report back to Alan by August 3, 2011 for the Building 200 RI screening. Email response: Per my action item: Bldg 168 and 168A are used to repair and test radar and antennas. They do not use chlorinated solvents. The building was built in 1996 so any spills were probably cleaned up quickly. Bldg 115 is an airplane hangar and has been for a very long time. It was built in 1941 and is considered an historic building. There is a good possibility that chlorinated solvents were used in this building as well as the other hangars(113, 114, 116) in the area. Bldg 115A was a weapons school and is now used as a warehouse. Chlorinated solvents were probably not used there.
A-80711	Alan	Done	10/1/11	Building 200 Wash Rack (PSC 45)	Alan will send the team a combined (SI and RI) data package prior to the next team meeting.

ACTION ITEMS					
Action Item No.	**Responsible Party**	**Status**	**Due Date**	**Site**	**Action Item**
A-90711	Pete	Done	10/1/11	Building 200 Wash Rack (PSC 45)	Pete to talk with his management and fill them in on the Removal process and RI/FS that is being conducted at PSC 45 to get their buy in on the site strategy.
A-100711	Pete and Dave	Working	10/1/11	Building 200 Wash Rack (PSC 45)	Dave and Pete to provide the PSC 45 combined data package to their risk assessors to get their buy in on the site strategy.
A-110711	Mark	Done	8/3/11	MRP Sites (SI Report)	Mark to review the SI and determine if there is sufficient data or if additional data is needed to complete the site specific leachability for the UFP SAP.
A-120711	Alan/Barb/Mark/Hal	Done	7/30/11	Akron Road Pistol Range	Barb/Mark/Alan/Hal to determine what topographic information is available for Akron Road Pistol Range for CSM. *Email from HDavis7/21/11 - Everyone,* *Here is the topo information that I had readily available and think that it will fit the need.* *Attached are four figures: Shooting Range 1: This shows the USGS topo of the shooting range (and contour of groundwater levels from about 1995). The two mounds in the center area are the berms that Dave was interested in. You can't read the contour lines (they are not readable on the tiff file either). But I don't think that Dave was interested in the exact height.* *Shooting Range 2: Photo of base overlaid on topo.* *Shooting Range 3: Photo of base overlaid on topo (at different transparency).*

ACTION ITEMS					
Action Item No.	**Responsible Party**	**Status**	**Due Date**	**Site**	**Action Item**
					Shooting Range and OU1: This shows the shooting range in relation to OU1, The pathlines show the groundwater flowing to the ditch south of the berm. This actually occurred only during heavy rainfall periods. During dryer times groundwater seepage to the creek started at about the first sharp bend just below the "Golf Course" label on the topo.
A-130711	David Grabka	Done	7/26/11	NEX Gas Station	Dave to check with the Department to see if a Site Rehab Completion Order can be made on NEX Gas Station. Email from Dave G. 7-25-11: *One of my action items was to determine how to transition the NEX Gas Station from the Petroleum to the IR Program. A simple statement in the SAR saying the site has been moved from one program to the other with the attendant reasons for moving the site would allow us to formally concur on that transference. However, in the case where there was petroleum contamination and all of the petroleum contamination had been cleaned up to below our CTLs and the only thing left was non-petroleum contamination, I believe a SAR/SRCR with a recommendation for No Further Action for petroleum products chemicals of concern may be doable. However, if there is any petroleum contamination*

ACTION ITEMS					
Action Item No.	**Responsible Party**	**Status**	**Due Date**	**Site**	**Action Item**
					left above our GCTLs and it is mixed with other non-petroleum contamination, the Department would not be able to issue a NFA Order because of the remaining petroleum contamination. I hope this makes some sense.
A-140711	Team	OBE	7/26/11	Success Stories	Team to send Adrienne success stories and issues for discussion at Tier II by 7/26/11
A-150711	OBE	OBE	7/29/11	Tier II Presentation	Mark Set up a conference call for the Tier II presentation preparation by 7/29/11. *Presentation pushed back to December meeting.*
A-160711	Dave/Adrienne	Done	8/2/11	DSMOA Cooperative Agreement	DSMOA Cooperative Agreement – Call to move to step 2, joint execution plan. Starts with NAVFAC SE and then goes to FDEP. Dave G. said it should start in July 2011 and must be approved in August 2011. Dave wants to have a separate meeting to go through sites.
A-170711	Dave G	Done	7/22/11	Meeting Minutes/Consensus Items	Dave to review the May 2011 Partnering Meeting Minutes and provide comments and approval to the team and copy Julie on the email.
A-180711	Mark	Done	7/21/11	NEX Gas Station	Mark to review the NEX Gas Station SAR to determine if any petroleum constituents exceed CTLs.
A-190711	Tim	Done		MRP Sites	Tim to determine whether location of spoils berm allows for sampling east of side berm.

MUNITIONS RESPONSE PROGRAM

FORMER MACHINE GUN RANGE COMPLEX REMEDIAL INVESTIGATION

DQO SCOPING SESSION

NAS JACKSONVILLE PARTNERING TEAM MEETING

Jacksonville, FL

July 19-20, 2011

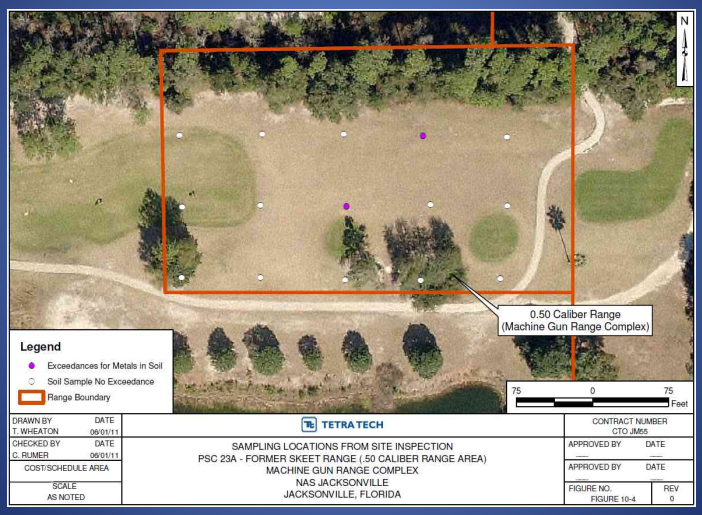
FORMER MACHINE GUN RANGE COMPLEX (UXO SITES 1 TO 6)

SITE INSPECTION RESULTS
UXO 1: FORT DIX SKEET RANGE

SITE INSPECTION RESULTS
UXO 1: FORT DIX SKEET RANGE

- COPCs - Human Health
  - Metals (Sb, As, Cu, Pb) and PAHs in soil
  - Metals (Pb) and PAHs in sediment
  - Metals (Sb, As, Pb) in groundwater
- COPCs – Ecological
  - Metals (Sb, Cu, Pb, Sn, Zn) and PAHs in soil
  - Metals (Sb, Pb) and PAHs in sediment

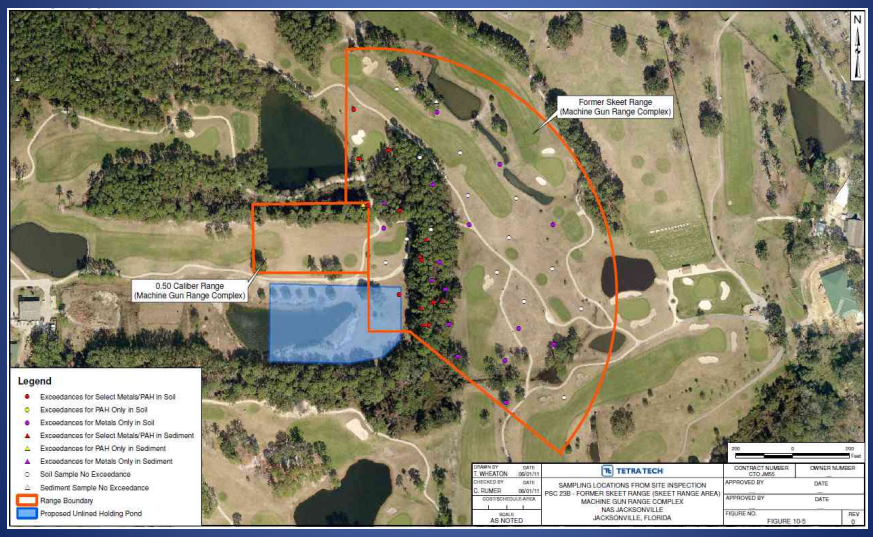
SITE INSPECTION RESULTS
UXO 2: FORMER .50-CALIBER RANGE



SITE INSPECTION RESULTS
UXO 2: FORMER .50-CALIBER RANGE

- COPCs - Human Health
  - Metals (Pb) in soil
  - Metals (Sb) in groundwater
- COPCs – Ecological
  - None in soil

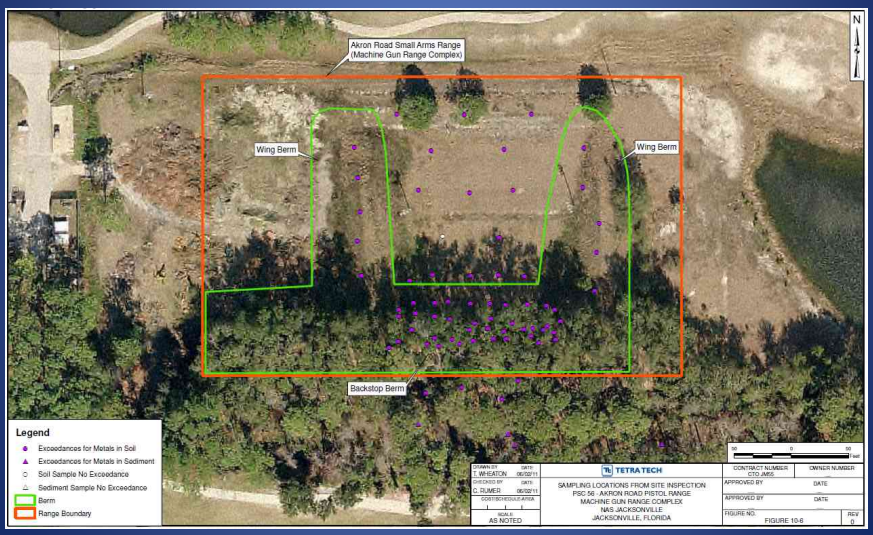
SITE INSPECTION RESULTS
UXO 3: FORMER SKEET RANGE



SITE INSPECTION RESULTS
UXO 3: FORMER SKEET RANGE

- COPCs - Human Health
  - Metals (As, Pb) and PAHs in soil
  - Metals (As, Pb) and PAHs in sediment
  - None in groundwater
- COPCs – Ecological
  - Metals (Sb, Pb, Zn) and PAHs in soil
  - Metals (Sb, As, Cu, Pb) and PAHs in sediment

SITE INSPECTION RESULTS
UXO 4: AKRON ROAD PISTOL RANGE



SITE INSPECTION RESULTS
UXO 4: AKRON ROAD PISTOL RANGE

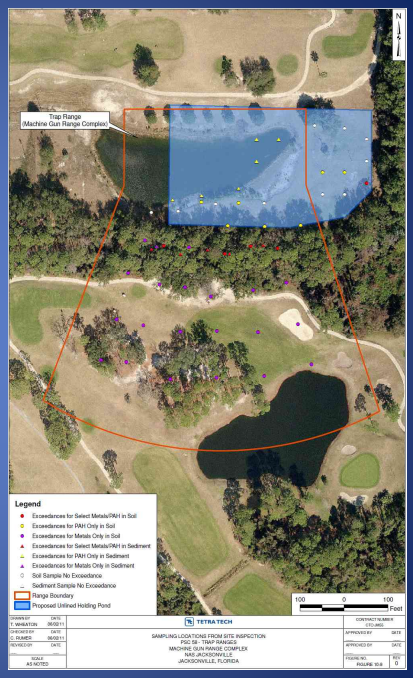
- COPCs - Human Health
  - Metals (As, Cu, Pb) in soil
  - Metals (Pb) in sediment
  - Metals (Pb) in groundwater
- COPCs – Ecological
  - Metals (As, Cu, Pb, Zn) in soil
  - Metals (Cu, Pb) in sediment

SITE INSPECTION RESULTS
UXO 5: .30-CALIBER RANGE

SITE INSPECTION RESULTS
UXO 5: .30-CALIBER RANGE

- COPCs - Human Health
  - None in soil
  - None in groundwater
- COPCs – Ecological
  - Metals (Pb) in soil

SITE INSPECTION RESULTS UXO 6: FORMER TRAP RANGES



SITE INSPECTION RESULTS UXO 6: FORMER TRAP RANGES

- COPCs - Human Health
  - Metals (As, Pb) and PAHs in soil
  - Metals (As) and PAHs in sediment
  - Metals (Sb, As, Pb) in groundwater
- COPCs – Ecological
  - Metals (Pb) and PAHs in soil
  - Metals (Pb) and PAHs in sediment

DATA QUALITY OBJECTIVES

- Problem Statement
- Information Inputs
- Study Area Boundaries
- Analytic Approach (Decision Rules)
- Performance/Acceptance Criteria
- Sampling Design and Rationale

PROBLEM STATEMENT

- SI results indicate the presence of munitions constituents (MC) in soil and sediment in concentrations that may pose an unacceptable human health and/or ecological risk.
- Additional data (soil, sediment, surface water, groundwater) are necessary to characterize the nature and horizontal/vertical extent of MC.
- The conceptual site model (CSM) for each site must be refined based on the additional data collected.
- Potential risks to site receptors from MC exposure must be assessed so the need for possible response actions can be evaluated.

INFORMATION INPUTS

- Chemical Data: concentrations of COPCs (select metals and PAHs)
- Physical Data: water quality data (pH, ORP, DO, temp, spec. conductivity, turbidity)
- Groundwater Level Measurements: depth to water
- Dissolved Metals Data (provisional): collect if turbidity > 10 NTUs
- Sample Location Data: horizontal coordinates and depth
- Project Action Limits (PALs): based on lowest of EPA and FDEP criteria, using base-wide background for metals if higher than EPA/FDEP values

STUDY AREA BOUNDARIES

- Population of interest
  - Surface and subsurface soil
  - Groundwater (surficial aquifer, expected at 4 to 10 ft bgs)
  - Ponds (surface water and sediment at end of drainages)
- Horizontal boundaries
  - Initial: Within boundaries established in PA; refined to reflect exceedances observed during SI.
  - Expanded: Step out, as necessary, to bound exceedances by "clean" sample locations and follow drainages to endpoints.
- Vertical boundaries
  - Initial: Soil to 4 ft bgs; top 5 feet of groundwater
  - Expanded: Step down as necessary to bound soil exceedances by "clean" sample locations.

ANALYTIC APPROACH (DECISION RULES - COPCS)

- Collect Data for COPC Delineation
  - If all COPCs in all media are < PALs, then no further delineation necessary. Use SI data as basis for HHRA/ERA.
  - If any COPCs in surface/subsurface soil are > PALs, then confer with Team on need for add'l step-out samples, and evaluate soil in HHRA/ERA.
  - If any COPCs in GW are > PALs, then confer with Team on installation of permanent wells to collect add'l data and evaluate GW in HHRA.
  - If any COPCs in SW/SD are > PALs, then evaluate SW/SD in HHRA/ERA.

ANALYTIC APPROACH (DECISION RULES - HHRA)

- Use UCL-95 of COPC Data for HHRA
  - If ILCR < $1x10^{-6}$ and HQ < 1, then recommend NFA w.r.t. human health risk.
  - If $1x10^{-6}$ > ILCR > $1x10^{-4}$ and HQ < 1, confer with Team on need for further evaluation , and proceed to either NFA or FS.
  - If risk to HHRA receptors is unacceptable (ILCR > $1x10^{-4}$ and/or HQ > 1), then proceed to FS.

ANALYTIC APPROACH (DECISION RULES - ERA)

- Use Arithmetic Mean of COPC Data for ERA
  - If SERA HQ < 1, then recommend NFA w.r.t. ecological risk.
  - If SERA HQ > 1, confer with Team on need for further evaluation, and proceed to either BERA or NFA.
  - If BERA shows unacceptable risk to eco receptors based on multiple lines of evidence, then proceed to FS.

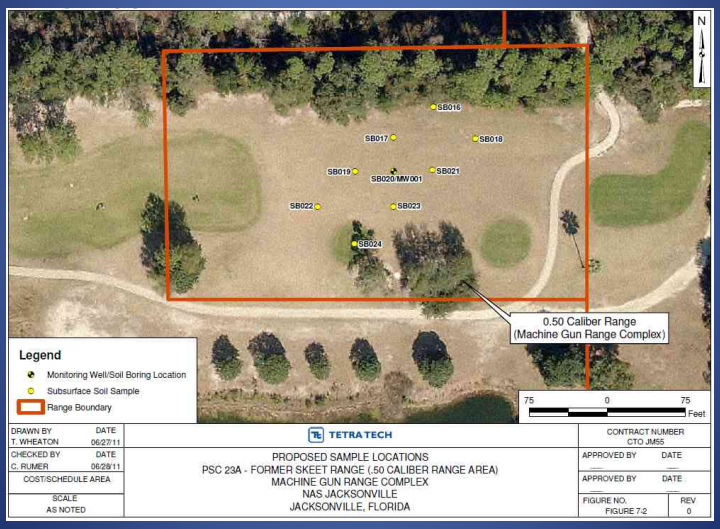
PERFORMANCE/ACCEPTANCE CRITERIA

- Collect all planned data with no significant quality deficiencies
- Collect additional step-out data, as necessary, to delineate the horizontal and vertical extent of MC contamination at each site

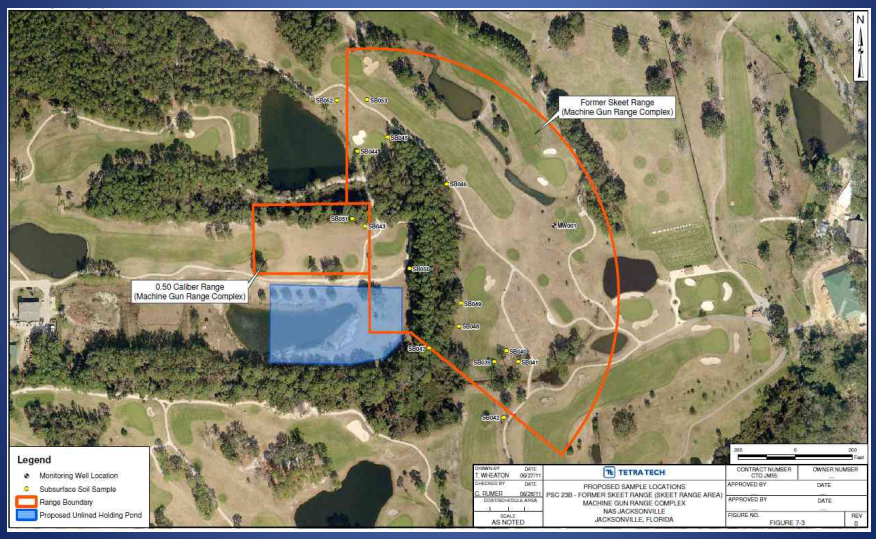
SAMPLING DESIGN

SAMPLING DESIGN
UXO 1: FORT DIX SKEET RANGE

SAMPLING DESIGN
UXO 2: FORMER .50-CALIBER RANGE



SAMPLING DESIGN
UXO 3: FORMER SKEET RANGE



SAMPLING DESIGN
UXO 4: AKRON ROAD PISTOL RANGE

SAMPLING DESIGN
UXO 5: .30-CALIBER RANGE

SAMPLING DESIGN UXO 6: FORMER TRAP RANGES

RI/FS FOR UXO SITES 1 TO 6 NEXT STEPS

- UFP-SAP submittal, review, and approval (Tier II format)
- Fieldwork (UFP-SAP implementation)
- RI Report submittal, review, and approval (includes HHRA/ERA)
- Proceed to Feasibility Study, as appropriate

APPENDIX B

CORRELATION BETWEEN XRF AND LABORATORY LEAD DATA

Correlation Analysis

The following information was obtained from Appendix E of the Site Inspection Report (Tetra Tech, 2010), with minor revisions that address the usability of the Fort Dix data set (i.e., by removing one gross outlier from the original set of 20 data points and revising Figure 2), and the addition of text that introduces Figure 8.

Correlations between XRF and Fixed Based Laboratory (FBL) lead concentrations were computed for six military ranges/sites at NAS Jacksonville. The correlation, r, always falls between -1 and 1. Correlation values near 0 indicate a very weak linear relationship. The strength of the linear relationship increases as the correlation moves away from 0 toward either -1 or 1. Correlation values close to -1 and 1 indicate that the points lie close to a straight line. The extreme values -1 and 1 occur only in the case of a perfect linear relationship. The coefficient of determination, R^2, is the correlation squared and can be thought of as the variation of the data points about a regression line that can be explained by the XRF concentrations. R^2 values between 0 and 0.30 are considered weak, 0.30 to 0.7 are considered moderate, and greater than about 0.80 are considered to indicate a very strong relationship between the two measurement methods. The maximum possible value is exactly 1.0.

The correlation analyses were conducted to determine whether XRF field measurements used to delineate contamination at the sites are comparable to laboratory data. As stated in the June 2009 Sampling and Analysis Plan (SAP), an acceptable correlation between the XRF and FBL will be between 0.65 and 1. Note that the correlation analysis establishes a relationship for the observed concentration ranges. The relationship should not be extrapolated to concentrations outside the observed concentrations. Predicted FBL concentrations can be obtained by using the regression equation for sites where an acceptable correlation between the XRF and FBL concentrations exists. The intercept of the regression equation is the average FBL concentration when the XRF concentration is not present. The slope of the regression equation is the average rate of change in the FBL concentration as the XRF concentration increases one unit. Table 1 presents the correlation, R^2, and regression equation for the military ranges/sites at NAS Jacksonville. A detailed discussion of the correlation analysis for each range/site follows Table 1.

Table 1
Summary of Correlation Analysis

Range/Site	Correlation	R^2	Acceptable for Prediction?	Prediction Equation	Applicable Concentration Range, mg/kg[1]
Fort Dix	0.99	0.99	Yes	FBL = 67.0 + 1.1*XRF	7 to 6000
0.50 Caliber Range	0.97	0.93	Yes	FBL = -9.1 + 1.5*XRF	7 to 108
Former Skeet Range	0.91	0.82	Yes	FBL = -29.8 + 2.2*XRF	7 to 94
Akron Road Pistol Range	0.95	0.90	Yes	FBL = 21.6 + 1.1*XRF	7 to 1960
0.30 Caliber Skeet Range	0.92	0.85	Yes	FBL = -0.48 + 1.0*XRF	7 to 160
Trap Ranges	0.77	0.60	Yes	FBL = 36.4 + 0.92*XRF	7 to 2381

NA = Not applicable correlation is not acceptable.
1 The lower end of the applicable range (i.e., 7 mg/kg) represents the XRF Limit of Quantitation

Figure 1 presents the scatter plot of the XRF and FBL lead concentrations for Fort Dix. With the exception of five samples, all the XRF concentrations are less than 406 mg/kg. The correlation between the XRF and FBL concentrations is 0.51 and the corresponding R^2 value is 0.27. The correlation indicates a weak linear relationship. However, with the removal of one gross outlier (JAX-22-SBSS033) from the original 20-point data set, a very strong correlation was observed among the remaining data points. Figure 2 presents the scatter plot of XRF and FBL lead concentrations when sample JAX-22-SBSS033 is removed. The correlation between the XRF and FBL concentrations is 0.99 and the corresponding R^2 value is 0.99. Therefore, the correlation between the XRF and FBL is acceptable as

outlined by the June 2009 SAP for XRF concentrations. FBL concentrations can be predicted from XRF concentrations from 7 to 6000 mg/kg using the following equation.

$$FBL = 67.0 + 1.1*XRF$$

Table 2 presents the samples that were used in the correlation analysis.

Table 2 Fort Dix 1		
Sample Location	XRF Concentration (mg/kg)	FBL Concentration (mg/kg)
JAX-22-SBSS005	9	3.35 U
JAX-22-SBSS002	11.33	12.7 J
JAX-22-SBSS001	13.67	7.1 U
JAX-22-SBSS029	21	7.54
JAX-22-SBSS010	24.33	28.2
JAX-22-SBSS008	25	24
JAX-22-SBSS009	51.67	27
JAX-22-SBSS022	57	228
JAX-22-SBSS032	93.67	124
JAX-22-SBSS038	142.67	148
JAX-22-SBSS027	164.67	507
JAX-22-SBSS040	195.33	290
JAX-22-SBSS039	211.33	255
JAX-22-SBSS015	259	367
JAX-22-SBSS018	405.67	1100
JAX-22-SBSS033	481	12100
JAX-22-SBSS019	812	652
JAX-22-SBSS025	918.33	1440
JAX-22-SBSS026	2233.33	2510
JAX-22-SBSS020	6053.33	7090 J

Figure 3 presents the scatter plot of the XRF and FBL lead concentrations for the 0.50 Caliber Range. The majority of the concentrations at the 0.50 Caliber Range were less than 150 mg/kg, three were three samples with concentrations greater than 144 mg/kg. One of these concentrations does not follow the same general linear trend as the rest of the samples. The correlation between the XRF and FBL concentrations is 0.86 and the corresponding R^2 value is 0.74. The correlation indicates a moderate linear relationship. Figure 4 presents the scatter plot of the XRF and FBL lead concentrations less than 144 mg/kg. With the three concentrations greater than 144 mg/kg removed the correlation is 0.97 and the corresponding R^2 value is 0.93 indicating that there is a strong linear relationship. Therefore, the correlation between the XRF and FBL is acceptable as outlined by the June 2009 SAP. FBL concentrations can be predicted from XRF concentrations from 7 to 108 mg/kg using the following equation.

$$FBL = -9.1 + 1.5*XRF$$

Table 3 presents the samples that were used in the correlation analysis.

Table 3 0.50 Caliber Range		
Sample Location	XRF Concentration (mg/kg)	FBL Concentration (mg/kg)
JAX-23A-SBSS001	10.33	2.22
JAX-23A-SBSS015	24.67	15.2
JAX-23A-SBSS011	35.33	66.4
JAX-23A-SBSS007	45.67	47.6
JAX-23A-SBSS015	49	58.6
JAX-23A-SBSS004	61.33	88.2
JAX-23A-SBSS008	108	144
JAX-23A-SBSS012	686.67	1020
JAX-23A-SBSS012	727.33	851
JAX-23A-SBSS008	1179	651

Figure 5 presents the scatter plot of the XRF and FBL lead concentrations for the Former Skeet Range. The majority of the concentrations at the Former Skeet Range have XRF concentrations less than 100 mg/kg. There are five samples with XRF concentrations greater than 100 mg/kg. These samples do not follow the same general linear trend as the rest of the samples. The correlation between the XRF and FBL concentrations is 0.92 and the corresponding R^2 value is 0.84. The correlation indicates a strong linear relationship. Figure 6 presents the scatter plot of the XRF and FBL lead concentrations with XRF concentrations less than 100 mg/kg. The correlation is 0.91 and the corresponding R^2 value is 0.82. The correlation between the XRF and FBL is acceptable as outlined by the June 2009 SAP. FBL concentrations can be predicted from XRF concentrations from 7 to 94 mg/kg using the following equation.

$$FBL = -29.8 + 2.2*XRF$$

Table 4 presents the samples that were used in the correlation analysis.

Table 4 Former Skeet Range		
Sample Location	XRF Concentration (mg/kg)	FBL Concentration (mg/kg)
JAX-23B-SBSS017	56.67	70.2
JAX-23B-SBSS022	303.33	157
JAX-23B-SBSS001	19.67	24.4
JAX-23B-SBSS002	21.67	12
JAX-23B-SBSS003	30.33	41.4
JAX-23B-SBSS004	91.67	148
JAX-23B-SBSS005	180.67	180
JAX-23B-SBSS006	16.67	15.6
JAX-23B-SBSS007	6.83	5.62
JAX-23B-SBSS008	38.33	41.6
JAX-23B-SBSS009	14	10.3
JAX-23B-SBSS010	645.33	573
JAX-23B-SBSS012	364	594
JAX-23B-SBSS014	28.33	29.5
JAX-23B-SBSS015	24.5	24.9
JAX-23B-SBSS027	93.33	254
JAX-23B-SBSS028	72.67	98.7
JAX-23B-SBSS032	467	467
JAX-23B-SBSS035	57	86.3
JAX-23B-SBSS038	51.67	43.1

Figure 7 presents the scatter plot of the XRF and FBL lead concentrations for the Akron Road Pistol Range. All but one sample at Akron Road Pistol Range were less than 1961 mg/kg. The one sample that has a lead concentration greater than 1960 follows the same general linear trend as the rest of the samples but most likely represents a different population. The correlation between the XRF and FBL concentrations is 0.99 and the corresponding R^2 value is 0.98. The correlation indicates a strong linear relationship. With the one sample removed, the correlation between the XRF and FBL concentrations is 0.95 and the corresponding R^2 value is 0.90. Figure 8 presents the scatter plot of the XRF and FBL lead concentrations for data pairs with XRF concentrations of less than 1960 mg/kg. The correlation between the XRF and FBL is acceptable as outlined by the June 2009 SAP. FBL concentrations can be predicted from XRF concentrations from 7 to 1960 mg/kg using the following equation.

$$FBL = 21.6 + 1.1*XRF$$

Table 5 presents the samples that were used in the correlation analysis.

Table 5
Akron Road Pistol Range

Sample Location	XRF Concentration (mg/kg)	FBL Concentration (mg/kg)
JAX-56-SBSS068	7.17	1.5
JAX-56-SBSS061	8.17	3.11
JAX-56-SBSS067	8.83	4.3
JAX-56-SBSS065	11.33	3.57
JAX-56-SBSS028	20	13.5
JAX-56-SBSS001	20.33	54.2
JAX-56-SBSS033	21.67	23.9
JAX-56-SBSS058	22.33	19.3
JAX-56-SBSS014	53.33	112
JAX-56-SBSS024	76.33	3.46
JAX-56-SBSS021	79.33	69.9
JAX-56-SBSS058	92.33	106
JAX-56-SBSS037	104	112
JAX-56-SBSS004	104.33	50.9
JAX-56-SBSS064	126	150
JAX-56-SBSS009	143	6.25
JAX-56-SBSS053	146	204
JAX-56-SBSS013	288	225
JAX-56-SBSS018	302.67	763
JAX-56-SBSS019	341.67	468
JAX-56-SBSS018	374.67	635
JAX-56-SBSS054	392.33	426
JAX-56-SBSS028	518.67	819
JAX-56-SBSS057	522.33	569
JAX-56-SBSS006	541.33	577
JAX-56-SBSS055	634.33	905
JAX-56-SBSS055	690	530
JAX-56-SBSS047	1144.67	1720
JAX-56-SBSS040	1957	1960
JAX-56-SBSS042	5229.67	8290

Figure 9 presents the scatter plot of the XRF and FBL lead concentrations for the 0.30 Caliber Skeet Range. The correlation between the XRF and FBL concentrations is 0.92 and the corresponding R^2 value is 0.85. The correlation indicates a strong linear relationship. The correlation between the XRF and FBL is acceptable as outlined by the June 2009 SAP. FBL concentrations can be predicted from XRF concentrations from 7 to 160 mg/kg using the following equation.

$$FBL = -0.48 + 1.0*XRF$$

Table 6 presents the samples that were used in the correlation analysis.

Table 6 **0.30 Caliber Skeet Range**		
Sample Location	XRF Concentration (mg/kg)	FBL Concentration (mg/kg)
JAX-57-SBSS016	6	4.61
JAX-57-SBSS017	6.33	5.6
JAX-57-SBSS012	7.5	5.96
JAX-57-SBSS001	8.5	16
JAX-57-SBSS020	8.56	11
JAX-57-SBSS019	10.18	7.55
JAX-57-SBSS002	14.33	14.4 J
JAX-57-SBSS020	15.33	13.7
JAX-57-SBSS013	16	8.59 J
JAX-57-SBSS013	17.33	17.6
JAX-57-SBSS004	28.67	4.97
JAX-57-SBSS014	31.67	19.2
JAX-57-SBSS009	35.67	75.1 J
JAX-57-SBSS003	37	48.7
JAX-57-SBSS010	40.67	68
JAX-57-SBSS017	47.33	37.9
JAX-57-SBSS006	75	85
JAX-57-SBSS018	81.33	38 J
JAX-57-SBSS007	109	101
JAX-57-SBSS008	159.67	180

Figure 10 presents the scatter plot of the XRF and FBL lead concentrations for the Trap Ranges. The correlation between the XRF and FBL concentrations is 0.77 and the corresponding R^2 value is 0.60. The correlation indicates a moderate linear relationship. The correlation between the XRF and FBL is acceptable as outlined by the June 2009 SAP. FBL concentrations can be predicted from XRF concentrations from 7 to 2,381 mg/kg using the following equation.

$$FBL = 36.4 + 0.92*XRF$$

Table 7 presents the samples that were used in the correlation analysis.

Table 7 Trap Ranges		
Sample Location	XRF Concentration (mg/kg)	FBL Concentration (mg/kg)
JAX-58-SBSS001	4.67	3.11
JAX-58-SBSS002	10.33	3.05
JAX-58-SBSS003	10.33	2.01
JAX-58-SBSS004	11.33	2.29
JAX-58-SBSS005	12.33	2.8
JAX-58-SBSS006	13.33	7.96
JAX-58-SBSS010	27.67	11.5
JAX-58-SBSS012	39.83	122
JAX-58-SBSS008	51.67	53.6
JAX-58-SBSS019	66.67	121
JAX-58-SBSS022	142.33	168
JAX-58-SBSS024	283.33	442
JAX-58-SBSS018	292.67	473
JAX-58-SBSS013	295.67	149
JAX-58-SBSS016	380	460
JAX-58-SBSS030	427.33	386
JAX-58-SBSS028	524.67	789
JAX-58-SBSS025	783.33	1190
JAX-58-SBSS028	1823.33	33 J
JAX-58-SBSS028	2381	3300

Figure 1
Fort Dix
Soil Correlation Analysis

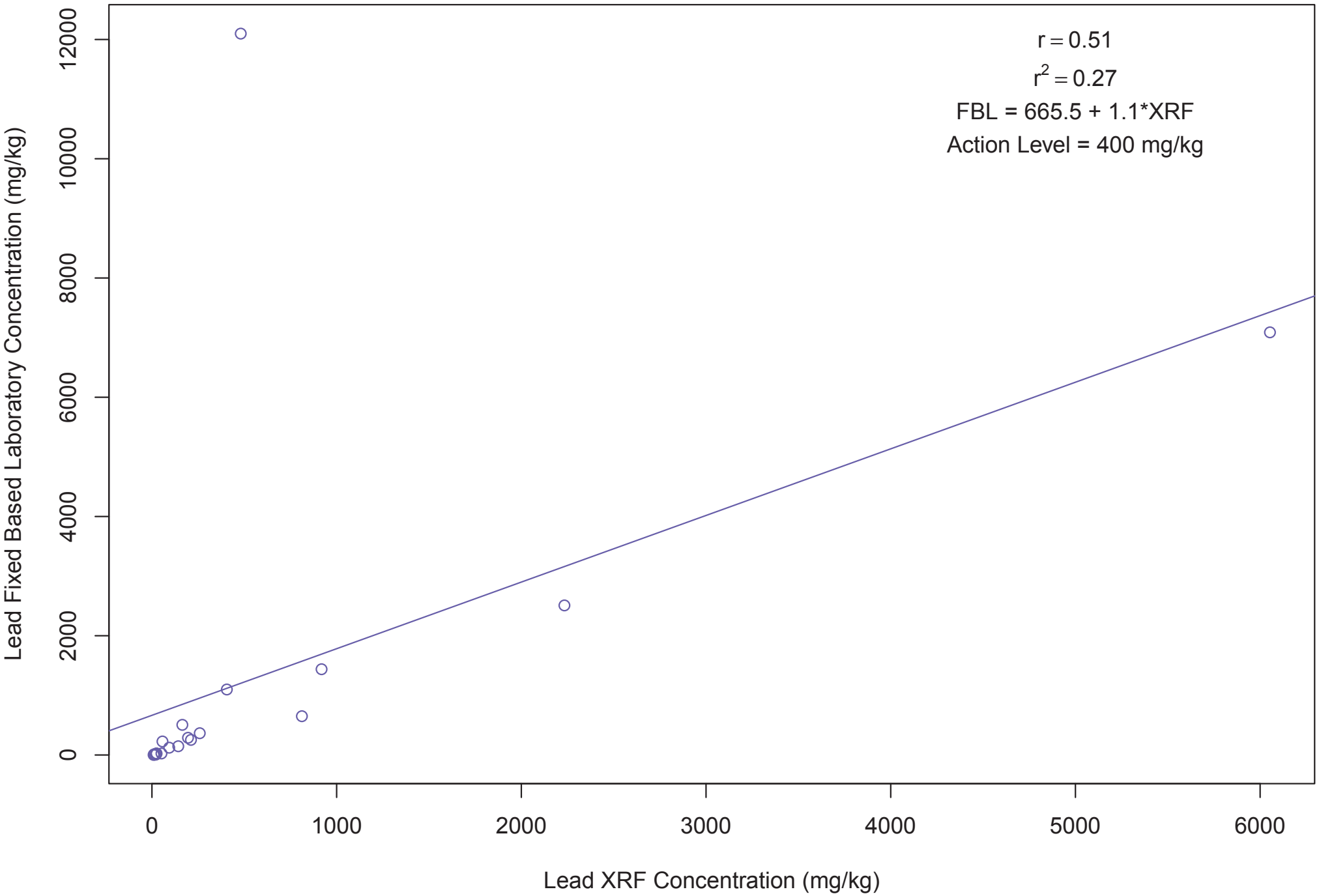


Figure 2
Fort Dix
Soil Correlation Analysis (without outlier mg/kg)

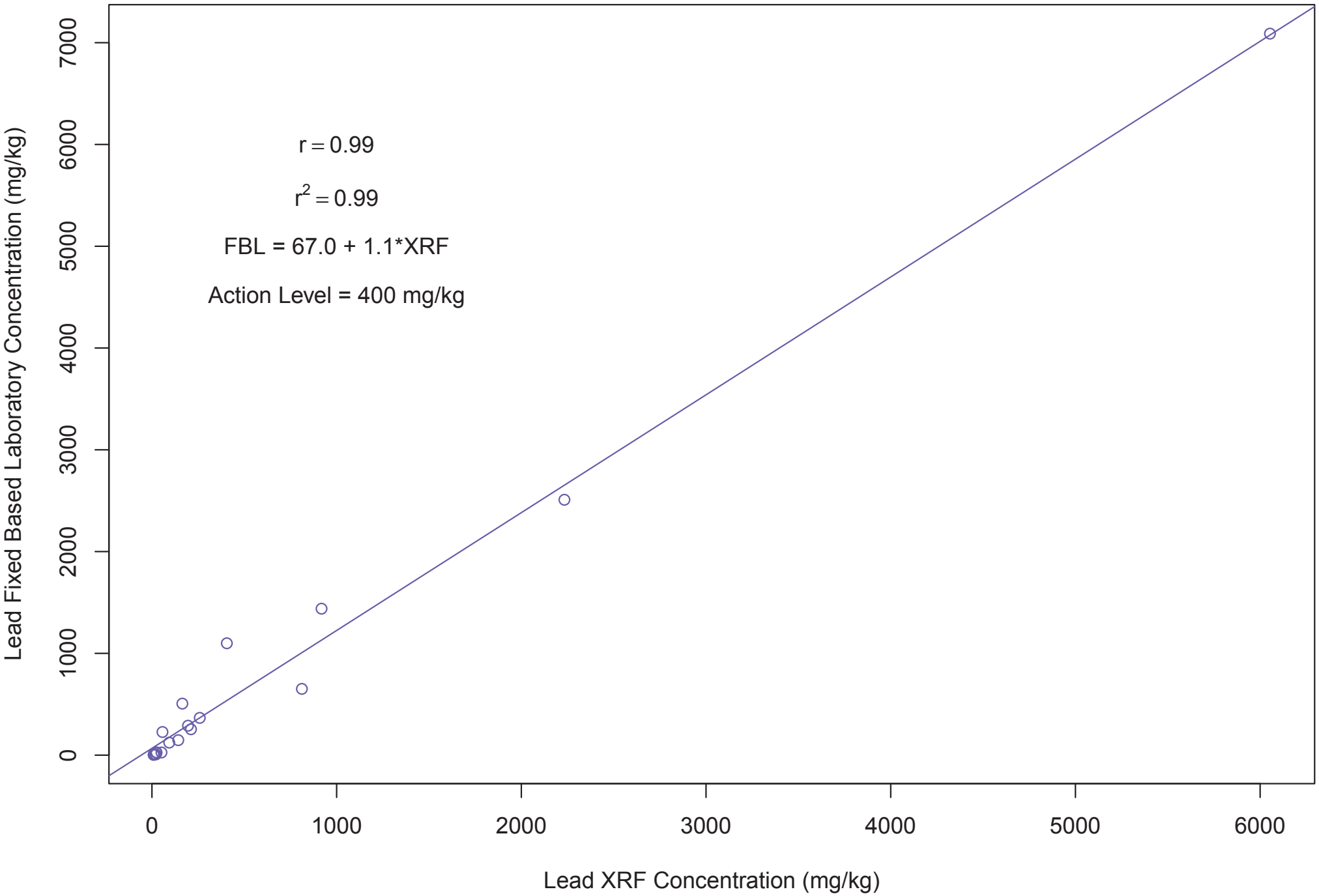


Figure 3
0.50 Caliber Range
Soil Correlation Analysis

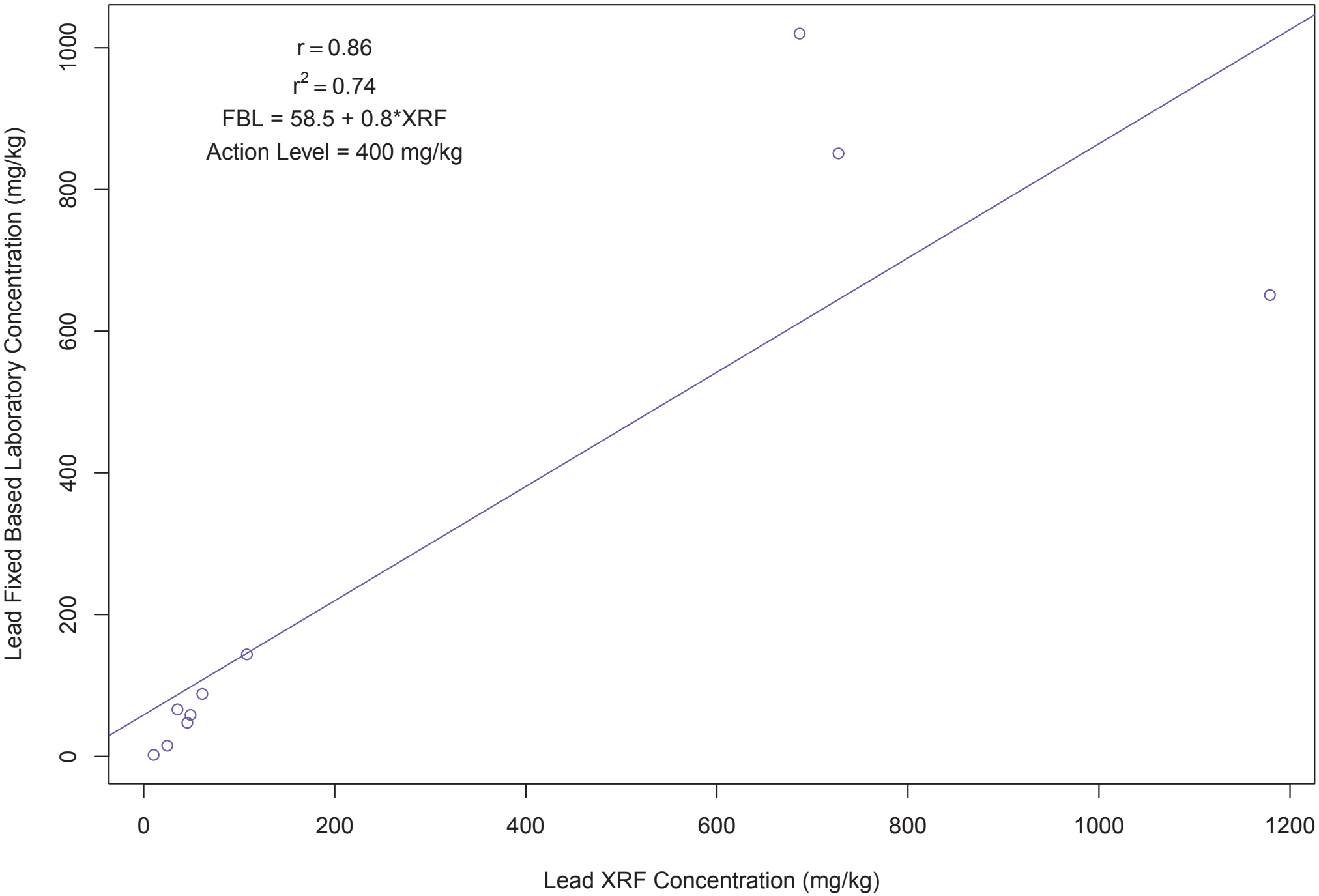


Figure 4
0.50 Caliber Range
Soil Correlation Analysis (XRF Concentrations Less 108 mg/kg)

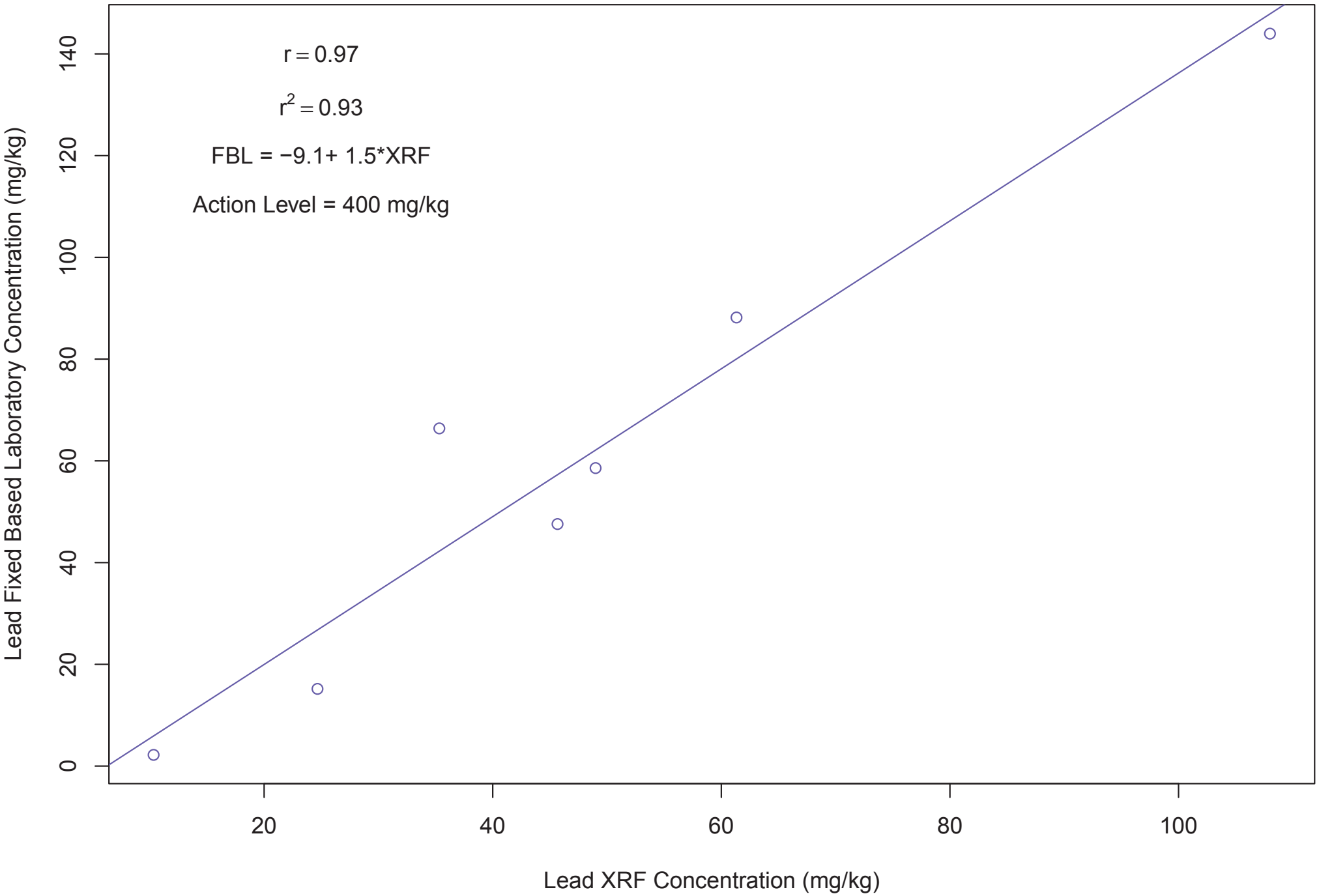


Figure 5
Former Skeet Range
Soil Correlation Analysis

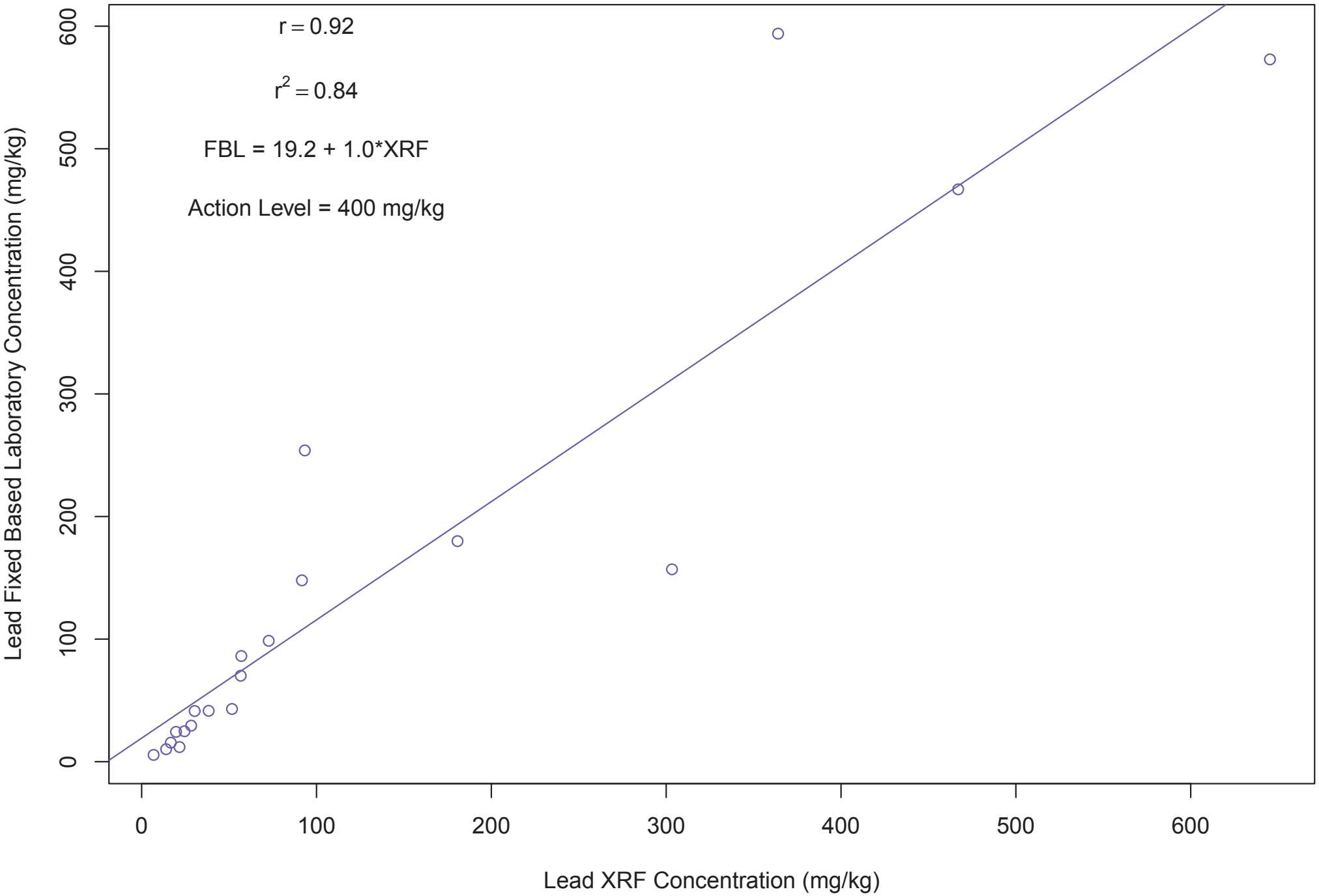


Figure 6
Former Skeet Range
Soil Correlation Analysis (XRF Concentrations Less 94 mg/kg)

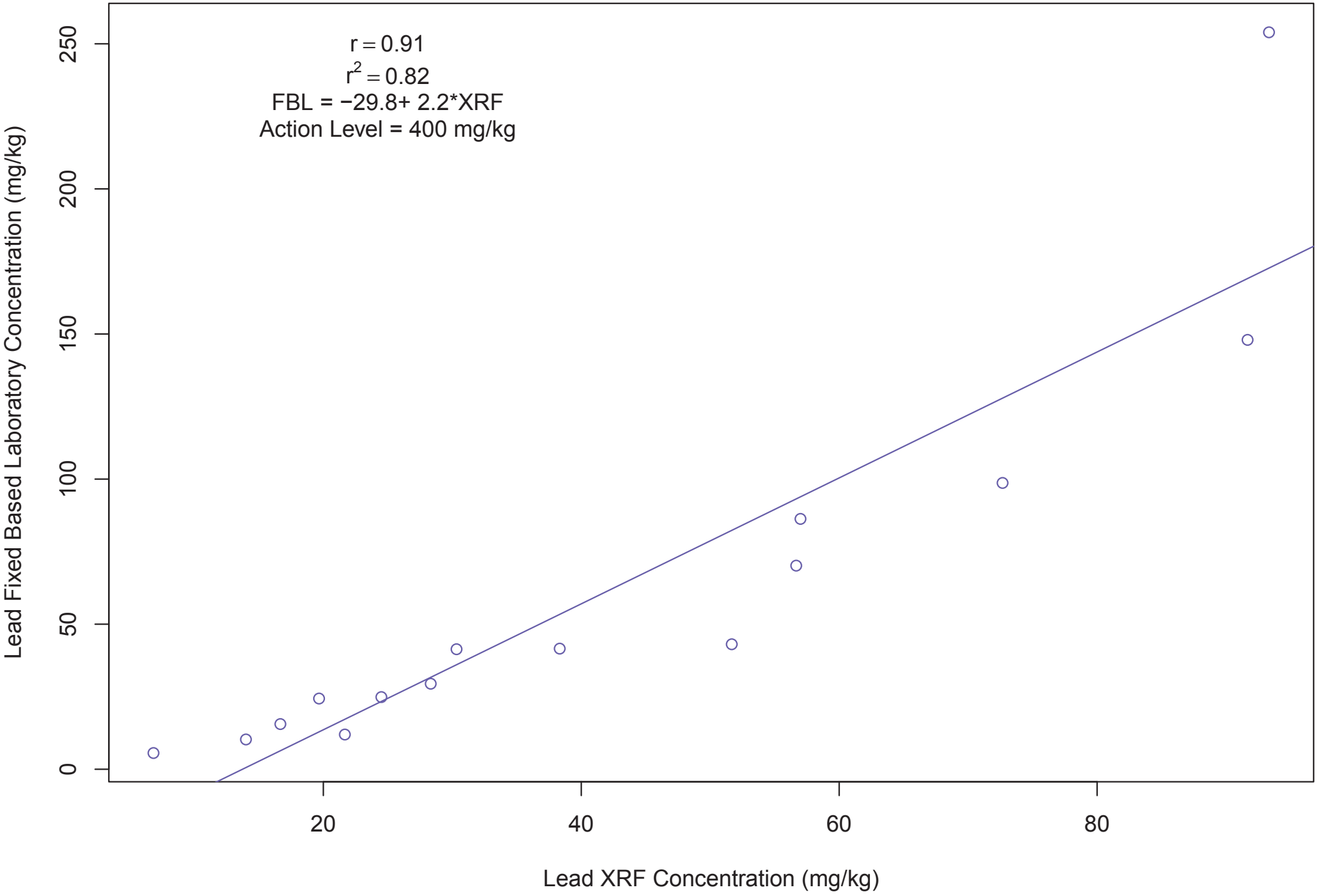


Figure 7
Akron Road Pistol Range
Soil Correlation Analysis

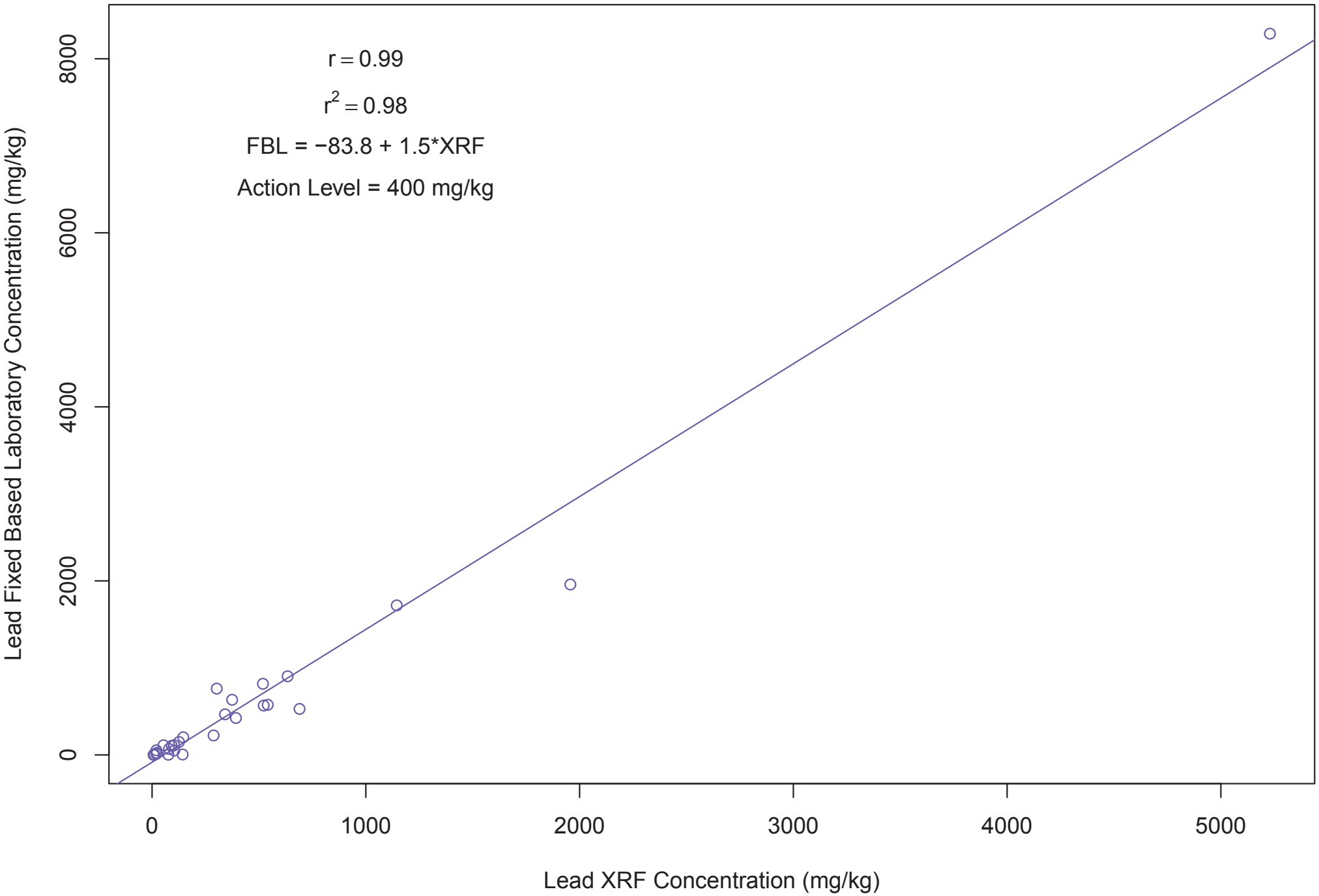


Figure 8
Akron Road Pistol Range
Soil Correlation Analysis (XRF Concentrations Less 1958 mg/kg)

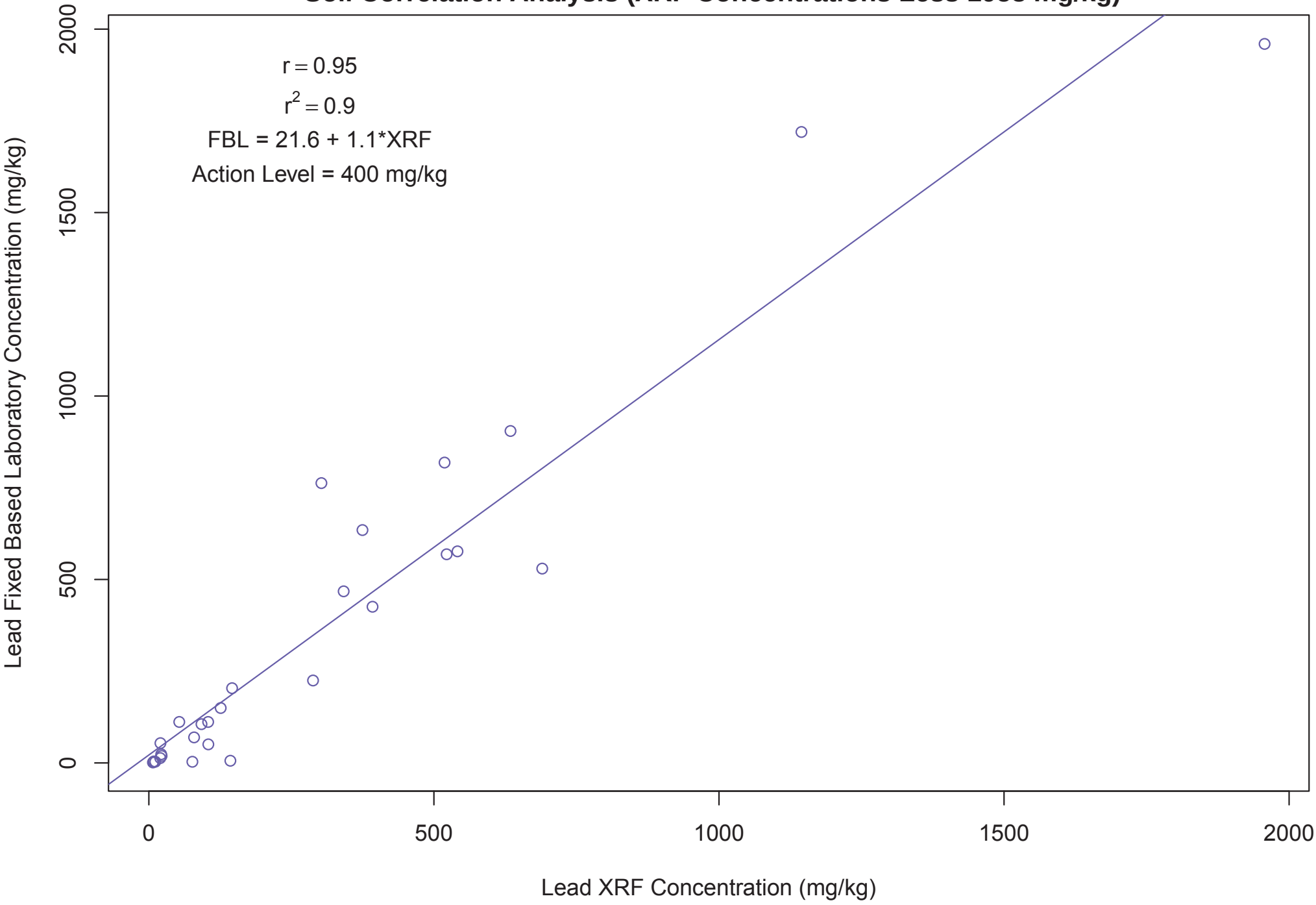


Figure 9
0.30 Caliber Skeet Range
Soil Correlation Analysis

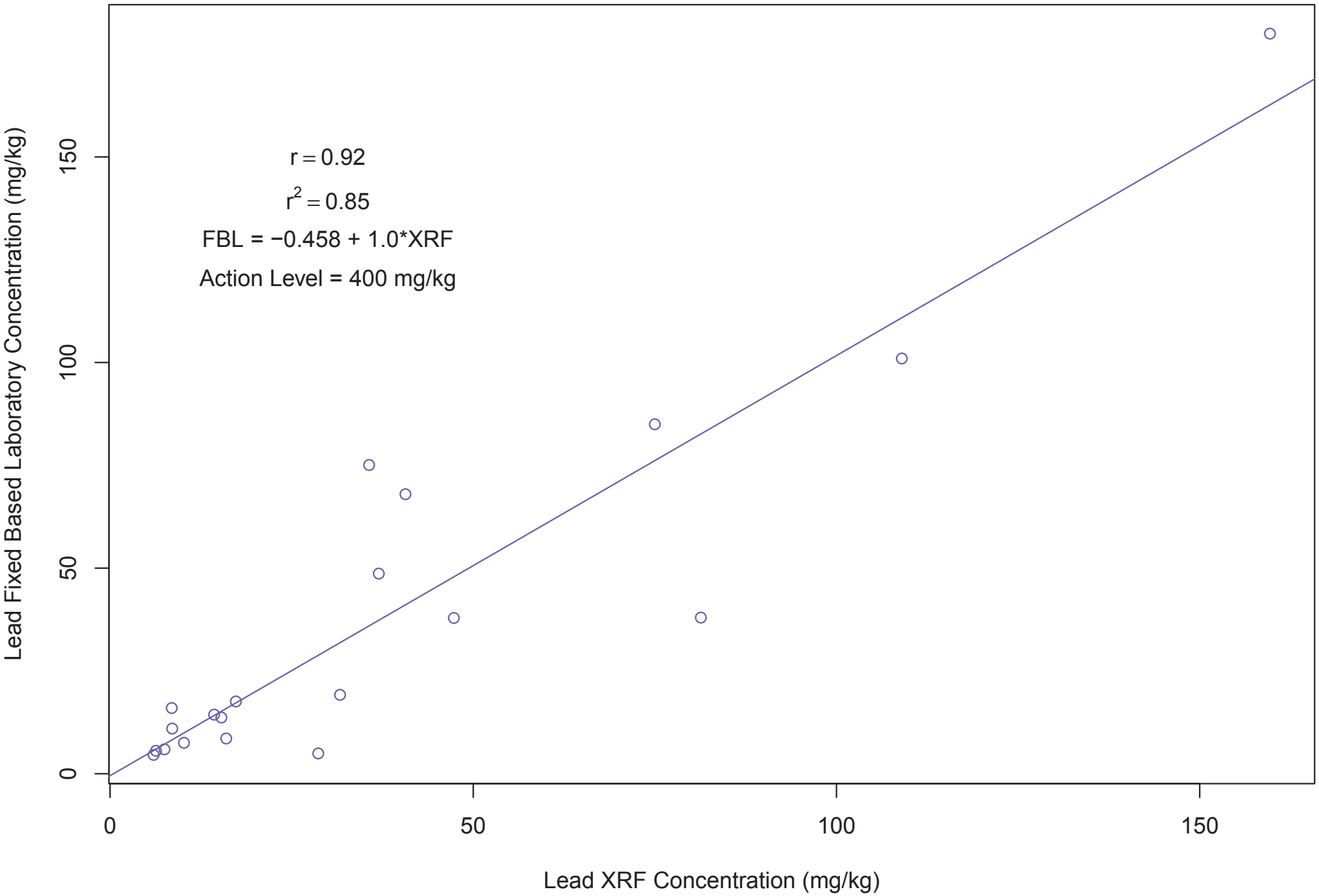
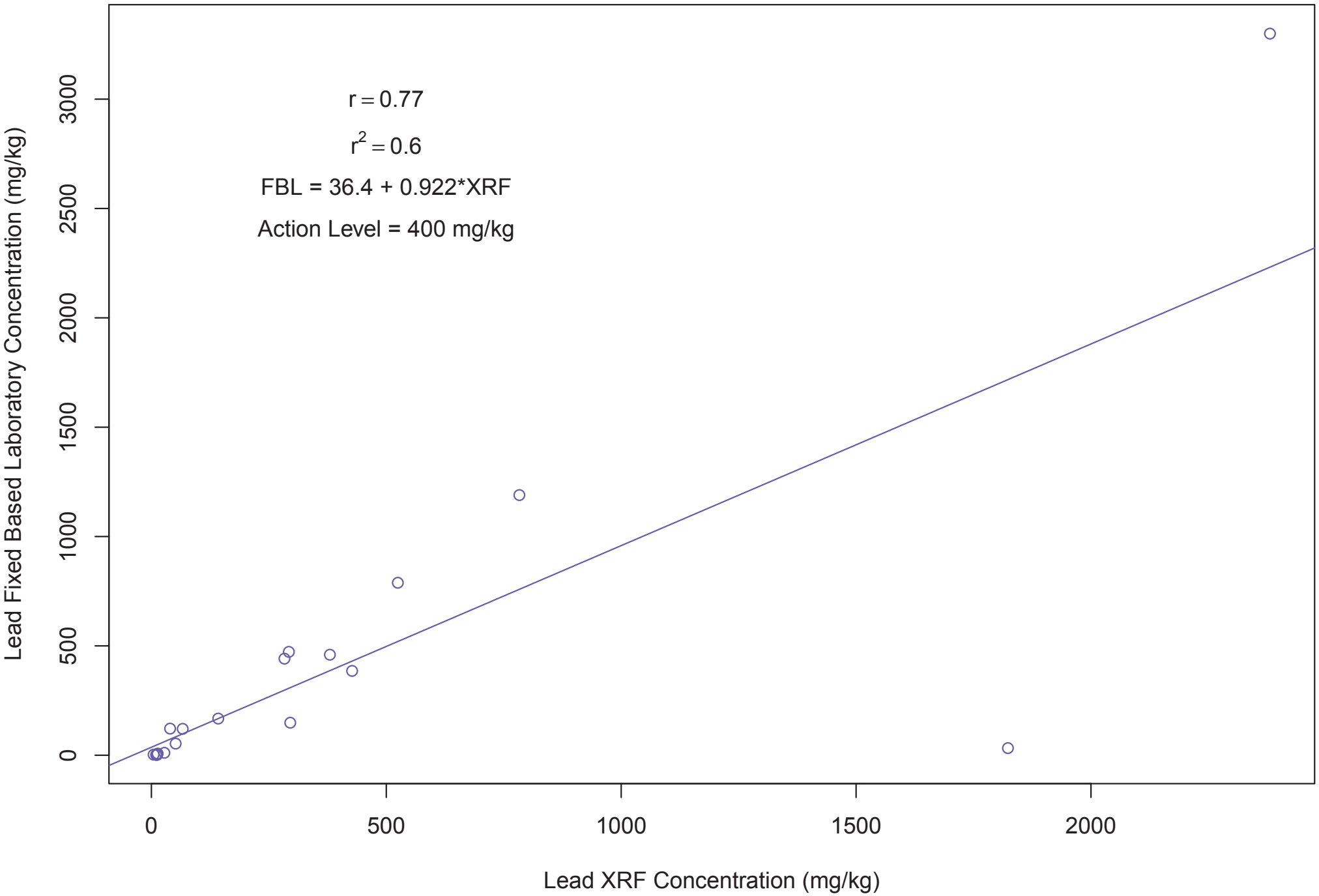


Figure 10
Trap Range
Soil Correlation Analysis



APPENDIX C

HISTORICAL SITE INFORMATION – SI REPORT FINDINGS

TABLE ES-1

SUMMARY OF FINDINGS AND RECOMMENDATIONS
SIX SMALL ARMS RANGES
NAVAL AIR STATION
JACKSONVILLE, FLORIDA

Site Name/Subareas	Screening Exceedance	Major Contaminants	Risk Screening Evaluation Conclusions	Recommendation
Fort Dix Skeet Range (PSC 22)				
Soil	Yes	Human Health: Arsenic, Antimony, Copper, Lead, PAHs Ecological: Antimony, Copper, Lead, Tin, Zinc, PAHs	Exceedances of human health and ecological screening levels for metals and PAHs in soil.	Proceed to: RI/FS
Sediment	Yes	Human Health: Lead, PAHs Ecological: Antimony, Lead, PAHs	Exceedances of human health and ecological screening levels for metals and PAHs in sediment.	Proceed to: RI/FS
Groundwater	Yes	Antimony, Arsenic, Lead	Soil samples exceeded their respective SPLP screening levels, as well as their alternative SCTLs.	Proceed to: RI/FS
.50-Caliber Range (PSC 23A)				
Soil	No	Human Health: None Ecological: None	Soil sample exceeded residential SCTL	Proceed to RI/FS
Groundwater	Yes	Antimony	Soil samples exceeded the respective SPLP screening level, as well as the alternative SCTL.	Proceed to: RI/FS
Former Skeet Range (PSC 23B)				
Soil	Yes	Human Health: Arsenic, Lead, PAHs Ecological: Antimony, Lead, Zinc, PAHs	Exceedances of human health and ecological screening levels for metals and PAHs in soil.	Proceed to: RI/FS
Sediment	Yes	Human Health: Arsenic, Lead, PAHs Ecological: Antimony, Arsenic, Copper, Lead, PAHs	Exceedances of human health and ecological screening levels for metals and PAHs in sediment.	Proceed to: RI/FS
Groundwater	No	None	Soil samples exceeded their respective SPLP screening levels; however, were less than their alternative SCTLs.	NFA

TABLE ES-1

SUMMARY OF FINDINGS AND RECOMMENDATIONS
SIX SMALL ARMS RANGES
NAVAL AIR STATION
JACKSONVILLE, FLORIDA

Site Name/Subareas	Screening Exceedance	Major Contaminants	Risk Screening Evaluation Conclusions	Recommendation
Akron Road Pistol Range (PSC 56)				
Soil	Yes	Human Health: Arsenic, Copper, Lead Ecological: Arsenic, Copper, Lead, Zinc	Exceedances of human health and ecological screening levels for metals and PAHs in soil.	Proceed to: RI/FS
Sediment	Yes	Human Health: Lead Ecological: Copper, Lead	Exceedances of human health and ecological screening levels for metals and PAHs in sediment.	Proceed to: RI/FS
Groundwater	Yes	Lead	Soil samples exceeded their respective SPLP screening levels, as well as their alternative SCTLs .	Proceed to: RI/FS
.30-Caliber Range (PSC 57)				
Soil	Yes	Human Health: None Ecological: Lead	No human health risks; however, there was an exceedance of an ecological screening level for lead in soil.	NFA
Groundwater	Yes	None	Soil samples exceeded their respective SPLP screening levels; however, were less than their alternative SCTLs.	Proceed to RI/FS
Trap Ranges (PSC 58)				
Soil	Yes	Human Health: Arsenic, Lead, PAHs Ecological: Lead, PAHs	Exceedances of human health and ecological screening levels for metals and PAHs in soil.	Proceed to: RI/FS
Sediment	Yes	Human Health: Arsenic, PAHs Ecological: Lead, PAHs	Exceedances of human health and ecological screening levels for metals and PAHs in sediment.	Proceed to: RI/FS
Groundwater	Yes	Antimony, Arsenic, Lead	Soil samples exceeded their respective SPLP screening levels, as well as their alternative SCTLs .	Proceed to: RI/FS

NFA = No further action
RI/FS = Remedial Investigation/ Feasibility Study
SPLP = Synthetic Precipitation Leaching Procedure

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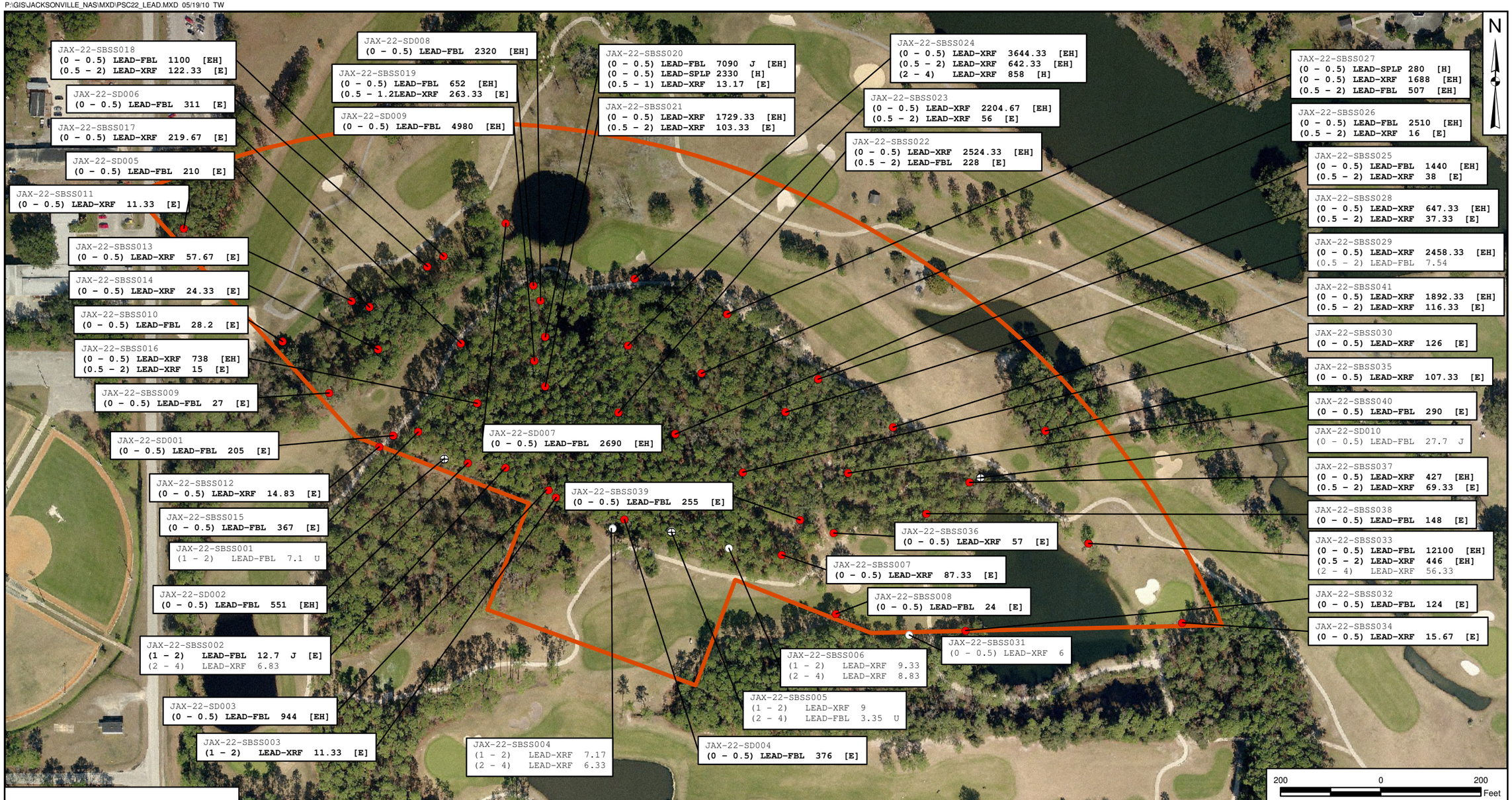


Legend

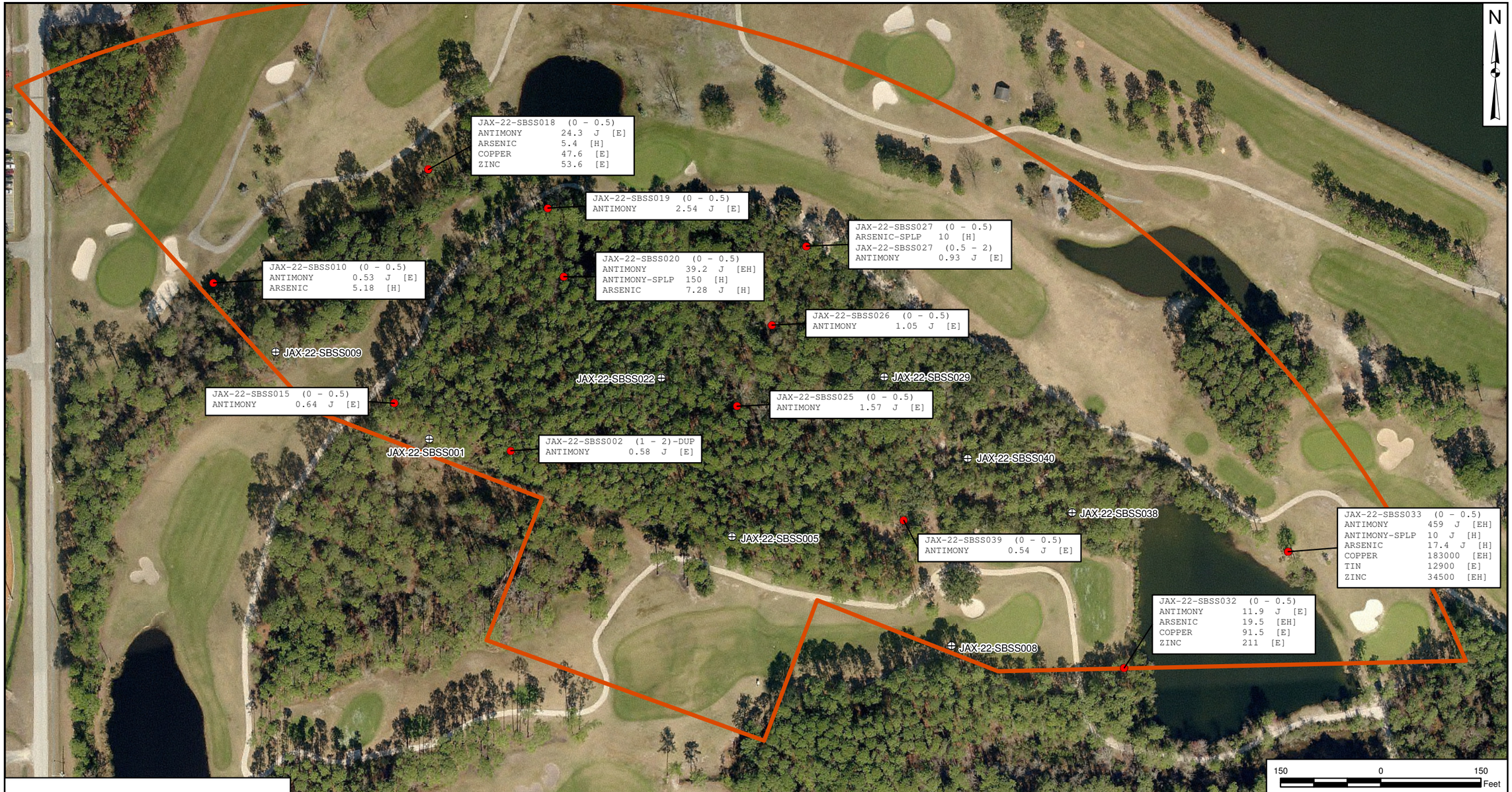
- ⊕ Sample Location (Fixed-Base Lab)
- ○ Sample Location (XRF)
- ● PAL Exceedance
- Range Boundary

Notes:
Lead Units are mg/kg (FBL), ppm (XRF), and ug/L (SPLP)

[E] – Ecological Exceedance
[H] – Human Health Exceedance
[EH] – Exceeds both Ecological and Human Health Criteria
( ) = Sample depth in feet

DRAWN BY T. WHEATON	DATE 05/19/10	TETRA TECH	CONTRACT NUMBER CTO 0086 / OWNER NUMBER —
CHECKED BY J. McCAY	DATE 05/19/10	LEAD DETECTIONS IN SOIL AND SEDIMENT PSC 22 - FORT DIX MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY — / DATE —
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 4-2 / REV 0

P:\GIS\JACKSONVILLE_NAS\MXD\PSC22_METALS.MXD 05/19/10 TW



Legend

- ⊕ Sample Location (Fixed-Base Lab)
- ● PAL Exceedance
- Range Boundary

Notes:
Metals Units are mg/kg (FBL) or ug/L (SPLP)

[E] – Ecological Exceedance
[H] – Human Health Exceedance
[EH] – Exceeds both Ecological and Human Health Criteria
( ) = Sample depth in feet

DRAWN BY T. WHEATON	DATE 05/19/10	TETRA TECH	CONTRACT NUMBER CTO 0086 / OWNER NUMBER —
CHECKED BY J. McCAY	DATE 05/19/10	METALS EXCEEDANCES IN SOIL PSC 22 - FORT DIX MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY — / DATE —
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 4-3 / REV 0

P:\GIS\JACKSONVILLE_NAS\MXD\PSC22_SD_METALS.MXD 05/19/10 TW

Legend

- ⊕ Sediment Sample Location (Fixed-Base Lab)
- ● PAL Exceedance
- Range Boundary

Notes:
Metals Units are mg/kg (FBL)

[E] – Ecological Exceedance
[H] – Human Health Exceedance
[EH] – Exceeds both Ecological and Human Health Criteria
( ) = Sample depth in feet

DRAWN BY T. WHEATON	DATE 05/19/10	TETRA TECH	CONTRACT NUMBER CTO 0086 / OWNER NUMBER —
CHECKED BY J. McCAY	DATE 05/19/10	METALS EXCEEDANCES IN SEDIMENT PSC 22 - FORT DIX MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY — / DATE —
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 4-4 / REV 0

P:\GIS\JACKSONVILLE_NAS\MXD\PSC22_BAP.MXD 05/19/10 TW

Legend

- Sample Location (Fixed-Base Lab)
- PAL Exceedance
- Range Boundary

Notes:
BAP Units are ug/kg

[E] – Ecological Exceedance
[H] – Human Health Exceedance
[EH] – Exceeds both Ecological and Human Health Criteria
( ) = Sample depth in feet

DRAWN BY T. WHEATON	DATE 05/19/10	TETRA TECH	CONTRACT NUMBER CTO 0086 / OWNER NUMBER —
CHECKED BY J. McCAY	DATE 05/19/10	BAP EXCEEDANCES IN SOIL PSC 22 - FORT DIX MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY — / DATE —
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 4-5 / REV 0

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Legend

- ⊕ Sediment Sample Location (Fixed-Base Lab)
- ● PAL Exceedance
- Range Boundary

Notes:
BAP Units are ug/kg

[E] – Ecological Exceedance
[H] – Human Health Exceedance
[EH] – Exceeds both Ecological and Human Health Criteria
( ) = Sample depth in feet

DRAWN BY T. WHEATON	DATE 05/19/10	TETRA TECH	CONTRACT NUMBER CTO 0086	OWNER NUMBER —
CHECKED BY J. McCAY	DATE 05/19/10	BAP EXCEEDANCES IN SEDIMENT PSC 22 - FORT DIX MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY —	DATE —
COST/SCHEDULE-AREA			APPROVED BY —	DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 4-6	REV 0

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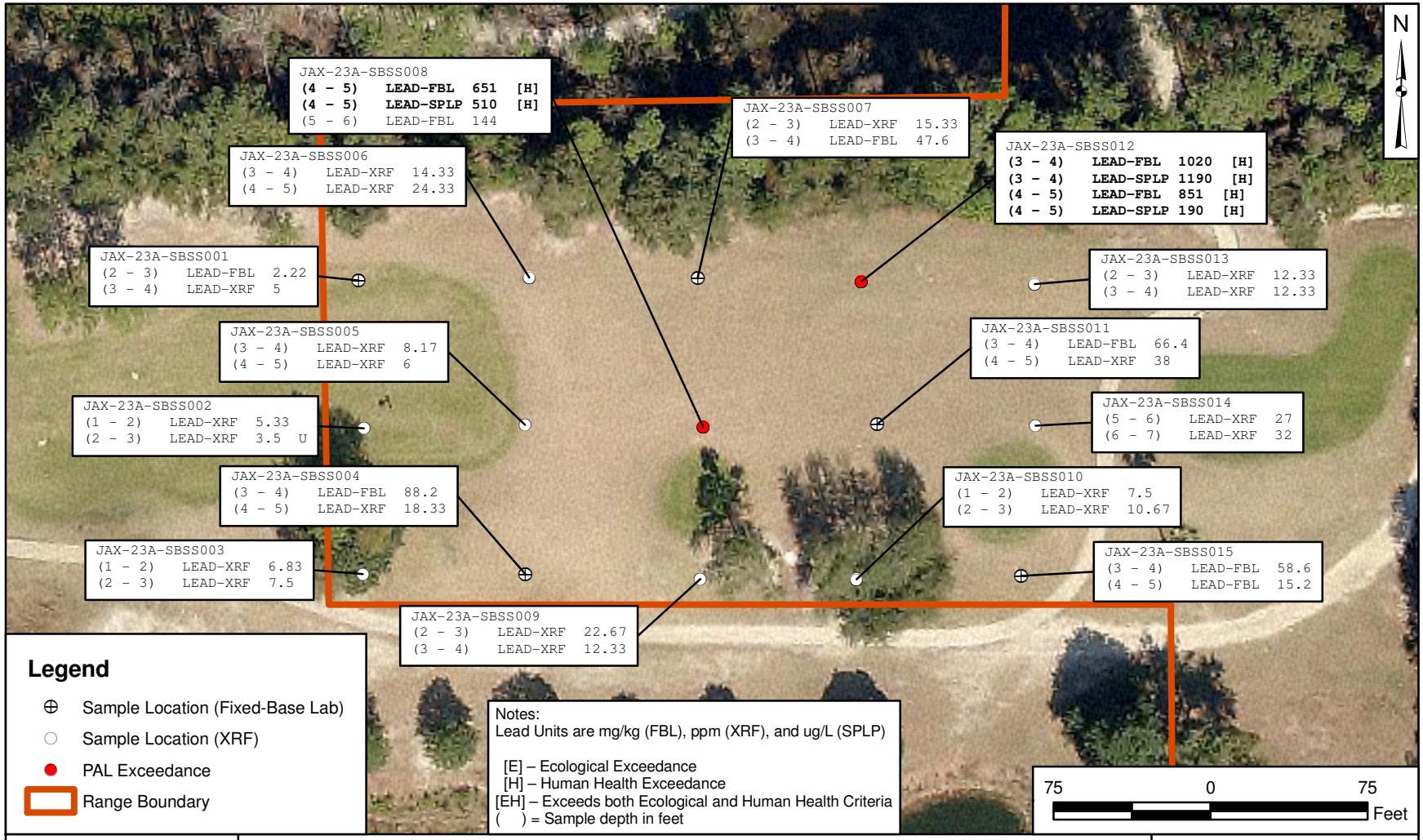

DRAWN BY T. WHEATON	DATE 05/19/10	TETRA TECH	CONTRACT NUMBER CTO 0086
CHECKED BY J. McCAY	DATE 05/19/10	LEAD DETECTIONS IN SOIL PSC 23A - FORMER SKEET RANGE (.50 CALIBER RANGE AREA) MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY ___ DATE ___
COST/SCHEDULE AREA			APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 5-2 / REV 0

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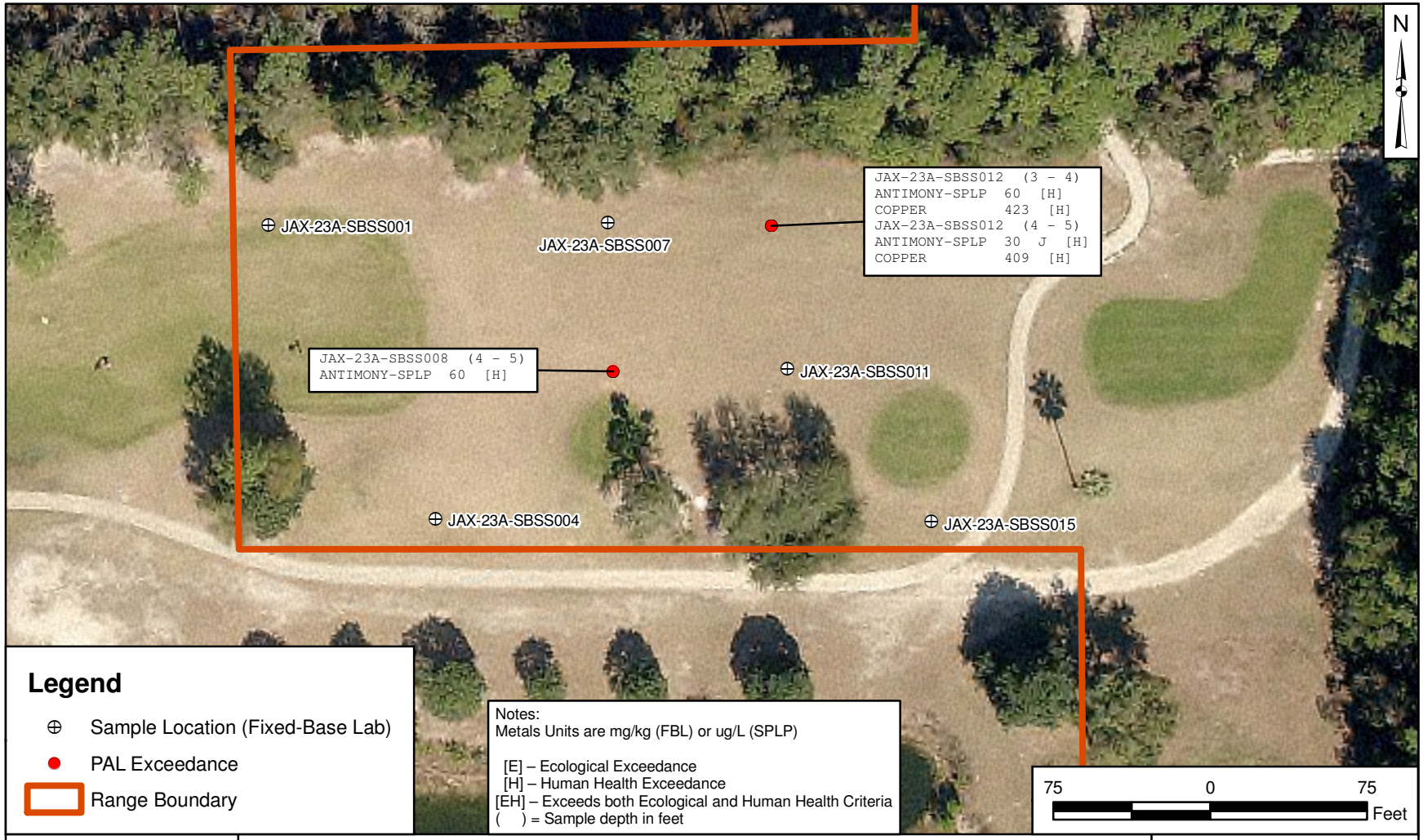

Legend

- ⊕ Sample Location (Fixed-Base Lab)
- ● PAL Exceedance
- Range Boundary

Notes:
Metals Units are mg/kg (FBL) or ug/L (SPLP)

[E] – Ecological Exceedance
[H] – Human Health Exceedance
[EH] – Exceeds both Ecological and Human Health Criteria
( ) = Sample depth in feet

DRAWN BY T. WHEATON	DATE 05/19/10	TETRA TECH	CONTRACT NUMBER CTO 0086
CHECKED BY J. McCAY	DATE 05/19/10	METALS EXCEEDANCES IN SOIL PSC 23A - FORMER SKEET RANGE (.50 CALIBER RANGE AREA) MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY ___ DATE ___
COST/SCHEDULE AREA			APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 5-3 / REV 0

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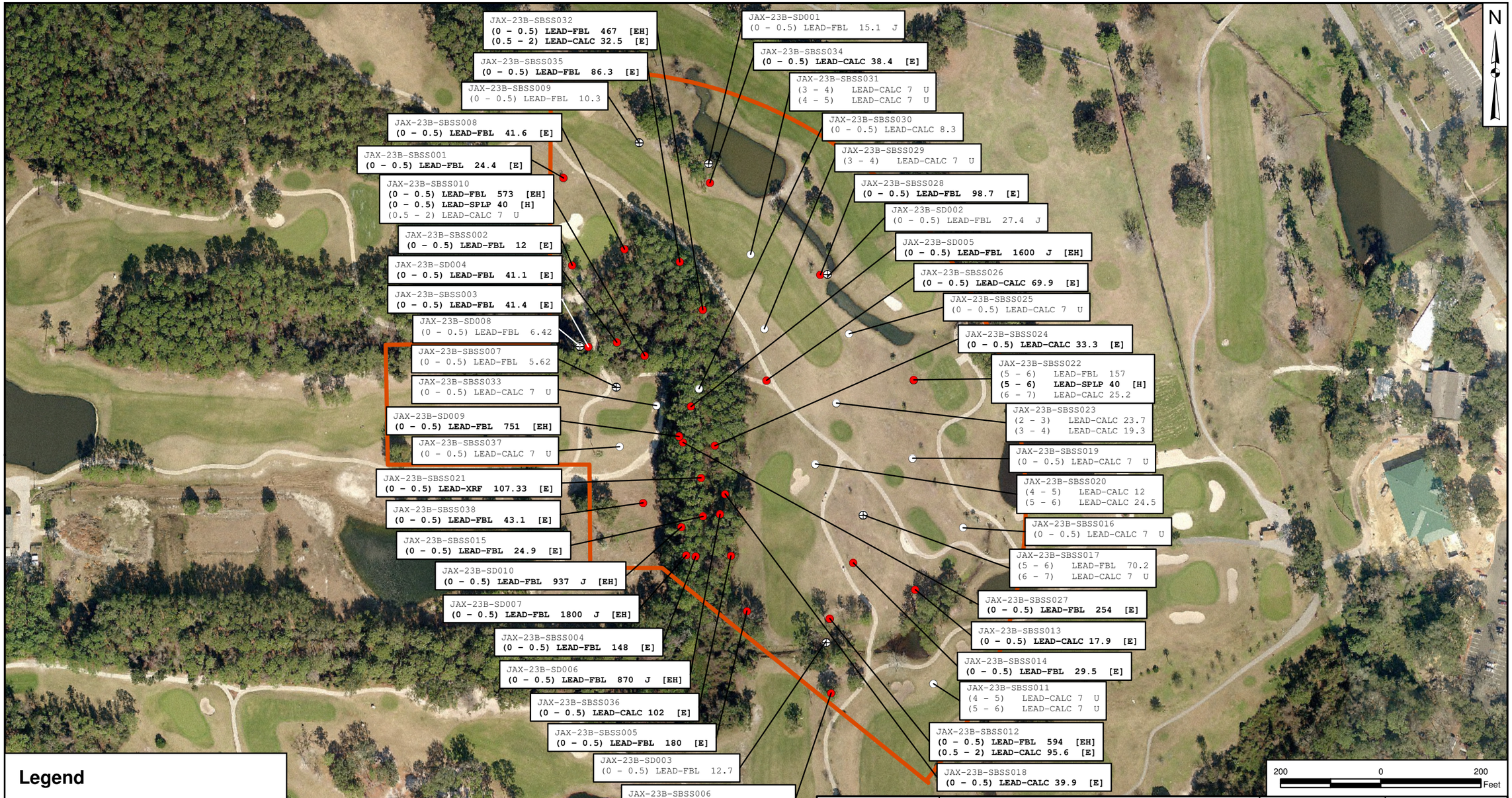

Legend

- Sample Location (Fixed-Base Lab)
- Sample Location (Calculated)
- PAL Exceedance
- Range Boundary

Notes:
Lead Units are mg/kg (FBL), ppm (XRF), and ug/L (SPLP)

[E] – Ecological Exceedance
[H] – Human Health Exceedance
[EH] – Exceeds both Ecological and Human Health Criteria
( ) = Sample depth in feet

DRAWN BY T. WHEATON	DATE 05/19/10	TETRA TECH	CONTRACT NUMBER CTO 0086 / OWNER NUMBER —
CHECKED BY J. McCAY	DATE 05/19/10	LEAD DETECTIONS IN SOIL AND SEDIMENT PSC 23B - FORMER SKEET RANGE (SKEET RANGE AREA) MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY — / DATE —
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 6-2 / REV 0

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Legend

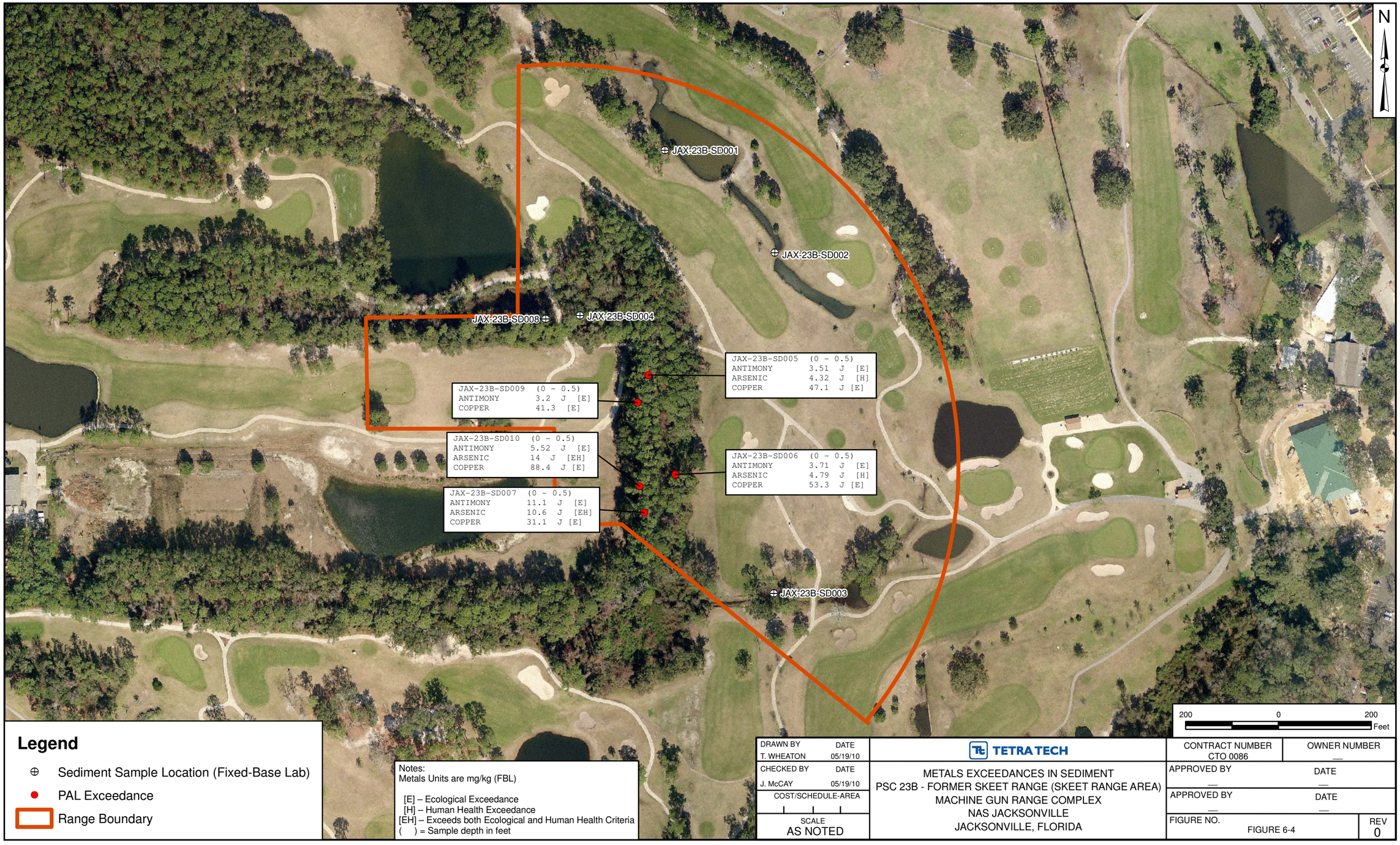
- ⊕ Sample Location (Fixed-Base Lab)
- ● PAL Exceedance
- Range Boundary

Notes:
Metals Units are mg/kg (FBL) or ug/L (SPLP)

[E] – Ecological Exceedance
[H] – Human Health Exceedance
[EH] – Exceeds both Ecological and Human Health Criteria
( ) = Sample depth in feet

DRAWN BY T. WHEATON	DATE 05/19/10	TETRA TECH	CONTRACT NUMBER CTO 0086 / OWNER NUMBER —
CHECKED BY J. McCAY	DATE 05/19/10	METALS EXCEEDANCES IN SOIL PSC 23B - FORMER SKEET RANGE (SKEET RANGE AREA) MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY — / DATE —
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 6-3 / REV 0

P:\GIS\JACKSONVILLE_NAS\MXD\PSC23B_SD_METALS.MXD 05/19/10 TW



Legend

- ⊕ Sediment Sample Location (Fixed-Base Lab)
- ● PAL Exceedance
- Range Boundary

Notes:
Metals Units are mg/kg (FBL)

[E] – Ecological Exceedance
[H] – Human Health Exceedance
[EH] – Exceeds both Ecological and Human Health Criteria
( ) = Sample depth in feet

DRAWN BY	DATE
T. WHEATON	05/19/10
CHECKED BY	DATE
J. McCAY	05/19/10
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

TETRA TECH

METALS EXCEEDANCES IN SEDIMENT
PSC 23B - FORMER SKEET RANGE (SKEET RANGE AREA)
MACHINE GUN RANGE COMPLEX
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NUMBER	OWNER NUMBER
CTO 0086	—
APPROVED BY	DATE
—	—
APPROVED BY	DATE
—	—
FIGURE NO.	REV
FIGURE 6-4	0

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Legend

- ⊕ Sample Location (Fixed-Base Lab)
- ● PAL Exceedance
- Range Boundary

Notes:
BAP Units are ug/kg

[E] – Ecological Exceedance
[H] – Human Health Exceedance
[EH] – Exceeds both Ecological and Human Health Criteria
( ) = Sample depth in feet

DRAWN BY T. WHEATON	DATE 05/11/10	TETRA TECH	CONTRACT NUMBER CTO 0086 / OWNER NUMBER —
CHECKED BY J. McCAY	DATE 05/19/10	BAP EXCEEDANCE IN SOIL PSC 23B - FORMER SKEET RANGE (SKEET RANGE AREA) MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY — / DATE —
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 6-5 / REV 0

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Legend

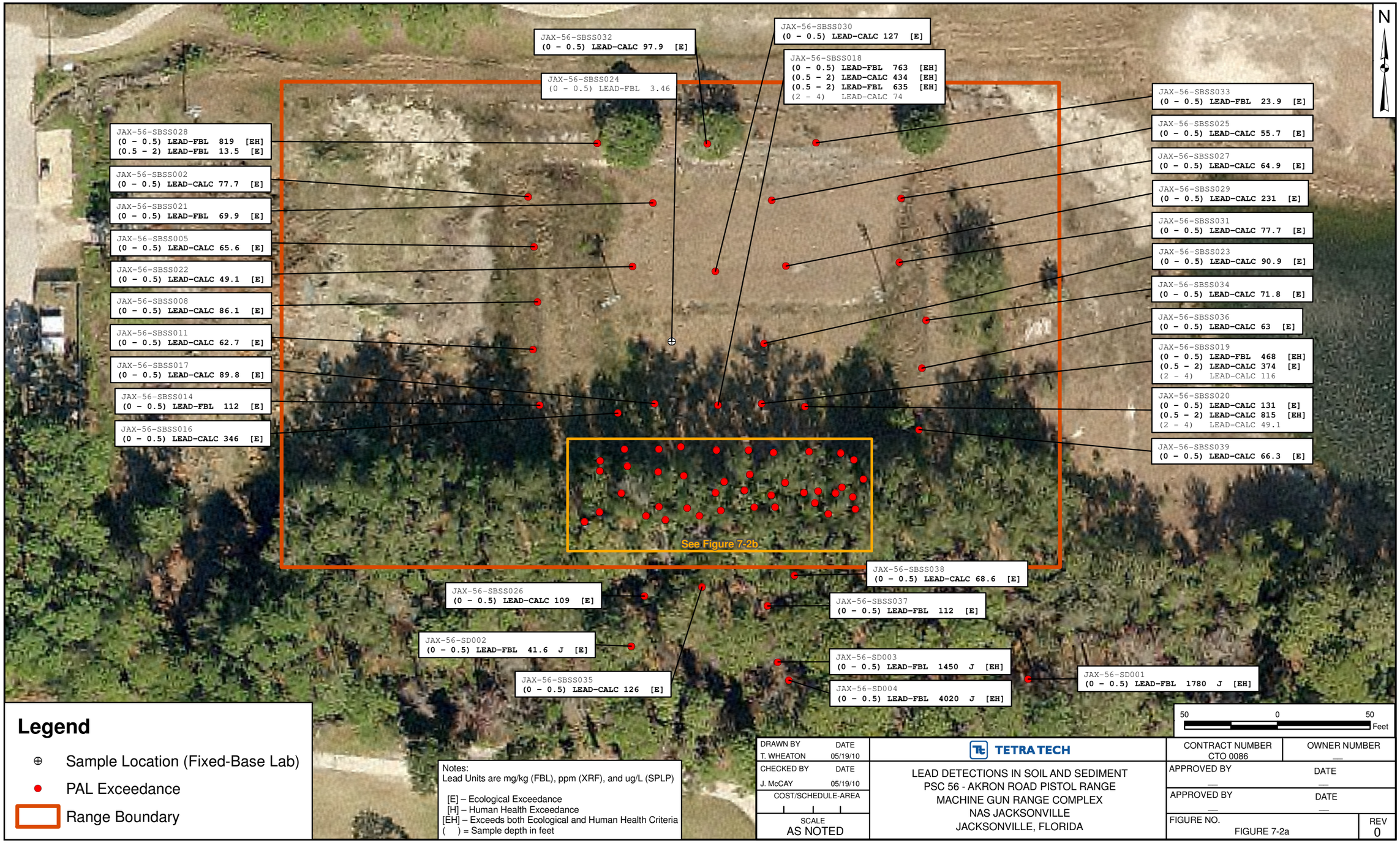
- ⊕ Sediment Sample Location (Fixed-Base Lab)
- ● PAL Exceedance
- Range Boundary

Notes:
BAP Units are ug/kg

[E] – Ecological Exceedance
[H] – Human Health Exceedance
[EH] – Exceeds both Ecological and Human Health Criteria
( ) = Sample depth in feet

DRAWN BY T. WHEATON	DATE 05/19/10	TETRA TECH	CONTRACT NUMBER CTO 0086 / OWNER NUMBER —
CHECKED BY J. McCAY	DATE 05/19/10	BAP EXCEEDANCES IN SEDIMENT PSC 23B - FORMER SKEET RANGE (SKEET RANGE AREA) MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY — / DATE —
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 6-6 / REV 0

P:\GIS\JACKSONVILLE_NAS\MXD\PSC56_LEAD.MXD 05/19/10 TW



Legend

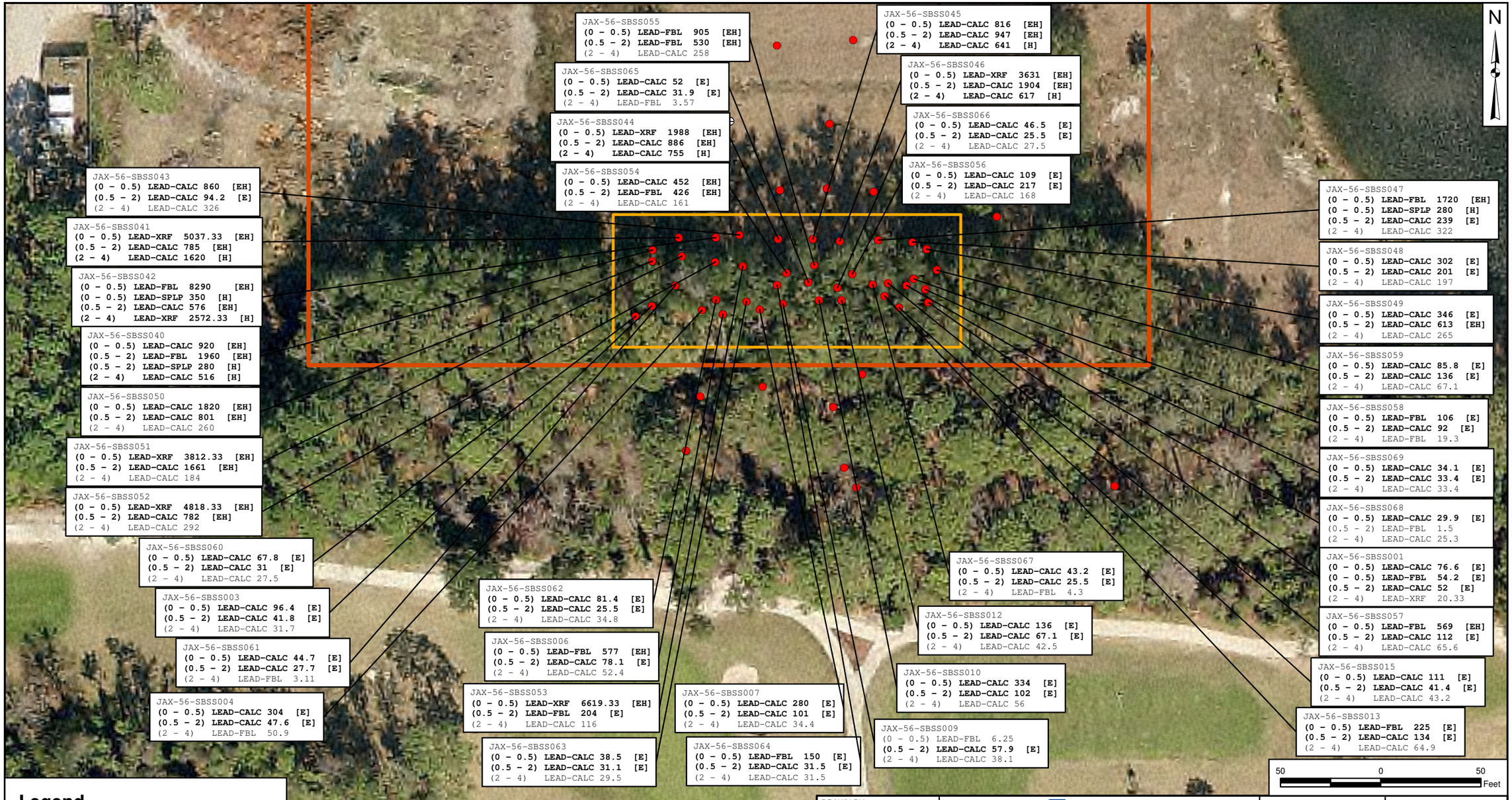
- ⊕ Sample Location (Fixed-Base Lab)
- ● PAL Exceedance
- Range Boundary

Notes:
Lead Units are mg/kg (FBL), ppm (XRF), and ug/L (SPLP)

[E] – Ecological Exceedance
[H] – Human Health Exceedance
[EH] – Exceeds both Ecological and Human Health Criteria
( ) = Sample depth in feet

DRAWN BY T. WHEATON	DATE 05/19/10	TETRA TECH	CONTRACT NUMBER CTO 0086 / OWNER NUMBER —
CHECKED BY J. McCAY	DATE 05/19/10	LEAD DETECTIONS IN SOIL AND SEDIMENT PSC 56 - AKRON ROAD PISTOL RANGE MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY — / DATE —
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 7-2a / REV 0

P:\GIS\JACKSONVILLE_NAS\MXD\PSC56_LEAD.MXD 05/20/10 TW



Legend

- ⊕ Sample Location (Fixed-Base Lab)
- ● PAL Exceedance
- Range Boundary

Notes:
Lead Units are mg/kg (FBL), ppm (XRF), and ug/L (SPLP)

[E] – Ecological Exceedance
[H] – Human Health Exceedance
[EH] – Exceeds both Ecological and Human Health Criteria
( ) = Sample depth in feet

DRAWN BY	DATE
T. WHEATON	05/20/10
CHECKED BY	DATE
J. McCAY	05/20/10
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

TETRA TECH

LEAD DETECTIONS IN SOIL AND SEDIMENT
AREA DETAIL - PSC 56 - AKRON ROAD PISTOL RANGE
MACHINE GUN RANGE COMPLEX
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NUMBER	OWNER NUMBER
CTO 0086	—
APPROVED BY	DATE
—	—
APPROVED BY	DATE
—	—
FIGURE NO.	REV
FIGURE 7-2b	0

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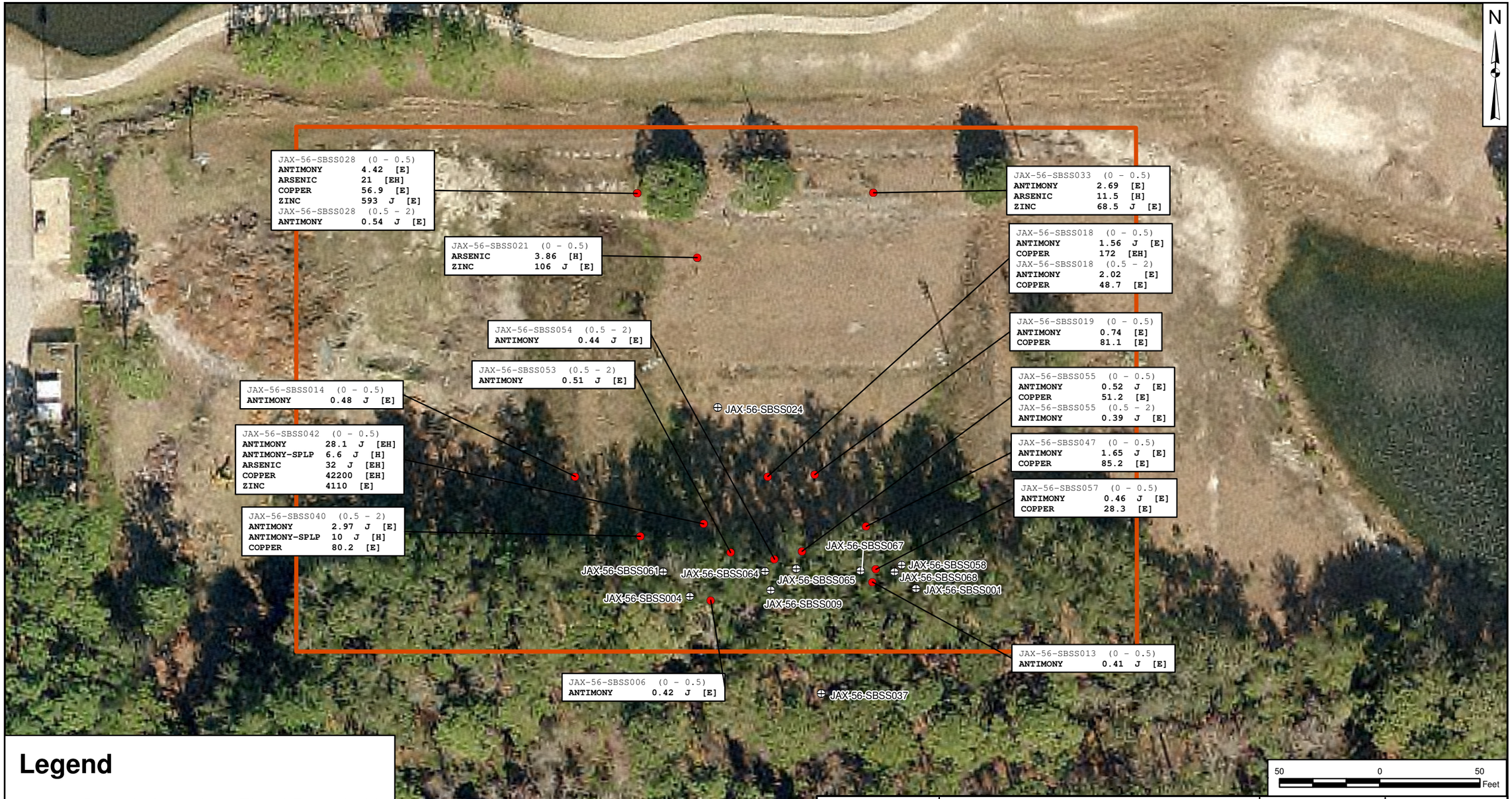

Legend

- ⊕ Sample Location (Fixed-Base Lab)
- ● PAL Exceedance
- Range Boundary

Notes:
Metals Units are mg/kg (FBL) or ug/L (SPLP)

[E] – Ecological Exceedance
[H] – Human Health Exceedance
[EH] – Exceeds both Ecological and Human Health Criteria
( ) = Sample depth in feet

DRAWN BY T. WHEATON	DATE 05/20/10	TETRA TECH	CONTRACT NUMBER CTO 0086 / OWNER NUMBER —
CHECKED BY J. McCAY	DATE 05/20/10	METALS EXCEEDANCES IN SOIL PSC 56 - AKRON ROAD PISTOL RANGE MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY — / DATE —
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 7-3 / REV 0

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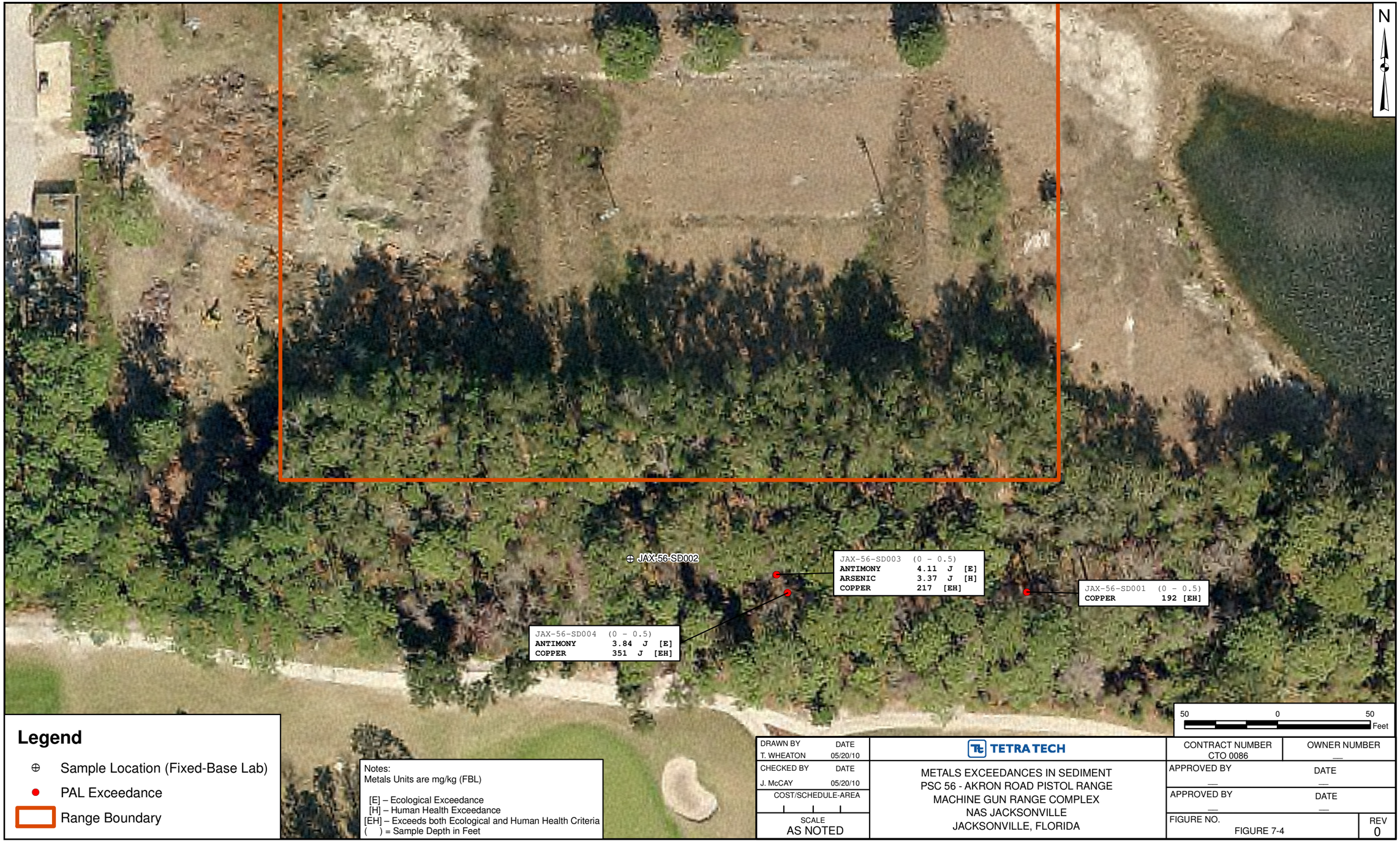


Legend

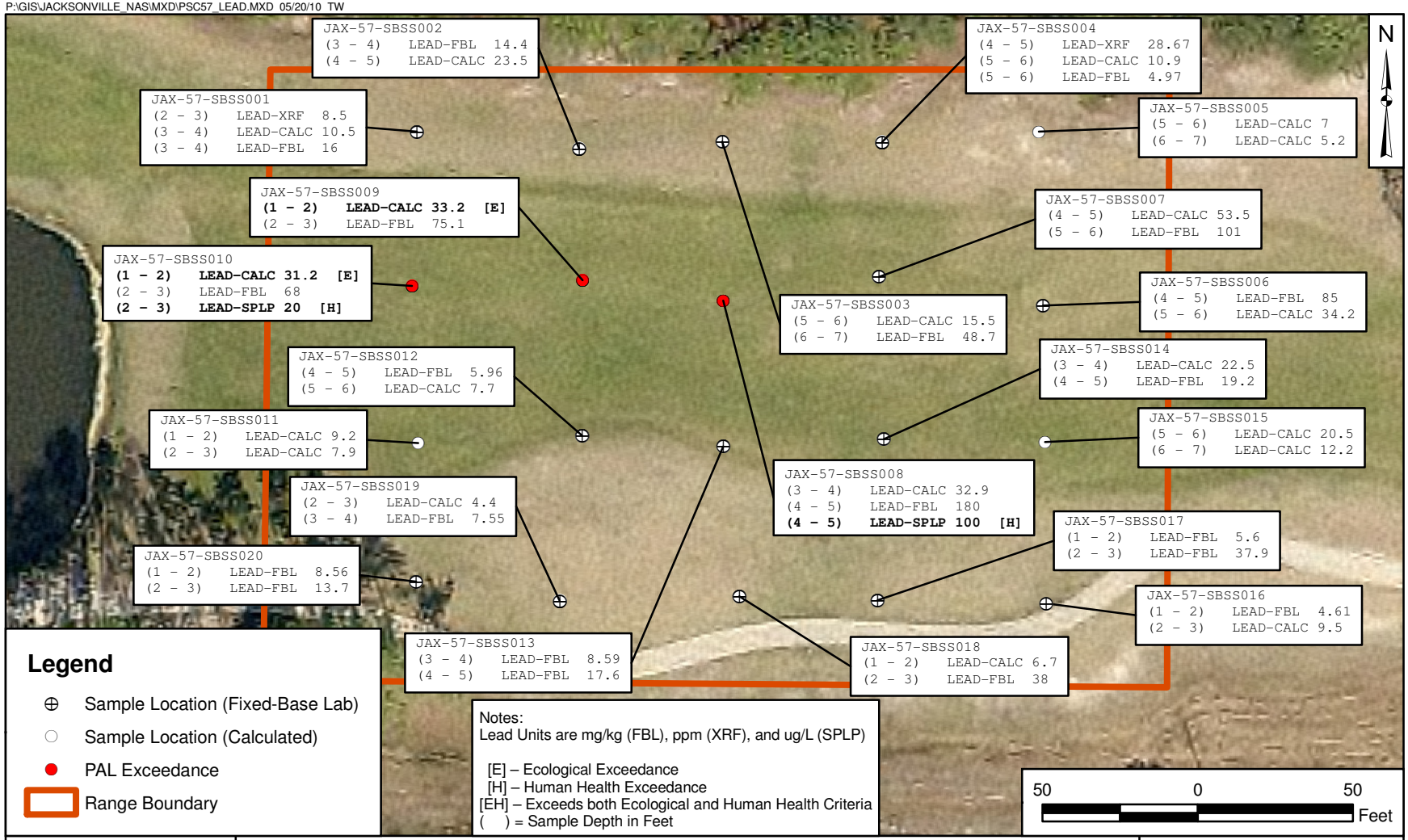
- ⊕ Sample Location (Fixed-Base Lab)
- ● PAL Exceedance
- ▭ Range Boundary

Notes:
Metals Units are mg/kg (FBL)

[E] – Ecological Exceedance
[H] – Human Health Exceedance
[EH] – Exceeds both Ecological and Human Health Criteria
( ) = Sample Depth in Feet

DRAWN BY T. WHEATON	DATE 05/20/10	TETRA TECH	CONTRACT NUMBER CTO 0086 / OWNER NUMBER —
CHECKED BY J. McCAY	DATE 05/20/10	METALS EXCEEDANCES IN SEDIMENT PSC 56 - AKRON ROAD PISTOL RANGE MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY — / DATE —
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 7-4 / REV 0

P:\GIS\JACKSONVILLE_NAS\MXD\PSC57_LEAD.MXD 05/20/10 TW



DRAWN BY T. WHEATON	DATE 05/20/10	TETRA TECH	CONTRACT NUMBER CTO 0086
CHECKED BY J. McCAY	DATE 05/20/10	LEAD DETECTIONS IN SOIL PSC 57 - .30 CALIBER RANGE MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY ___ DATE ___
COST/SCHEDULE AREA			APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 8-2 / REV 0

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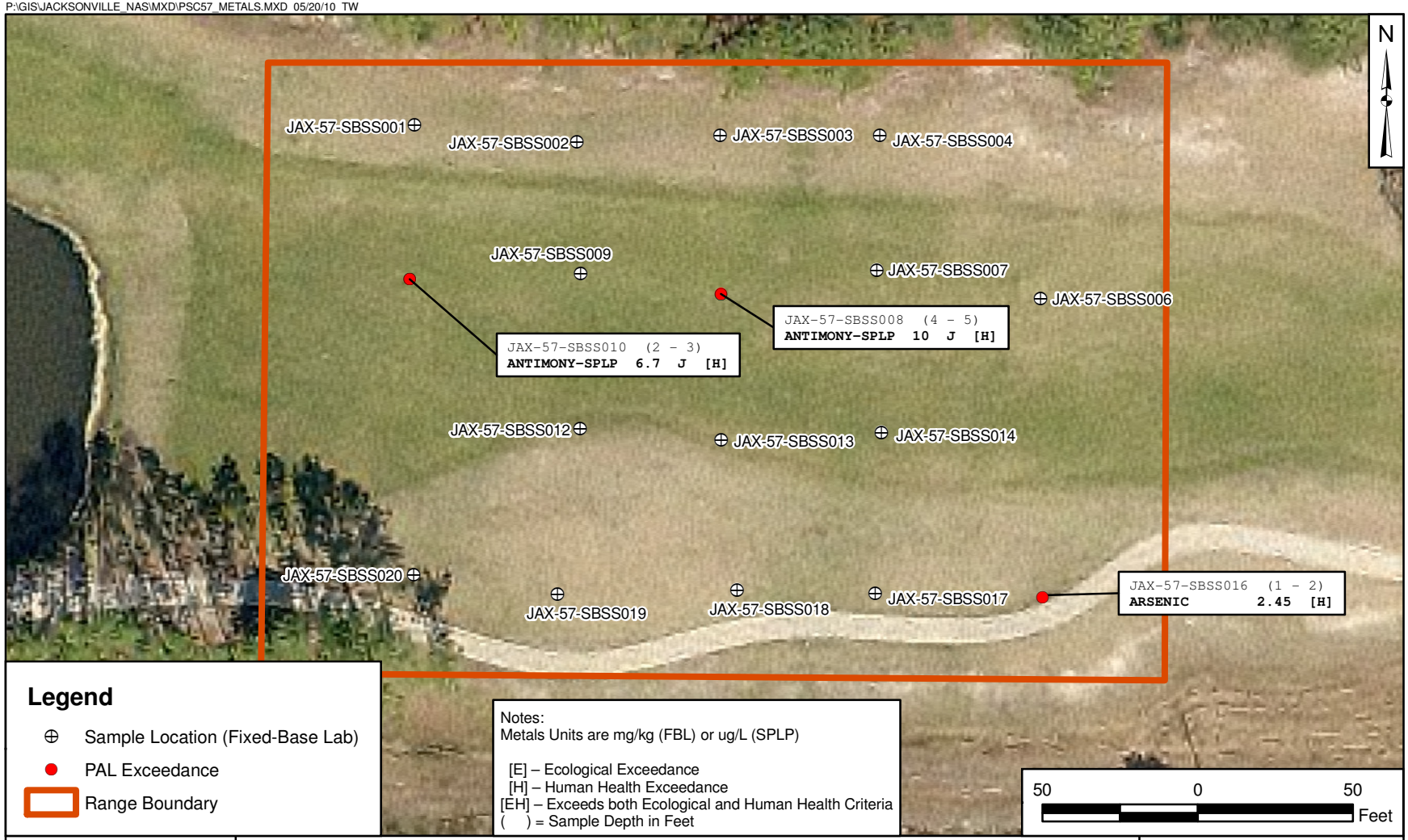

Legend

- ⊕ Sample Location (Fixed-Base Lab)
- ● PAL Exceedance
- Range Boundary

Notes:
Metals Units are mg/kg (FBL) or ug/L (SPLP)

[E] – Ecological Exceedance
[H] – Human Health Exceedance
[EH] – Exceeds both Ecological and Human Health Criteria
( ) = Sample Depth in Feet

DRAWN BY T. WHEATON	DATE 05/20/10	TETRA TECH	CONTRACT NUMBER CTO 0086
CHECKED BY J. McCAY	DATE 05/20/10	METALS EXCEEDANCES IN SOIL PSC 57 - .30 CALIBER RANGE MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY ___ DATE ___
COST/SCHEDULE AREA			APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 8-3 / REV 0

P:\GIS\JACKSONVILLE_NAS\MXD\PSC58_LEAD.MXD 05/20/10 TW

Legend

⊕ Sample Location (Fixed-Base Lab)

● PAL Exceedance

Range Boundary

Notes:
Lead Units are mg/kg (FBL), ppm (XRF), and ug/L (SPLP)

[E] – Ecological Exceedance
[H] – Human Health Exceedance
[EH] – Exceeds both Ecological and Human Health Criteria
( ) = Sample Depth in Feet

100 0 100
Feet

DRAWN BY T. WHEATON	DATE 05/20/10	TETRA TECH	CONTRACT NUMBER CTO 0086
CHECKED BY J. McCAY	DATE 05/20/10	LEAD DETECTIONS IN SOIL AND SEDIMENT PSC 58 - TRAP RANGES MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY ___ DATE ___
REVISED BY ___	DATE ___		APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 9-2 / REV 0

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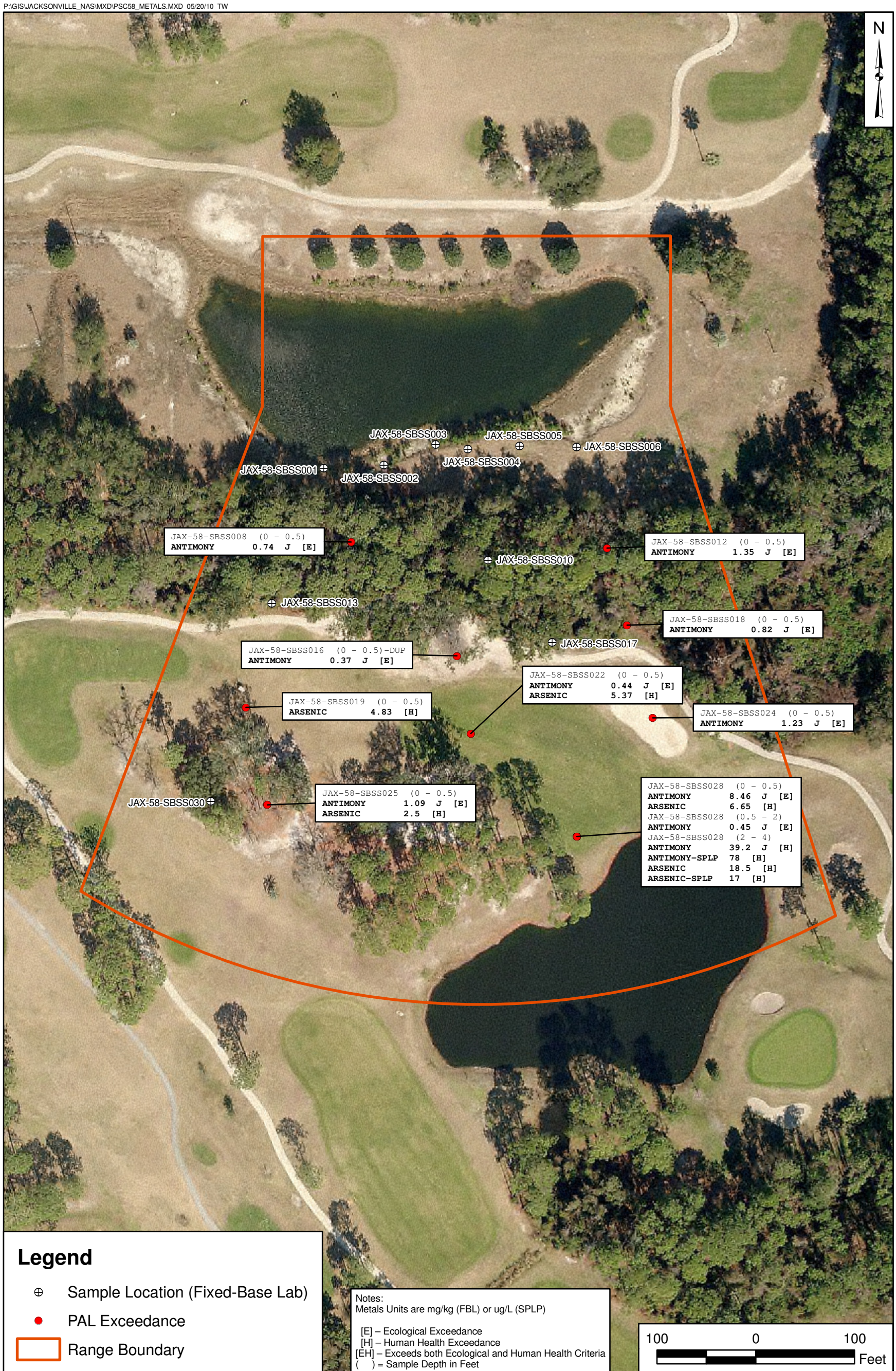

DRAWN BY T. WHEATON	DATE 05/20/10	TETRA TECH	CONTRACT NUMBER CTO 0086
CHECKED BY J. McCAY	DATE 05/20/10	METALS EXCEEDANCES IN SOIL PSC 58 - TRAP RANGES MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY ___ DATE ___
REVISED BY ___	DATE ___		APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 9-3 / REV 0

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DRAWN BY T. WHEATON	DATE 05/20/10	TETRA TECH	CONTRACT NUMBER CTO 0086
CHECKED BY J. McCAY	DATE 05/20/10	METALS EXCEEDANCES IN SEDIMENT PSC 58 - TRAP RANGES MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY ___ DATE ___
REVISED BY ___	DATE ___		APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 9-4 / REV 0

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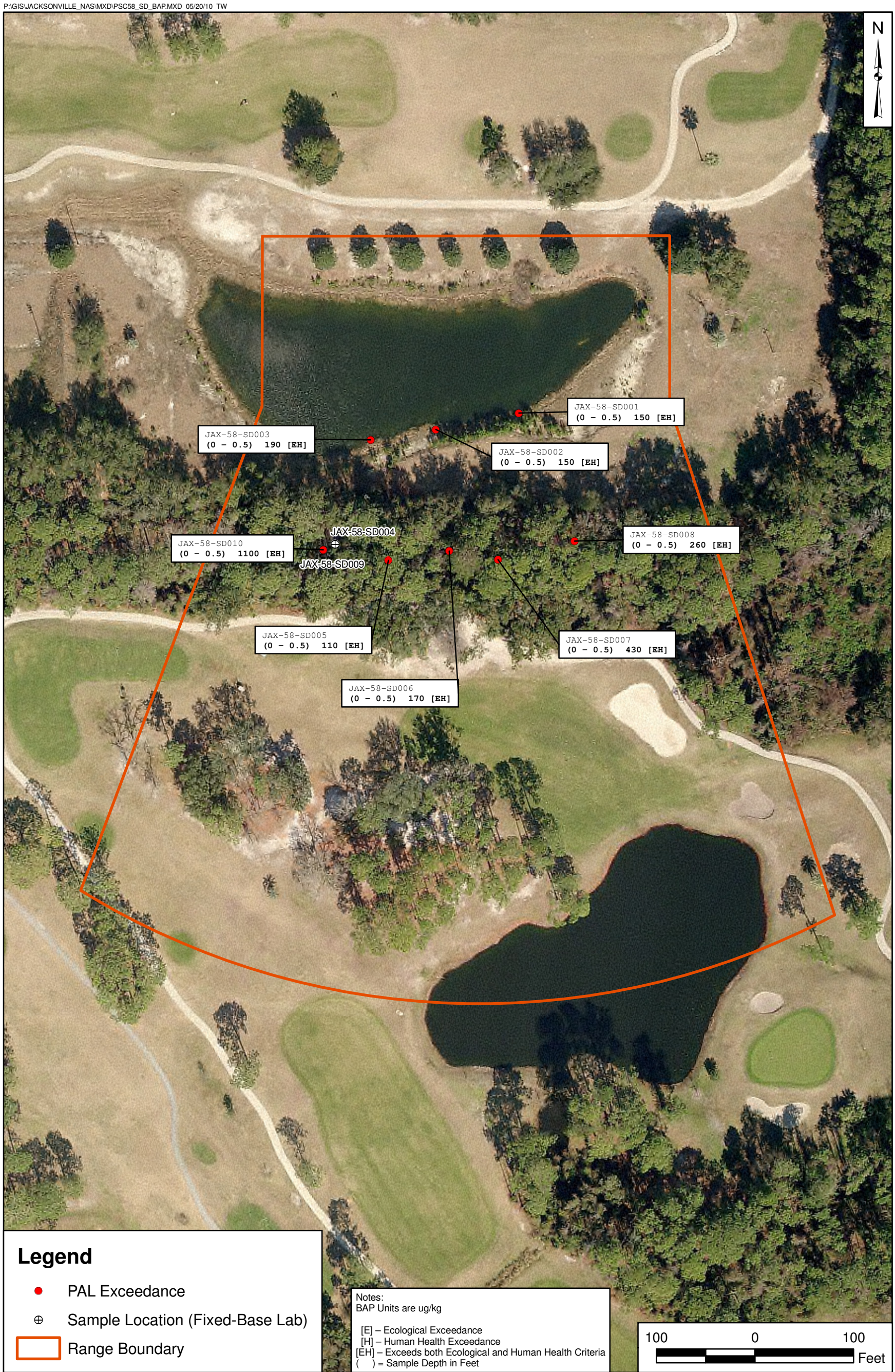
DRAWN BY T. WHEATON	DATE 05/20/10	TETRA TECH	CONTRACT NUMBER CTO 0086
CHECKED BY J. McCAY	DATE 05/20/10	BAP EXCEEDANCES IN SOIL PSC 58 - TRAP RANGES MACHINE GUN RANGE COMPLEX NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY ___ DATE ___
REVISED BY ___	DATE ___		APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 9-5 / REV 0

P:\GIS\JACKSONVILLE_NAS\MXD\PSC58_SD_BAP.MXD 05/20/10 TW



DRAWN BY	DATE	TETRA TECH	CONTRACT NUMBER
T. WHEATON	05/20/10		CTO 0086
CHECKED BY	DATE	BAP EXCEEDANCES IN SEDIMENT	APPROVED BY / DATE
J. McCAY	05/20/10	PSC 58 - TRAP RANGES	
REVISED BY	DATE	MACHINE GUN RANGE COMPLEX	APPROVED BY / DATE
		NAS JACKSONVILLE	
SCALE		JACKSONVILLE, FLORIDA	FIGURE NO. / REV
AS NOTED			FIGURE 9-6 / 0

APPENDIX D

PROJECT SCREENING LEVELS SUPPORT DOCUMENTATION

Soil (applicable to surface soil, subsurface soil, and exposed drainageway sediment)

The surface and subsurface soil human health risk assessment (HHRA) PALs were selected to be the lowest of the following:

- Florida Soil Cleanup Target Levels (SCTLs) per Chapter 62-777, F.A.C., Table II (Soils) – residential and industrial direct exposure and leachability to groundwater.
- The laboratory Practical Quantitation Limit (PQL) should be used if it is less stringent than the Cleanup Target Level (CTL) according to Chapter 62-780.680(2)(b)2.a.(III), F.A.C. The PQL, as defined by the FDEP, is the lowest concentration that a laboratory can accurately report on a chemical. Derived Alternative CTLs per Chapter 62-780(5), F.A.C.
- Apportioned SCTLs in accordance with Chapter 62-780(2)(b)1.2.(V), F.A.C.
- 95% Upper Confidence Limit (UCL) approach in accordance with Chapter 62-780.680(2)(b)1.2.(II), F.A.C.
- USEPA Regions 3, 6, and 9 Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites – Residential Soil Values (R-RSLs) (USEPA, May 2012).
- USEPA Regions 3, 6, and 9 Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites – Risk-Based Migration-to-Groundwater Soil Screening Values (RBSSLs) (USEPA, May 2012).

For delineation purposes, if a background concentration for a particular metal analyte is greater than the PAL for that analyte, the background concentration will replace the PAL prior to decision-making.

The surface soil ecological risk assessment (ERA) PALs were selected from the following sources of criteria, presented in hierarchical order:

- USEPA Ecological Soil Screening Level (Eco-SSL) (USEPA, 2008).
- USEPA Region 4 Ecological Soil Screening Level (R4 Eco) (USEPA, 2001).

Sediment (applicable to submerged pond sediment)

The sediment HHRA PALs were selected to be the lowest of the following:

- Florida SCTLs per Chapter 62-777, F.A.C., Table II (Soils) – residential and industrial direct exposure.
- The laboratory PQL should be used if it is less stringent than the CTL, as described previously.
- Apportioned SCTLs, as described previously.
- 95% UCL, as described previously.
- USEPA R-RSLs, as described previously.

For delineation purposes, if a background concentration for a particular metal analyte is greater than the PAL for that analyte, the background concentration will replace the PAL prior to decision-making.

The sediment ERA PALs were selected from the following sources of criteria, presented in hierarchical order:

- USEPA Region 4 Ecological Sediment Screening Level (R4 SDSL) (USEPA, 2001).
- USEPA Region 3 Biological Technical Assistance Group Sediment Screening Benchmarks (R3 BTAG SED) (USEPA, 2006).

Surface Water

The surface water HHRA PALs were selected to be the lowest of the following:

- Florida Groundwater Cleanup Target Levels (GCTLs) per Chapter 62-777, F.A.C., Table 1 (Groundwater).
- Florida Freshwater Surface Water CTLs per Chapter 62-777, F.A.C., Table 1 (Freshwater Surface Water).
- Florida Primary Drinking Water Standards per Chapter 62-550.310, F.A.C.
- Florida Secondary Drinking Water Standards per Chapter 62-550.320, F.A.C.
- Chapter 62-780, F.A.C., definition for low yield, poor quality aquifers.
- The laboratory PQL should be used if it is less stringent than the CTL according to Chapter 62-780(1)(c), F.A.C.
- Federal Maximum Contaminant Levels (MCLs) per the Safe Drinking Water Act (USEPA, April 2012).
- USEPA Regions 3, 6, and 9 RSLs for Chemical Contaminants at Superfund Sites – Tapwater Values (T-RSLs) (USEPA, May 2012).

The surface water ERA PALs were selected from the following sources of criteria, presented in hierarchical order:

- USEPA Region 4 Ecological Freshwater Surface Water Screening Level (R4 Eco) (USEPA, 2001).
- USEPA Region 3 Biological Technical Assistance Group Freshwater Surface Water Screening Benchmarks (R3 BTAG) (USEPA, 2006).
- National Oceanographic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (SQuiRTs), freshwater chronic surface water benchmarks (Buchman, 2008).

Groundwater

The groundwater HHRA PALs were selected as the Federal MCLs, where an MCL exists for a target analyte, or the lowest of the following:

- Florida GCTLs per Chapter 62-777, F.A.C., Table 1 (Groundwater).
- Florida Primary Drinking Water Standards, as described previously.
- Florida Secondary Drinking Water Standards, as described previously.
- Chapter 62-780, F.A.C., definition for low yield, poor quality aquifers.
- The laboratory PQL should be used if it is less stringent than the CTL, as described previously.
- USEPA T-RSLs, as described previously.

For delineation purposes, if a background concentration for a particular metal analyte is greater than the PAL for that analyte, the background concentration will replace the PAL prior to decision-making.

NAS Jacksonville UXO Sites 1 to 6 Human Health Screening Criteria - Surface and Subsurface Soil Samples

Analyte	CAS Number	EPA Regional Screening Level, Residential Soil [1] (mg/kg)	Adjusted EPA Regional Screening Level, Residential Soil [2] (mg/kg)	EPA Regional Screening Level, Migration to Groundwater [1] (mg/kg)	Adjusted EPA Regional Screening Level, Migration to Groundwater [2] (mg/kg)	FDEP Soil Cleanup Target Levels (mg/kg) [3]			Lowest Human Health Criterion	Lowest Human Health Criterion Reference	EPA Regional Screening Level, Industrial Soil [1] (mg/kg)	FDEP Commercial/ Industrial Direct Exposure Levels for Soil (mg/kg) [3]		
						Residential Direct Exposure	Leach - Groundwater	Leach - Surface Water				Surface Soil Background	Subsurface Soil Background	Commercial/ Industrial Direct Exposure
Polycyclic Aromatic Hydrocarbons (PAHs)														
2-Methylnaphthalene	91-57-6	230 N	23 N	0.14	2.8	210	8.5	9.1	2.8	RBSSL	2200 N	NA	NA	2100
Acenaphthene	83-32-9	3400 N	340 N	4.1	82	2400	2.1	0.3	2.1	SCTL-LGW	33000 N	NA	NA	20000
Acenaphthylene	208-96-8	3400 N[4]	340 N[4]	4.1 [4]	82 [4]	1800	27	NA	27	SCTL-LGW	170000 N[4]	NA	NA	20000
Anthracene	120-12-7	17000 N	1700 N	360	7200	21000	2500	0.4	1700	R-RSL	170000 N	NA	NA	300000
Benzo(a)anthracene	56-55-3	0.15 C	0.15 C	0.010	0.20	1[5]	0.8	NA	0.15	R-RSL	2.1 C	NA	NA	7[5]
Benzo(a)pyrene	50-32-8	0.015 C	0.015 C	0.0035	0.070	0.1	8	NA	0.015	R-RSL	0.21 C	NA	NA	0.7
Benzo(b)fluoranthene	205-99-2	0.15 C	0.15 C	0.035	0.70	1[5]	2.4	NA	0.15	R-RSL	2.1 C	NA	NA	7[5]
Benzo(g,h,i)perylene	191-24-2	1700 N[6]	170 N[6]	9.5 [6]	190 [6]	2500	32000	NA	170	R-RSL	17000 N[10]	NA	NA	52000
Benzo(k)fluoranthene	207-08-9	1.5 C	1.5 C	0.35	7.0	10[5]	24	NA	1.5	R-RSL	21 C	NA	NA	70[5]
Chrysene	218-01-9	15 C	15 C	1.1	22	100[5]	77	NA	15	R-RSL	210 C	NA	NA	700[5]
Dibenzo(a,h)anthracene	53-70-3	0.015 C	0.015 C	0.011	0.22	0.1[5]	0.7	NA	0.015	R-RSL	0.21 C	NA	NA	0.7[5]
Fluoranthene	206-44-0	2300 N	230 N	70	1400	3200	1200	1.3	230	R-RSL	22000 N	NA	NA	59000
Fluorene	86-73-7	2300 N	230 N	4.0	80	2600	160	17	80	RBSSL	22000 N	NA	NA	33000
Indeno(1,2,3-c,d)pyrene	193-39-5	0.15 C	0.15 C	0.12	2.4	1[5]	6.6	NA	0.15	R-RSL	2.1 C	NA	NA	7[5]
Naphthalene	91-20-3	3.6 C	3.60 C	0.00047	0.0094	55	1.2	2.2	0.0094	RBSSL	18 C	NA	NA	300
Phenanthrene	85-01-8	1700 N[6]	170 N[6]	9.5 [6]	190 [6]	2200	250	NA	170	R-RSL	17000 N[6]	NA	NA	36000
Pyrene	129-00-0	1700 N	170 N	9.5	190	2400	880	1.3	170	R-RSL	17000 N	NA	NA	45000
Benzo(a)pyrene (BaP) Equivalents	NA	NA	NA	NA	NA	0.1[5]	NA	NA	NA	NA	NA	NA	NA	0.7[5]
Propellants (Surface Soil only)														
Nitroglycerin	55-63-0	6.1 N	0.61 N	0.00066	0.013	27	0.03	NA	0.61	R-RSL	62 N	NA	NA	54
Metals														
Antimony	7440-36-0	31 N	3.1 N	0.27	5.4	27	5.4	3900	3.1	R-RSL	410 N	NA	NA	370
Arsenic	7440-38-2	0.39 C	0.39 C	0.0013	0.026	2.1	NA	NA	0.026	RBSSL	1.6 C	0.8	1.48	12
Copper	7440-50-8	3100 N	310 N	22	440	150	NA	NA	150	SCTL-RDE	41000 N	5.8	NA	89000
Lead	7439-92-1	400 L[7]	400 L[7]	14 [8]	280 [8]	400	NA	NA	280	RBSSL	800 [9]	14.4	6.46	1400
Tin	7440-31-5	47000 N	4700 N	2300	46000	47000	NA	NA	4700	R-RSL	610000 N	NA	NA	880000
Zinc	7440-66-6	23000 N	2300 N	290	5800	26000	NA	NA	2300	R-RSL	310000 N	15.2	14.49	630000

Notes:

1 - The residential direct contact (R-RSL) and risk-based migration to groundwater soil screening levels (RBSSL) from the USEPA Regions 3, 6, and 9 Regional Screening Levels for Chemical Contaminants at Superfund Sites, May 2012 available online at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm. The risk-based screening levels are based on a target hazard quotient of 1 for noncarcinogens (denoted with a "N" flag) or an incremental lifetime cancer risk (ILCR) of 1E-6 for carcinogens (denoted with a "C" flag). (Industrial criteria are also presented for information purposes.)

2 - The USEPA R-RSL (May 2012) residential soil screening level for noncarcinogens adjusted by dividing by 10, equivalent to a target hazard quotient of 0.1. The residential soil screening level for carcinogens (not adjusted) is equivalent to an incremental lifetime cancer risk (ILCR) of 1E-6. The USEPA RBSSL (May 2012) is adjusted for a dilution attenuation factor (DAF) of 20.

3 - Florida Department of Environmental Protection (FDEP) Soil Cleanup Target Levels (SCTLs) from Table II of FDEP guidance document, "Final Technical Report: Development of Cleanup Target Levels (CTLs) For Chapter 62-777, F.A.C." (February, 2005). SCTL-LGW = Soil Cleanup Target Level - Leachability Based on Groundwater Criteria; SCTL-RDE = Soil Cleanup Target Level - Residential Direct Exposure. (Leach - Surface Water and Industrial values presented for informational purposes.)

4 - Value is for acenapththene.

5 - Site concentrations for carcinogenic PAHs must be converted to benzo(a)pyrene equivalents before comparison with the appropriate direct exposure SCTL for benzo(a)pyrene using the approach described in the FDEP guidance document (FDEP, February 2005).

6 - Value is for pyrene.

7 - Office of Solid Waste and Emergency Response soil screening level (EPA, 1994b). Incorporated into May 2012 RSL Tables under code "L".

8 - Calculated from the EPA website (http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).

9 - USEPA Technical Review Workgroup for Lead. Guidance Document. "Frequently Asked Question (FAQs) on the Adult-Lead Model." October 2010. http://www.epa.gov/superfund/lead/almfaq.htm.

Abbreviations:

NA - Not applicable or not available
C - Carcinogen
EPA - U.S. Environmental Protection Agency
N - Noncarcinogen
NA - Not available
SSL - Soil Screening Level

NAS Jacksonville UXO Sites 1 to 6 Human Health Screening Criteria - Groundwater Samples

Analyte	CAS Number	EPA Regional Screening Level, Tap Water[1] (ug/L)	Adjusted EPA Regional Screening Level, Tap Water[2] (ug/L)	EPA Regional Screening Level, Vapor[1] (ug/L)	Adjusted EPA Regional Screening Level, Vapor[2] (ug/L)	EPA MCL/ SMCL (ug/L)[3]	FDEP GCTL[4] (ug/L)	Minimum Criteria[5] (ug/L)	Minimum Criterion Reference
Polycyclic Aromatic Hydrocarbons (PAHs)									
2-Methylnaphthalene	91-57-6	27 N	2.7 N	NA	NA	NA	28	2.7	T-RSL
Acenaphthene	83-32-9	400 N	40 N	NA	NA	NA	20	20	GCTL
Acenaphthylene	208-96-8	400 N[6]	40 N[6]	NA	NA	NA	210	40	T-RSL
Anthracene	120-12-7	1300 N	130 N	NA	NA	NA	2100	130	T-RSL
Benzo(a)anthracene	56-55-3	0.029 C	0.029 C	NA	NA	NA	0.05	0.029	T-RSL
Benzo(a)pyrene	50-32-8	0.0029 C	0.0029 C	NA	NA	0.2	0.2	0.2	MCL
Benzo(b)fluoranthene	205-99-2	0.029 C	0.029 C	NA	NA	NA	0.05	0.029	T-RSL
Benzo(g,h,i)perylene	191-24-2	87 N[7]	8.7 N[7]	NA	NA	NA	210	8.7	T-RSL
Benzo(k)fluoranthene	207-08-9	0.29 C	0.29 C	NA	NA	NA	0.5	0.29	T-RSL
Chrysene	218-01-9	2.9 C	2.9 C	NA	NA	NA	4.8	2.9	T-RSL
Dibenzo(a,h)anthracene	53-70-3	0.0029 C	0.0029 C	NA	NA	NA	0.005	0.0029	T-RSL
Fluoranthene	206-44-0	630 N	63 N	NA	NA	NA	280	63	T-RSL
Fluorene	86-73-7	220 N	22 N	NA	NA	NA	280	22	T-RSL
Indeno(1,2,3-c,d)pyrene	193-39-5	0.029 C	0.029 C	NA	NA	NA	0.05	0.029	T-RSL
Naphthalene	91-20-3	0.14 C	0.14 C	4.0 C	4.0 C	NA	14	0.14	T-RSL
Phenanthrene	85-01-8	87 N[7]	8.7 N[7]	NA	NA	NA	210	8.7	T-RSL
Pyrene	129-00-0	87 N	8.7 N	NA	NA	NA	210	8.7	T-RSL
Benzo(a)pyrene (BaP) Equivalents	NA	NA	NA	NA	NA	NA	NA	NA	NA
Metals									
Antimony	7440-36-0	6 N	0.6 N	NA	NA	6	6	6	MCL
Arsenic	7440-38-2	0.045 C	0.045 C	NA	NA	10	10	10	MCL
Copper	7440-50-8	620 N	62 N	NA	NA	1300	1300	1300	SMCL
Lead	7439-92-1	15 [8]	15 [8]	NA	NA	15	15	15	MCL
Tin	7440-31-5	9300 N	930 N	NA	NA	NA	NA	930	T-RSL
Zinc	7440-66-6	4700 N	470 N	NA	NA	NA	5000	470	T-RSL

Notes:

1 - The tapwater screening levels from the USEPA Regions 3, 6, and 9 Regional Screening Levels (T-RSLs) for Chemical Contaminants at Superfund Sites, May 2012 available online at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm. The vapor screening levels (VAPOR) were calculated using USEPA Vapor Intrusion Screening Guidance Calculator (USEPA, May 2012). The risk-based screening levels are based on a target hazard quotient of 1 for noncarcinogens (denoted with a "N" flag) or an incremental lifetime cancer risk (ILCR) of 1E-6 for carcinogens (denoted with a "C" flag).

2 - The USEPA T-RSL and VAPOR (calculated using USEPA guidance [May 2012]) adjusted values from the risk-based screening level for noncarcinogens adjusted by dividing by 10, equivalent to a target hazard quotient of 0.1. The risk-based screening level for carcinogens is equivalent to an incremental lifetime cancer risk (ILCR) of 1E-6.

3 - USEPA Maximum Contaminant Levels (MCLs) from the 2012 Edition of the Drinking Water Standards and Health Advisories (USEPA, April 2012).

4 - Florida Department of Environmental Protection (FDEP) Groundwater Cleanup Target Levels (GCTLs) from Table I of FDEP guidance document, "Final Technical Report: Development of Cleanup Target Levels (CTLs) For Chapter 62-777, F.A.C." (February, 2005). (Industrial values presented for informational purposes.)

5 - Hierarchy for groundwater criteria for this project is primarily the MCL/SMCL; if an MCL/SMCL is not available, then the minimum value of the other listed criteria will be selected.

6 - Value is for acenapththene.

7 - Value is for pyrene.

8 - Action level under Safe Drinking Water Act. Incorporated into May 2012 RSL Tables.

NA - Not available or not applicable

N - Noncarcinogen

NAS Jacksonville UXO Sites 1 to 6 Human Health Screening Criteria - Submerged Sediment Samples

Analyte	CAS Number	EPA Regional Screening Level, Residential Soil [1] (mg/kg)	Adjusted EPA Regional Screening Level, Residential Soil [2] (mg/kg)	FDEP Residential Soil Target Cleanup Levels (mg/kg) [3]	Lowest Human Health Criterion	Lowest Human Health Criterion Reference	EPA Regional Screening Level, Industrial Soil [1] (mg/kg)	FDEP Commercial/ Industrial Soil Target Cleanup Levels (mg/kg) [3]
				Residential Direct Contact				Commercial/ Industrial Direct Exposure
Polycyclic Aromatic Hydrocarbons (PAHs)								
2-Methylnaphthalene	91-57-6	230 N	23 N	210	23	R-RSL	2200 N	2100
Acenaphthene	83-32-9	3400 N	340 N	2400	340	R-RSL	33000 N	20000
Acenaphthylene	208-96-8	3400 N[4]	340 N[4]	1800	340	R-RSL	170000 N[9]	20000
Anthracene	120-12-7	17000 N	1700 N	21000	1700	R-RSL	170000 N	300000
Benzo(a)anthracene	56-55-3	0.15 C	0.15 C	1[5]	0.15	R-RSL	2.1 C	7[5]
Benzo(a)pyrene	50-32-8	0.015 C	0.015 C	0.1	0.015	R-RSL	0.21 C	0.7
Benzo(b)fluoranthene	205-99-2	0.15 C	0.15 C	1[5]	0.15	R-RSL	2.1 C	7[5]
Benzo(g,h,i)perylene	191-24-2	1700 N[6]	170 N[6]	2500	170	R-RSL	17000 N[10]	52000
Benzo(k)fluoranthene	207-08-9	1.5 C	1.5 C	10[5]	1.5	R-RSL	21 C	70[5]
Chrysene	218-01-9	15 C	15 C	100[5]	15	R-RSL	210 C	700[5]
Dibenzo(a,h)anthracene	53-70-3	0.015 C	0.015 C	0.1[5]	0.015	R-RSL	0.21 C	0.7[5]
Fluoranthene	206-44-0	2300 N	230 N	3200	230	R-RSL	22000 N	59000
Fluorene	86-73-7	2300 N	230 N	2600	230	R-RSL	22000 N	33000
Indeno(1,2,3-c,d)pyrene	193-39-5	0.15 C	0.15 C	1[5]	0.15	R-RSL	2.1 C	7[5]
Naphthalene	91-20-3	3.6 C	3.6 C	55	3.6	R-RSL	18 C	300
Phenanthrene	85-01-8	1700 N[6]	170 N[6]	2200	170	R-RSL	17000 N[10]	36000
Pyrene	129-00-0	1700 N	170 N	2400	170	R-RSL	17000 N	45000
Benzo(a)pyrene (BaP) Equivalents	NA	NA	NA	0.1[5]	NA	NA	NA	0.7[5]
Metals								
Antimony	7440-36-0	31 N	3.1 N	27	3.1	R-RSL	410 N	370
Arsenic	7440-38-2	0.39 C	0.39 C	2.1	0.39	R-RSL	1.6 C	12
Copper	7440-50-8	3100 N	310 N	150	150	SCTL-RDE	41000 N	89000
Lead	7439-92-1	400 L[7]	400 L[7]	400	400	R-RSL	800 [8]	1400
Tin	7440-31-5	47000 N	4700 N	47000	4700	R-RSL	610000 N	880000
Zinc	7440-66-6	23000 N	2300 N	26000	2300	R-RSL	310000 N	630000

Notes:

1 - The residential direct contact (R-RSL) and risk-based migration to groundwater soil screening levels (RBSSL) from the USEPA Regions 3, 6, and 9 Regional Screening Levels for Chemical Contaminants at Superfund Sites, May 2012 available online at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm. The risk-based screening levels are based on a target hazard quotient of 1 for noncarcinogens (denoted with a "N" flag) or an incremental lifetime cancer risk (ILCR) of 1E-6 for carcinogens (denoted with a "C" flag). (Industrial criteria are also presented for information purposes.)

2 - The USEPA R-RSL (May 2012) residential soil screening level for noncarcinogens adjusted by dividing by 10, equivalent to a target hazard quotient of 0.1. The residential soil screening level for carcinogens (not adjusted) is equivalent to an incremental lifetime cancer risk (ILCR) of 1E-6. The USEPA RBSSL (May 2012) is adjusted for a dilution attenuation factor (DAF) of 20.

3 - Florida Department of Environmental Protection (FDEP) Soil Cleanup Target Levels (SCTLs) from Table II of FDEP guidance document, "Final Technical Report: Development of Cleanup Target Levels (CTLs) For Chapter 62-777, F.A.C." (February, 2005). SCTL-LGW = Soil Cleanup Target Level - Leachability Based on Groundwater Criteria; SCTL-RDE = Soil Cleanup Target Level - Residential Direct Exposure. (Leach - Surface Water and Industrial values presented for informational purposes.)

4 - Value is for acenapththene.

5 - Site concentrations for carcinogenic PAHs must be converted to benzo(a)pyrene equivalents before comparison with the appropriate direct exposure SCTL for benzo(a)pyrene using the approach described in the FDEP guidance document (FDEP, February 2005).

6 - Value is for pyrene.

7 - Office of Solid Waste and Emergency Response soil screening level (EPA, 1994b). Incorporated into May 2012 RSL Tables under code "L".

8 - USEPA Technical Review Workgroup for Lead. Guidance Document. “Frequently Asked Question (FAQs) on the Adult-Lead Model.” October 2010. http://www.epa.gov/superfund/lead/almfaq.htm.

NAS Jacksonville UXO Sites 1 to 6 Human Health Screening Criteria - Submerged Sediment Samples

Analyte	CAS Number	EPA Regional Screening Level, Residential Soil [1] (mg/kg)	Adjusted EPA Regional Screening Level, Residential Soil [2] (mg/kg)	FDEP Residential Soil Target Cleanup Levels (mg/kg) [3]		Lowest Human Health Criterion	Lowest Human Health Criterion Reference	EPA Regional Screening Level, Industrial Soil [1] (mg/kg)	FDEP Commercial/ Industrial Soil Target Cleanup Levels (mg/kg) [3]	
				Residential Direct Contact						Commercial/ Industrial Direct Exposure

Abbreviations:
NA - Not applicable or not available
C - Carcinogen
EPA - U.S. Environmental Protection Agency
N - Noncarcinogen
NA - Not available
SSL - Soil Screening Level

NAS Jacksonville UXO Sites 1 to 6 Human Health Screening Criteria - Surface Water Samples

Analyte	CAS Number	EPA Regional Screening Level, Tap Water[1] (ug/L)	Adjusted EPA Regional Screening Level, Tap Water[2] (ug/L)	EPA MCL (ug/L)[3]	FDEP FW SW CTL[4] (ug/L)	FDEP Marine SW CTL[4] (ug/L)	Minimum Criteria (ug/L)	Minimum Criterion Reference
Polycyclic Aromatic Hydrocarbons (PAHs)								
2-Methylnaphthalene	91-57-6	27 N	2.7 N	NA	30	30	2.7	T-RSL
Acenaphthene	83-32-9	400 N	40 N	NA	3	3	3	GCTL
Acenaphthylene	208-96-8	400 N[5]	40 N[5]	NA	[6]	[6]	40	T-RSL
Anthracene	120-12-7	1300 N	130 N	NA	0.3	0.3	0.3	GCTL
Benzo(a)anthracene	56-55-3	0.029 C	0.029 C	NA	[6]	[6]	0.029	T-RSL
Benzo(a)pyrene	50-32-8	0.0029 C	0.0029 C	0.2	[6]	[6]	0.0029	T-RSL
Benzo(b)fluoranthene	205-99-2	0.029 C	0.029 C	NA	[6]	[6]	0.029	T-RSL
Benzo(g,h,i)perylene	191-24-2	87 N[7]	8.7 N[7]	NA	[6]	[6]	8.7	T-RSL
Benzo(k)fluoranthene	207-08-9	0.29 C	0.29 C	NA	[6]	[6]	0.29	T-RSL
Chrysene	218-01-9	2.9 C	2.9 C	NA	[6]	[6]	2.9	T-RSL
Dibenzo(a,h)anthracene	53-70-3	0.0029 C	0.0029 C	NA	[6]	[6]	0.0029	T-RSL
Fluoranthene	206-44-0	630 N	63 N	NA	0.3	0.3	0.3	GCTL
Fluorene	86-73-7	220 N	22 N	NA	30	30	22	T-RSL
Indeno(1,2,3-c,d)pyrene	193-39-5	0.029 C	0.029 C	NA	[6]	[6]	0.029	T-RSL
Naphthalene	91-20-3	0.14 C	0.14 C	NA	26	26	0.14	T-RSL
Phenanthrene	85-01-8	87 N[7]	8.7 N[7]	NA	[6]	[6]	8.7	T-RSL
Pyrene	129-00-0	87 N	8.7 N	NA	0.3	0.3	0.3	GCTL
Benzo(a)pyrene (BaP) Equivalents	NA	NA	NA	NA	NA	NA	NA	GCTL
Metals								
Antimony	7440-36-0	6 N	0.6 N	6	14[6]	14[6]	0.6	T-RSL
Arsenic	7440-38-2	0.045 C	0.045 C	10	10[6]	10[6]	0.045	T-RSL
Copper	7440-50-8	1500 N	150 N	1300	3.7[6]	3.7[6]	3.7	GCTL
Lead	7439-92-1	15 [8]	15 [8]	15	8.5[6]	8.5[6]	8.5	GCTL
Tin	7440-31-5	9300 N	930 N	NA	NA	NA	930	T-RSL
Zinc	7440-66-6	4700 N	470 N	NA	86[6]	86[6]	86	GCTL

Notes:

1 - The surface water screening levels from the USEPA Regions 3, 6, and 9 Tapwater Regional Screening Levels (T-RSLs) for Chemical Contaminants at Superfund Sites, May 2012 available online at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm. The risk-based screening levels are based on a target hazard quotient of 1 for noncarcinogens (denoted with a "N" flag) or an incremental lifetime cancer risk (ILCR) of 1E-6 for carcinogens (denoted with a "C" flag).

2 - The USEPA T-RSL (May 2012) adjusted values from the risk-based screening level for noncarcinogens adjusted by dividing by 10, equivalent to a target hazard quotient of 0.1. The risk-based screening level for carcinogens is equivalent to an incremental lifetime cancer risk (ILCR) of 1E-6.

3 - USEPA Maximum Contaminant Levels (MCLs) from the 2012 Edition of the Drinking Water Standards and Health Advisories (USEPA, April 2012).

4 - Florida Department of Environmental Protection (FDEP) Surface Water Cleanup Target Levels (SWCTLs) from Table I of FDEP guidance document for Freshwater (FW) and Marine Surface Water (SW), Final Technical Report: Development of Cleanup Target Levels (CTLs) For Chapter 62-777, F.A.C. (February, 2005). (Industrial values presented for informational purposes.)

5 - Value is for acenapththene.

6 - Criteria from F.A.C. Chapter 62-302, Surface Water Quality Standards (0.0028 ug/L annual average for PAHs).

7 - Value is for pyrene.

8 - Action level under Safe Drinking Water Act. Incorporated into May 2012 RSL Tables.

NAS Jacksonville UXO Sites 1 to 6 Human Health Screening Criteria - Surface Water Samples

Analyte	CAS Number	EPA Regional Screening Level, Tap Water[1] (ug/L)	Adjusted EPA Regional Screening Level, Tap Water[2] (ug/L)	EPA MCL (ug/L)[3]	FDEP FW SW CTL[4] (ug/L)	FDEP Marine SW CTL[4] (ug/L)	Minimum Criteria (ug/L)	Minimum Criterion Reference

Abbreviations:
NA - Not available or not applicable
N - Noncarcinogen
C - carcinogen
FW - Freshwater
SW - Surface water

3 - Florida Department of Environmental Protection (FDEP) Soil Cleanup Target Levels (SCTLs) from Table II of FDEP guidance document, Technical Report: Development of Cleanup Target Levels (CTLs) For Chapter 62-777, F.A.C. (February, 2005). (Leach - Surface Water and Industrial values presented for informational purposes.)

NAS Jacksonville UXO Sites 1 to 6 Ecological Screening Criteria - Surface Soil and Drainageway Sediment Samples

Analyte	CAS Number	Ecological Soil Screening Level (1) (mg/kg)	Source of Ecological Soil Screening Level	EPA Eco SSL (mg/kg)	EPA R4 Eco Soil (mg/kg)	NOAA SQUIRT (mg/kg)
Polycyclic Aromatic Hydrocarbons (PAHs)						
2-Methylnaphthalene	91-57-6	29	Eco SSL	**29**	NA	3.24
Acenaphthene	83-32-9	29	Eco SSL	**29**	20	682
Acenaphthylene	208-96-8	29	Eco SSL	**29**	NA	682
Anthracene	120-12-7	29	Eco SSL	**29**	0.1	1480
Benzo(a)anthracene	56-55-3	1.1	Eco SSL	**1.1**	NA	5.21
Benzo(a)pyrene	50-32-8	1.1	Eco SSL	**1.1**	0.1	1.52
Benzo(b)fluoranthene	205-99-2	1.1	Eco SSL	**1.1**	NA	59.8
Benzo(g,h,i)perylene	191-24-2	1.1	Eco SSL	**1.1**	NA	119
Benzo(k)fluoranthene	207-08-9	1.1	Eco SSL	**1.1**	NA	148
Chrysene	218-01-9	1.1	Eco SSL	**1.1**	NA	4.73
Dibenzo(a,h)anthracene	53-70-3	1.1	Eco SSL	**1.1**	NA	18.4
Fluoranthene	206-44-0	29	Eco SSL	**29**	0.1	122
Fluorene	86-73-7	29	Eco SSL	**29**	NA	122
Indeno(1,2,3-c,d)pyrene	193-39-5	1.1	Eco SSL	**1.1**	NA	109
Naphthalene	91-20-3	29	Eco SSL	**29**	0.1	0.0994
Phenanthrene	85-01-8	29	Eco SSL	**29**	0.1	45.7
Pyrene	129-00-0	1.1	Eco SSL	**1.1**	0.1	78.5
Benzo(a)pyrene (BaP) Equivalents	NA	NA	NA	**NA**	**NA**	**NA**
Propellants (Surface Soil only)						
Nitroglycerin	55-63-0	NA	NA	**NA**	**NA**	**NA**
Metals						
Antimony	7440-36-0	0.27	Eco SSL	**0.27**	3.5	0.142
Arsenic	7440-38-2	18	Eco SSL	**18**	10	5.7
Copper	7440-50-8	28	Eco SSL	**28**	40	5.4
Lead	7439-92-1	11	Eco SSL	**11**	50	0.0537
Tin	7440-31-5	53	R4 Eco	NA	**53**	7.62
Zinc	7440-66-6	46	Eco SSL	**46**	50	6.62

1- The following hierarchy was used for selecting the Ecological Soil Screening Level, in order of preference:
USEPA Ecological Soil Screening Levels (Eco SSL) (EPA, 2003, 2005, 2006, 2007). The lower of the plant, invertebrate, or wildlife Eco SSL is selected as the screening level.
USEPA Region 4 Ecological Soil Screening Levels (R4 Eco SSL) (USEPA, 2001).
Lowest of National Oceanographic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (SQUIRT) surface soil benchmarks (Buchman, 2008).

Shaded cells are values that were selected as the overall ecological soil screening level.

NAS Jacksonville UXO Sites 1 to 6 Ecological Screening Criteria - Submerged Pond Sediment Samples

Analyte	CAS Number	Ecological Sediment Screening Level [1] (mg/kg)	Source of Ecological Sediment Screening Level	EPA R4 Eco SED (mg/kg)	EPA R3 BTAG SED (mg/kg)	NOAA SQUIRT (mg/kg)
Polycyclic Aromatic Hydrocarbons (PAHs)						
2-Methylnaphthalene	91-57-6	0.02023	R4 SDSL	**0.02023**	0.0202	NA
Acenaphthene	83-32-9	0.00671	R4 SDSL	**0.00671**	0.0067	**0.00671**
Acenaphthylene	208-96-8	0.00587	R4 SDSL	**0.00587**	0.0059	**0.00587**
Anthracene	120-12-7	0.0469	R4 SDSL	**0.0469**	0.0572	**0.0469**
Benzo(a)anthracene	56-55-3	0.0748	R4 SDSL	**0.0748**	0.108	0.01572
Benzo(a)pyrene	50-32-8	0.0888	R4 SDSL	**0.0888**	0.15	0.0319
Benzo(b)fluoranthene	205-99-2	0.312	R4 SDSL	**0.312**	NA	NA
Benzo(g,h,i)perylene	191-24-2	0.655	R4 SDSL	**0.655**	0.17	0.17
Benzo(k)fluoranthene	207-08-9	0.312	R4 SDSL	**0.312**	0.24	0.0272
Chrysene	218-01-9	0.108	R4 SDSL	**0.108**	0.166	0.02683
Dibenzo(a,h)anthracene	53-70-3	0.00622	R4 SDSL	**0.00622**	0.033	**0.00622**
Fluoranthene	206-44-0	0.113	R4 SDSL	**0.113**	0.423	0.03146
Fluorene	86-73-7	0.0212	R4 SDSL	**0.0212**	0.0774	0.01
Indeno(1,2,3-c,d)pyrene	193-39-5	0.312	R4 SDSL	**0.312**	0.017	0.02
Naphthalene	91-20-3	0.0346	R4 SDSL	**0.0346**	0.176	0.01465
Phenanthrene	85-01-8	0.0867	R4 SDSL	**0.0867**	0.204	0.01873
Pyrene	129-00-0	0.153	R4 SDSL	**0.153**	0.195	0.04427
Benzo(a)pyrene (BaP) Equivalents	NA	NA	NC	**NA**	**NA**	**NA**
Metals						
Antimony	7440-36-0	2	R4 SDSL	**2**	2	3.0
Arsenic	7440-38-2	7.24	R4 SDSL	**7.24**	9.8	5.9
Copper	7440-50-8	18.7	R4 SDSL	**18.7**	31.6	28.012
Lead	7439-92-1	30.2	R4 SDSL	**30.2**	35.8	31.0
Tin	7440-31-5	NA	NC	**NA**	**NA**	**NA**
Zinc	7440-66-6	124	R4 SDSL	**124**	121	120

1- The following hierarchy was used for selecting the Ecological Sediment Screening Level, in order of preference:
USEPA Region 4 Ecological Sediment Screening Levels (R4 Eco SDSL) (USEPA, 2001).
USEPA Region 3 BTAG Ecological Sediment Screening Levels (R3 BTAG SED) (USEPA, 2006).
Lowest of National Oceanographic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (SQUIRT) freshwater sediment benchmarks (Buchman, 2008).
Shaded cells are values that were selected as the overall ecological sediment screening level.
NC - No criteria

NAS Jacksonville UXO Sites 1 to 6 Ecological Screening Criteria - Surface Water Samples

Analyte	CAS Number	Ecological Surface Water Screening Level [1] (ug/L)	Source of Ecological Surface Water Screening Level	NRWQC (ug/L)	R4 Eco (ug/L)	R3 BTAG (ug/L)	NOAA (ug/L)
Polycyclic Aromatic Hydrocarbons (PAHs)							
2-Methylnaphthalene	91-57-6	4.7	R3 BTAG	NA	NA	**4.7**	330
Acenaphthene	83-32-9	17	R4 Eco	NA	**17**	5.8	5.8
Acenaphthylene	208-96-8	4840	NOAA	NA	NA	NA	**4840**
Anthracene	120-12-7	0.012	R3 BTAG	NA	NA	**0.012**	0.73
Benzo(a)anthracene	56-55-3	0.018	R3 BTAG	NA	NA	**0.018**	0.027
Benzo(a)pyrene	50-32-8	0.015	R3 BTAG	NA	NA	**0.015**	0.014
Benzo(b)fluoranthene	205-99-2	9.07	NOAA	NA	NA	NA	**9.07**
Benzo(g,h,i)perylene	191-24-2	7.64	NOAA	NA	NA	NA	**7.64**
Benzo(k)fluoranthene	207-08-9	NC	None	NA	NA	NA	NA
Chrysene	218-01-9	NC	None	NA	NA	NA	NA
Dibenzo(a,h)anthracene	53-70-3	NC	None	NA	NA	NA	NA
Fluoranthene	206-44-0	39.8	R4 Eco	NA	**39.8**	0.04	0.04
Fluorene	86-73-7	3	R3 BTAG	NA	NA	**3**	3.9
Indeno(1,2,3-c,d)pyrene	193-39-5	4.31	NOAA	NA	NA	NA	**4.31**
Naphthalene	91-20-3	62	R4 Eco	NA	**62**	1.1	1.1
Phenanthrene	85-01-8	0.4	R3 BTAG	NA	NA	**0.4**	3.6
Pyrene	129-00-0	0.025	R3 BTAG	NA	NA	**0.025**	**0.025**
Benzo(a)pyrene (BaP) Equivalents	NA	NC	None	NA	NA	NA	NA
Metals							
Antimony	7440-36-0	160	R4 Eco	NA	**160**	30	30
Arsenic	7440-38-2	150	NRWQC	**150**	NA	5	**150**
Copper	7440-50-8	6.54	R4 Eco	NA	**6.54**	9	9
Lead	7439-92-1	2.5	NRWQC	**2.5**	1.32	**2.5**	**2.5**
Tin	7440-31-5	73	R3 BTAG	NA	NA	**73**	NA
Zinc	7440-66-6	120	NRWQC	**120**	58.91	**120**	**120**

1- The following hierarchy was used for selecting the Ecological Screening Level, in order of preference:
National Recommended Water Quality Criteria (NRWQC), freshwater chronic values (USEPA, 2009).
USEPA Region 4 Ecological (R4 Eco) Chronic Screening Value (CSV) Freshwater Surface Water Screening Levels (USEPA, 2001).
USEPA Region 3 BTAG (R3 BTAG) Freshwater Surface Water Screening Levels (USEPA, 2006).
National Oceanographic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (SQUIRT) freshwater chronic surface water benchmarks (Buchman, 2008).
Shaded cells are values that were selected as the overall ecological surface water screening level.

FW - Freshwater
NC - No criteria

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REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
OPERABLE UNIT 1

NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

Unit Identification Code: N00207

Contract No. N62467-89-D-0317/040

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March 1996

Table 4-1
Identification of Background Concentration - Surface Soil

Remedial Investigation and Feasibility Study, Operable Unit 1
Naval Air Station Jacksonville
Jacksonville, Florida

Parameter	Frequency of Detection[1]	Range of Detected Concentrations	Mean of Detected Concentrations[2]	Background Screening Concentration[3]
Volatiles (µg/kg)				
Acetone	6/10	3 - 11	6.7	NA
Semivolatiles (µg/kg)				
Anthracene	1/10	37 - 37	37	NA
Benzo(a)Anthracene	2/10	27 - 250	139	NA
Benzo(a)Pyrene	3/10	29 - 150	71	NA
Benzo(b)Fluoranthene	3/10	26 - 330	140	NA
Benzo(g,h,i)Perylene	3/10	43 - 80	57.3	NA
Benzo(k)Fluoranthene	3/10	20 - 100	49.3	NA
Carbazole	1/10	46 - 46	46	NA
Chrysene	3/10	24 - 350	138	NA
Di-n-Butylphthalate	1/10	355 - 355	355	NA
Dibenz(a,h)Anthracene	2/10	18 - 31	24.5	NA
Fluoranthene	3/10	20 - 390	147	NA
Indeno(1,2,3-cd)Pyrene	3/10	41 - 88	57	NA
Phenanthrene	1/10	36 - 36	36	NA
Phenol	1/10	19 - 19	19	NA
Pyrene	3/10	28 - 430	163	NA
bis(2-Ethylhexyl)Phthalate	1/10	18 - 18	18	NA
Pesticides and PCBs (µg/kg)				
4,4-DDD	1/10	2.7 - 2.7	2.7	NA
4,4-DDE	4/10	1.8 - 12	4.6	NA
4,4-DDT	3/10	2.2 - 18	8.2	NA
Aroclor-1260	1/10	26 - 26	26	NA
Dieldrin	2/10	0.43 - 97	48.7	NA
alpha-Chlordane	1/10	0.25 - 0.25	0.25	NA
gamma-Chlordane	2/10	0.37 - 0.81	0.59	NA
Dioxins (µg/kg)				
1,2,3,4,6,7,8-HpCDD	1/3	0.0614 - 0.0614	0.0614	NA
OCDD	2/3	0.211 - 0.517	0.364	NA
Inorganics (mg/kg)				
Aluminum	10/10	31.8 - 1,710	670	1,340
Arsenic	7/10	0.29 - 0.6	0.4	0.8
Barium	10/10	1.1 - 12.7	5.6	11.2
Calcium	10/10	48.2 - 6,200	1,180	2,360
Chromium	7/10	1.5 - 4.6	3.3	6.6
Copper	3/10	1.7 - 5.2	2.9	5.8

See notes at end of table.

Table 4-1 (Continued)
Identification of Background Concentration - Surface Soil

Remedial Investigation and Feasibility Study, Operable Unit 1
Naval Air Station Jacksonville
Jacksonville, Florida

Parameter	Frequency of Detection[1]	Range of Detected Concentrations	Mean of Detected Concentrations[2]	Background Screening Concentration[3]
Inorganics (mg/kg)				
Cyanide	3/7	0.18 - 0.22	0.2	0.4
Iron	10/10	124 - 928	426	852
Lead	10/10	1.2 - 26.6	7.2	14.4
Magnesium	9/10	15.9 - 154	49.9	99.8
Manganese	10/10	1.4 - 37.4	9	18
Nickel	5/10	2.8 - 14.7	5.5	11
Sodium	8/10	103 - 221	144	288
Thallium	1/10	0.21 - 0.21	0.21	0.42
Vanadium	8/9	0.58 - 4.6	1.9	3.8
Zinc	8/10	3.8 - 16.1	7.6	15.2
Radioisotopes (pCi/g)[4]				
Actinium-228	10/10	0.652 - 1.46	1	2
Bismuth-210	4/10	1.4 - 2.58	1.9	3.8
Bismuth-214	10/10	0.437 - 1.02	0.71	1.42
Cesium-137	8/10	0.0301 - 0.527	0.14	0.28
Lead-212	10/10	0.325 - 0.923	0.63	1.26
Lead-214	10/10	0.412 - 0.991	0.67	1.34
Potassium-40	10/10	0.8 - 4.335	2.6	5.2
Radium-223	4/10	0.709 - 1.56	1.1	2.2
Radium-224	7/10	0.82 - 2.14	1.5	3.0
Radium-228	10/10	0.652 - 1.46	1	2
Thallium-208	10/10	0.175 - 0.529	0.33	0.66
Thorium-231	5/10	0.069 - 0.145	0.12	0.24
Thorium-232	9/10	0.724 - 1.46	1.1	2.2
Thorium-234	2/10	0.595 - 4.24	2.4	4.8
Uranium-234	2/10	2.23 - 2.38	2.3	4.6
Uranium-238	2/10	2.23 - 2.38	2.3	4.6

[1] Frequency of detection is the number of samples in which the analyte was detected divided by the total number of samples analyzed. The samples are identified in Section 4.2.1.7 and Appendix P-4.
[2] The average of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples in which the analyte was not detected.
[3] Two times the mean for inorganic analytes and radionuclides. Values of organic compounds detected in background surface soil samples are considered on a case-by-case basis in the evaluation of "site" samples.
[4] The surface soil background screening concentration for radium-226, calculated from lead-214 concentrations, has been determined at 1.3 pCi/g.

Notes: µg/kg = micrograms per kilogram.
NA = not applicable.
PCBs = polychlorinated biphenyls.
DDD = dichlorodiphenyldichloroethane.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.
HpCDD = heptachlorodibenzo-p-dioxin.
OCDD = octachlorodibenzodioxin.
mg/kg = milligrams per kilogram.
pCi/g = picocuries per gram.

Table 4-2
Identification of Background Concentration - Subsurface Soil

Remedial Investigation and Feasibility Study, Operable Unit 1
Naval Air Station Jacksonville
Jacksonville, Florida

Parameter	Frequency of Detection[1]	Range of Detected Concentrations	Mean of Detected Concentrations[2]	Background Screening Concentration[3]
Volatiles (µg/kg)				
Acetone	4/11	4 - 11	7.25	NA
Semivolatiles (µg/kg)				
Benzo(a)Pyrene	1/11	21 - 21	21	NA
Benzo(b)Fluoranthene	1/11	34 - 34	34	NA
Benzo(g,h,i)Perylene	1/11	29 - 29	29	NA
bis(2-Ethylhexyl)Phthalate	6/11	54 - 170	90.33	NA
Di-n-Butylphthalate	1/11	460 - 460	460	NA
Indeno(1,2,3-cd)Pyrene	1/11	23 - 23	23	NA
Phenol	4/11	20 - 24	21.5	NA
Pesticides and PCBs (µg/kg)				
4,4-DDE	1/11	0.29 - 0.29	0.29	NA
4,4-DDT	1/11	1.7 - 1.7	1.7	NA
alpha-Chlordane	2/11	0.37 - 0.45	0.41	NA
gamma-Chlordane	2/10	0.41 - 0.55	0.48	NA
Methoxychlor	1/11	1.2 - 1.2	1.2	NA
Inorganics (mg/kg)				
Aluminum	10/10	373 - 7,620	3,411.6	6,823.2
Arsenic	6/10	0.41 - 2.0	0.74	1.48
Barium	10/10	2.0 - 20.9	10.4	20.8
Beryllium	2/10	0.24 - 0.25	0.245	0.49
Calcium	10/10	44.8 - 1,200	334.15	668.3
Chromium	9/10	2.9 - 12.3	7.056	14.1
Iron	10/10	105 - 15600	2909.1	5818.2
Lead	10/10	1.5 - 5.6	3.23	6.46
Magnesium	8/10	104 - 700	250.125	500.25
Manganese	10/10	1.5 - 7.2	3.45	6.90
Potassium	3/10	187 - 252	225.33	450.67
Sodium	9/10	117 - 342	171.556	343.10
Zinc	9/10	4.1 - 12.8	7.244	14.49
Radionuclides (pCi/g)[4]				
Actinium-228	8/10	0.466 - 1.95	1.201	2.40
Bismuth-210	3/10	0.444 - 2.03	1.241	2.48
Bismuth-214	9/10	0.642 - 1.58	0.936	1.87
Lead-212	10/10	0.237 - 1.17	0.671	1.34
Lead-214	10/10	0.212 - 1.34	0.744	1.49

See notes at end of table.

Table 4-2 (Continued)
Identification of Background Concentration - Subsurface Soil

Remedial Investigation and Feasibility Study, Operable Unit 1
Naval Air Station Jacksonville
Jacksonville, Florida

Parameter	Frequency of Detection[1]	Range of Detected Concentrations	Mean of Detected Concentrations[2]	Background Screening Concentration[3]
Radionuclides (pCi/g)				
Potassium-40	8/10	2.12 - 8.76	5.57	11.14
Radium-223	3/10	0.286 - 1.56	0.9	1.80
Radium-224	6/10	1.13 - 2.31	1.585	3.17
Radium-228	8/10	0.429 - 1.95	1.216	2.43
Thallium-208	10/10	0.113 - 0.511	0.328	0.66
Thorium-231	6/10	0.044 - 0.240	0.145	0.29
Thorium-232	7/10	0.429 - 1.95	1.171	2.34
Thorium-234	5/10	2.96 - 4.53	3.484	6.98
Uranium-234	5/10	1.6 - 2.52	1.962	3.92
Uranium-238	5/10	1.6 - 2.52	1.962	3.92
Vanadium	9/10	0.99 - 16.7	7.288	14.58

[1] Frequency of detection is the number of samples in which the analyte was detected divided by the total number of samples analyzed. The samples are identified in Section 4.2.2.6 and Appendix P-4.
[2] The average of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples in which the analyte was not detected.
[3] Two times the mean for inorganic analytes and radionuclides. Values of organic compounds detected in background surface soil samples are considered on a case-by-case basis in the evaluation of "site" samples.
[4] The subsurface soil background screening concentration for radium-226, calculated from lead-214 concentrations, has been determined at 1.5 pCi/g.

Notes: µg/kg = micrograms per kilogram.
NA = not applicable.
PCBs = polychlorinated biphenyls.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.
mg/kg = milligrams per kilogram.
pCi/g = picocuries per gram.

Table 4-3
List of Soil Sampling Locations

Remedial Investigation and Feasibility Study, Operable Unit 1
Naval Air Station Jacksonville
Jacksonville, Florida

Soil Locations Inside Boundaries of Presumptive Remedy			
SL001	SL027	SL045	SL099
SL002	SL028	SL046	SL100
SL003	SL029	SL047	SL101
SL009	SL030	SL048	SL102
SL010	SL032	SL049	SL103
SL011	SL033	SL050	SL27001
SL012	SL034	SL051	SL27002
SL013	SL035	SL052	SL27003
SL014	SL036	SL064	SL27004
SL016	SL037	SL072	SL27005
SL017	SL038	SL083	SL27006
SL018	SL039	SL088	SL27007
SL019	SL040	SL091	SL27008
SL022	SL041	SL093	SL27009
SL023	SL042	SL094	SL27010
SL024	SL043	SL097	SL27011
SL025	SL044	SL098	

Soil Locations Outside Boundaries of Presumptive Remedy			
SL004	SL063	SL087	SL119
SL005	SL065	SL089	SL120
SL006	SL066	SL090	SL121
SL007	SL067	SL092	SL122
SL008	SL068	SL095	SL123
SL015	SL069	SL096	SL124
SL020	SL070	SL104	SL125
SL021	SL071	SL105	SL126
SL026	SL073	SL106	SL127
SL031	SL074	SL107	U1DSMW100
SL053	SL075	SL108	U1DSMW102
SL054	SL076	SL109	U1DSMW104
SL055	SL077	SL110	U1DSMW106
SL056	SL078	SL111	U1DSMW108
SL057	SL079	SL112	U1DSMW88
SL058	SL080	SL113	U1DSMW90
SL059	SL081	SL114	U1DSMW94
SL060	SL082	SL115	U1DSMW96
SL061	SL084	SL116	U1DSMW98
SL062	SL085	SL117	U1SSMW93
	SL086	SL118	U1SSMW97
			U1SSMW99

Table 4-4
Identification of Background Concentrations - Surface Water

Remedial Investigation and Feasibility Study, Operable Unit 1
Naval Air Station Jacksonville
Jacksonville, Florida

Parameter	Frequency of Detection[1]	Range of Detected Concentrations	Mean of Detected Concentrations[2]	Background Screening Concentration[3]
Inorganics (μg/ℓ)				
Arsenic	3/4	0.7 - 2.9	1.6	3.2
Barium	4/4	29.2 - 70.2	41.5	83
Calcium	4/4	7,320 - 34,200	19,555	39,110
Copper	4/4	2.1 - 7.1	3.8	7.6
Cyanide	3/4	0.6 - 3.1	1.5	3
Iron	4/4	362 - 1,920	1,218	2,436
Lead	4/4	0.8 - 8.7	3.3	6.6
Magnesium	4/4	1,800 - 5,090	3,063	6,126
Manganese	4/4	6.1 - 28.9	19.8	39.6
Potassium	4/4	453 - 1,530	896	1,792
Sodium	4/4	7,770 - 14,400	10,435	20,870
Vanadium	4/4	2 - 3.4	2.8	5.6
Zinc	4/4	14.8 - 38.7	23.2	46.4
Radionuclides (pCi/ℓ)				
Bismuth-214	1/4	11.2 - 11.2	11.2	(*)
Thorium-234	1/4	158 - 158	158	(*)
Dissolved Inorganics (μg/ℓ)				
Diss. Aluminum	4/4	32.5 - 301	211	422
Diss. Arsenic	4/4	0.9 - 2.7	1.5	3.0
Diss. Barium	4/4	28.8 - 48.1	35.3	70.6
Diss. Cadmium	1/4	0.73 - 0.73	0.73	1.46
Diss. Calcium	4/4	7,050 - 32,500	19,013	38,026
Diss. Copper	3/4	1.6 - 6.2	3.1	6.2
Diss. Iron	4/4	232 - 1,090	601	1,202
Diss. Lead	2/4	0.9 - 1.5	1.2	2.4
Diss. Magnesium	4/4	1,780 - 4,930	3,013	6,026
Diss. Manganese	4/4	6.8 - 29.2	17.8	35.6
Diss. Potassium	4/4	615 - 1,430	940	1,880
Diss. Sodium	4/4	7,760 - 14,300	10,410	20,820
Diss. Vanadium	1/4	4.3 - 4.3	4.3	8.6
Diss. Zinc	4/4	14.5 - 21.1	17.8	35.6

[1] Frequency of detection is the number of samples in which the analyte was detected divided by the total number of samples analyzed. The four samples used are taken from SW/SD58, SW/SD59, SW/SD60 and SW/SD62.
[2] The average of detected concentrations is the mean of all samples in which the analyte was detected. It does not include those samples in which the analyte was not detected.
[3] Two times the mean for inorganic analytes and radiological parameters.
(*) Background screening concentrations for radionuclides were not developed for this set.

Notes: μg/ℓ = micrograms per liter.
pCi/ℓ = picocuries per liter.

Table 4-5
Identification of Background Concentrations - Sediment

Remedial Investigation and Feasibility Study, Operable Unit 1
Naval Air Station Jacksonville
Jacksonville, Florida

Chemical	Frequency of Detection[1]	Range of Detected Concentrations	Mean of Detected Concentrations[2]	Background Screening Concentration[3]
Volatiles (µg/kg)				
2-Butanone	1/4	8 - 8	8	NA
Acetone	3/4	24 - 35	28.7	NA
Semivolatiles (µg/kg)				
Anthracene	1/4	84 - 84	84	NA
Benzo(a)Anthracene	1/4	470 - 470	470	NA
Benzo(a)Pyrene	1/4	480 - 480	480	NA
Benzo(b)Fluoranthene	1/4	540 - 540	540	NA
Benzo(g,h,i)Perylene	1/4	90 - 90	90	NA
Benzo(k)Fluoranthene	1/4	370 - 370	370	NA
Chrysene	1/4	540 - 540	540	NA
Dibenz(a,h)Anthracene	1/4	80 - 80	80	NA
Fluoranthene	1/4	1,300 - 1,300	1,300	NA
Indeno(1,2,3-cd)Pyrene	1/4	180 - 180	180	NA
Phenanthrene	1/4	590 - 590	590	NA
Pyrene	1/4	1,100 - 1,100	1,100	NA
Pesticides and PCBs (µg/kg)				
4,4-DDD	1/4	51 - 51	51	NA
4,4-DDE	2/4	3.1 - 170	86.6	NA
Inorganics (mg/kg)				
Aluminum	4/4	239 - 1,220	595	1,190
Antimony	1/4	4.6 - 4.6	4.6	9.2
Arsenic	3/4	0.2 - 0.97	0.63	1.26
Barium	4/4	2.2 - 9.6	4.9	9.8
Beryllium	1/4	0.24 - 0.24	0.24	0.48
Cadmium	1/4	0.3 - 0.3	0.3	0.6
Calcium	4/4	124 - 8,660	3,234	6,468
Chromium	3/4	0.73 - 2.9	1.9	3.8
Cobalt	1/4	1.9 - 1.9	1.9	3.8
Copper	3/4	2.6 - 4.2	3.5	7
Cyanide	3/4	0.06 - 0.11	0.08	0.16
Iron	4/4	560 - 2,290	1,150	2,300
Lead	4/4	2 - 12.3	7.2	14.4
Magnesium	4/4	25.2 - 110	65.5	131
Manganese	4/4	1.5 - 4.9	3.4	6.8
Mercury	1/4	0.05 - 0.05	0.05	0.1

See notes at end of table.

Table 4-5 (Continued)
Identification of Background Concentrations - Sediment

Remedial Investigation and Feasibility Study, Operable Unit 1
Naval Air Station Jacksonville
Jacksonville, Florida

Chemical	Frequency of Detection[1]	Range of Detected Concentrations	Mean of Detected Concentrations[2]	Background Screening Concentration[3]
Inorganics (mg/kg)				
Nickel	3/4	2.9 - 3.4	3.1	6.2
Potassium	1/4	109 - 109	109	218
Selenium	1/4	0.21 - 0.21	0.21	0.42
Sodium	3/4	239 - 260	249	498
Thallium	1/4	0.19 - 0.19	0.19	0.38
Vanadium	3/4	0.77 - 4.6	2.6	5.2
Zinc	4/4	2.6 - 18.8	9.2	18.4
Radionuclides (pCi/g)				
Actinium-228	4/4	0.64 - 0.887	0.8	1.6
Bismuth-212	2/4	1.06 - 1.34	1.2	2.4
Bismuth-214	4/4	0.418 - 0.668	0.54	1.08
Cesium-137	2/4	0.0953 - 0.14	0.12	0.24
Lead-212	4/4	0.378 - 0.816	0.52	1.04
Lead-214	1/4	0.447 - 0.447	0.45	0.90
Potassium-40	1/4	3.66 - 3.66	3.7	7.4
Thallium-208	4/4	0.188 - 0.286	0.24	0.48
Uranium-235	1/4	0.125 - 0.125	0.13	0.26

[1] Frequency of detection is the number of samples in which the analyte was detected divided by the total number of samples analyzed. The samples used are taken from SW/SD58, SW/SD59, SW/SD60, and SW/SD62.
[2] The average of detected concentrations is the mean of all samples in which the analyte was detected. It does not include those samples in which the analyte was not detected.
[3] Two times the mean for inorganic analytes and radiological parameters.

Notes: µg/kg = micrograms per kilogram.
NA = not applicable.
PCBs = polychlorinated biphenyls.
DDD = dichlorodiphenyldichloroethane.
DDE = dichlorodiphenyldichloroethene.
mg/kg = milligrams per kilogram.
pCi/g = picocuries per gram.

Table 4-6
Identification of Background Screening Concentration - Groundwater

Remedial Investigation and Feasibility Study, Operable Unit 1
Naval Air Station Jacksonville
Jacksonville, Florida

Parameter	Frequency of Detection[1]	Range of Detected Concentrations	Mean of Detected Concentrations[2]	Background Screening Concentration[3]
Volatiles (µg/ℓ)				
Carbon Disulfide	5/42	1 - 7	3	NA
Chloroform	1/42	2 - 2	2	NA
Chloromethane	2/42	1 - 3	2	NA
Xylene (total)	1/42	1 - 1	1	NA
Semivolatiles (µg/ℓ)				
Diethylphthalate	1/42	3 - 3	3	NA
Phenol	1/42	1 - 1	1	NA
bis(2-Ethylhexyl)Phthalate	18/42	0.6 - 64	6.1	NA
Pesticides and PCBs (µg/ℓ)				
4,4'-DDE	1/42	0.006 - 0.006	0.01	NA
Dieldrin	1/42	*0.016 - *0.016	0.02	NA
Inorganics (µg/ℓ)				
Aluminum	42/42	146 - 451,000	73,659	147,318
Antimony	2/40	20.2 - *22.7	21.5	43
Arsenic	34/42	*1.05 - 14.2	6.6	13.2
Barium	42/42	19.3 - 3,160	308	616
Beryllium	30/42	*0.335 - 30	4.1	8.2
Cadmium	12/42	0.78 - 8.8	4.1	8.2
Calcium	42/42	2,300 - 163,000	29,533	59,066
Chromium	36/42	*2.35 - 542	104	208
Cobalt	26/42	3.5 - 57.8	11.3	22.6
Copper	30/42	3.2 - 78.5	20.2	40.4
Cyanide	4/42	1.8 - 2.5	2.2	4.4
Iron	42/42	255 - 187,000	34,146	68,292
Lead	36/42	0.5 - 136	22.9	45.8
Magnesium	42/42	3,340 - 36,700	9,658	19,316
Manganese	42/42	7.4 - 1,240	102	204
Mercury	18/42	0.14 - 2.1	0.49	0.98
Nickel	21/42	9.6 - 174	37.4	74.8
Potassium	41/42	902 - 17,700	4,519	9,038
Selenium	9/42	*0.56 - 47.9	6.9	13.8
Silver	2/42	4.2 - *5.1	4.7	9.4
Sodium	42/42	790 - 29,000	12,313	24,626
Vanadium	37/42	*2.625 - *728.5	147	294
Inorganics (µg/ℓ)				
Zinc	42/42	6.6 - 261	86.6	173.2

See notes at end of table.

Table 4-6 (Continued)
Identification of Background Screening Concentration - Groundwater

Remedial Investigation and Feasibility Study, Operable Unit 1
Naval Air Station Jacksonville
Jacksonville, Florida

Parameter	Frequency of Detection[1]	Range of Detected Concentrations	Mean of Detected Concentrations[2]	Background Screening Concentration[3]
Radioisotope (µg/ℓ)				
Actinium-228	2/42	*11.7 - 21.8	16.8	33.6
Bismuth-214	3/42	*5.3 - 11.6	7.5	15
Lead-214	3/42	*6.7 - 18.1	13.3	26.6
Potassium-40	3/42	60.1 - 138	92.6	185.6
Radium-224	6/42	*54.5 - 105	88.4	176.8
Thallium-208	3/42	*3.7 - 7.3	5.7	11.4
Diss. Aluminum	34/42	8 - 74,200	8,905	NA
Diss. Antimony	9/42	12.8 - *30.05	19.6	NA
Diss. Arsenic	16/42	*0.6 - 6.6	3.2	NA
Diss. Barium	42/42	*9.9 - *250	64.1	NA
Diss. Beryllium	10/42	*0.43 - 3.2	1.3	NA
Diss. Cadmium	4/42	1 - 6.2	3.7	NA
Diss. Calcium	42/42	1,130 - *99,300	23,232	NA
Diss. Chromium	16/42	2.5 - 75.8	23.7	NA
Diss. Cobalt	8/42	*2.75 - *6.4	4.8	NA
Diss. Copper	22/42	1.1 - 12.7	5.3	NA
Diss. Iron	41/42	11.8 - *27,800	4,509	NA
Diss. Lead	21/42	0.6 - 18.9	4.1	NA
Diss. Magnesium	42/42	1,030 - *15,800	4,773	NA
Diss. Manganese	41/42	*2.65 - 134	35.4	NA
Diss. Mercury	1/42	0.1 - 0.1	0.1	NA
Diss. Nickel	4/42	*10.3 - 19.5	13.2	NA
Diss. Potassium	42/42	585 - *5,770	1,912	NA
Diss. Selenium	2/42	1.2 - 4.1	2.7	NA
Diss. Sodium	42/42	2,070 - 31,200	12,410	NA
Diss. Thallium	1/42	1 - 1	1	NA
Diss. Vanadium	24/42	*2.625 - *105.55	25.6	NA
Diss. Zinc	39/42	6.2 - 134	35.1	NA

[1] Frequency of detection is the number of samples in which the analyte was detected divided by the total number of samples analyzed. The samples analyzed are identified in Table R-4.7.
[2] The mean of detected concentrations is the mean of all samples in which the analyte was detected. It does not include those samples in which the analyte was not detected.
[3] Two times the mean for inorganic analytes.
[4] The groundwater background screening concentration for radium-226, calculated from lead-214 concentrations, has been determined at 26.6 pCi/ℓ.
* Value is the average of a sample and its duplicate.

Notes: µg/ℓ = micrograms per liter.
NA = not applicable.
PCBs = polychlorinated biphenyls.
DDE = dichlorodiphenyldichloroethene.

APPENDIX E

SITE-SPECIFIC FIELD STANDARD OPERATING PROCEDURES AND FIELD FORMS

E-1

Field Standard Operating Procedures

STANDARD OPERATING PROCEDURE
SOP-01

SAMPLE LABELING

1.0 PURPOSE

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

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

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

3.0 PROCEDURES

3.1 The following information will be electronically printed on each sample label prior to the field activities.

- Contract Task Order number (CTO JM55)
- Project location (Naval Air Station [NAS] Jacksonville)
- Sample location
- Preservative
- Analysis to be performed
- Matrix type

- Laboratory name

3.2 Complete the label by filling in the sample ID and time of collection at the well head during sample collection event.

3.3 Select the containers that are appropriate for a given sample. Complete the associated sample label and affix to the sample container.

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

3.5 Check to determine if the information printed on the label is correct.

3.6 Place the sample container in a Ziploc plastic bag and place in a cooler containing ice.

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

4.0 ATTACHMENTS

1. Sample Label

ATTACHMENT 1
SAMPLE LABEL

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

STANDARD OPERATING PROCEDURE
SOP-02

SAMPLE IDENTIFICATION NOMENCLATURE

1.0 PURPOSE

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

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

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

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

3.0 SAMPLE IDENTIFICATION NOMENCLATURE

3.1 <u>Samples</u>

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

3.1.1 Sample Numbering Scheme

Use a sample tracking number consisting of a four- or five-segment alpha-numeric code that identifies the sample's associated Unexploded Ordnance (UXO) site, sample matrix, sample location, sample depth interval (solids), sample collection date (aqueous), and for aqueous samples, where applicable, whether a sample is filtered.

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

AN or ANN	AA	NNN or NN	XXXX (solids)	MMDDYY (aqueous)	-F (aqueous)
UXO Site Number	Matrix	Sample Location Number	Depth interval, in inches	Date - Month, date, and year sample collected	Filtered

Character Type:

A = Alpha

N = Numeric

UXO Number (ANN):

UXO 1 = X1

UXO 2 = X2

UXO 3 = X3

UXO 4 = X4

UXO 5 = X5

UXO 6 = X6

Matrix Code (AA):

GW = Groundwater Sample

SB = Subsurface Soil Sample

SD = Sediment Sample

SS = Surface Soil Sample

SW = Surface Water Sample

TW = Temporary Well Groundwater Sample

Location Number (NNN or NN):

Well identification number (i.e., temporary well X1TW01 = 01)

Depth Interval (XX):

This code section will be used with solid samples to record the depth interval of the sample that was collected, in inches.

Date (MMDDYY):

This code section will be used with aqueous samples to record the date when the sample is collected, month, date, and year. This is utilized in lieu of a sample round designation.

Filtered Samples (-F):

Groundwater samples that will be collected and analyzed for dissolved metals will be filtered in the field with a 0.45 micron filter and designated with a "-F" to indicate that it was filtered in the field.

3.1.2 Examples of Sample Nomenclature

A surface soil sample (from 0 to 6 inches below ground surface) collected from UXO 1, soil boring sample location 001, would be labeled as X1SS0010006.

A sediment sample (from 0 to 6 inches below ground surface) collected from UXO 1, sediment sample location 001, would be labeled as X1SD0010006.

A surface water sample (from 0 to 6 inches below pond surface) collected from UXO 1, surface water sample location 001, would be labeled as X1SW0010006.

A temporary well groundwater sample collected from UXO 2, well X2TW04, on December 19, 2011 would be labeled as X2TW04-121911.

A temporary well groundwater sample collected from UXO 2, well X2TW04, on December 19, 2011 and field filtered for dissolved metals analysis would be labeled as X2TW04-121911-F.

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

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

3.2.1 QC Sample Numbering

Use the QC code consisting of a four-segment alpha-numeric code that identifies the UXO Site number, sample matrix, QC type, and the number of this type of QC sample collected at that particular UXO Site during the investigation.

AN or ANN	AA	AA or AAA	NN
UXO Site Number	Matrix	QC Type	Sequence Number (per sampling event)

Character Type:

A = Alpha

N = Numeric

QC Types:

DUP = Field Duplicate

RB = Rinsate Blank

Record the time of sampling on the Chain-of-Custody Form, labels, and tags for field duplicate samples with 0000 so that the samples are "blind" to the laboratory. Record notes detailing the sample number, time, date, and type on the sample log sheets and document the location of the duplicate sample (sample log sheets are not provided to the laboratory).

3.2.2 Examples of Field QA/QC Sample Nomenclature

The first field duplicate collected at UXO 1 for a sediment sample would be designated as X1SDDUP-01.

The first rinsate blank collected at UXO 1 for a temporary well groundwater sample would be designated as X1TWRB-01.

STANDARD OPERATING PROCEDURE
SOP-03

SAMPLE CUSTODY AND DOCUMENTATION OF FIELD ACTIVITIES

1.0 PURPOSE

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

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

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

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

3.0 PROCEDURES

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

3.1 <u>Site Logbook</u>

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

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

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

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

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

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

3.2 Field Logbooks

The field logbook is a separate dedicated notebook used by field personnel to document his or her activities in the field. This notebook is hardbound and paginated.

3.3 Sample Labels

Adhesive sample container labels must be completed and applied to every sample container. Information on the label includes the project name, location, sample number, date, time, preservative, analysis, matrix, sampler's initials, and the name of the laboratory performing the analysis.

3.4 Chain-of-Custody Form

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

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

3.5 Custody Seal

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

3.6 Equipment Calibration Log

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

3.7 Sample Log Sheets

The Soil and Sediment Sample Log Sheets are used to document the sampling of soils and sediments. The surface water sample log sheets are used to document the sampling of surface waters.

4.0 ATTACHMENTS

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

ATTACHMENT 1

CHAIN-OF-CUSTODY RECORD

CHAIN OF CUSTODY | NUMBER | PAGE ____ OF ____

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

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

DATE YEAR	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	CONTAINER TYPE PLASTIC (P) or GLASS (G) / PRESERVATIVE USED / TYPE OF ANALYSIS												COMMENTS

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

COMMENTS

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

3/99
FORM NO. TINUS-001

ATTACHMENT 2
EQUIPMENT CALIBRATION LOG

Tetra Tech NUS, Inc.

EQUIPMENT CALIBRATION LOG

PROJECT NAME : _____

SITE NAME: _____

PROJECT No.: _____

INSTRUMENT NAME/MODEL: _____

MANUFACTURER: _____

SERIAL NUMBER: _____

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

ATTACHMENT 3

SOIL AND SEDIMENT SAMPLE LOG SHEET

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____
Project No.: _____

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

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

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

GRAB SAMPLE DATA:

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

COMPOSITE SAMPLE DATA:

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

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

ATTACHMENT 4

SURFACE WATER SAMPLE LOG SHEET

Tetra Tech NUS, Inc. **SURFACE WATER SAMPLE LOG SHEET**

Page___ of ___

Project Site Name: _____
Project No.: _____

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

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

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

SAMPLING DATA:

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

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

STANDARD OPERATING PROCEDURE

SOP-04

SAMPLE PRESERVATION, PACKAGING, AND SHIPPING

1.0 PURPOSE

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

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

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

3.0 PROCEDURES FOR SAMPLE PRESERVATION, PACKAGING, AND SHIPPING

3.1 The laboratory provides sample containers with preservative already included (as required) for the analytical parameter for which the sample is to be analyzed. All samples will be held, stored, and shipped at less than 6 degrees Celsius (< 6°C), but not be frozen. This will be accomplished through refrigeration (used to hold samples prior to shipment) and/or ice.

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

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

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

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

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

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

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

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

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

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

STANDARD OPERATING PROCEDURE
SOP-05

LITHOLOGIC SOIL SAMPLE LOGGING

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the standard procedures and technical guidance on the logging of soil cores collected at Naval Air Station (NAS) Jacksonville.

2.0 FIELD FORMS AND EQUIPMENT

Knife
Ruler (marked in tenths and hundredths of feet)
Boring Log: An example of this form is attached.
Writing utensil

3.0 RESPONSIBILITIES

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

4.0 PROCEDURES FOR BOREHOLE AND SAMPLE LOGGING

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

4.1 <u>USCS Classification</u>

Soils are to be classified according to the Unified Soil Classification System (USCS). This method of classification is detailed in Figure 1 (attached to this SOP).

This method of classification identifies soil types on the basis of grain size and cohesiveness.

Fine-grained soils, or fines, are smaller than the No. 200 sieve and are of two types: silt (M) and clay (C). Some classification systems define size ranges for these soil particles, but for field classification

purposes, they are identified by their respective behaviors. Organic material (O) is a common component of soil but has no distinguishable size range; it is recognized by its composition. The careful study of the USCS will aid in developing the competence and consistency necessary for the classification of soils.

Coarse-grained soils will be divided into categories: rock fragments, sand, or gravel. The terms "sand" and "gravel" not only refer to the size of the soil particles but also to their depositional history. To insure accuracy in description, the term "rock fragments" will be used to indicate angular granular materials resulting from the breakup of rock. The sharp edges that are typically observed indicate little or no transport from their source area; and therefore, the term provides additional information in reconstructing the depositional environment of the soils encountered. When the term "rock fragments" is used, it will be followed by a size designation such as "(1/4 inchΦ-1/2 inchΦ)" or "coarse-sand size" either immediately after the entry or in the remarks column. The USCS classification would not be affected by this variation in terms.

4.2 Color

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

Colors must be described while the sample is still moist. Break or split soil samples vertically to render the colors clearly visible. Samplers tend to smear the sample surface, creating color variations between the sample interior and exterior.

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

4.3 Relative Density and Consistency

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

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

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

CONSISTENCY FOR COHESIVE SOILS

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

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

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

4.4 Weight Percentages

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

Terms of Identifying Proportion of the Component	Defining Range of Percentages by Weight
Trace	0 - 10 percent
Some	11 - 30 percent
Adjective form of the soil type (e.g., sandy)	31 - 50 percent

Examples:

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

4.5 Moisture

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

4.6 Classification of Soil Grain Size for Chemical Analysis

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

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

4.7 Summary of Soil Classification

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

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

4.0 ATTACHMENTS

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

ATTACHMENT 1

FIGURE 1 - UNIFIED SOIL CLASSIFICATION SYSTEM

Unified Soil Classification System

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

Grain Size Chart

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

Relative Density (SPT)

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

Consistency (SPT)

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

ATTACHMENT 2

BORING LOG

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

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

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

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

Drilling Area Background (ppm): [ ]

Remarks: _____

Converted to Well: Yes _____ No _____ Well I.D. #: _____

STANDARD OPERATING PROCEDURE
SOP-06

TEMPORARY MONITORING WELL INSTALLATION AND ABANDONMENT

1.0 PURPOSE

This procedure provides general guidance and information pertaining to proper design and installation of temporary groundwater monitoring wells. The methods described herein are specific for temporary monitoring well construction at Naval Air Station (NAS) Jacksonville.

2.0 RESPONSIBILITIES

Driller - The driller provides adequate and operable equipment, sufficient quantities of materials, and an experienced and efficient labor force capable of performing all phases of proper monitoring well installation and construction. The drilling contractor personnel must have all the health and safety training required to perform the work, as specified in the health and safety plan. All well drilling activities shall be performed under the direct supervision of a driller licensed in the State of Florida. The driller is also responsible for obtaining, in advance, any required permits for drilling and monitoring well installation and construction for the State of Florida.

Field Geologist - The Field Geologist supervises and documents well installation and construction performed by the driller and ensures that the screen interval for each monitoring well is properly placed to provide representative groundwater data from the monitored interval. Geotechnical engineers, field technicians, or other suitable trained personnel may also serve in this capacity.

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

3.0 REQUIRED EQUIPMENT/ITEMS

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

Health and safety equipment as required by the Health and Safety Plan (HASP) and the Tetra Tech SSO.

Well drilling and installation equipment with associated materials (typically supplied by the driller). Wells can be installed using direct push techniques (DPT) drilling methods or hollow-stem auger (HSA). The preferred method is DPT, but if DPT is not feasible, HSA will be used.

Hydrogeologic equipment (weighted engineer's tape, water-level indicator, retractable engineer's rule, electronic calculator, clipboard, mirror and flashlight for observing downhole activities, paint and ink marker for marking monitoring wells, sample jars, well installation forms, boring logs, soil sample log forms, chain-of-custody records, sample coolers with ice, and a field notebook).

4.0 WELL DESIGN, CONSTRUCTION, AND ABANDONMENT

Temporary wells shall be constructed using nominal 1-inch ID, PVC riser and nominal 1-inch ID, PVC factory slotted screen (0.010 slot) pre-packed screen. Clean silica sand of U.S. Standard Sieve Size No. 20 to 40 will be used for the sand pack, 100 percent certified pure sodium bentonite will be used for the seal above the sand pack and hydrated.

DPT - The temporary well will be installed by driving a nominal 3-inch ID drill casing (with an expendable tip) to the desired depth. After the casing has been advanced to approximately 8 feet below the first water bearing zone, a 10-foot-long screen attached to the riser pipe will be lowered to the bottom through the casing. The casing will then be withdrawn from the ground, exposing the pre-pack screen to the formation material. The saturated formation material may collapse around the screen, and the remaining annular space around the screen will be filled with silica sand to at least 1 to 2 feet above the screen. The depths of backfill materials will be constantly monitored, if possible, during well installation using a weighted stainless-steel or fiberglass tape measure. A bentonite seal will then be installed to the ground surface or at least ten feet above the sand-pack completing the temporary well construction.

HSA – The temporary well will be installed by driving a nominal 3 ½ or 4 ½ -inch ID drill HSA to the desired depth if DPT is not feasible. After the HSA has been advanced to approximately 8 feet below the first water bearing zone, a 10-foot-long screen attached to the riser pipe will be lowered to the bottom through the HSA. The HSA will then be withdrawn from the ground, exposing the pre-pack screen to the formation material. The saturated formation material may collapse around the screen, and the remaining annular space around the screen will be filled with silica sand to at least 1 to 2 feet above the screen. The depths of backfill materials will be constantly monitored, if possible, during well installation using a weighted stainless-steel or fiberglass tape measure. A bentonite seal will then be installed to the ground surface or at least ten feet above the sand-pack completing the temporary well construction.

The annular space at the ground surface will be covered with plastic sheeting around the riser if needed to prevent infiltration of surface runoff or rainwater into the annulus. The riser pipe will be capped to prevent rain water from entering into the well and will remain in place until the point is abandoned.

Once the well has been sampled by Tetra Tech personnel, the driller shall abandon the well in accordance with State of Florida regulations. This requires that the PVC screen and riser be removed from the boring and the boring backfilled with cement/bentonite grout from the bottom up using a tremie pipe.

5.0 DOCUMENTATION OF FIELD ACTIVITIES

A critical part of monitoring well installation is recording of significant details and events in the site logbook, on field forms, and in a field logbook. Details of borehole logging are contained in SOP-05.

6.0 ATTACHMENTS

1. Overburden Monitoring Well Sheet

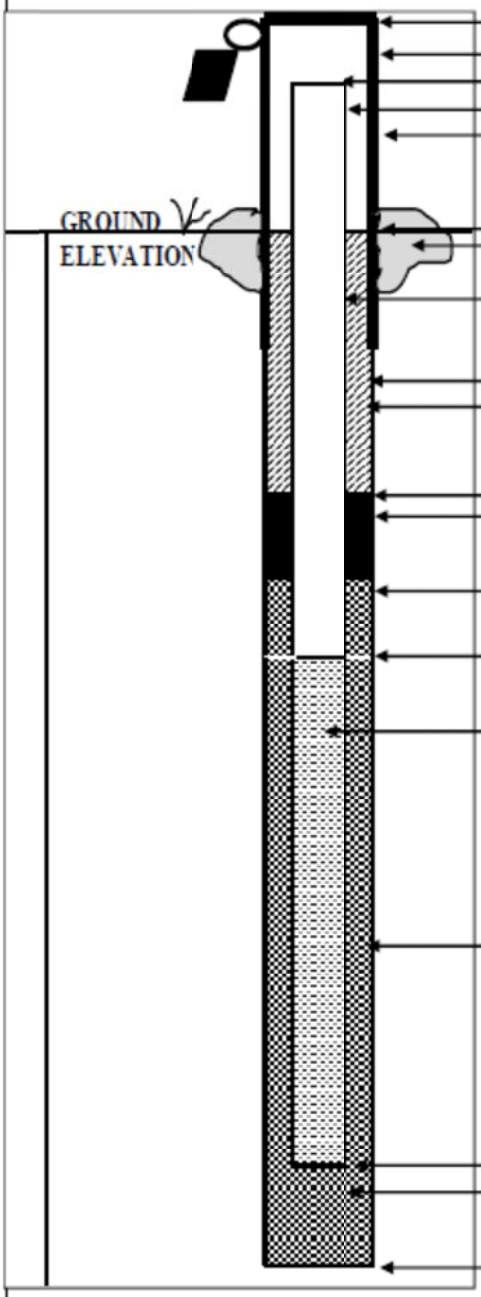
ATTACHMENT 1

OVERBURDEN MONITORING WELL SHEET

BORING NO.: _____

Tetra Tech NUS, Inc. **TEMPORARY OVERBURDEN MONITORING WELL SHEET**

PROJECT:		DRILLING Co.:		BORING No.:	
PROJECT No.:		DRILLER:		DATE COMPLETED:	
SITE:		DRILLING METHOD:		NORTHING:	
GEOLOGIST:		DEV. METHOD:		EASTING:	



ELEVATION OF TOP OF SURFACE CASING: _____
STICK -UP TOP OF SURFACE CASING: _____
ELEVATION OF TOP OF RISER PIPE: _____
RISER STICK-UP ABOVE GROUND SURFACE: _____
I.D. OF SURFACE CASING: _____
TYPE OF SURFACE CASING: _____

GROUND ELEVATION: _____
TYPE OF SURFACE SEAL: _____

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

BOREHOLE DIAMETER: _____
TYPE OF SEAL: _____

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

ELEVATION / DEPTH TOP OF FILTER PACK: ____ / ____

ELEVATION / DEPTH TOP OF SCREEN: ____ / ____

TYPE OF SCREEN: _____

SLOT SIZE X LENGTH: _____

I.D. OF SCREEN: _____

TYPE OF FILTER PACK: _____

ELEVATION / DEPTH BOTTOM OF SCREEN: ____ / ____
ELEVATION / DEPTH BOTTOM OF FILTER PACK: ____ / ____
TYPE OF BACKFILL BELOW WELL: _____
ELEVATION / DEPTH OF BOREHOLE: ____ / ____

STANDARD OPERATING PROCEDURE
SOP-07

TEMPORARY WELL DEVELOPMENT

1.0 PURPOSE

This procedure provides general guidance and information pertaining to proper development of temporary wells. The methods described herein are specific for monitoring wells located at Naval Air Station (NAS) Jacksonville.

2.0 RESPONSIBILITIES

The drilling contractor or Tetra Tech personnel shall provide adequate and operable equipment, sufficient quantities of materials, and an experienced and efficient labor force capable of developing monitoring wells. The field personnel must have all the health and safety training required to perform the work, as specified in the Health and Safety Plan (HASP).

3.0 REQUIRED EQUIPMENT/ITEMS

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

Health and safety equipment as required by the HASP and the Tetra Tech Site Safety Officer (SSO).

Well development equipment with associated materials (supplied by the driller or Tetra Tech)
Peristaltic and/or 0.75" submersible bladder pump.

Hydrogeologic equipment (water-level indicator, electronic calculator, clipboard, paint and ink marker, well development forms, and a field notebook).

4.0 PROCEDURES

Development of the temporary wells will be accomplished using a peristaltic pump or bladder pump and polyethylene (PE) tubing.

4.1 Insert the intake end of a length of PE tubing to the bottom of the screen point and attach a length of silicon tubing (approximately 1 foot) to the discharge end of the PE tubing. The silicon tubing

will be threaded around the rotor of the pump and out of the pump. Or attach PE twin-line tubing to the bladder pump and lower in to well to approximately two feet off the bottom of the well. The bladder pump will be activated using an environmental standard compressed gas cylinder and control system.

4.2 The PE tubing or bladder pump will be lifted and lowered slightly while the pump is operating. The maximum pump rate will be approximately 2 liters per minute during development. However, the yield of the formation will dictate the pumping rate.

4.3 Measurement of pH, specific conductance, turbidity, dissolved oxygen (DO), oxidation-reduction potential (ORP), and temperature shall be recorded every 5 to 10 minutes during the development process using a water quality meter and flow-through cell.

4.4 The temporary monitoring well will be pumped until discharge water is visibly clear, the turbidity readings do not improve over time, or the well screen goes dry.

4.5 Sampling will commence in accordance with Florida Department of Environmental Protection (FDEP) field sampling Standard Operating Procedure (SOP) FS 2200.

5.0 ATTACHMENTS

1. Monitoring Well Development Record

ATTACHMENT 1
MONITORING WELL DEVELOPMENT RECORD

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Page ___ of _____

Well: _____ Depth to Bottom (ft.): _____ Responsible Personnel: _____
Site: _____ Static Water Level Before (ft.): _____ Drilling Company: _____
Date Installed: _____ Static Water Level After (ft.): _____ Project Name: _____
Date Developed: _____ Screen Length (ft.): _____ Project Number: _____
Dev. Method: _____ One Well Volume (gal/L): _____ PID Readings: Bore Hole_____ppm
Pump Type: _____ Casing ID (in.): _____ PID Readings: Breathing Zone_____ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (mL/min.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units _____)	Turbidity (NTU)	Remarks (odor, color, etc.)

STANDARD OPERATING PROCEDURE

SOP-08

MEASUREMENT OF WATER LEVELS IN MONITORING WELLS

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes procedures for determining water levels in monitoring wells.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

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

Ground Water Level Measurement Form: A copy of the Ground Water Level Measurement Form is attached.
Bound field logbook
Well key
Writing utensil
Electronic water-level indicator: The water-level indicator must have a cable of sufficient length to reach the water surface and be capable of measurements of 0.01 foot.
Decontamination supplies: Florida Department of Environmental Protection (FDEP) SOP FC 1000 describes decontamination procedures including decontamination supplies.

3.0 WATER-LEVEL MEASUREMENT PROCEDURES

3.1 Check the operation of the electronic water-level indicator or interface meter.

3.2 Record the well identification (ID), date, and time (using military time) on the Ground Water-Level Measurement Form.

3.3 Unlock the well and remove the well cap.

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

3.5 Ensure that the water-level indicator probe has been decontaminated before use, in accordance with the procedures outlined in FDEP SOP FC 1000.

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

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

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

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

3.12 Replace the well cap and lock.

3.13 Decontaminate the meter's probe and cable following the procedures outlined in FDEP SOP FC 1000.

3.13 Containerize any decontamination fluids and PPE in accordance with the procedures described in Tetra Tech SOP-10.

4.0 ATTACHMENTS

1. Ground Water Level Measurement Sheet

ATTACHMENT 1

GROUND WATER LEVEL MEASUREMENT SHEET

Tetra Tech NUS, Inc.

GROUNDWATER LEVEL MEASUREMENT SHEET

Project Name: _____ **Project No.:** _____
Location: _____ **Personnel:** _____
Weather Conditions: _____ **Measuring Device:** _____
Tidally Influenced: Yes ___ No ___ **Remarks:** _____

Well or Piezometer Number	Date	Time	Elevation of Reference Point (feet)*	Total Well Depth From TOC (feet)*	Water Level Indicator Reading (feet)*	Groundwater Elevation (feet)*	Comments

* All measurements to the nearest 0.01 foot

Page ____ of ____

STANDARD OPERATING PROCEDURE

SOP-09

GLOBAL POSITIONING SYSTEM

1.0 PURPOSE

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

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

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

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

2.0 REQUIRED EQUIPMENT

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

2.1 Required GPS Hardware

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

Optional Accessories:

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

- Indelible marker
- Non-metallic pin flags for temporary marking of positions

2.2 Required GPS Software

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

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

- Microsoft ActiveSync version 4.2 or later. Download to personal computer from: http://www.microsoft.com/windowsmobile/en-us/downloads/eulas/eula_activesync45_1033.mspx?ProductID=76

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

3.0 START-UP PROCEDURES

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

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

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

Start Up:

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

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

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

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

3.1 Confirm Setup Settings

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

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

4.0 ANTENNA CONNECTION

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

5.0 COLLECTING NEW DATA IN THE FIELD

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

5.1 Collecting Features

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

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

GPS unit can be adjusted as the number of usable satellites changes throughout the day. To determine if GPS is correctly recording data, see Section 5.2.

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

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

5.3 Viewing Data or Entering Data Points from an Existing File

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

6.0 NAVIGATION

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

1) From the Main Menu select Map.
2) Using the Select tool, pick the point on the map to where you want to navigate.
3) The location you select will have a box placed around the point.
4) From the Options menu, choose the Set Nav Target (aka set navigation target).
5) The location will now have double blue flags indicating this point is you navigation target.
6) From the Main Menu select Navigation.
7) The dial and data on this page will indicate what distance and direction you need to travel to reach the desired target.
8) Follow the navigation guide until you reach the point you select.
9) Repeat as needed for any map point by going back to Step 1.

7.0 PULLING IN A BACKGROUND FILE

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

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

8.0 DATA TRANSFER

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

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

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

9.0 SHUTTING DOWN

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

1) When shutting down the GPS unit for the day, first click on the "X" in the upper right hand corner.
2) You will be prompted to ensure you want to exit TerraSync. Select Yes.
3) Power off the GPS unit by pushing the small green button located on the bottom face of the unit.
4) Place the GPS unit in its cradle to recharge the battery overnight. Ensure the green charge light is visible on the charging cradle.

ATTACHMENT A

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

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

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

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

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

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

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

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

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

To Transfer Data Collected in the Field:

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

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

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

STANDARD OPERATING PROCEDURE

SOP-10

MANAGEMENT OF INVESTIGATION-DERIVED WASTE

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes how investigation-derived waste (IDW) will be collected and managed during the field investigations at Naval Air Station (NAS) Jacksonville. The following types of IDW will be generated during this investigation:

- Residual soil remaining from subsurface DPT drilling activities
- Well development water and purge water related to monitoring well installation and sampling
- Decontamination solutions
- Personal protective equipment and clothing (PPE)
- Miscellaneous trash and incidental items

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Health and safety equipment (with PPE)
Decontamination equipment
Field logbook and indelible ink pen
Plastic sheeting and/or tarps
55-gallon drums with sealable lids
IDW labels for drums
Wastewater container tanks
Plastic garbage bags

3.0 PROCEDURES

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

3.1 Liquid and Soil Wastes

Liquid wastes that will be generated during the site activities include well development water, well purge water (collected during low-flow sampling), and decontamination solutions from drilling and sampling equipment. Soil wastes may include soil cuttings generated during borehole drilling.

3.1.1 Transfer wastewaters, including monitoring well purge water, to 55-gallon drums. Purge water will be collected at the well using 5-gallon spill proof containers which will then be used to transport the waste water to the 55-gallon drums marshaled at a central location on the NAS Jacksonville facility for proper disposal.

3.1.2 Place waste soils in 55-gallon drums staged at the location of generation. Waste soils will remain in the drums until groundwater sampling and removal of the temporary monitoring well at that location are completed. To the extent possible, return waste soils to the empty boreholes from which they were derived. Excess soil that cannot be returned to the boreholes will be containerized, marshaled at the same location as the waste water drums, and sampled for waste characterization. Based on the characterization results, drums of waste soil will be transported and appropriately disposed off site by the IDW subcontractor at a Navy-approved disposal facility.

3.1.3 The location and number of drums used for the completion of work will be documented in the field note book. Each drum will be labeled and the following information will be placed on the label.

- Contents (soil or water)
- Site (i.e., UXO 1, 2, 3, 4, 5, or 6)
- Location (NAS Jacksonville)
- Volume of waste in the drum
- Date and time the waste was placed in the drum
- The NAS Jacksonville Point of Contact (POC) name and contact phone number

3.2 PPE, Pump Discharge Tubing, Direct-Push Technology (DPT) Sample Liners, and Incidental Trash

All PPE wastes, pump discharge tubes, DPT sample liners, and incidental trash materials (e.g., wrapping or packing materials from supply cartons, waste paper) must be decontaminated (if contaminated), double bagged, securely tied shut, and placed in a designated waste receptacle at NAS Jacksonville.

E-2

Field Forms

Tetra Tech

BORING LOG

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

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

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): _____

Remarks: _____

Converted to Well: Yes _____ No _____ Well I.D. #: _____

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CONTAINER SAMPLE & INSPECTION SHEET

Page_____ of _____

Project Site Name: _____
Project Number: _____
Site Identification: _____
Container Number(s): _____
Sample Type: [] Grab
[] Composite

Sample ID No. _____
Sampled By: _____
C.O.C. No.: _____
Concentration: [] High
[] Medium
[] Low

CONTAINER SOURCE

DRUM:
[] Bung Top
[] Lever Lock
[] Bolted Ring
[] Other _____

TANK:
[] Plastic
[] Metal
[] Other _____

OTHER: _____

CONTAINER DESCRIPTION

COLOR: _____

CONDITION: _____

MARKINGS: _____

VOL. OF CONTENTS: _____

OTHER: _____

CONTAINER DISPOSITION

SAMPLED: _____

OPENED BUT NOT SAMPLED:
Reason _____
_____

NOT OPENED:
Reason _____
_____

CONTENTS DESCRIPTION

SINGLE PHASED: _____
_____

MULTIPHASE :

	Layer 1	Layer 2	Layer 3
Phase (Sol. or Liq.)	_____	_____	_____
Color	_____	_____	_____
Viscosity	L, M or H	L, M or H	L, M orH
% of Total Volume	_____	_____	_____

MONITOR READING:

SAMPLE and /or INSPECTION DATE & TIME:
_____HRS.
METHOD:_____

SAMPLER(S) and / or INSPECTOR(S) SIGNATURE:

ANALYSIS:

Tetra Tech

PROJECT: _____ **JOB #:** _____
LOCATION: _____ **DATE:** _____
PROJECT MANAGER: _____ **FOL:** _____

DAILY ACTIVITIES CHECKLIST

Startup Checklist

Activity	Yes	No	N/A
Pertinent site activities/information entered into site logbook			
All onsite personnel listed in logbook			
Required medical information onsite for all workers (Tetra Tech and Subcontractors)			
Required MSDS's onsite			
Proper equipment calibrations performed (list equipment)			
1 _____			
2 _____			
3 _____			
4 _____			
Calibration logs filled out			
Tailgate H&S meeting held prior to beginning field activities			
Required work permits filled out/signed			
Required utility clearances obtained			
Required PPE onsite and in use			
Information required to be posted is in place			
(OSHA poster, hospital route, key phone numbers, etc.)			

Exit Checklist

Activity	Yes	No	N/A
Logbooks completely and comprehensively filled out			
Field forms complete and accounted for/properly filed			
Samples properly packaged/shipped			
COCs faxed to appropriate in-house personnel			
All equipment accounted for, on charge if needed, and properly secured			
All personnel accounted for			
Arrangements made for upcoming work (permits, clearances, equipment, etc.)			
Site properly secured			

Note - not all items listed apply to every job, and some additional requirements may apply on a job-specific basis.

Tetra Tech

DAILY ACTIVITIES RECORD

PROJECT NAME: _____ **PROJECT NUMBER:** _____

CLIENT: _____ **LOCATION:** _____

DATE: _____ **ARRIVAL TIME:** _____

Tt PERSONNEL: _____ **DEPARTURE TIME:** _____

CONTRACTOR: _____ **DRILLER:** _____

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

COMMENTS: _____

_____

_____

_____

APPROVED BY:

_____ _____

TETRA TECH REPRESENTATIVE DRILLER

DATE: _____

Tetra Tech

PROJECT: _____ **LOCATION:** _____

JOB & CTO #: _____ **MOBILIZATION DATE:** _____

PROJECT MANAGER: _____ **RETURN DATE:**_____

FIELD PROJECT DEMOBILIZATION CHECKLIST

TRAVEL

___ Airline reservations
___ Hotel reservations/BOQs
___ Vehicle rental
___ Itinerary
___ Phone/pager number

DRILLING/DPT/SURVEY

Subcontractor

___ POC phone #/address
___ Drill Specification RFP
___ Contact (time & place to meet)
___ Confirm subcontract w/ TtNUS Procurement
___ Health and Safety documentation for all personnel on site
___ Copy of Drillers license
___ Well / boring permits

Utilities (2 weeks lead time)

___ Contact Site POC (Date:_____)
___ Contact Local "Call Before You Dig"
___ Utility Clearance Form

Forms

___ Boring logs / Test Pit logs
___ Well construction / development forms
___ Daily activity forms
___ IDW inventory
___ IDW drum labels
___ Chemical Inventory
___ MSDS's

EQUIPMENT MOBILIZATION

___ Equipment Requisition form completed / equipment ordered
___ 3rd Party rental / misc. equipment ordered
___ Equipment calibration forms
___ Span / calibration gas and regulator

SAMPLING

Forms

___ Sample log sheets
___ Low-flow purge data sheets
___ COC records
___ COC seals
___ Sample labels (from database group)

Laboratory

___ POC address/phone#
___ Order bottles / preservatives
___ Shipping address, also check Sat. address
___ Bottle & preservation req'ts from lab
___ _____

MISCELLANEOUS

Schedule

___ Plan field operations w/ Project manager

Documents for Field Program

___ Logbook(s)
___ Field Sampling plan
___ Health & Safety plan
___ Maps
___ H & S Guidance Manual

Authorization

___ Kick-off meeting held
___ Gov't rate letter
___ H&S/OSHA 40-hour certifcate
___ 8-Hour Refresher Training Certificate
___ Medical Clearance Letter
___ Supervisory Training Certificate
___ Health & Safety Clearance Letter
___ Full-size OSHA Poster

HYDROGEOLOGY EQUIPMENT

___ Slug test/pumping test forms
___ Groundwater elevation data sheets
___ Graph paper
___ Data Logger/transducer/data cable
___ Existing well construction & water level data
___ M-Scope, slug

SHIPPING

Forms

___ FedEx Airbills, local dropoff location & hours
___ FedEx Gov. Acct# (1771-8058-0)
___ Lab Shipping Labels
___ Warehouse Shipping Labels
___ Blank Labels

Supplies

___ Tape
___ Packing materials
___ Baggies, Large garbage bags

OTHER

___ Site POC name/phone #
___ Personnel information to POC
___ Mobilization schedule to POC
___ Site access authorizations
___ Field office / trailer arrangements made
___ Electric, phone hookups arranged
___ Steel-toed boots, safety glasses, & hard hat
___ First aid equipment
___ Insect repellent
___ _____
___ _____

Note - not all items listed apply to every job, and some additional requirements may apply on a job-specific basis.

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EQUIPMENT CALIBRATION LOG

PROJECT NAME : _____ INSTRUMENT NAME/MODEL: _____

SITE NAME: _____ MANUFACTURER: _____

PROJECT No.: _____ SERIAL NUMBER: _____

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

TETRA TECH
FIELD TASK MODIFICATION REQUEST FORM

Project/Installation Name	Project Number	Project Mod. Number
Modification To (e.g. Work Plan)	Site/Sample Location	Date
Activity Description:		
Reason for Change:		
Recommended Disposition:		
Field Operations Leader (Signature)	Date	
Approved Disposition:		
Project Manager (Signature)	Date	
Distribution: Program/Project File – Project Manager – Field Operations Leader –	Other:	

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FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Project Site Name: _____ Sample ID No.: _____

Project No.: _____ Sample Location: _____

Sampled By: _____ Duplicate: ☐

Field Analyst: _____ Blank: ☐

Field Form Checked as per QA/QC Checklist (initials): _____

SAMPLING DATA:

Date: / Time:	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (^{0}C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP (Eh) (+/- mv)
Method:								

SAMPLE COLLECTION/ANALYSIS INFORMATION:

ORP (Eh) (+/- mv)

Electrode Make & Model: _____

Reference Electrode (circle one): Silver-Silver Chloride / Calomel / Hydrogen

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Concentration: _____ ppm

Range Used:	Range	Method	Concentration ppm
☐	0 to 1 ppm	K-7510	
☐	1 to 12 ppm	K-7512	

Analysis Time: _____

Equipment: HACH Digital Titrator OX-DT

Analysis Time: _____

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier		Concentration
_____	x 0.01	=	mg/L
_____	x 0.02	=	mg/L

Notes:

Carbon Dioxide:

Equipment: Chemetrics Test Kit

Concentration: _____ ppm

Range Used:	Range	Method	Concentration ppm
☐	10 to 100 ppm	K-1910	
☐	100 to 1000 ppm	K-1920	
☐	250 to 2500 ppm	K-1925	

Analysis Time: _____

Equipment: HACH Digital Titrator CA-DT

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	10-50 mg/L	200 ml	0.3636 N	0.1
☐	20-100 mg/L	100 ml	0.3636 N	0.2
☐	100-400 mg/L	200 ml	3.636 N	1.0
☐	200-1000 mg/L	100 ml	3.636 N	2.0

Titration Count			Concentration
_____	x 0.1	=	mg/L
_____	x 0.2	=	mg/L
_____	x 1.0	=	mg/L
_____	x 2.0	=	mg/L

Standard Additions: ☐ Titrant Molarity: _____ Digits Required: 1st.: _____ 2nd.: _____ 3rd.: _____

Notes:

Hydrogen, dissolved

Equipment: Bubble strip sampling field method

Start stripper at _____ (time)

End stripper at _____ (time)

Total stripper time _____

Pump rate _____ milliliters/minute

Tetra Tech

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Project Site Name: _____ Sample ID No.: _____

Project No.: _____ Sample Location: _____

Sampled By: _____ Duplicate: ☐

Field Analyst: _____ Blank: ☐

Alkalinity:

Equipment: Chemetrics Test Kit Concentration: _____ ppm

Range Used:	Range	Method	Concentration ppm
☐	10 to 100 ppm	K-9810	
☐	50 to 500 ppm	K-9815	
☐	100 to 1000 ppm	K-9820	

Analysis Time: _____

Filtered: ☐

Equipment: HACH Digital Titrator AL-DT

Range Used:	Range	Sample Vol.	Cartridge	Multiplier	Titration Count	Multiplier	Concentration
☐	10-40 mg/L	100 ml	0.1600 N	0.1	_____ & _____	**x** 0.1	= mg/L
☐	40-160 mg/L	25 ml	0.1600 N	0.4	_____ & _____	**x** 0.4	= mg/L
☐	100-400 mg/L	100 ml	1.600 N	1.0	_____ & _____	**x** 1.0	= mg/L
☐	200-800 mg/L	50 ml	1.600 N	2.0	_____ & _____	**x** 2.0	= mg/L
☐	500-2000 mg/L	20 ml	1.600 N	5.0	_____ & _____	**x** 5.0	= mg/L
☐	1000-4000 mg/L	10 ml	1.600 N	10.0	_____ & _____	**x** 10.0	= mg/L

Parameter:	Hydroxide	Carbonate	Bicarbonate
Relationship:			

Standard Additions: ☐ Titrant Molarity:_____ Digits Required: 1st.:_____ 2nd.:_____ 3rd.:_____

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 _ _ Range: 0 - 3.00 mg/L Concentration: _____ ppm

Program/Module: 500nm 33

Analysis Time: _____

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes: Filtered: ☐

Hydrogen Sulfide (H_2S):

Range: 0 - 5 mg/L

Equipment: HS-C Other: _____ Concentration: _____ ppm

Exceeded 5.0 mg/L range on color chart: ☐ Analysis Time: _____

Notes:

Sulfide (S^{2-}):

Equipment: Chemetrics Test Kit Range: 0 - 10 mg/L Concentration: _____ ppm

Range Used:	Range	Method	Concentration ppm
☐	0 to 1 ppm	K-9510	
☐	1 to 10 ppm	K-9510	

Analysis Time: _____

Filtered: ☐

Equipment: DR-850 DR-8 _ _ Range: 0 - 0.70 mg/L

Program/Module: 610nm 93

Notes:

Tetra Tech

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Project Site Name: _____ Sample ID No.: _____

Project No.: _____ Sample Location: _____

Sampled By: _____ Duplicate: ☐

Field Analyst: Blank: ☐

Sulfate ($S0_4^{2-}$):

Equipment: DR-850 DR-8 _ _ Range: 0 - 70 mg/L Concentration: _____ ppm

Program/Module: _____ 91 Analysis Time: _____

Standard Solution: ☐ Results: _____ Filtered: ☐

Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____

Notes:

Nitrate (NO_3^--N):

Equipment: DR-850 DR-8 _ _ Range: 0 - 0.50 mg/L (1) Concentration: _____ ppm

Program/Module: 55 Analysis Time: _____ Filtered: ☐

Standard Solution: ☐ Results: _____ Nitrite Interference Treatment: ☐ Reagent Blank Correction: ☐

Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____

Alternate forms: NO_2 _____ $NaNO_2$ _____ mg/L

Notes (1): If results are over limit use dilution method at step 3, 5ml sample 10ml DI result X3, range upto 1.5mg/L

Notes:

Nitrite (NO_2^--N): Concentration: _____ ppm

Equipment: DR-850 DR-8 _ _ Range: 0 - 0.350 mg/L Analysis Time: _____ Filtered: ☐

Program/Module: 62

Standard Solution: ☐ Results: _____ Reagent Blank Correction: ☐

Notes:

Manganese (Mn^{2+}): Concentration: _____ ppm

Equipment: DR-850 DR-8 _ _ Range: 0 - 20.0 mg/L Analysis Time: _____ Filtered: ☐

Program/Module: 525nm 41

Standard Solution: ☐ Results: _____ Digestion: ☐ Reagent Blank Correction: ☐

Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____

Equipment: HACH MN-5 Range: 0 - 3 mg/L

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☐

Correct measurement units are cited in the SAMPLING DATA block: ☐

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☐

Mulitplication is correct for each *Multiplier* table: ☐

Final calulated concentration is within the appropriate *Range Used* block: ☐

Alkalinity *Relationship* is determined appropriatly as per manufacturer (HACH) instructions: ☐

QA/QC sample (e.g., Std. Additions, etc.) frequency is appropriate as per the project planning documents: ☐

Nitrite Interference treatment was used for Nitrate test if Nitrite was detected: ☐

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☐

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: _____ **WELL ID.:** _____

PROJECT NUMBER: _____ **DATE:** _____

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

SIGNATURE(S): _____

PAGE___OF___

Tetra Tech

MONITORING WELL DEVELOPMENT RECORD

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

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

Tetra Tech

PROJECT: _____ **LOCATION:** _____

JOB & CTO #: _____ **MOBILIZATION DATE:** _____

PROJECT MANAGER: _____ **RETURN DATE:** _____

FIELD PROJECT PRE-MOBILIZATION CHECKLIST

TRAVEL

___ Airline reservations
___ Hotel reservations/BOQs
___ Vehicle rental
___ Itinerary
___ Phone/pager number

DRILLING/DPT/SURVEY

Subcontractor

___ POC phone #/address
___ Drill Specification RFP
___ Contact (time & place to meet)
___ Confirm subcontract w/ TtNUS Procurement
___ Health and Safety documentation for all personnel on site
___ Copy of Drillers license
___ Well / boring permits

Utilities (2 weeks lead time)

___ Contact Site POC (Date:_____)
___ Contact Local "Call Before You Dig"
___ Utility Clearance Form

Forms

___ Boring logs / Test Pit logs
___ Well construction / development forms
___ Daily activity forms
___ IDW inventory
___ IDW drum labels
___ Chemical Inventory
___ MSDS's

EQUIPMENT MOBILIZATION

___ Equipment Requisition form completed / equipment ordered
___ 3rd Party rental / misc. equipment ordered
___ Equipment calibration forms
___ Span / calibration gas and regulator

SAMPLING

Forms

___ Sample log sheets
___ Low-flow purge data sheets
___ COC records
___ COC seals
___ Sample labels (from database group)

Laboratory

___ POC address/phone#
___ Order bottles / preservatives
___ Shipping address, also check Sat. address
___ Bottle & preservation req'ts from lab
___ _____

MISCELLANEOUS

Schedule

___ Plan field operations w/ Project manager

Documents for Field Program

___ Logbook(s)
___ Field Sampling plan
___ Health & Safety plan
___ Maps
___ H & S Guidance Manual

Authorization

___ Kick-off meeting held
___ Gov't rate letter
___ H&S/OSHA 40-hour certifcate
___ 8-Hour Refresher Training Certificate
___ Medical Clearance Letter
___ Supervisory Training Certificate
___ Health & Safety Clearance Letter
___ Full-size OSHA Poster

HYDROGEOLOGY EQUIPMENT

___ Slug test/pumping test forms
___ Groundwater elevation data sheets
___ Graph paper
___ Data Logger/transducer/data cable
___ Existing well construction & water level data
___ M-Scope, slug

SHIPPING

Forms

___ FedEx Airbills, local dropoff location & hours
___ FedEx Gov. Acct# (1771-8058-0)
___ Lab Shipping Labels
___ Warehouse Shipping Labels
___ Blank Labels

Supplies

___ Tape
___ Packing materials
___ Baggies, Large garbage bags

OTHER

___ Site POC name/phone #
___ Personnel information to POC
___ Mobilization schedule to POC
___ Site access authorizations
___ Field office / trailer arrangements made
___ Electric, phone hookups arranged
___ Steel-toed boots, safety glasses, & hard hat
___ First aid equipment
___ Insect repellent
___ _____
___ _____

Note - not all items listed apply to every job, and some additional requirements may apply on a job-specific basis.

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QA SAMPLE LOG SHEET

Project Site Name: _____ Sample ID Number: _____
Project Number: _____ Sampled By: _____
Sample Location: _____ C.O.C. Number: _____
QA Sample Type:

[] Trip Blank [] Rinsate Blank
[] Source Water Blank [] Other Blank _____

SAMPLING DATA:

Date: _____
Time: _____
Method: _____

WATER SOURCE:

[] Laboratory Prepared [] Tap
[] Purchased [] Fire Hydrant
[] Other _____

PURCHASED WATER INFORMATION (If Applicable as Source or Rinsate Water):

Product Name: _____
Supplier: _____
Manufacturer: _____
Order Number: _____
Lot Number: _____
Expiration Date: _____

RINSATE INFORMATION (If Applicable):

Media Type: _____
Equipment Used: _____
Equipment Type:

[] Dedicated
[] Reusable

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Volatiles	Cool 4°C & HCl		YES / NO
Semivolatiles	Cool 4°C		YES / NO
Pesticide / PCB	Cool 4°C		YES / NO
Metals	Cool 4°C & HNO_3		YES / NO
Cyanide	Cool 4°C & NaOH		YES / NO

OBSERVATIONS / NOTES:

Signature(s):

Tetra Tech

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: _____
Project No.: _____

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

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

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

GRAB SAMPLE DATA:

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

COMPOSITE SAMPLE DATA:

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

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

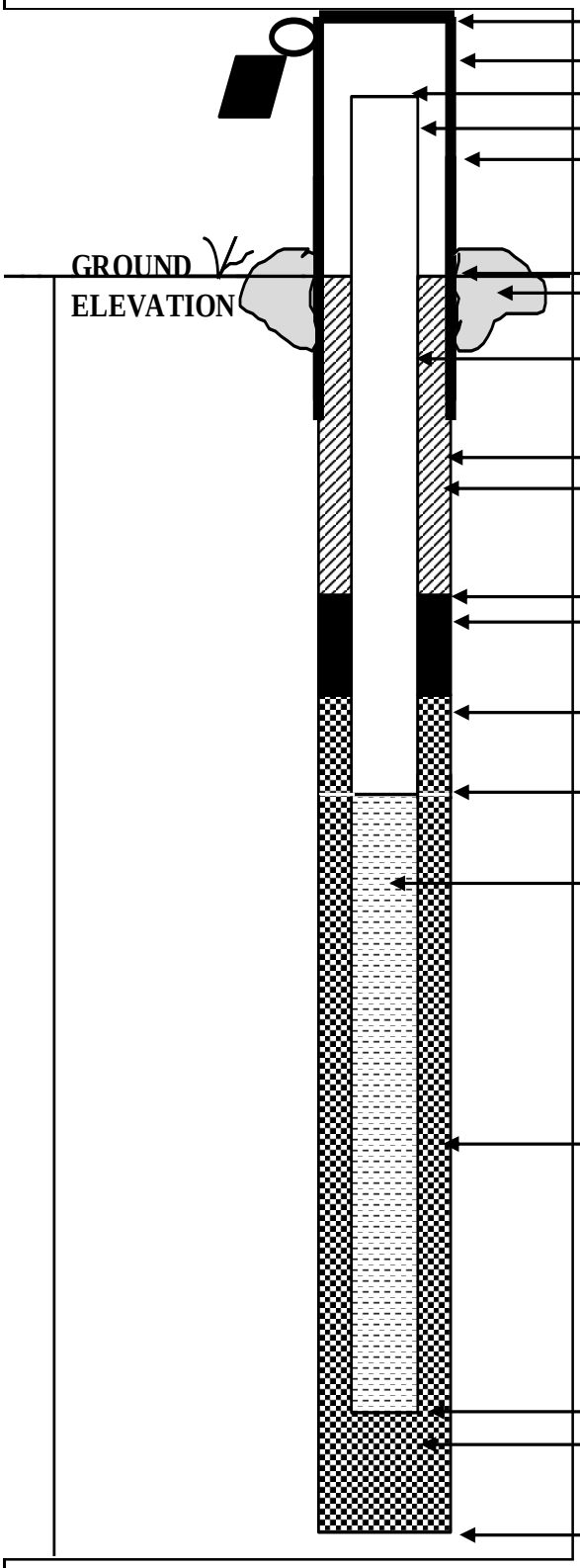
MS/MSD	Duplicate ID No.:

Signature(s):

BORING NO.: _____

Tetra Tech **TEMPORARY OVERBURDEN MONITORING WELL SHEET**

PROJECT:		DRILLING Co.:		BORING No.:	
PROJECT No.:		DRILLER:		DATE COMPLETED:	
SITE:		DRILLING METHOD:		NORTHING:	
GEOLOGIST:		DEV. METHOD:		EASTING:	



ELEVATION OF TOP OF SURFACE CASING: _____

STICK -UP TOP OF SURFACE CASING: _____

ELEVATION OF TOP OF RISER PIPE: _____

RISER STICK-UP ABOVE GROUND SURFACE: _____

I.D. OF SURFACE CASING: _____

TYPE OF SURFACE CASING: _____

GROUND ELEVATION: _____

TYPE OF SURFACE SEAL: _____

RISER PIPE I.D.: _____

TYPE OF RISER PIPE: _____

BOREHOLE DIAMETER: _____

TYPE OF SEAL: _____

ELEVATION / DEPTH OF SEAL: _____ / _____

TYPE OF SEAL: _____

ELEVATION / DEPTH TOP OF FILTER PACK: _____ / _____

ELEVATION / DEPTH TOP OF SCREEN: _____ / _____

TYPE OF SCREEN: _____

SLOT SIZE X LENGTH: _____

I.D. OF SCREEN: _____

TYPE OF FILTER PACK: _____

ELEVATION / DEPTH BOTTOM OF SCREEN: _____ / _____

ELEVATION / DEPTH BOTTOM OF FILTER PACK: _____ / _____

TYPE OF BACKFILL BELOW WELL: _____

ELEVATION / DEPTH OF BOREHOLE: _____ / _____

APPENDIX F

LABORATORY DoD ELAP ACCREDITATION, FDOH CERTIFICATION, AND STANDARD OPERATING PROCEDURES

Scope of Accreditation
For
CHEMTECH

284 Sheffield Street
Mountainside, NJ 07092
Divyajit Mehta
908-789-8900

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.2) based on the National Environmental Laboratory Accreditation Conference Chapter 5 Quality Systems Standard (NELAC Voted Revision June 5, 2003), accreditation is granted to CHEMTECH to perform the following tests:

Accreditation granted through: **October 20, 2012**

Testing – Environmental

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8081A,B	4,4`-DDD
GC/ECD	EPA 8081A,B	4,4`-DDE
GC/ECD	EPA 8081A,B	4,4`-DDT
GC/ECD	EPA 8081A,B	Aldrin
GC/ECD	EPA 8081A,B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 8081A,B	alpha Chlordane
GC/ECD	EPA 8081A,B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 8081A,B	Chlordane (tech.)
GC/ECD	EPA 8081A,B	delta-BHC
GC/ECD	EPA 8081A,B	Dieldrin
GC/ECD	EPA 8081A,B	Endosulfan I
GC/ECD	EPA 8081A,B	Endosulfan II
GC/ECD	EPA 8081A,B	Endosulfan sulfate
GC/ECD	EPA 8081A,B	Endrin aldehyde
GC/ECD	EPA 8081A,B	Endrin ketone
GC/ECD	EPA 8081A,B	Endrin
GC/ECD	EPA 8081A,B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8081A,B	gamma Chlordane
GC/ECD	EPA 8081A,B	Heptachlor epoxide
GC/ECD	EPA 8081A,B	Heptachlor
GC/ECD	EPA 8081A,B	Methoxychlor
GC/ECD	EPA 8081A,B	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 8082/8082A	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 8082/8082A	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 8082/8082A	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 8082/8082A	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 8082/8082A	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 8082/8082A	Aroclor-1254 (PCB-1254)
GC/ECD	EPA 8082/8082A	Aroclor-1260 (PCB-1260)
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4-D
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dinoseb
GC/ECD	EPA 8151A	Picloram
GC/ECD	EPA 8151A	Silvex (2,4,5-TP)
GC/FID	EPA 8015B/D	Diesel range organics (DRO)
GC/FID	EPA 8015B/D	Gasoline range organics (GRO)
GC/MS	EPA 8260B,C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B,C	1,1,1-Trichloroethane
GC/MS	EPA 8260B,C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B,C	1,1,2-Trichloroethane
GC/MS	EPA 8260B,C	1,1-Dichloroethane
GC/MS	EPA 8260B,C	1,1-Dichloroethylene
GC/MS	EPA 8260B,C	1,1-Dichloropropene
GC/MS	EPA 8260B,C	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B,C	1,2,3-Trichloropropane
GC/MS	EPA 8260B,C	1,2,4-Trichlorobenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B,C	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B,C	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B,C	1,2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 8260B,C	1,2-Dichlorobenzene
GC/MS	EPA 8260B,C	1,2-Dichloroethane
GC/MS	EPA 8260B,C	1,2-Dichloropropane
GC/MS	EPA 8260B,C	1,3,5-Trimethylbenzene
GC/MS	EPA 8260B,C	1,3-Dichlorobenzene
GC/MS	EPA 8260B,C	1,3-Dichloropropane
GC/MS	EPA 8260B,C	1,4-Dichlorobenzene
GC/MS	EPA 8260B,C	2,2-Dichloropropane
GC/MS	EPA 8260B,C	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 8260B,C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B,C	2-Chlorotoluene
GC/MS	EPA 8260B,C	2-Hexanone
GC/MS	EPA 8260B,C	4-Chlorotoluene
GC/MS	EPA 8260B,C	4-Methyl-2-pentanone (MIBK)
GC/MS	EPA 8260B,C	Acetone
GC/MS	EPA 8260B,C	Acrolein (Propenal)
GC/MS	EPA 8260B,C	Acrylonitrile
GC/MS	EPA 8260B,C	1,1,2-Trichlorotrifluoroethane
GC/MS	EPA 8260B,C	Allyl chloride (3-Chloropropene)
GC/MS	EPA 8260B,C	Benzene
GC/MS	EPA 8260B,C	Bromobenzene
GC/MS	EPA 8260B,C	Bromochloromethane
GC/MS	EPA 8260B,C	Bromodichloromethane
GC/MS	EPA 8260B,C	Bromoform
GC/MS	EPA 8260B,C	Carbon disulfide
GC/MS	EPA 8260B,C	Carbon tetrachloride
GC/MS	EPA 8260B,C	Chlorobenzene
GC/MS	EPA 8260B,C	Chloroethane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B,C	Chloroform
GC/MS	EPA 8260B,C	cis-1,2-Dichloroethylene
GC/MS	EPA 8260B,C	cis-1,3-Dichloropropene
GC/MS	EPA 8260B,C	Dibromochloromethane
GC/MS	EPA 8260B,C	Dibromomethane
GC/MS	EPA 8260B,C	Dichlorodifluoromethane
GC/MS	EPA 8260B,C	Ethyl acetate
GC/MS	EPA 8260B,C	Ethyl methacrylate
GC/MS	EPA 8260B,C	Ethylbenzene
GC/MS	EPA 8260B,C	Hexachlorobutadiene
GC/MS	EPA 8260B,C	Isopropylbenzene
GC/MS	EPA 8260B,C	m+p-Xylenes
GC/MS	EPA 8260B,C	Methacrylonitrile
GC/MS	EPA 8260B,C	Methyl bromide (Bromomethane)
GC/MS	EPA 8260B,C	Methyl chloride (Chloromethane)
GC/MS	EPA 8260B,C	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 8260B,C	Methylene chloride
GC/MS	EPA 8260B,C	Naphthalene
GC/MS	EPA 8260B,C	n-Butylbenzene
GC/MS	EPA 8260B,C	n-Propylbenzene
GC/MS	EPA 8260B,C	o-Xylene
GC/MS	EPA 8260B,C	p-Dioxane
GC/MS	EPA 8260B,C	p-Isopropyltoluene
GC/MS	EPA 8260B,C	sec-Butylbenzene
GC/MS	EPA 8260B,C	Styrene
GS/MS	EPA 8260B,C	Tert-butyl alcohol
GC/MS	EPA 8260B,C	tert-Butylbenzene
GC/MS	EPA 8260B,C	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260B,C	Toluene
GC/MS	EPA 8260B,C	trans-1,2-Dichloroethylene
GC/MS	EPA 8260B,C	trans-1,3-Dichloropropylene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B,C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B,C	Trichloroethene (Trichloroethylene)
GC/MS	EPA 8260B,C	Trichlorofluoromethane
GC/MS	EPA 8260B,C	Vinyl acetate
GC/MS	EPA 8260B,C	Vinyl chloride
GC/MS	EPA 8260B,C	Xylene (total)
GC/MS	EPA 8270C,D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270C,D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270C,D	1,2-Dichlorobenzene
GC/MS	EPA 8270C,D	1,2-Diphenylhydrazine
GC/MS	EPA 8270C,D	1,3-Dichlorobenzene
GC/MS	EPA 8270C,D	1,4-Dichlorobenzene
GC/MS	EPA 8270C,D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270C,D	2,4,5-Trichlorophenol
GC/MS	EPA 8270C,D	2,4,6-Trichlorophenol
GC/MS	EPA 8270C,D	2,4-Dichlorophenol
GC/MS	EPA 8270C,D	2,4-Dimethylphenol
GC/MS	EPA 8270C,D	2,4-Dinitrophenol
GC/MS	EPA 8270C,D	2,4-Dinitrotoluene (2,4-DNT)
GC/MS	EPA 8270C,D	2,6-Dinitrotoluene (2,6-DNT)
GC/MS	EPA 8270C,D	2-Chloronaphthalene
GC/MS	EPA 8270C,D	2-Chlorophenol
GC/MS	EPA 8270C,D	2-Methyl-4,6-dinitrophenol
GC/MS	EPA 8270C,D	2-Methylnaphthalene
GC/MS	EPA 8270C,D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270C,D	2-Nitroaniline
GC/MS	EPA 8270C,D	2-Nitrophenol
GC/MS	EPA 8270C,D	3,3`-Dichlorobenzidine
GC/MS	EPA 8270C,D	3+4-Methylphenol
GC/MS	EPA 8270C,D	3-Nitroaniline
GC/MS	EPA 8270C,D	4-Bromophenyl phenyl ether

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C,D	4-Chloro-3-methylphenol
GC/MS	EPA 8270C,D	4-Chloroaniline
GC/MS	EPA 8270C,D	4-Chlorophenyl phenylether
GC/MS	EPA 8270C,D	4-Nitroaniline
GC/MS	EPA 8270C,D	4-Nitrophenol
GC/MS	EPA 8270C,D	Acenaphthene
GC/MS	EPA 8270C,D	Acenaphthylene
GC/MS	EPA 8270C,D	Acetophenone
GC/MS	EPA 8270C,D	Aniline
GC/MS	EPA 8270C,D	Anthracene
GC/MS	EPA 8270C,D	Benzidine
GC/MS	EPA 8270C,D	Benzo(a)anthracene
GC/MS	EPA 8270C,D	Benzo(a)pyrene
GC/MS	EPA 8270C,D	Benzo(b)fluoranthene
GC/MS	EPA 8270C,D	Benzo(g,h,i)perylene
GC/MS	EPA 8270C,D	Benzo(k)fluoranthene
GC/MS	EPA 8270C,D	Benzoic acid
GC/MS	EPA 8270C,D	Benzyl alcohol
GC/MS	EPA 8270C,D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270C,D	bis(2-Chloroethyl) ether
GC/MS	EPA 8270C,D	bis(2-Chloroisopropyl) ether (2,2`-Oxybis(1-chloropropane))
GC/MS	EPA 8270C,D	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 8270C,D	Butyl benzyl phthalate
GC/MS	EPA 8270C,D	Carbazole
GC/MS	EPA 8270C,D	Chrysene
GC/MS	EPA 8270C,D	Dibenz(a,h)anthracene
GC/MS	EPA 8270C,D	Dibenzofuran
GC/MS	EPA 8270C,D	Diethyl phthalate
GC/MS	EPA 8270C,D	Dimethyl phthalate
GC/MS	EPA 8270C,D	Di-n-butyl phthalate
GC/MS	EPA 8270C,D	Di-n-octyl phthalate

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C,D	Diphenylamine
GC/MS	EPA 8270C,D	Fluoranthene
GC/MS	EPA 8270C,D	Fluorene
GC/MS	EPA 8270C,D	Hexachlorobenzene
GC/MS	EPA 8270C,D	Hexachlorobutadiene
GC/MS	EPA 8270C,D	Hexachlorocyclopentadiene
GC/MS	EPA 8270C,D	Hexachloroethane
GC/MS	EPA 8270C,D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270C,D	Isophorone
GC/MS	EPA 8270C,D	Naphthalene
GC/MS	EPA 8270C,D	Nitrobenzene
GC/MS	EPA 8270C,D	n-Nitrosodimethylamine
GC/MS	EPA 8270C,D	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270C,D	n-Nitrosodiphenylamine
GC/MS	EPA 8270C,D	Pentachlorophenol
GC/MS	EPA 8270C,D	Phenanthrene
GC/MS	EPA 8270C,D	Phenol
GC/MS	EPA 8270C,D	Pyrene
GC/MS	EPA 8270C,D	Pyridine
HPLC	EPA 8330/8330A	1,3,5-Trinitrobenzene
HPLC	EPA 8330/8330A	1,3-Dinitrobenzene
HPLC	EPA 8330/8330A	2,4,6-Trinitrotoluene
HPLC	EPA 8330/8330A	2,4-Dinitrotoluene
HPLC	EPA 8330/8330A	2,6-Dinitrotoluene
HPLC	EPA 8330/8330A	2-Amino-4,6-Dinitrotoluene
HPLC	EPA 8330/8330A	2-Nitrotoluene
HPLC	EPA 8330/8330A	3-Nitrotoluene
HPLC	EPA 8330/8330A	4-Amino-2,6-Dinitrotoluene
HPLC	EPA 8330/8330A	4-Nitrotoluene
HPLC	EPA 8330/8330A	HMX
HPLC	EPA 8330/8330A	Nitrobenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
HPLC	EPA 8330/8330A	RDX
HPLC	EPA 8330/8330A	Tetryl
Gravimetric	EPA 1664A	Oil & Grease
Gravimetric	EPA 1664A	Total Petroleum Hydrocarbons (TPH)
Gravimetric	EPA 9071B	Oil & Grease
IC	EPA 9056/9056A	Bromide
IC	EPA 9056/9056A	Chloride
IC	EPA 9056/9056A	Fluoride
IC	EPA 9056/9056A	Nitrate
IC	EPA 9056/9056A	Nitrite
IC	EPA 9056/9056A	O-phosphate
IC	EPA 9056/9056A	Sulfate
CVAA	EPA 7470A	Mercury
ICP	EPA 6010B,C	Aluminum
ICP	EPA 6010B,C	Antimony
ICP	EPA 6010B,C	Arsenic
ICP	EPA 6010B,C	Barium
ICP	EPA 6010B,C	Beryllium
ICP	EPA 6010B,C	Boron
ICP	EPA 6010B,C	Cadmium
ICP	EPA 6010B,C	Calcium
ICP	EPA 6010B,C	Chromium
ICP	EPA 6010B,C	Cobalt
ICP	EPA 6010B,C	Copper
ICP	EPA 6010B,C	Iron
ICP	EPA 6010B,C	Lead
ICP	EPA 6010B,C	Magnesium
ICP	EPA 6010B,C	Manganese
ICP	EPA 6010B,C	Molybdenum
ICP	EPA 6010B,C	Nickel
ICP	EPA 6010B,C	Potassium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP	EPA 6010B,C	Selenium
ICP	EPA 6010B,C	Silicon
ICP	EPA 6010B,C	Silver
ICP	EPA 6010B,C	Sodium
ICP	EPA 6010B,C	Thallium
ICP	EPA 6010B,C	Tin
ICP	EPA 6010B,C	Titanium
ICP	EPA 6010B,C	Vanadium
ICP	EPA 6010B,C	Zinc
ICP-MS	EPA 6020/6020A	Aluminum
ICP-MS	EPA 6020/6020A	Antimony
ICP-MS	EPA 6020/6020A	Arsenic
ICP-MS	EPA 6020/6020A	Barium
ICP-MS	EPA 6020/6020A	Beryllium
ICP-MS	EPA 6020/6020A	Boron
ICP-MS	EPA 6020/6020A	Cadmium
ICP-MS	EPA 6020/6020A	Calcium
ICP-MS	EPA 6020/6020A	Chromium
ICP-MS	EPA 6020/6020A	Cobalt
ICP-MS	EPA 6020/6020A	Copper
ICP-MS	EPA 6020/6020A	Iron
ICP-MS	EPA 6020/6020A	Lead
ICP-MS	EPA 6020/6020A	Magnesium
ICP-MS	EPA 6020/6020A	Manganese
ICP-MS	EPA 6020/6020A	Molybdenum
ICP-MS	EPA 6020/6020A	Nickel
ICP-MS	EPA 6020/6020A	Potassium
ICP-MS	EPA 6020/6020A	Selenium
ICP-MS	EPA 6020/6020A	Silicon
ICP-MS	EPA 6020/6020A	Silver
ICP-MS	EPA 6020/6020A	Sodium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 6020/6020A	Thallium
ICP-MS	EPA 6020/6020A	Tin
ICP-MS	EPA 6020/6020A	Titanium
ICP-MS	EPA 6020/6020A	Vanadium
ICP-MS	EPA 6020/6020A	Zinc
Preparation	**Method**	**Type**
ISE	EPA 9040C	Corrosivity (pH)
ISE	EPA 9040C	pH
pH Paper	EPA 9041A	pH
ISE	EPA 9050A	Conductivity
Physical	EPA 1010A	Ignitability
Titrimetric	EPA 9034	Sulfide
Probe21	EPA 9040C	pH
TOC	EPA 9060/9060A	Total organic carbon
Turbidimetric	EPA 9038	Sulfate
Preparation	EPA 3060A	Chromium VI
UV/VIS	EPA 7196A	Chromium VI
Distillation	EPA 9010C	Total cyanide
UV/VIS	EPA 9012B	Total cyanide
Distillation	EPA 9013	Total cyanide
UV/VIS	EPA 9065	Total phenolics
Organic Preparation	3510C	Separatory Funnel
Organic Preparation	3541	Automated Soxhlet Extraction
Clean Up	3620C	Florisil Cleanup
Clean Up	3630C	Silica Gel Cleanup
Clean Up	3640A	Gel-Permeation Cleanup
Clean Up	3660	Sulfur Cleanup
Inorganic Preparation	3050B	Hotblock
Inorganic Preparation	3010A	Hotblock
Volatile Organic Preparation	5030B	Purge and Trap
Distillation	9030B	Sulfide
Extraction/Titrimetric	9031	Sulfide

Solid and Chemical Waste		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8081A,B	4,4`-DDD
GC/ECD	EPA 8081A,B	4,4`-DDE
GC/ECD	EPA 8081A,B	4,4`-DDT
GC/ECD	EPA 8081A,B	Aldrin
GC/ECD	EPA 8081A,B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 8081A,B	alpha Chlordane
GC/ECD	EPA 8081A,B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 8081A,B	Chlordane (tech.)
GC/ECD	EPA 8081A,B	delta-BHC
GC/ECD	EPA 8081A,B	Dieldrin
GC/ECD	EPA 8081A,B	Endosulfan I
GC/ECD	EPA 8081A,B	Endosulfan II
GC/ECD	EPA 8081A,B	Endosulfan sulfate
GC/ECD	EPA 8081A,B	Endrin aldehyde
GC/ECD	EPA 8081A,B	Endrin ketone
GC/ECD	EPA 8081A,B	Endrin
GC/ECD	EPA 8081A,B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC/ECD	EPA 8081A,B	gamma Chlordane
GC/ECD	EPA 8081A,B	Heptachlor epoxide
GC/ECD	EPA 8081A,B	Heptachlor
GC/ECD	EPA 8081A,B	Methoxychlor
GC/ECD	EPA 8081A,B	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 8082/8082A	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 8082/8082A	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 8082/8082A	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 8082/8082A	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 8082/8082A	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 8082/8082A	Aroclor-1254 (PCB-1254)
GC/ECD	EPA 8082/8082A	Aroclor-1260 (PCB-1260)
GC/ECD	EPA 8151A	2,4,5-T

Solid and Chemical Waste		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8151A	2,4-D
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dinoseb
GC/ECD	EPA 8151A	Picloram
GC/ECD	EPA 8151A	Silvex (2,4,5-TP)
GC/FID	EPA 8015B/D	Diesel range organics (DRO)
GC/MS	EPA 8015B/D	GRO
GC/MS	EPA 8260B,C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B,C	1,1,1-Trichloroethane
GC/MS	EPA 8260B,C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B,C	1,1,2-Trichloroethane
GC/MS	EPA 8260B,C	1,1,2-Trichlorotrifluoroethane
GC/MS	EPA 8260B,C	1,1-Dichloroethane
GC/MS	EPA 8260B,C	1,1-Dichloroethylene
GC/MS	EPA 8260B,C	1,1-Dichloropropene
GC/MS	EPA 8260B,C	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B,C	1,2,3-Trichloropropane
GC/MS	EPA 8260B,C	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B,C	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B,C	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B,C	1,2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 8260B,C	1,2-Dichlorobenzene
GC/MS	EPA 8260B,C	1,2-Dichloroethane
GC/MS	EPA 8260B,C	1,2-Dichloropropane
GC/MS	EPA 8260B,C	1,3,5-Trimethylbenzene
GC/MS	EPA 8260B,C	1,3-Dichlorobenzene
GC/MS	EPA 8260B,C	1,3-Dichloropropane
GC/MS	EPA 8260B,C	1,4-Dichlorobenzene
GC/MS	EPA 8260B,C	2,2-Dichloropropane

Solid and Chemical Waste		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B,C	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 8260B,C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B,C	2-Chlorotoluene
GC/MS	EPA 8260B,C	2-Hexanone
GC/MS	EPA 8260B,C	4-Chlorotoluene
GC/MS	EPA 8260B,C	4-Methyl-2-pentanone (MIBK)
GC/MS	EPA 8260B,C	Acetone
GC/MS	EPA 8260B,C	Acrolein (Propenal)
GC/MS	EPA 8260B,C	Acrylonitrile
GC/MS	EPA 8260B,C	Allyl chloride (3-Chloropropene)
GC/MS	EPA 8260B,C	Benzene
GC/MS	EPA 8260B,C	Bromobenzene
GC/MS	EPA 8260B,C	Bromochloromethane
GC/MS	EPA 8260B,C	Bromodichloromethane
GC/MS	EPA 8260B,C	Bromoform
GC/MS	EPA 8260B,C	Carbon disulfide
GC/MS	EPA 8260B,C	Carbon tetrachloride
GC/MS	EPA 8260B,C	Chlorobenzene
GC/MS	EPA 8260B,C	Chloroethane
GC/MS	EPA 8260B,C	Chloroform
GC/MS	EPA 8260B,C	Methylcyclohexane
GC/MS	EPA 8260B,C	m+p-xylene
GC/MS	EPA 8260B,C	o-xylene
GC/MS	EPA 8260B,C	cis-1,2-Dichloroethylene
GC/MS	EPA 8260B,C	cis-1,3-Dichloropropene
GC/MS	EPA 8260B,C	Dibromochloromethane
GC/MS	EPA 8260B,C	Dibromomethane
GC/MS	EPA 8260B,C	Dichlorodifluoromethane
GC/MS	EPA 8260B,C	Ethyl methacrylate
GC/MS	EPA 8260B,C	Ethylbenzene

Solid and Chemical Waste		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B,C	Hexachlorobutadiene
GC/MS	EPA 8260B,C	Isopropylbenzene
GC/MS	EPA 8260B,C	Methacrylonitrile
GC/MS	EPA 8260B,C	Methyl bromide (Bromomethane)
GC/MS	EPA 8260B,C	Methyl chloride (Chloromethane)
GC/MS	EPA 8260B,C	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 8260B,C	Methylene chloride
GC/MS	EPA 8260B,C	Naphthalene
GC/MS	EPA 8260B,C	n-Butylbenzene
GC/MS	EPA 8260B,C	n-Propylbenzene
GC/MS	EPA 8260B,C	p-Dioxane
GC/MS	EPA 8260B,C	p-Isopropyltoluene
GC/MS	EPA 8260B,C	sec-Butylbenzene
GC/MS	EPA 8260B,C	Styrene
GC/MS	EPA 8260B,C	tert-butyl alcohol
GC/MS	EPA 8260B,C	tert-Butylbenzene
GC/MS	EPA 8260B,C	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260B,C	Toluene
GC/MS	EPA 8260B,C	trans-1,2-Dichloroethylene
GC/MS	EPA 8260B,C	trans-1,3-Dichloropropylene
GC/MS	EPA 8260B,C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B,C	Trichloroethene (Trichloroethylene)
GC/MS	EPA 8260B,C	Trichlorofluoromethane
GC/MS	EPA 8260B,C	Vinyl acetate
GC/MS	EPA 8260B,C	Vinyl chloride
GC/MS	EPA 8260B,C	Xylene (total)
GC/MS	EPA 8270C,D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270C,D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270C,D	1,2-Dichlorobenzene
GC/MS	EPA 8270C,D	1,2-Diphenylhydrazine

Solid and Chemical Waste		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C,D	1,3-Dichlorobenzene
GC/MS	EPA 8270C,D	1,4-Dichlorobenzene
GC/MS	EPA 8270C,D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270C,D	2,4,5-Trichlorophenol
GC/MS	EPA 8270C,D	2,4,6-Trichlorophenol
GC/MS	EPA 8270C,D	2,4-Dichlorophenol
GC/MS	EPA 8270C,D	2,4-Dimethylphenol
GC/MS	EPA 8270C,D	2,4-Dinitrophenol
GC/MS	EPA 8270C,D	2,4-Dinitrotoluene (2,4-DNT)
GC/MS	EPA 8270C,D	2,6-Dinitrotoluene (2,6-DNT)
GC/MS	EPA 8270C,D	2-Chloronaphthalene
GC/MS	EPA 8270C,D	2-Chlorophenol
GC/MS	EPA 8270C,D	2-Methyl-4,6-dinitrophenol
GC/MS	EPA 8270C,D	2-Methylnaphthalene
GC/MS	EPA 8270C,D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270C,D	2-Nitroaniline
GC/MS	EPA 8270C,D	2-Nitrophenol
GC/MS	EPA 8270C,D	3,3`-Dichlorobenzidine
GC/MS	EPA 8270C,D	3+4-Methylphenol
GC/MS	EPA 8270C,D	3-Nitroaniline
GC/MS	EPA 8270C,D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270C,D	4-Chloro-3-methylphenol
GC/MS	EPA 8270C,D	4-Chloroaniline
GC/MS	EPA 8270C,D	4-Chlorophenyl phenylether
GC/MS	EPA 8270C,D	4-Nitroaniline
GC/MS	EPA 8270C,D	4-Nitrophenol
GC/MS	EPA 8270C,D	Acenaphthene
GC/MS	EPA 8270C,D	Acenaphthylene
GC/MS	EPA 8270C,D	Acetophenone
GC/MS	EPA 8270C,D	Aniline

Solid and Chemical Waste		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C,D	Anthracene
GC/MS	EPA 8270C,D	Aramite
GC/MS	EPA 8270C,D	Benzidine
GC/MS	EPA 8270C,D	Benzo(a)anthracene
GC/MS	EPA 8270C,D	Benzo(a)pyrene
GC/MS	EPA 8270C,D	Benzo(b)fluoranthene
GC/MS	EPA 8270C,D	Benzo(g,h,i)perylene
GC/MS	EPA 8270C,D	Benzo(k)fluoranthene
GC/MS	EPA 8270C,D	Benzoic acid
GC/MS	EPA 8270C,D	Benzyl alcohol
GC/MS	EPA 8270C,D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270C,D	bis(2-Chloroethyl) ether
GC/MS	EPA 8270C,D	bis(2-Chloroisopropyl) ether (2,2`-Oxybis(1-chloropropane))
GC/MS	EPA 8270C,D	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 8270C,D	Butyl benzyl phthalate
GC/MS	EPA 8270C,D	Carbazole
GC/MS	EPA 8270C,D	Chrysene
GC/MS	EPA 8270C,D	Dibenz(a,h)anthracene
GC/MS	EPA 8270C,D	Dibenzofuran
GC/MS	EPA 8270C,D	Diethyl phthalate
GC/MS	EPA 8270C,D	Dimethyl phthalate
GC/MS	EPA 8270C,D	Di-n-butyl phthalate
GC/MS	EPA 8270C,D	Di-n-octyl phthalate
GC/MS	EPA 8270C,D	Diphenylamine
GC/MS	EPA 8270C,D	Fluoranthene
GC/MS	EPA 8270C,D	Fluorene
GC/MS	EPA 8270C,D	Hexachlorobenzene
GC/MS	EPA 8270C,D	Hexachlorobutadiene
GC/MS	EPA 8270C,D	Hexachlorocyclopentadiene
GC/MS	EPA 8270C,D	Hexachloroethane

Solid and Chemical Waste		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C,D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270C,D	Isophorone
GC/MS	EPA 8270C,D	Naphthalene
GC/MS	EPA 8270C,D	Nitrobenzene
GC/MS	EPA 8270C,D	n-Nitrosodimethylamine
GC/MS	EPA 8270C,D	n-Nitroso-di-n-butylamine
GC/MS	EPA 8270C,D	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270C,D	n-Nitrosodiphenylamine
GC/MS	EPA 8270C,D	Pentachlorophenol
GC/MS	EPA 8270C,D	Phenanthrene
GC/MS	EPA 8270C,D	Phenol
GC/MS	EPA 8270C,D	Pyrene
GC/MS	EPA 8270C,D	Pyridine
Gravimetric	EPA 1664A	Oil & Grease
Gravimetric	EPA 1664A	Total Petroleum Hydrocarbons (TPH)
HPLC	EPA 8330/8330A	1,3,5-Trinitrobenzene
HPLC	EPA 8330/8330A	1,3-Dinitrobenzene
HPLC	EPA 8330/8330A	2,4,6-Trinitrotoluene
HPLC	EPA 8330/8330A	2,4-Dinitrotoluene
HPLC	EPA 8330/8330A	2,6-Dinitrotoluene
HPLC	EPA 8330/8330A	2-Amino-4,6-Dinitrotoluene
HPLC	EPA 8330/8330A	2-Nitrotoluene
HPLC	EPA 8330/8330A	3-Nitrotoluene
HPLC	EPA 8330/8330A	4-Amino-2,6-Dinitrotoluene
HPLC	EPA 8330/8330A	4-Nitrotoluene
HPLC	EPA 8330/8330A	HMX
HPLC	EPA 8330/8330A	Nitrobenzene
HPLC	EPA 8330/8330A	RDX
HPLC	EPA 8330/8330A	Tetryl
Colorimetric	EPA 9012B	Total cyanide

Solid and Chemical Waste		
Technology	**Method**	**Analyte**
CVAA	EPA 7471A,B	Mercury
Gravimetric	EPA 9071B	Oil & Grease
IC	EPA 9056/9056A	Nitrite
IC	EPA 9056/9056A	Nitrate
IC	EPA 9056/9056A	Bromide
IC	EPA 9056/9056A	Chloride
IC	EPA 9056/9056A	Fluoride
IC	EPA 9056/9056A	O-phosphate
ICP	EPA 6010B,C	Aluminum
ICP	EPA 6010B,C	Antimony
ICP	EPA 6010B,C	Arsenic
ICP	EPA 6010B,C	Barium
ICP	EPA 6010B,C	Beryllium
ICP	EPA 6010B,C	Boron
ICP	EPA 6010B,C	Cadmium
ICP	EPA 6010B,C	Calcium
ICP	EPA 6010B,C	Chromium
ICP	EPA 6010B,C	Cobalt
ICP	EPA 6010B,C	Copper
ICP	EPA 6010B,C	Iron
ICP	EPA 6010B,C	Lead
ICP	EPA 6010B,C	Magnesium
ICP	EPA 6010B,C	Manganese
ICP	EPA 6010B,C	Molybdenum
ICP	EPA 6010B,C	Nickel
ICP	EPA 6010B,C	Potassium
ICP	EPA 6010B,C	Selenium
ICP	EPA 6010B,C	Silicon
ICP	EPA 6010B,C	Silver
ICP	EPA 6010B,C	Sodium

Solid and Chemical Waste		
Technology	**Method**	**Analyte**
ICP	EPA 6010B,C	Thallium
ICP	EPA 6010B,C	Tin
ICP	EPA 6010B,C	Titanium
ICP	EPA 6010B,C	Vanadium
ICP	EPA 6010B,C	Zinc
ICP-MS	EPA 6020/6020A	Aluminum
ICP-MS	EPA 6020/6020A	Antimony
ICP-MS	EPA 6020/6020A	Arsenic
ICP-MS	EPA 6020/6020A	Barium
ICP-MS	EPA 6020/6020A	Beryllium
ICP-MS	EPA 6020/6020A	Boron
ICP-MS	EPA 6020/6020A	Cadmium
ICP-MS	EPA 6020/6020A	Calcium
ICP-MS	EPA 6020/6020A	Chromium
ICP-MS	EPA 6020/6020A	Cobalt
ICP-MS	EPA 6020/6020A	Copper
ICP-MS	EPA 6020/6020A	Iron
ICP-MS	EPA 6020/6020A	Lead
ICP-MS	EPA 6020/6020A	Magnesium
ICP-MS	EPA 6020/6020A	Manganese
ICP-MS	EPA 6020/6020A	Molybdenum
ICP-MS	EPA 6020/6020A	Nickel
ICP-MS	EPA 6020/6020A	Potassium
ICP-MS	EPA 6020/6020A	Selenium
ICP-MS	EPA 6020/6020A	Silicon
ICP-MS	EPA 6020/6020A	Silver
ICP-MS	EPA 6020/6020A	Sodium
ICP-MS	EPA 6020/6020A	Thallium
ICP-MS	EPA 6020/6020A	Tin
ICP-MS	EPA 6020/6020A	Titanium

Solid and Chemical Waste		
Technology	**Method**	**Analyte**
ICP-MS	EPA 6020/6020A	Vanadium
ICP-MS	EPA 6020/6020A	Zinc
Preparation	**Method**	**Type**
pH Paper	EPA 9041A	pH
Probe	EPA 9045C	pH
ISE	EPA 9040C	pH/Corrosivity
TOC	EPA 9060/9060A	Total organic carbon
Physical	EPA 1010A	Ignitability
Titrimetric	EPA 9034	Sulfide
Turbidimetric	EPA 9038	Sulfate
Physical	EPA 9095A,B	Paint Filter Liquids Test
Preparation	EPA 3060A	Chromium VI
UV/VIS	EPA 7196A	Chromium VI
Distillation	EPA 9010C	Total cyanide
UV/VIS	EPA 9012B	Total cyanide
Distillation	EPA 9013	Total cyanide
UV/VIS	EPA 9065	Total phenolics
Preparation	EPA 1311	Toxicity Characteristic Leaching Procedure
Preparation	EPA 1312	SPLP
Organic Preparation	3541	Automated Soxhlet Extraction
Clean Up	3620C	Florisil Cleanup
Clean Up	3630C	Silica Gel Cleanup
Clean Up	3640A	Gel-Permeation Cleanup
Clean Up	3660	Sulfur Cleanup
Inorganics Preparation	3050B	Hotblock
Volatile Organics Preparation	5035A	Closed System Purge and Trap
Organic Preparation	3580A	Waste dilution
Distillation	9030B	Sulfide
Extraction/Titrimetric	9031	Sulfide

Air		
Technology	**Method**	**Analyte**
GC/MS	TO-15	1,1,1-Trichloroethane
GC/MS	TO-15	1,1,2,2-Tetrachloroethane
GC/MS	TO-15	1,1,2-Trichloroethane
GC/MS	TO-15	1,1,2-Trichlorotrifluoroethane
GC/MS	TO-15	1,1-Dichloroethane
GC/MS	TO-15	1,1-Dichloroethene
GC/MS	TO-15	1,2,4-Trichlorobenzene
GC/MS	TO-15	1,2,4-Trimethylbenzene
GC/MS	TO-15	1,2-Dibromoethane
GC/MS	TO-15	1,2-Dichlorobenzene
GC/MS	TO-15	1,2-Dichloroethane
GC/MS	TO-15	1,2-Dichloropropane
GC/MS	TO-15	1,3,5-Trimethylbenzene
GC/MS	TO-15	1,3-Butadiene
GC/MS	TO-15	1,3-Dichlorobenzene
GC/MS	TO-15	1,4-Dichlorobenzene
GC/MS	TO-15	1,4-Dioxane
GC/MS	TO-15	2,2,4-Trimethylpentane
GC/MS	TO-15	2-Butanone
GC/MS	TO-15	2-Chlorotoluene
GC/MS	TO-15	2-Hexanone
GC/MS	TO-15	4-Ethyltoluene
GC/MS	TO-15	4-Methyl-2-Pentanone
GC/MS	TO-15	Acetone
GC/MS	TO-15	Allyl Chloride
GC/MS	TO-15	Benzene
GC/MS	TO-15	Benzyl Chloride
GC/MS	TO-15	Bromodichloromethane
GC/MS	TO-15	Bromoethene
GC/MS	TO-15	Bromoform
GC/MS	TO-15	Bromomethane

Air		
Technology	**Method**	**Analyte**
GC/MS	TO-15	Carbon Disulfide
GC/MS	TO-15	Carbon Tetrachloride
GC/MS	TO-15	Chlorobenzene
GC/MS	TO-15	Chloroethane
GC/MS	TO-15	Chloroform
GC/MS	TO-15	Chloromethane
GC/MS	TO-15	cis-1,2-Dichloroethene
GC/MS	TO-15	cis-1,3-Dichloropropene
GC/MS	TO-15	Cyclohexane
GC/MS	TO-15	Dibromochloromethane
GC/MS	TO-15	Dichlorodifluoromethane
GC/MS	TO-15	Dichlorotetrafluoroethane
GC/MS	TO-15	Ethanol
GC/MS	TO-15	Ethyl Acetate
GC/MS	TO-15	Ethyl Benzene
GC/MS	TO-15	Heptane
GC/MS	TO-15	Hexachloro-1,3-Butadiene
GC/MS	TO-15	Hexane
GC/MS	TO-15	Isopropyl Alcohol
GC/MS	TO-15	m/p-Xylene
GC/MS	TO-15	Methyl methacrylate
GC/MS	TO-15	Methyl tert-Butyl Ether
GC/MS	TO-15	Methylene Chloride
GC/MS	TO-15	Naphthalene
GC/MS	TO-15	o-Xylene
GC/MS	TO-15	Propene
GC/MS	TO-15	Styrene
GC/MS	TO-15	t-1,3-Dichloropropene
GC/MS	TO-15	tert-butyl alcohol
GC/MS	TO-15	Tetrachloroethene
GC/MS	TO-15	Tetrahydrofuran

Air		
Technology	**Method**	**Analyte**
GC/MS	TO-15	Toluene
GC/MS	TO-15	trans-1,2-Dichloroethene
GC/MS	TO-15	Trichloroethene
GC/MS	TO-15	Trichlorofluoromethane
GC/MS	TO-15	Vinyl Acetate
GC/MS	TO-15	Vinyl Chloride

Notes:

1) This laboratory offers commercial testing service.

Approved by: _____ Date: June 22, 2011

R. Douglas Leonard
Chief Technical Officer

Issued: 10/20/09 Revised: 10/28/09 Revised: 08/02/10 Revised: 8/11/10 Revised: 10/5/10 Revised: 11/11/10 Revised: 6/22/11

FLORIDA DEPARTMENT OF HEALTH

State of Florida

Department of Health, Bureau of Laboratories

This is to certify that

E87476

CHEMTECH
7210A CORPORATE COURT
FREDERICK, MD 21703

has complied with Florida Administrative Code 64E-1,
for the examination of Environmental samples in the following categories

DRINKING WATER - GROUP II UNREGULATED CONTAMINANTS, DRINKING WATER - PRIMARY INORGANIC CONTAMINANTS, DRINKING WATER - SECONDARY INORGANIC CONTAMINANTS, NON-POTABLE WATER - EXTRACTABLE ORGANICS, NON-POTABLE WATER - GENERAL CHEMISTRY, NON-POTABLE WATER - METALS, NON-POTABLE WATER - PESTICIDES-HERBICIDES-PCB'S, NON-POTABLE WATER - VOLATILE ORGANICS, SOLID AND CHEMICAL MATERIALS - EXTRACTABLE ORGANICS, SOLID AND CHEMICAL MATERIALS - GENERAL CHEMISTRY, SOLID AND CHEMICAL MATERIALS - METALS, SOLID AND CHEMICAL MATERIALS - PESTICIDES-HERBICIDES-PCB'S, SOLID AND CHEMICAL MATERIALS - VOLATILE ORGANICS

Continued certification is contingent upon successful on-going compliance with the NELAC Standards and FAC Rule 64E-1 regulations. Specific methods and analytes certified are cited on the Laboratory Scope of Accreditation for this laboratory and are on file at the Bureau of Laboratories, P. O. Box 210, Jacksonville, Florida 32231. Clients and customers are urged to verify with this agency the laboratory's certification status in Florida for particular methods and analytes.

Date Issued: July 01, 2011 Expiration Date: June 30, 2012

Max Salfinger, M.D.
Chief, Bureau of Laboratories
Florida Department of Health
DH Form 1697, 7/04
NON-TRANSFERABLE E87476-23-07/01/2011
Supersedes all previously issued certificates

State of New Jersey
Department of Environmental Protection

Certifies That

Chemtech

Laboratory Certification ID # 20012

is hereby approved as a

Nationally Accredited Environmental Laboratory

to perform the analyses as indicated on the Annual Certified Parameter List
which must accompany this certificate to be valid

having duly met the requirements of the

Regulations Governing The Certification Of
Laboratories And Environmental Measurements N.J.A.C. 7:18 et. seq.

and

having been found compliant with the standards approved by the

The NELAC Institute

Expiration Date June 30, 2012

NJDEP is a NELAP Recognized Accreditation Body

Joseph F. Aiello, Chief
Office of Quality Assurance

This certificate is to be conspicuously displayed at the laboratory with the annual certified parameter list in a location on the premises visible to the public.
Consumers are urged to verify the laboratory's current accreditation status with the State of NJ, NELAP.

QA Control Code: A2040031

SOP Name:	Determination of Extractable Semi-Volatile Organic Compounds by SW-846 Method 8270C/D
SOP ID:	M8270C/D-BNA-16
Revision #:	16
Date Created:	June 11, 2002
Effective Date:	December 25, 2010
Reason for Revision:	Annual Review
Supercedes:	M8270C/D-BNA-15

Approvals:

QI MO	12/29/2010
Analyst	Date
HIMANSHU PRAJAPATI	12/29/2010
Supervisor	Date
	12/29/10
QA/QC Director	Date
	12/29/10
Technical Director	Date

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DETERMINATION OF EXTARCTABLE SEMI-VOLATILE ORGANIC COMPOUNDS BY SW-846 METHOD 8270C/D

1. TEST METHOD

1.1 Determination of extractable semi-volatile organic compounds by SW-846 Method 8270C/D.

2. APPLICABLE MATRICES

2.1 Ground and surface water, wastewater, soils/sediments, and solid waste.

3. METHOD DETECTION LIMITS

3.1 Method detection limits are established once a year.

4. SCOPE AND APPLICATION

4.1 The following method outlines the procedure used for the Gas Chromatography/Mass Spectrometry (GC/MS) analysis of a number of semi-volatile compounds.

4.2 The compounds determined by this method are extractable by organic solvents and lend themselves to gas chromatography.

4.3 This method is applicable to waters, such as groundwater, soils/sediment and solid waste.

4.4 The compounds determined by this method can be found in Table 1.

5. SUMMARY OF METHOD

5.1 Analyze all extracts by GC/MS and quantitate using internal standard technique along with response factors for each analyte generated from known amounts of standards.

5.2 Non-target compounds are tentatively identified by a library search program. Hewlett Packard software is used exclusively for acquisition and data reduction procedures.

6. DEFINITIONS

6.1 Calibration**:** to determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter, instrument, or other device. The levels of the applied calibration standard should bracket the range of planned or expected sample measurement.

6.2 Calibration Curve: The graphical relationship between the known values, such as concentration, of a series of calibration standards and their instrument response.

6.3 Duplicate Analyses: The analysis or measurements of the variable of interest performed identically on two sub-samples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory.

6.4 Matrix Spike: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of Target

analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

6.5 Matrix Spike Duplicate: A second replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.

6.6 Method Blank: A sample of a matrix similar to the batch of associated samples (when available) that is free form the analytes of interest, which is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.

6.7 Method Detection Limit: The minimum concentration of a substance (an analyte) that can be measured and reported with 99 % confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.

6.8 Semivolatile Organic Compounds: Compounds that are amenable to analysis by extraction of the sample with an organic solvent, also called base/neutral/acid (BNA) compounds.

7. INTERFERENCES

7.1 Common interferences with this method include contaminants in solvents, reagents, glassware and sample processing hardware.

7.2 Laboratory method blanks are routinely analyzed to show that the system is free of contamination.

8. SAFETY

8.1 The toxicity and carcinogenity of each reagent in this method has not been fully established. Each chemical should be regarded as a potential health hazard and exposure to these compounds should be minimized.

8.2 Always wear safety glasses for eye protection when working with these reagents.

8.3 Use protective gloves when handling corrosive chemicals.

8.4 Read Material Safety Data Sheets (MSDS) for the chemicals used in the laboratory for the identity

9. EQUIPMENT AND SUPPLIES

9.1 Mass Spectrometer

9.1.1 Hewlett Packard Model 5971 & Agilent Model 5973 and 5975 or equivalent.

9.1.2 The 5971, 5973 & 5975 scan from 35 to 500 amu every 1 second or less, utilizing 70 volts (nominal) electron energy in the electron impact ionization mode.

9.2 Gas Chromatograph

9.2.1 Temperature programmable Hewlett Packard Model 5890 & Agilent Model 6890 or equivalent.

9.2.2 The MS is capable of producing a mass spectrum that meets all instrument performance criteria (Table 2) when 25ng of decafluorotriphenylphosphine (DFTPP) is injected.

9.2.3 Column-30m x 0.32-mm 0.5 µm film thickness fused silica RTX-5 (bonded polysiloxane, 5% diphenyl/95% dimethyl). Restek Catalog #10239 or equivalent.

9.2.4 Column-30m x 0.25-mm 0.5 µm film thickness fused silica RTX-5 (bonded polysiloxane, 5% diphenyl/95% dimethyl). Restek Catalog #10238 or equivalent.

9.2.5 Column - 20m x 0.18mm x 0.36um film thickness fused silica RTX-5 (bonded polysiloxane, 5% diphenyl/95% dimethyl). Restek Catalog #42704 or equivalent.

9.3 GC is directly interfaced to the Mass Spectrometer.

9.4 Data System-computer system is interfaced to the Mass Spectrometer.

9.4.1 The PCs are used to acquire and process data.

9.4.2 Systems are equipped with Agilent Technologies MSD Chemstation Aug 2003 edition, version G1701DA & EISC Software.

9.4.3 The computer systems are capable of continuous acquisition and storage of all GC/MS data.

9.4.4 System allows for searching of any GC/MS data file for ions of a specific mass and plotting it versus time or scan number. This is Extracted Ion Current Profile (EICP).

9.4.5 A computer accessible library allows for the searching of non-targeted spectra.

9.4.6 The latest revision of software, 2002, provides a mass spectral library from HP Analytical NIST MS Spectral Database that contains 125,000 compounds that are used in tentative identification of unknown peaks.

9.4.7 The data system flags all data files that have been edited manually by the laboratory.

9.5 All GC/MS data is stored on magnetic tape so that it may be retrieved as needed once the hard disk has been cleared.

9.6 Hewlett-Packard Automatic Sampler Model 7673A (2uL or 1uL splitless inject) & Agilent Technologies Automatic Sampler Model 7683 (2uL or 1uL splitless inject) or equivalent.

9.7 Volumetric flasks (10mL and 100mL)

9.8 O-ring Agilent #5180-4132 or equivalent

9.9 10 µL Injection Syringe Cat # 20169 from Hamilton or equivalent

9.10 Inlet Liner Restek # 22407 or equivalent.

9.11 Septa Restek # 27143

9.12 Gold seal Restek # **21318**

9.13 Vespel/Graphite Ferrule Restek # 20229 & 20231

10. REAGENTS AND STANDARDS

10.1 Reagents

10.1.1 Methylene Chloride, pesticide grade JT Baker #9264-03 for making dilutions and standard preparation or equivalent.
10.1.2 Water-analyte free. Laboratory DI water
10.1.3 Acetone – JT Baker 9254-03, Ultra Resi Analyzed or equivalent.

10.2 Calibration Standards: Standard mixes in Methylene chloride.

- Store all standards at <-10 deg.C, protected from light, in sealed (unopened) vials or teflon-sealed screw-cap bottles.
- Replace all solutions after 6 months, or sooner, if comparison with quality control samples indicates a problem.
- Prepare the calibration standards according to the following Table (*or equivalent)

*Standard Name	*Supplier	Catalog Number	Concentration of stock	Preparation Details	Final Concentration of Stock Solution
*8270 Calibration Stock Standard	Restek	555223 555224 31850 30287 31082 31083	1,000ug/mL 1,000ug/mL 1,000ug/mL 2,000ug/mL 5,000ug/mL 7,500ug/mL	1.0mL 1.0mL 1.0mL 0.5mL 0.4mL 0.266mL Combined in vial with 0.834mL of Methylene chloride final volume is 5.0mL	200ug/mL each Spike compound and 400ug/mL each Surrogate compound

Second Source Calibration Solution: (Different LOT# from Primary Source)

Standard Name	Supplier	Catalog Number	Concentration of stock	Preparation Details	Final Concentration of Stock Solution
*8270 Second Source Calibration Stock	Restek	555223 555224 31850 30287 31082 31083	1,000ug/mL 1,000ug/mL 1,000ug/mL 2,000ug/mL 5,000ug/mL 7,500ug/mL	0.2mL 0.2mL 0.2mL 0.1mL 0.080mL 0.053mL Combined in vial with 1.167mL of Methylene chloride final volume is 2.0mL	100ug/mL each Spike compound and 200ug/mL each Surrogate compound

10.3 Laboratory Control Sample and Matrix Spike/Matrix Spike Duplicate – See Extraction SOP.

10.4 Internal standard solution, all compounds at 2000ng/µL in methylene chloride -

Standard Name	Supplier	Catalog Number	Concentration of stock	Preparation Details	Final Concentration of Stock Solution
*8270 Internal Standard	Restek	31206	2,000ug/mL	None Required	2000ug/mL each compound

Compounds:

1,4-Dichlorobenzene-d4 Napththalene-d8 Acenaphthene-d10
Phenanthrene-d10 Chyrsene-d12 Perylene-d12

10.5 Decafluorotriphenylphosphine (DFTPP) tune solution, 25ng/µL in methylene chloride, also contains 4,4-DDT, benzidine and pentachlorophenol – Protocol CLPS-T4

Standard Name	Supplier	Catalog Number	Concentration of stock	Preparation Details	Final Concentration of Stock Solution
*DFTPP	Restek	31615	1,000ug/mL	0.5mL Combined in beaker with 19.5mL of Methylene chloride final volume is 20.0mL	25ug/mL each compound

10.5.1 Prepare by making a 1:100 dilution of Protocol (25-mg/mL) solution, and store in the same manner as standards.

10.6 Extra targeted compounds (when requested by the client) at an appropriate concentrate purchased from Restek, Supelco, Aldrich or an alternate supplier in concentrated mixtures.

10.6.1 Store spiking solutions in the same manner as surrogate solutions (see above) and prepare by making an appropriate dilution of the concentrated mixture in a volumetric flask.

10.7 Record all standard receipts in the Standard Receipt Logbook.

10.8 Record all standard preparation details in the Organic Standard Prep Logbook.

11. SAMPLE COLLECTION, PRESERVATION, SHIPMENT AND STORAGE

11.1 Collect water samples in 1L amber glass containers with Teflon lined caps.

11.2 Collect soil samples in 16 oz. glass jars with Teflon lined caps.

11.3 Protect all samples from light and refrigerate at 4ºC from the time of sampling until extraction.

11.4 Holding Times

11.4.1 The extraction holding time for water samples is 7 days; the extraction holding time for soil samples is 14 days.

11.4.2 Analyze all extracts within 40 days of their extraction date.

12. QUALITY CONTROL

12.1 DFTPP

12.1.1 Analyze a MS tuning check compound every 12 hours.

12.1.2 Spectrum produced must meet criteria outlined in Table 2. Evaluate DFTPP using Autofind or by evaluating the average of 3 scans (apex, apex + 1, apex – 1) and background correction not more than 20 scans before the elution of the DFTPP peak.

12.1.3 Verify the %DDT breakdown from the tuning check. Degradation of DDT to DDE and DDD should not exceed 20%.

12.1.4 Verify the Benzidine and Pentachlorophenol peak tailing. Benzidine and Pentachlorophenol should be present at their normal responses and no peak tailing should be present over a factor of 2.

12.2 Initial Calibration

12.2.1 Analyze five or six calibration standards at the concentrations: 10, 25, 40, 50, 60, and 80ug/mL for SCAN analysis and 0.1, 0.5, 2.5, 10, 25, 40 & 50ug/mL for SIM analysis (concentrations subject to change based on instrument/column sensitivity or saturation).

12.2.2 Assure that relative response factors (RRFs) and % relative standard deviation (%RSD) criteria are met. Acceptance criteria are listed in Section 13.2.7.

12.2.3 Confirm the integrity of the initial calibration by analyzing an initial calibration verification standard (second source) immediately after the initial calibration. The acceptance criteria are listed in Section 18.8 of this SOP. Verify the retention time for each calibration standard agrees within 0.06min.

12.3 Continuing Calibration

12.3.1 Analyze continuing calibration standard to show that the system is operating as it did when it was initially calibrated.

12.3.2 Analyze a continuing calibration check, after the DFTPP and before the analysis of any blanks, spikes, or samples.

12.3.3 Make sure that continuing calibration meets RRF and % difference (%D) criteria listed in Section 18.3. For SIM analysis, all compounds must have %D less than 20%.

12.4 Method Blank

12.4.1 Extract a method blank for each batch of samples of similar matrix and concentration level.

12.4.2 Carry the method blank through the entire sample prep, concentration, and analysis and treat it just like a sample.

12.4.3 For DoD work – No analytes detected >1/2RL and >1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected >RL.

12.5 Surrogate Recoveries

12.5.1 Spike surrogate compounds into all samples, blanks and spikes during the extraction procedure.

12.5.2 Make sure that all samples, blanks and spikes meet criteria as established by the laboratory control limits using control charts.

12.6 Laboratory Control Sample (LCS), Matrix Spike/Matrix Spike Duplicate (MS/MSD)

12.6.1 Perform a LCS, MS and MSD for each batch.

12.6.2 Choose a representative sample to be used for the MS/MSD.

12.6.3 An MS/MSD is required for each matrix type, for water samples if there is not enough sample for spiking LCS & LCSD performed.

12.6.4 Calculate % recovery and %D.

12.7 Internal Standards (IS)

12.7.1 Monitor the integrated area and the retention time of the quant ion of the IS for all standards, blanks, samples and spikes.

12.7.2 Monitor the integrated area and the retention time of the continuing calibration immediately after analysis.

12.7.3 Refer to Section 18.7 for internal standard criteria.

12.8 Accuracy and Precision

12.8.1 Perform an initial one-time demonstration of accuracy and precision per analyst.

12.8.2 The standard used for the QC check sample must be from a source other than that used for the calibration standards.

12.8.3 Extract and analyze the four QC check samples under the same conditions used for sample analysis by this method.

12.8.4 Recoveries must meet LCS recovery limits. Repeat if necessary to document performance ability.

12.8.5 For DoD work – Demonstration of Capability study is performed at the LOQ level and evaluated using the LCS limits.

12.9 Method Detection Limits

12.9.1 Determine MDLs annually by analyzing seven or eight replicate standards (each containing all analytes) by method and statistical calculations in order to determine the values.

12.9.2 Perform an MDL study for extra-targeted compounds as required.

12.9.3 Set up required number of separatory funnels each containing 1 L of DI water. Add 25µL of a 200µg/mL calibration standard to each separatory funnel.

12.9.4 Extract the sample according to the method.

12.9.5 The final concentration of the extract is 5ppm in the vial translating to 5ppb in the sample.

12.9.6 Analyze the extracts according to the method.

12.9.7 Prepare an additional set of extracts at a concentration of 20ppm for certain compounds which have higher MDLs.

12.9.8 After acquisition down load the quantitation files to a PC where Microsoft Excel software is used to do the statistical calculations.

- Use all seven runs.

- Calculate the MDL by determining the standard deviation of the values and multiply by a "t" value either 3.143 for seven points or 2.998 for eight points.
- QC office maintains EXCEL Templates that are used to evaluate seven or eight replicates.

12.9.9 Analyze an MDL verification standard immediately after the MDL study and then every quarter.

12.10 Manual Integration (Refer to P243-Electronic Logbook SOP for further details)

12.10.1 At times manual integration will be necessary due to incomplete or incorrect integration by the automated analytical system.

12.10.2 Manual integration cannot be used to satisfy Quality Control Criteria.

12.10.3 Do not include baseline background noise; include only the area between where the beginning and end of the peak intersects with the baseline.

12.10.4 Any time a compound is integrated in the calibration standard it must then be consistently integrated in the samples.

12.10.5 When a manual integration is performed the hardcopy of the quantitation report will flag the compound with an “m”.

12.10.6 Report the before and after manual integration chromatograms with the raw data.

12.11 Client Special requirements

12.11.1 Special requirements or QC criteria for a specific project will be attached to this SOP for laboratory use.

12.12 Limit of Detection (LOD)

12.12.1 Establish LOD by spiking a quality system matrix at approximately 2-3X the detection limit for single analyte tests and 1-4X detection limit for multiple analyte tests.

12.12.2 LOD is specific to each combination of analyte, matrix, method (including sample preparation) and instrument configuration.

12.12.3 LOD must be verified quarterly.

12.12.4 LOD must be verified on each instrument used, and every time the method is modified.

12.13 Limit of Quantitation (LOQ)

12.13.1 LOQ must be greater than the LOD.

12.13.2 LOQ must be verified quarterly for each quality system matrix, method and analyte, by analyzing QC sample containing the analytes of concern in each quality system matrix 1-2X the claimed LOQ.

12.13.3 LOQ must be performed if the method is modified.

13. CALIBRATION AND STANDARDIZATION

13.1 Tune and Performance Check of GC/MS

13.1.1 Prior to the analysis of calibration standards, tune GC/MS system using PFTBA (perfluorotributylamine).

13.1.2 Tune the mass axis and abundance scales such that the analyses of the instrument performance check solution (DFTPP) meet the criteria outlined in Table 2.

13.1.3 Retune the MS and reanalyze the DFTPP if the spectrum does not meet criteria.

13.1.4 Analyze the DFTPP solution every 12 hours to verify acceptable instrument performance.

13.1.5 Once an acceptable DFTPP has been acquired, instrument conditions must remain the same throughout the calibration and sample analyses.

13.1.6 Verify Benzidine and Pentachlorophenol peak tailing and the %DDT breakdown for column performance and injection port inertness.

13.1.7 All these checks must be done prior to the initial calibration analysis and the continuing calibration.

13.2 Initial Calibration

13.2.1 After the tuning criteria has been met, run an initial calibration at the following concentration levels: 1 (quarterly MDL check), 10, 25, 40, 50, 60, and 80µg/mL for SCAN analysis and 0.1, 0.5, 2.5, 10, 25, 40 & 50ug/mL for SIM analysis including the second source initial calibration verification solution at 40ug/mL. (Standard concentrations subject to change based on instrument/column sensitivity or saturation).

Note: Refer to Table 5 for SIM analysis.

- *A separate initial calibration is required for each instrument. If there are any major changes to the instrument (source cleaning, change of columns, etc.), perform a new calibration.*
- *System performance and calibration check criteria must be met prior to the analysis of any blanks, spikes or samples.*

13.2.2 Tabulate the area response of the characteristic ions against the concentration for each target analyte and each internal standard.

13.2.3 Verify the retention time for each calibration standard agrees within 0.06min.

13.2.4 Calculate relative response factors (RRF) for each target analyte relative to one of the internal standards.

13.2.5 The RRF is calculated as follows:

$$RF = \frac{A_s \times C_{is}}{A_{is} \times C_s}$$

Where:
A_s = Peak area of the analyte or surrogate
A_{is} = Peak area of the internal standard
C_s = Concentration of the analyte or surrogate
C_{is} = Concentration of the internal standard
CF = Area of Compound/Concentration in ppm

13.2.6 Calculate the %RSD for all target analytes from the initial calibration.

$$\%RSD = \frac{\text{Standard Deviation of CF}}{\text{Mean of CF}} \times 100$$

Where: $\text{Mean of CF} = \frac{\text{sum of CF}}{n}$

n = number of calibration standards used

13.2.7 The %RSD should be less than or equal to 15% for each target analyte for Method 8270C and less than or equal to 20% for each target analyte for Method 8270D.

13.2.8 If the %RSD of any target analyte meets criteria in Section 13.2.7, then the RRF is assumed to be constant over the calibration range, and the average response factor may be used for quantitation.

13.2.9 If the client requests extra target compounds the curve for these compounds will be deemed acceptable only when a 30% RSD is achieved between the initial response factors.

13.2.10 When the %RSD exceeds criteria, plot and visually inspect the calibration curve.

13.2.10.1 If the %RSD of the calibration or response factors is greater then required criteria, employ a regression equation.

13.2.10.2 Perform a linear or quadratic regression of the instrument response versus the concentration of the standards.

- Make certain that the instrument response is treated as the dependent variable (y) and the concentration as the independent variable (x).
- The regression will produce the slope and intercept terms for a linear equation in the form

$$y = ax + b,$$

Where: y = instrument response (peak area or height)
a = slope of the line(also called the coefficient of x)
x = concentration of the calibration standard
b = intercept

- The use of linear regression may not be used as a rationale for reporting results below the calibration range demonstrated by the analysis of the standards.
- The regression calculation will generate a correlation coefficient(r) that is a measure of the "goodness of fit" of the regression line to the data.
- In order to be used for quantitative purposes, it must be greater or equal to 0.99.

13.2.11 System Performance Check Compounds (SPCC), namely, n-nitroso-di-n-propylamine, Hexachlorocyclopentadiene, 2,4-Dinitrophenol and 4-Nitrophenol must meet minimum RF 0.050 for Method 8270C.

13.2.12 9Calibration Check Compounds (CCC), namely, Acenaphthene, 1,4-Dichlorobenzene, Hexachlorobutadiene, Diphenylamine, Di-n-octylphthalate, Fluoranthene, Benzo(a)pyrene, 4-Chloro-3-methylphenol,

2,4-Dichlorophenol, 2-Nitrophenol, Phenol, Pentachlorophenol and 2,4,6-Trichlorophenol, must meet %RSD < 30% for Method 8270C.

13.3 Continuing Calibration

13.3.1 Analyze a DFTPP. Make sure it meets criteria listed in Table 2.

13.3.2 Analyze continuing calibration check standard at midpoint concentration and compare it to the initial curve rather than running an entire initial calibration curve every 12 hours.

13.3.3 Calculate %D for all target analytes.

$$\%D = \frac{RRF_C - RRF_I}{RRF_I} \times 100$$

Where: RRF_C = Relative Response factor from continuing calibration
RRF_I = Mean Relative Response factor from initial calibration

13.3.4 If continuing calibration passes criteria listed in Section 18.3, proceed with analysis of blanks and samples.

14. PROCEDURE

Note: At the beginning of each day, evaluate the instrument for potential problems, particularly around the injection port area.

- *Check the autosampler syringe for clogs or bends in the needle or the plunger.*
- *Check that the glass inlet liner is clean, and change the septum and O-ring.*
- *Depending upon the nature of the samples analyzed the previous day, clip a portion of the GC column. After re-assembly is complete, bake the system at 300º C for approximately 1/2 hour.*

14.1 Fill Run log with all of the required information.

14.1.1 Continue to fill out laboratory run log page as you perform this procedure.

14.2 Allow all standards to warm to ambient temperature prior to use.

14.3 Tune Performance Check of GC/MS

14.3.1 Tune the GC/MS system using PFTBA (perfluorotributylamine) to adjust the mass and abundance scales as desired for the analytical range of this method.

- Recommended: 69= 100%, 219 = 40%, and 502 = 1%.

14.3.2 Verify the tune by analyzing the instrument performance check solution (DFTPP).

14.3.3 The resulting spectra produced must meet the criteria outlined in Table 2.

Note: Convention for Data File Naming

- *Name data files according to the department name, than instrument and sequential file number.*
- *E.g., the subdirectory is named as: department name – instrument name – month – date – year.*

- *Directory is named as: department – instrument – month – date – injection number (01, 02, 03, etc.) BA041202 B is for BNA, A is for instrument.*
- *File name example BAXXXXXX.D*

14.3.4 Analyze the DFTPP (decafluorotriphenylphosphine) as follows:
- Click on the instrument icon.
- Click on Edit sequence to acquire next available data file and to run DFTPP
- Click on OK
- Click on run sequence
- Wait for instrument to complete run

14.3.5 The proceeding will inject a mixture of 50ng DFTPP, benzidine and pentachlorophenol and p-p'DDT onto the GC column.

14.3.6 Use the following temperature program for the instrument (subject to change) :

Instrument Identifier	Initial Temp	Initial Hold	Rate	Final Temp	Final Hold	Injection Port Temp	Detector B Temp
MSBNA A	40°C	1 min.	13 °C/min.	300 °C	12 min.	250 °C	280 °C
MSBNA B	40°C	1 min.	13 °C/min.	300 °C	12 min.	250 °C	280 °C
MSBNA E	40°C	1 min.	20 °C/min.	300 °C	8 min.	250 °C	280 °C
MSBNA F	40°C	1 min.	20 °C/min.	270 °C	8 min.	250 °C	280 °C

Instrument Identifier	Head Pressure	Split Valve Purge Time	Septum Vent Flow	Split Vent Flow
MSBNA A	3-12 psi	0.5 min	1 mL/min.	50 mL/min.
MSBNA B	3-12 psi	0.5 min	1 mL/min.	50 mL/min.
MSBNA E	EPC	0.5 min	1 mL/min.	50 mL/min.
MSBNA F	EPC	0.5 min	1 mL/min.	50 mL/min.

14.3.7 Use the MSD ChemStation software to acquire the spectrum of DFTPP in the following manner: Integrate m/z 198 (the major ion of DFTPP) to find the max scan or apex of the peak.

14.3.7.1 Average three scans; the max scan and the scans immediately before and after the max and subtract background less than 20 scans before the elution of DFTPP peak or perform Autofind DFTPP.

Note: If the spectrum does not meet criteria, the MS must be re-tuned and the DFTPP must be re- analyzed.

- *Analysis of the DFTPP solution to verify acceptable instrument performance must be done every 12 hours.*
- *Once an acceptable DFTPP has been acquired, instrumental conditions must remain the same throughout calibration and sample analysis.*

- *Analyze samples using a 12-hour sequence. The 12-hour period begins at the injection time of the DFTPP.*
- *DFTPP acceptance criteria must be met before any standards, samples, MS/MSD or blanks are analyzed.*

14.3.8 In addition, examine benzidine and pentachlorophenol for peak shape. If tailing is visible clip the column, replace inlet liner, replace septa and bake system for 1 hour and retest.

14.3.9 Calculate the %DDT breakdown before proceeding to the initial calibration.

14.4 Initial Calibration

14.4.1 After tuning criteria has been met, initially calibrate the GC/MS system at 5 concentration levels: 10, 25, 40, 50, 60, 80µg/mL for SCAN analysis and 0.1, 0.5, 2.5, 10, 25, 40 & 50ug/mL for SIM analysis.

14.4.2 Prepare the calibration standards by diluting the 200-µg/mL stock as follows (subject to change) & prepare calibration verification standard by diluting the 100-ug/ml stock as follows (subject to change).

Standard Name	Source	Amount Of Stock	Preparation
10ppm Calibration Point	Calibration Stock Standard	50uL	Final volume 1000uL
25ppm Calibration Point	Calibration Stock Standard	125uL	Final volume 1000uL
40ppm Calibration Point	Calibration Stock Standard	200uL	Final volume 1000uL
50ppm Calibration Point	Calibration Stock Standard	250uL	Final volume 1000uL
60ppm Calibration Point	Calibration Stock Standard	300uL	Final volume 1000uL
80ppm Calibration Point	Calibration Stock Standard	400uL	Final volume 1000uL
0.5ppm Calibration Point	Calibration Stock Standard	2.5uL	Final volume 1000uL
2.5ppm Calibration Point	Calibration Stock Standard	12.5uL	Final volume 1000uL
40ppm Calibration Verification Standard	Second Source Calibration Stock Standard	400uL	Final volume 1000uL
25ppm Calibration Verification Standard	Second Source Calibration Stock Standard	250ul	Final volume 1000uL

14.4.3 Add 10uL (for SCAN analysis) and 2.5uL (for SIM analysis) of internal standard (2000ug/mL) to each 1mL calibration standard, so that a 2uL injection of the calibration standard onto the GC column will yield 40ng of internal standard for SCAN analysis and 10ng of internal standard for SIM analysis.

14.4.4 Analyze the standards, blanks, and samples under the following instrumental conditions:

14.4.4.1 Inject 2 µL or 1uL of each extract onto the column using the splitless injection mode.

- Click on the instrument icon.
- Click on Edit sequence to run the curve
- Click on OK
- Click on run sequence
- Wait for instrument to complete the run

14.4.4.2 Temperature program and GC parameters as follows (subject to change)

Instrument Identifier	Initial Temp	Initial Hold	Rate	Final Temp	Final Hold	Injection Port Temp	Detector B Temp
MSBNA A	40°C	1 min.	13 °C/min.	300 °C	12 min.	250 °C	280 °C
MSBNA B	40°C	1 min.	13 °C/min.	300 °C	12 min.	250 °C	280 °C
MSBNA E	40°C	1 min.	20 °C/min.	300 °C	8 min.	250 °C	280 °C
MSBNA F	40°C	1 min.	20 °C/min.	270 °C	8 min.	250 °C	280 °C

Note: Initially the final hold is set at 12 minutes and the rate at 13 °C/minute. As the column is used and a portion is clipped off during daily maintenance, the final temperature and rate is decreased so that compound separation can continue to be achieved. Benzo(b) and Benzo(k)fluoranthene being the two most difficult to separate. Make sure some separation is evident. The initial rate must not be set to below 8 °C/minute. The final hold must not be set below 1minute.

Instrument Identifier	Head Pressure	Split Valve Purge Time	Septum Vent Flow	Split Vent Flow
MSBNA A	3-12 psi	0.5 min	1 mL/min.	50 mL/min.
MSBNA B	3-12 psi	0.5 min	1 mL/min.	50 mL/min.
MSBNA E	EPC	0.5 min	1 mL/min.	50 mL/min.
MSBNA F	EPC	0.5 min	1 mL/min.	50 mL/min.

Note: The GC column separates the analytes that are then detected by the mass spectrometer detector.

14.4.5 Acquire data for each of the calibration standards.

14.4.5.1 Compare the data using a METHOD FILE set up for the target compounds, containing expected retention times, and ion ratios for each analyte.

14.4.5.2 A quant ion and one or two secondary ions have been chosen (Table 3) for each analyte and make up a characteristic ratio used to identify each compound.

14.4.5.3 The quant ion for each compound is integrated and these areas are used to generate RRFs.

14.4.6 Create a calibration file inside the METHOD from the data points run for the initial curve.

14.4.6.1 The METHOD shows a RRF for each analyte at each concentration level.

14.4.6.2 The average RRF, the relative retention time (each analytes distance from the internal standard), and the Relative Standard Deviation (RSD) are calculated.

14.4.6.3 Reanalyze any data point that appears drastically different from the others.

14.4.7 Monitor internal standard areas and retention times from initial calibration.

14.4.8 Once a valid initial curve is run, proceed with the analysis of blanks, spikes and samples if there is time remaining in the 12-hour period.

14.4.8.1 Update the average response factors from the curve into the METHOD and they will be used for quantitation for all blanks and samples that follow. See section 13.3.

14.4.8.2 If there is no time remaining, begin a new 12-hour sequence with the analysis of a DFTPP.

14.4.8.3 If the DFTPP passes criteria, analyze a continuing calibration check standard.

14.5 Continuing Calibration

14.5.1 Analyze a DFTPP.

14.5.2 If the DFTPP passes criteria (see section 13.1 and Table 2), analyze a continuing calibration check standard.

14.5.3 If the continuing calibration meets criteria, proceed with the analysis of blanks and samples.

- In this case, update the retention times from the continuing calibration check standard into the METHOD, but not the responses. Continue to use the initial calibration for all quantitation.

14.5.4 If continuing calibration does not meet criteria, then perform instrument maintenance, reanalyze the continuing calibration standard. If reanalysis of the continuing calibration does not meet criteria, analysis must stop and a new DFTPP and initial calibration must be run.

14.5.5 A continuing calibration must be performed every twelve hours at the levels specified in the analytical sequence section 14.9.

14.5.5.1 The extracted ion current profile (area of the quantitation ion) must not change by more than a factor of 2 in either direction from the midpoint of the initial calibration.

14.5.5.2 The retention time for any internal standard must not change by more than 0.50 minutes.

14.5.5.3 Should either of these two items be out of limits, the GC/MS system must be inspected for potential problems and corrections made as needed.

14.6 Sample and Method Blank Analysis

14.6.1 Following successful calibration of the GC/MS system, analyze sample, spikes and method blank extracts. The same instrument conditions must be employed for sample analysis as were used for calibration.

14.6.2 Add 10uL (for SCAN analysis) and 2.5uL (for SIM analysis) of 2000ug/mL internal standard solution into each 1.0-mL blank, sample, and spike.

14.6.3 Shake each extract briefly to mix in the internal standard.

14.6.4 Inject 2uL or 1uL of each extract onto the GC column.

14.6.4.1 The GC column separates the semivolatile compounds that are then detected with the mass spectrometer.

14.6.4.2 If any target analytes are detected at a concentration above the highest calibration standard, a dilution is required.

14.6.4.3 Additional internal standard must be added to the diluted extract to maintain a concentration of 20ng/uL in the extract for SCAN analysis and 5ug/mL in the extract for SIM analysis.

14.6.5 Run samples until the 12 hour clock is up since the injection of the latest DFTPP

- Click on the instrument icon.
- Click on Edit sequence to acquire next available data file and to run DFTPP
- Click on OK
- Click on run sequence

Note: Sequence will run for 12 hours. After 12 hours follow the instructions given below if we are not running second sequence.

14.6.6 Cool off the instrument.

- Replace the septum and inlet liner.
- Clip off 2-3 inches of the column.
- Reinstall the column and heat oven to 300°C for one hour. Start with new 12-hour sequence.

14.7 <u>Dilutions Analysis for Samples</u>

14.7.1 Water Samples

Note: Samples require dilution when:

- *Target compounds are over the linear range of instrument*
- *"Loaded" to the point where chromatographic overload does not allow for the identification of internal standards/surrogates, target and non-target peaks.*
- *Sample extracts that require dilution are handled in the following manner and re-acquired under a valid calibration.*
- *The dilution factor should get the largest analyte peak in the upper half of the initial calibration range.*

14.7.1.1 Label a new injection vial with the sample information as the undiluted sample extract including the dilution factor used.

14.7.1.2 Label two 40 mL VOA vials one as clean methylene chloride and one as waste methylene chloride.

- Fill one vial with clean methylene chloride and add required amount of internal standard so that it will maintain the 20ug/mL concentration for SCAN analysis, and 5ug/mL concentration for SIM analysis.
- For example: For 1mL clean Methylene Chloride, add 10uL of Internal Standard solution.

14.7.1.3 For a 10x dilution to be performed on a 1.0-mL extract use a 1000 µL syringe.

14.7.1.4 Rinse it well with methylene chloride pulling clean methylene chloride into the syringe and dispensing it into the waste vial.

- Do this three times at the beginning and in between each dilution.

14.7.1.5 Withdraw 900 µL from the clean methylene chloride vial and put it into the injector vial.

14.7.1.6 Withdraw 100 µL from the sample extract and put it into the injector vial.

14.7.1.7 Cap the vial.

14.7.1.8 For other dilutions follow the table below: (Prepare clean Methylene Chloride and add required amount of internal standard to maintain 20ug/mL concentration of internal standard for SCAN and 5ug/mL concentration for SIM analysis)

Dilution	µL of clean methylene chloride with Internal Standard	µL of Sample Extract
2x	500	500
5x	800	200
10x	900	100
20x	950	50
50x	980	20
100x	990	10

14.7.2 Soil Samples

14.7.2.1 Label a new injection vial with the sample information as the undiluted sample extract including the dilution factor used.

14.7.2.2 Label two 40 mL VOA vials one as clean methylene chloride and one as waste methylene chloride.

- Fill one vial with clean methylene chloride and add required amount of internal standard to maintain 20ug/mL concentration of internal standard for SCAN analysis and 5ug/mL concentration for SIM analysis.
- For example: Add 10uL internal standard solution to 1mL clean Methylene Chloride

14.7.2.3 For a 10x dilution to be performed on a 0.5-mL extract use a 1000 µL syringe.

14.7.2.4 Rinse it well with methylene chloride pulling clean methylene chloride into the syringe and dispensing it into the waste vial.

- Do this three times at the beginning and in between each dilution.

14.7.2.5 Withdraw 450 µL from the clean methylene chloride vial and put it into the injector vial.

14.7.2.6 Withdraw 50 µL from the sample extract and put it into the injector vial

14.7.2.7 Cap the vial.

14.7.2.8 For other dilutions follow the table below: (Prepare clean Methylene Chloride and add the required amount of internal standard solution to maintain 20ug/mL concentration for SCAN and 5ug/mL concentration for SIM analysis. For example: Add 10uL internal standard solution to 1mL Methylene Chloride)

Dilution	µL of clean methylene chloride with Internal Standard	µL of sample extract
2x	250	250
5x	400	100
10x	450	50
20x	475	25

14.8 Matrix Spike/Matrix Spike Duplicate

14.8.1 With each group of samples analyzed as a batch, analyze a blank spike matrix spike and matrix spike duplicate.

14.8.2 The purpose of these matrix spikes is to determine whether the sample matrix contributes to the analytical results.

14.8.3 Spike a representative sample with all of the compounds being analyzed for at a concentration of 50ug/L for water and 1670ug/Kg for soil. 1.0mL of a 50ug/mL solution is used by the extractions department. See SOP M3510C,3520C,3550B,3580A-Extraction SVOA

14.8.4 Calculate the % recovery and relative % difference (RPD) between the recoveries and ensure that they meet the criteria.

14.8.5 To calculate spike recovery (%R):

$$\%R = \frac{SSR-SR}{SA} \times 100$$

Where: SSR = spiked sample result
SR = sample result
SA = spike added

14.8.6 To calculate relative percent difference (RPD) for the Matrix Spike/ Matrix Spike Duplicate:

$$\%\ RPD = \frac{MSR-MSDR}{\frac{1}{2}(MSR + MSDR)} \times 100$$

Where: MSR = matrix spike recovery
MSDR = matrix spike duplicate recovery

14.8.7 Field or trip blanks may not be used for MS/MSD purposes.

14.9 Analytical Sequence (For SCAN analysis) (Analytical Sequence for SIM analysis remains same except for the concentration of the Initial calibration standards and Continuing calibration standard)

Initial Analytical Run	Continuous Analytical

• DFTPP0501	• DFTPP0502
• SSTD080 ppm	• SSTD040ppm
• SSTD060 ppm	• SBLK(Method Blank)*
• SSTD040 ppm	• LCS (Blank Spike)*
• SSTD025 ppm	• MS (Matrix Spike)*
• SSTD010 ppm	• MSD(Matrix Spike Duplicate)*
• SSTD00.5 ppm	• Samples
• SSTD040 ppm Initial Calibration verification Standard (Second Source)	
• SBLK(Method Blank)*	
• LCS (Blank Spike)*	
• MS (Matrix Spike)*	
• MSD(Matrix Spike Duplicate)*	
• Samples	

* These are Extraction QC samples and do not run with every 12-hour sequence. QC samples are run only once.

14.10 Manual Integration

Note: At times manual integration will be necessary due to incomplete or incorrect integration by the automated analytical system. This normally occurs when there is matrix interference, baseline noise or compound co-elution.

- *Manual integration cannot be used in order to solely satisfy Quality Control Criteria. It should also not be used as a substitute for corrective action on the chromatographic system. All manual integrations should be noted in the case narrative.*

14.10.1 Integrate the area of the quantitation ion of the compound of interest.
14.10.2 Do not include baseline background noise, and include only the area between where the beginning and end of the peak intersects with the baseline.
14.10.3 Integrate the compound in the sample any time it is integrated in the calibration standard.
14.10.4 Flag the compound with an “m” in the hardcopy (quantitation report) when a manual integration is performed.
14.10.5 Print out the EICP for all compounds that have been manually integrated.
14.10.6 Document the reason for the manual integrations.

14.11 Data Interpretation

14.11.1 Summary

14.11.1.1 Maintain all GC and mass spectral data generated with each run of the instrument within a data file.

14.11.1.2 Store data files on the computer hard drive, and archive on magnetic tapes for retrieval as needed once the hard drive has been cleared.

14.11.1.3 For quantitation, send data files through MSD Chemstation, where the computer compares known information about target compounds to what is present in each data file.

14.11.1.4 Information contained in the Method used by the program MSD Chemstation includes:

- The relative retention time of each analyte.
- The ion to be used for quantitation and one or two secondary ions that are characteristic to each compound (Table 3).
- The response factor for each analyte to be used in determining the concentration.

14.11.1.5 Method Files are updated at least daily, with newly generated response factors and retention times, whether from an initial or continuing calibration.

14.11.2 Procedure MSD Chemstation

*Naming Methods: Department name, instrument name, month, date, and prefix/suffix e.g. 'LP' for CLP (BC0413LP.M, '8270' for 8270 (BC0413**C.**M)*

Create a default method. For example, 8270.M which is a default method for Method 8270. Then save the new method with name 8270-BA062209.M.

14.11.3 Data Interpretation for MSD Chemstation

14.11.3.1 Examine spectra for all possible "hits" or matches made to target compounds are printed out and examined by an analyst trained in the interpretation of mass spectra.

14.11.3.2 Generate a reference spectrum for each analyte by running known standards.

14.11.3.3 Compare this reference spectrum and the spectrum of the peak found in the sample.

14.11.3.4 The criteria required for positive identification of an analyte are as follows:

- The analyte in the sample must elute at the same relative retention time as in the daily calibration standard (±0.06 RRT units).
- All ions present in the reference spectrum >10% of the largest ion must be found in the sample spectrum.
- The ratio of the ions found in the sample must agree within ±20% of the ions found in the reference spectrum.
- Ions >10% in the sample spectrum but not found in the reference spectrum must be accounted for.

14.11.3.5 Quantitative analysis is done once a target compound is identified by the internal standard method using the equations below. The relative response factor from the continuing calibration standard is used to calculate the concentration of the sample.

14.11.3.6 "Qdel" each data file.

- Use this program to remove the false computer hits from the quant report.

14.11.3.7 If there are interferences to the quant ion caused by either high background or co-eluting compounds with similar ions, use a secondary ion for quantitation.

- A list of the target analytes and their primary and secondary ions is found in Table 3.

14.11.3.8 Perform a library search on all blanks and samples in order to identify non-target compounds.

14.11.3.9 Send each sample and blank to the library search program using the pull down menus in Enviroquant for each data file.

14.11.3.10 Compare all non-target peaks, using total ion areas, to the nearest internal standard and concentrations are calculated using a response factor of 1.

14.11.3.11 Do not include the following:

- Non-targets with responses less than 10% of the nearest internal standard,
- Non-targets which elute prior to 30 seconds before the first semivolatile target compounds or later than 3 minutes after the last target compounds.
- Compounds that appear on the volatile target compound list.
- Include a summary of name and concentration in the sample in the case narrative.
- Also provide the library search information for each peak.

14.11.3.12 Search and report peaks that are suspected to be aldol condensation products (4-methyl-4-hydroxy-2-pentanone and 4-methyl-3-pentene-2-one) and flag with an "A" on Form I TIC.

- Count these peaks as part of the 30 largest non-target peaks.

14.11.3.14 The computer software provides a mass spectral library of compounds for comparison to unknown compounds found in samples. Criteria for making tentative identifications are as follows:

- Ions greater than 10% of the largest ion in the reference spectrum must be present in the sample spectrum.
- The relative intensities of major ions should agree within 20%.

- Molecular ions present in the reference spectrum must be present in the sample spectrum.
- Ions present in the sample spectrum but not in the reference spectrum should be examined for possible background contamination or presence of co-eluting compounds.
- Ions present in the reference spectrum but not in the sample spectrum should be verified by performing manual background subtraction to remove interference.

14.11.3.15 If after review, the analyst is at a loss to identify the compound use the following method:

- If the computers match probability is 85% or greater report that compound.
- If the computer match probability is <85%, try to classify the compound and give it a name like “unknown chlorinated hydrocarbon” if it can be determined.

14.11.3.16 Display (graphically) and inspect whenever there is a reason to suspect that the GC/MS data system has misquantified a particular compound due to poor baseline definition or perpendicular placement.

- This type of problem is most likely to occur in "dirty" samples that have many poorly resolved peaks.
- Redraw baseline &/or perpendicular to give the correct area for the compound if it is determined that a compound has been misquantified.
- Recalculate the concentration of that compound calculated using the new area and the current response factor for that compound.
- Flag the corrected area with a "M" (for manual integration) on the quant report.

14.11.3.17 Use Table 4 to determine which internal standard is used to “QUANT” each of the target compounds.

14.12 Documentation Requirement

14.12.1 Label the sample Chromatograms with the following information:

- Date and time of injection
- Identified compound names

14.12.2 Make sure that the extraction logs contain:

14.12.3 Extraction logs must contain:

- Sample ID numbers in the batch
- Date extracted and date concentrated
- Analyst and supervisor initials
- Surrogate lot number and concentration
- Spiking solution lot number and concentration
- Reagent lot number and concentration

- Type of extraction performed (sonication, continuous, separatory funnel or waste dilution)
- Sample weight\volume
- Final extract volume
- Any comments by analyst
- Signature for receipt of extracts in the BNA Department from the Extractions Department
- Prep Batch Number.

14.12.4 Assure that GC Instrument log contains the following:

- CHEMTECH sample ID
- Dilution details
- All standards, samples, blanks, etc., run on the instrument in the order they were analyzed
- Computer data file number, each column

14.13 Instrument Maintenance

14.13.1 Instrument Preventative Maintenance

14.13.1.1 A maintenance and repair log is kept on the opposite page of the instrument log for each instrument.

14.13.1.2 Regularly scheduled maintenance, instrument repairs, and/or any instrument problems are recorded, dated, and initialed.

14.13.2 Daily

14.13.2.1 Change the septum and inlet liner, clip off column as per the requirement.

14.13.3 Monthly

14.13.3.1 Dust around instrument and instrument surfaces to reduce airborne particles.

14.13.3.2 Check all fans and clean to remove dust from filter.

14.13.3.3 Remove syringe, clean, reinstall or replace.

14.13.4 Every 6 Months

14.13.4.1 Replace roughing pump oil.

14.13.4.2 Replace forline trap absorbent.

14.13.4.3 Lubricate turbo pump.

14.13.5 Yearly

14.13.5.1 Renew chemical filter.

14.13.5.2 Clean injection port.

14.13.6 As Needed

14.13.6.1 Clean source.

14.13.6.2 Change column.

15. CALCULATIONS

Quantitative analysis is done once a target compound is identified by the internal standard method using the equations below. The relative response factor from the initial calibration standard is used to calculate the concentration of the sample.

15.1 <u>Water Calculation (concentration in ug/L)</u>

$$\frac{(A_x)(I_s))(V_t)(Df)}{(A_{is})(RRF)(V_0)(V_i)}$$

Where, A_x = Area for the compound to be measured
A_{is} = Area for the specific internal standard
I_s = Amount of internal standard added in nanograms (ng)
RRF = Relative response factor of initial calibration standard average.
V_o = Volume of water extracted in milliliters (mL)
V_i = Volume of extract injected in microliters (uL)
V_t = Volume of concentrated extract in microliters (uL)
Df = Dilution factor

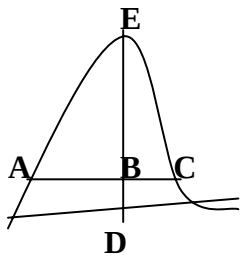
15.2 Soil/Sediment Calculation (Concentration in ug/Kg dry weight basis)

$$\frac{(A_x)(I_s))(V_t)(Df)}{(A_{is})(RRF)(W_s)(V_i)(D)}$$

Where, A_x = Area for the compound to be measured
A_{is} = Area for the specific internal standard
I_s = Amount of internal standard added in nanograms (ng)
RRF = Relative response factor of initial calibration standard average
V_i = Volume of extract injected in microliters (uL)
V_t = Volume of concentrated extract in microliters (uL)
W_s = Weight of sample extracted in grams (g)
Df = Dilution factor
D $= \frac{100 - \%moisture}{100}$

15.3 % breakdown of DDT= $\frac{\text{sum of peak areas of (DDD + DDE) X 100}}{\text{sum of all peak areas of (DDD+DDE+DDT)}}$

15.4 %Tailing= BC/AB (Enviroquant software calculated)



Where: AB = 1/2 the width of the peak at 10% from the start of the peak
BC = the width of the peak at 10% the peak height from the center of the peak to the end of the of the peak
BD = %10 of the peak height
DE = the peak height

16. METHOD PERFORMANCE

16.1 Analysis is performed in accordance with the method. All quality control and quality assurance procedures are followed. Refer to P203-IDOC,MDL SOP for further information.

16.2 Each analyst will demonstrate the ability to generate acceptable accuracy and precision with this method. Refer to P203-IDOC,MDL SOP for further information.

17. POLLUTION PREVENTION

17.1 Use only the amounts of chemicals required. Do not make large quantities of solutions.

17.2 Use hood when working with solvents.

17.3 Keep the area clean and clutter free in the extractions lab and around the instruments in order to avoid any mishaps.

17.4 Trap septum vent and split vent on GC.

17.5 Keep chemicals away from drains.

17.6 Properly collect and dispose of waste according to Chemtech's Waste Disposal SOP.

17.7 Laboratory is properly equipped with spill cleanup equipment and laboratory personnel trained. Depending upon the size and type of spill, it may be handled by the individual or department creating the spill or by specially trained personnel.

17.8 Small spills may occur routinely and shall be handled by the individual person or department creating the spill. Spill kits are stored in a blue basket or blue cover bin located in each laboratory and chemical storage area. The spill kits can handle water based, solvent and mercury spills. Specially trained personnel handle larger spills, which may pose a threat to health or environment involves a large volume not easily contained.

17.9 A detailed description of the procedure for handling a spill or accident is covered in the CHEMTECH Emergency and Contingency Plan.

17.10 The Safety Coordinator is responsible for implementing the Chemical Hygiene and the CHEMTECH Emergency and Contingency Plans. It is the responsibility of various company personnel to assist in implementing the different aspects of the Plan. These include: Laboratory Coordinator, Technical Director, Operations Manager, Department Managers and Supervisors

18. DATA ASSESSMENT AND ACCEPTANCE CRITERIA FOR QC

18.1 DFTPP

18.1.1 Resulting spectrum must meet all the QC criteria in Table 2. If criteria are not met, then retune the Mass Spectrometer and reanalyze DFTPP.

18.2 Initial Calibration

18.2.1 The RSD must be ≤15% for each target analyte for Method 8270C and ≤20% for each target analyte for Method 8270D.

18.2.2 Any extra compounds requested by client must meet the 30% RSD criterion.

18.2.3 For DoD work, see Appendix A.

18.3 Continuing Calibration

18.3.2 The %D for each compound must be ≤20%.

18.3.3 For the extra targeted compounds the %D must be ≤20.

18.4 Method Blank

18.4.1 The method blank must contain target compounds <RL for all target compounds.

18.4.2 For DoD work – No analyte must be detected at ≥1/2RL, except for common laboratory contaminants that should not be detected at ≥RL.

18.5 Surrogate Recoveries

18.5.1 Surrogate recovery limits must be within the limits specified for each matrix.

18.5.2 All surrogates must be greater than 10%.

18.6 Matrix Spike Recoveries and LCS

18.6.1 MS/MSD limits are generated in-house using control charts.

18.6.2 For **DOD** work - compare the % recovery to the DOD QSM requirements in Appendix D unless client specific criteria are required.

18.7 Internal Standards

18.7.1 Monitor all CCC for retention time shift and fluctuation of extracted ion areas.

18.7.2 Verify the retention time for each calibration standard agrees within 0.06min.

18.7.3 Monitor all samples, blanks, and spikes for retention time shift and fluctuation of extracted ion areas.

18.7.4 Make sure that the GC retention time is within ±30 seconds of the corresponding internal standard in the latest continuing calibration or in the midpoint standard of the initial calibration.

18.7.5 Verify that the areas of the internal standard do not change by more than a factor of 2 (-50% to +100%) from the areas in the latest continuing calibration or in the 50µg/L standard of the initial calibration when samples are run directly after the calibration.

18.7.6 Refer to Table 4 for internal standard areas and their associated target compounds used for quantitation.

18.8 Initial Calibration Verification

18.8.1 The ICV standard recoveries must be within 70-130% range. Up to 10% compounds may be allowed to fail marginally.

18.8.2 For DoD work – All analytes must be within ±25% of the expected value (initial source).

18.9 Limit of Detection

18.9.1 All analytes spiked should be positively identified.

18.10 Limit of Quantitation

18.10.1 Analysis must meet the acceptance criteria for the laboratory control sample.

19. CORRECTIVE ACTIONS FOR OUT-OF-CONTROL DATA

19.1 DFTPP

19.1.1 If tailing is visible clip the column, replace inlet liner, replace septa and bake system for 1 hour and retest the DFTPP tune.

19.1.2 If the %DDT breakdown exceeds criteria, replace inlet liner, replace septa and bake system for 1 hour and retest.

19.1.3 If the tune criteria are not met reanalyze the DFTPP after retuning the Mass Spectrometer.

19.1.4 If it still fails, clean the source.

19.2 Initial Calibration

19.2.1 If the QC criterion is not met for any analyte, take corrective action prior to sample analysis.

19.2.2 If the problem cannot be corrected, generate a new five-point calibration.

19.3 Continuing Calibration

19.3.1 If the criteria for continuing calibration are not met, rerun the continuing calibration after appropriate instrument maintenance.

19.3.2 If the continuing calibration fails again follow the steps given in Section 19.2.

19.4 Method Blank

19.4.1 Reanalyze the method blank.

19.4.2 If it still fails to meet criteria, then re-extract the method blank and all associated samples.

19.4.3 If there is not enough sample volume to re-extract, then mention in the case narrative/non-conformance.

19.4.2 For DoD work – Reprocess the failing blank with the associated samples in a subsequent preparation batch, except when the sample analysis results in a non-detect.

19.5 Surrogate Recoveries

19.5.1 If a sample falls outside QC limits from each group, re-extract and reanalyze the sample to confirm matrix interference or laboratory error.

19.5.2 If the second injection is acceptable, report only the second set of data.

19.5.3 If the second injection also fails, report both sets of data.

19.5.4 If surrogate recoveries in the method blank do not meet criteria, re-extract all samples associated with that blank.

19.6 Matrix Spike and Matrix Spike Duplicate and LCS

19.6.1 If any MS/MSD compound data is out of control limits verify LCS results are all within limits and consider it matrix interference.

19.6.2 If LCS and MS/MSD are out of control limits re-analyzed to verify that is an instrument problem.

19.6.3 If still do not meet control limits re-extract samples.

19.6.4 For **DOD** work- If after reanalysis, the LCS fails again or there is insufficient volume to reanalyze the samples, flag all data with a **Q**. Mention the problem and action taken on the case narrative

19.7 Internal Standards

19.7.1 If any sample fails to meet criteria, re-analyze the sample.

19.7.2 If the reanalysis is within limits, then report only the second set of data.

19.7.3 If the re-analysis also fails, report both sets of data.

19.8 Initial Calibration Verification

19.8.1 Reanalyze the Initial Calibration Curve if the ICV does not meet criteria.

19.9 Limit of Detection

19.9.1 If LOD verification fails, then repeat the detection limit determination and LOD verification at a higher concentration and set the LOD at the higher concentration.

19.10 Limit of Quantitation

19.10.1 Reevaluate the LOD and the LOQ.

20. CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

20.1 Issue a corrective action form any time there is a deviation from the SOP or the client requirements are not met.

20.2 If a sample is damaged, broken, or spilled, contact the project manager and issue a corrective action.

20.3 Following are the result qualifiers used for out-of-control and unacceptable data:

- **U**: Indicates the compound was analyzed but not detected.
- **J**: Indicates an estimated value, the result reported is below the initial calibrations lowest point.
- **B**: Indicates the analytes were found in the blank as well as the sample.
- **E**: Indicates the analyte concentrate exceeds the calibrated range of the GC instrument.
- **D**: Indicates all compounds identified in an analysis at a secondary dilution factor.
- **N**: Indicates presumptive evidence of a compound. This is used for all non-target results where an identification is made.

21. WASTE MANAGEMENT

21.1 Keep samples for 40 days after analysis and dispose of them according to the procedures explained in the SOP for waste disposal.

22. REFERENCES

22.1 USEPA Test Methods for Evaluating Solid Wastes, SW-846, Method 8000B – Determinative Chromatographic Separations. Revision 2, December 1996

22.2 USEPA Test Methods for Evaluating Solid Wastes, SW-846, Method 8000C – Revision 3, March 2003.

22.3 Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS), Method 8270C. Test Methods for Evaluating Solid Waste, SW-846, Revision 3, December 1996.

22.4 Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS), Method 8270D Revision 4, February 2007.

22.5 Department of Defense Quality Systems Manual for Environmental Laboratories, Version 4.1 April 2009.

22.6 Department of Defense Quality Systems Manual for Environmental Laboratories, Version 4.2, 10/25/2010.

23. LIST OF TABLES/ATTACHMENTS

Table 1 Target Compounds
Table 2 DFTPP Key Ions and Ion Abundance Criteria
Table 3 Characteristic Ions for Semivolatile Target Compounds, Surrogates and Internal Standards
Table 4 Internal Standards Used for Quantitation
Table 5 SIM analysis Quantitation Ions and Groups

Table 1
Target Compound List

Compound	Compound	Compound
1,1-Biphenyl	Benzidine	Phenanthrene
1,2,4-Trichlorobenzene	Benzo(a)anthracene	Phenol
1,2-Dichlorobenzene	Benzo(a)pyrene	Pyridine
1,3-Dichlorobenzene	Benzo(b)fluoranthene	Pyrene
1,4-Dichlorobenzene	Benzo(g,h,i)perylene	2,3,4,6-Tetrachlorophenol
2,2-oxybis(1-Chloropropane)	Benzo(k)fluoranthene	1,2,4,5-Tetrachlorobenzene

2,4,5-Trichlorophenol	Benzoic acid	1,4-Dioxane
2,4,6-Trichlorophenol	Benzyl Alcohol	
2,4-Dichlorophenol	Benzaldehyde	
2,4-Dimethylphenol	bis(2-Chloroethoxy)methane	
2,4-Dinitrophenol	bis(2-Chloroethyl)ether	
2,4-Dinitrotoluene	bis(2-Ethylhexyl)phthalate	
2,6-Dinitrotoluene	Butylbenzylphthalate	
2-Chloronaphthalene	Caprolactam	
2-Chlorophenol	Carbazole	
2-Methylnaphthalene	Chrysene	
2-Methylphenol	Dibenz(a,h)anthracene	
2-Nitroaniline	Dibenzofuran	
2-Nitrophenol	Diethylphthalate	
3,3-Dichlorobenzidine	Dimethylphthalate	
3+4-Methylphenols	Di-n-butylphthalate	
3-Nitroaniline	Di-n-octyl phthalate	
4,6-Dinitro-2-methylphenol	Fluoranthene	
4-Bromophenyl-phenylether	Fluorene	
4-Chloro-3-methylphenol	Hexachlorobenzene	
4-Chloroaniline	Hexachlorobutadiene	
4-Chlorophenyl-phenylether	Hexachlorocyclopentadiene	
4-Nitroaniline	Hexachloroethane	
4-Nitrophenol	Indeno(1,2,3-cd)pyrene	
Acenaphthene	Isophorone	
Acenaphthylene	Naphthalene	
Acetophenone	Nitrobenzene	
Anthracene	n-Nitrosodimethylamine	
Atrazine	N-Nitroso-di-n-propylamine	
Aniline	N-Nitrosodiphenylamine	
Azobenzene	Pentachlorophenol	

Table 2

DFTPP QC Criteria for Method 8270C

Mass	Ion Abundance Criteria
51	30-60% of mass 198
68	<2% of mass 69
70	<2% of mass 69
127	40-60% of mass 198

197	<1% of mass 198
198	Base peak, 100% relative abundance
199	5-9% of mass 198
275	10-30% of mass 198
365	>1% of mass 198
441	Present but less than mass 443
442	>40% of mass 198 <100% of mass 198
443	17-23% of mass 442
% DDT Breakdown	<20%
Benzidine and Pentachlorophenol peak tailing	<3 and 5 respectively

DFTPP QC Criteria for Method 8270D

Mass	Ion Abundance Criteria
51	10-80% of mass 198
68	<2% of mass 69
70	<2% of mass 69
127	10-80% of mass 198
197	<2% of mass 198
198	Base peak, or >50% of mass 442
199	5-9% of mass 198
275	10-60% of mass 198
365	>1% of mass 198
441	Present but <24% of mass 442
442	Base peak, or >50% of mass 198
443	15-24% of mass 442
% DDT Breakdown	<20%
Benzidine and Pentachlorophenol peak tailing	<2 respectively

Table 3
Characteristic Ions for Semivolatile Target Compounds and Surrogates

Parameter	Primary Ion	Secondary Ion(s)
N-Nitrosodimethylamine	42	74, 44
Phenol	94	65, 66
bis(2-Chloroethyl)ether	93	63, 95
2-Chlorophenol	128	64, 130
1,3-Dichlorobenzene	146	148, 111
1,4-Dichlorobenzene	146	148, 111
1,2-Dichlorobenzene	146	148, 111
2-Methylphenol	107	108, 77, 79, 90
2,2'-oxybis(1-Chloropropane)	45	77, 121
4-Methylphenol	107	108, 77, 79, 90
N-Nitroso-di-n-propylamine	70	42, 101, 130
Hexachloroethane	117	201, 199
Nitrobenzene	77	123, 65
Isophorone	82	95, 138
2-Nitrophenol	139	65, 109
2,4-Dimethylphenol	122	121, 107
bis(2-Chloroethoxy)methane	93	95, 123
2,4-Dichlorophenol	162	164, 98
1,2,4-Trichlorobenzene	180	182, 145
Naphthalene	128	129, 127
4-Chloroaniline	127	129, 65, 92
Hexachlorobutadiene	225	223, 227
4-Chloro-3-methylphenol	107	144, 142
2-Methylnaphthalene	142	141
Hexachlorocyclopentadiene	237	235, 272
2,4,6-Trichlorophenol	196	198, 200
2,4,5-Trichlorophenol	196	198, 97, 132, 99
2-Chloronaphthalene	162	164, 127
2-Nitroaniline	65	92, 138
Dimethyl phthalate	163	194, 164
Acenaphthylene	152	151, 153
3-Nitroaniline	138	108, 92
Acenaphthene	154	152, 153
2,4-Dinitrophenol	184	63, 154
4-Nitrophenol	139	109, 65
2,6-dinitrophenol	162	164, 126, 98, 63
2,6-dinitrotoluene	165	63,89
Dibenzofuran	168	139
2,4-Dinitrotoluene	165	63, 89

Table 3 (Cont.)
Characteristic Ions for Semivolatile Target Compounds and Surrogates/Internal Standards

Parameter	Primary Ion	Secondary Ion(s)
Diethylphthalate	149	177, 150
4-Chlorophenyl-phenyl ether	204	206, 141
Fluorene	166	165, 167
4-Nitroaniline	138	92, 108, 65, 80, 39
4,6-Dinitro-2-methylphenol	198	51, 105
N-nitrosodiphenylamine	169	168, 167
4-Bromophenyl-phenylether	248	250, 141
Hexachlorobenzene	284	142, 249
Pentachlorophenol	266	264, 268
Phenanthrene	178	179, 176
Anthracene	178	179, 176
Carbazole	167	166, 139
Di-n-butylphthalate	149	150, 104
Fluoranthene	202	101, 203
Pyrene	202	200, 203
Butylbenzylphthalate	149	91, 206
3,3'-Dichlorobenzidine	252	254, 126
Benzo(a)anthracene	228	229, 226
bis(2-ethylhexyl)phthalate	149	167, 279
Chrysene	228	226, 229
Di-n-octyl phthalate	149	---
Benzo(b)fluoranthene	252	253, 125
Benzo(k)fluoranthene	252	253, 125
Benzo(a)pyrene	252	253, 125
Indeno(1,2,3-cd)pyrene	276	138, 227
Dibenz (a,h)anthracene	278	139, 279
Benzo(g,h,i)perylene	276	138, 277
Surrogates		
Phenol-d5	99	42, 71
2-Fluorophenol	112	64
2,4,6-Tribromophenol	330	332, 141
Nitrobenzene-d5	82	128, 54
2-Fluorobiphenyl	172	171
Terphenyl	244	122, 212
2-Chlorophenol-d4	132	68, 134
1,2-Dichlorobenzene-d4	152	115, 150
Internal Standards		
Parameter	**Primary Ion**	**Secondary Ion(s)**
1,4-Dichlorobenzene-d4	152	150-115

Table 3 (Cont.)
Characteristic Ions for Semivolatile Target Compounds and Surrogates/Internal Standards

Internal Standards		
Parameter	**Primary Ion**	**Secondary Ion(s)**
Acenaphthene-d10	164	162, 160
Phenanthrene-d10	188	94,80
2-Fluorobiphenyl	172	171
Chrysene-d12	240	120, 236
Perylene-d12	264	260, 265

Table 4
Internal Standards Used for Quantitation of Each Compound

1,4-Dichlorobenzene-d_4
1,3-dichlorobenzene
Phenol
1,4-Dioxane
bis(2-Chloroethyl)ether
2-Chlorophenol
2-Methylphenol
2,2'-oxybis(1-Chloropropane)
1,2-dichlorobenzene
4-Methylphenol
N-Nitroso-di-n-propylamine
Hexachloroethane
Phenol-d_5 (surr)
2-Fluorophenol (surr)
n-nitrosodimethylamine
1,4-dichlorobenzene
2-chlorophenol-d4
1,2-dichlorobenzene-d4

Naphthalene-d_8
Nitrobenzene
Isophorone
2-Nitrophenol
2,4-Dimethylphenol
bis(2-Chloroethoxy)methane
2,4-Dichlorophenol
Naphthalene
4-Chloroaniline
Hexachlorobutadiene
1,2,4-trichlorobenzene
4-Chloro-3-methylphenol
2-Methylnaphthalene
Nitrobenzene-d_5 (surr)

Table 4 (Cont.)
Internal Standards Used for Quantitation of Each Compound

Acenaphthene-d_{10}
Hexachlorocyclopentadiene
2,4,6-Trichlorophenol
2,4,5-Trichlorophenol
2,4,6-Tribromophenol(Surr)
2-Chloronaphthalene
2-Nitroaniline
Dimethylphthalate
2,6-Dinitrotoluene
Acenaphthylene
3-Nitroaniline
Acenaphthene
2,4-Dinitrophenol
4-Nitrophenol
Dibenzofuran
2,4-Dinitrotoluene
Diethylphthalate
Fluorene
4-Chlorophenyl-phenylether
4-Nitroaniline
2-Fluorobiphenyl (surr)
1,2,4,5-Tetrachlorobenzene
2,3,4,6-Tetrachlorophenol

Phenantherene-d_{10}
4,6-Dinitro-2-methylphenol
4-Bromophenyl-phenylether
N-nitrosodiphenylamine
Hexachlorobenzene
Di-n-butylphthalate
Pentachlorophenol
Phenanthrene
Anthracene
Fluoranthene

Chrysene-d_{12}
Pyrene
Butylbenzylphthalate
3,3'-Dichlorobenzidine
Benzo(a)anthracene
Chrysene
bis(2-ethylhexyl)phthalate
Terphenyl-d_{14} (surr)
Di-n-octylphthalate
Indeno(1,2,3-cd)pyrene
Benzidine

Perylene-d_{12}
Benzo(g,h,i)perylene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a)pyrene
Dibenz(a,h)anthracene

Surr = Surrogate Compound

Table 5
SIM Analysis Quantitation Ions and Groups (subject to change)

Group No.	Parameter	Primary Ion	Secondary Ion(s)
1	n-Nitrosodimethylamine	42	74
	2-Fluorophenol	112	64
2	Phenol-d5	99	42 ,71
	Bis(2-Chloroethyl)ether	93	63, 95
	2-Chlorophenol-d4	132	68, 134
	1,4-Dichlorobenzene-d4	152	115
	1,2-Dichlorobenzene-d4	152	115, 150
	Nitrobenzene-d5	82	128, 54
	Naphthalene-d8	136	68
	Hexachlorobutadiene	225	223, 227
3	2-Fluorobiphenyl	172	171
	Acenaphthene-d10	164	162, 160
	2,4,6-Tribromophenol	330	332, 141
	Hexachlorobenzene	284	142, 249
	Pentachlorophenol	266	264, 268
	Phenanthrene-d10	188	94, 80
4	Terphenyl-d14	244	122, 212
	Benzo(a)anthracene	228	229, 226
	Chrysene-d12	240	120, 236
5	Benzo(b)fluoranthene	252	253, 125
	Benzo(k)fluoranthene	252	253, 125
	Benzo(a)pyrene	252	253, 125
	Perylene-d12	264	260, 265
6	Indeno(1,2,3-cd)pyrene	276	138, 227
	Dibenzo(a,h)anthracene	278	139, 279

CHEMTECH 284 Sheffield Street, Mountainside, NJ 07092 (908) 789-8900

READ RECEIPT

Employee Name: _____

Department: _____

_____ **M8270C/D-BNA-16**_____
Method or Document Read (Include Title, Number, Revision, as applicable)

Employee Statement: I have read and understood the information in the above-mentioned method or document.

_____ _____
Employee Signature Date

Supervisory Statement: I have reviewed this document or method with the employee.

_____ _____
Supervisor Signature Date

Note: This receipt is to be returned to the Quality Assurance/Quality Control Department for incorporation into employee training record files. If you have questions or would like to review your train record files, please see QA/QC Director.

CHEMTECH

APPENDIX A

CORRECTIVE ACTION/PREVENTIVE ACTION REPORT

CAR TRACKING #: CAR0611-015

Created By : Krupa Dubey

Client: Chemtech Consulting Group Order ID: Date Initiated: 06/15/2011

Project ID : SOP correction Initiated By: Client No Client notification: No

Approved By: Divyajit Mehta Department: QA/QC Due Date : 06/22/2011 Given To: Krupa Dubey

Description : SOPs for Methods 8260B-C and 8270C-D need to be revised. Internal standards in all samples and QC are evaluated such that the retention time is ± 30 seconds from retention time of the midpoint standard in the ICAL; EICP area must be within -50% to +100% of ICAL midpoint standard, for all DOD work.

Root Cause Analysis : This is a DOD requirement. SOP does not specify evaluating internal standards for samples using ICAL, samples are evaluated using the CCV.

Analysis submitted By: Krupa Dubey Review By: Divyajit Mehta

Proposed Corrective Action : CAR will be followed until the SOP is revised.

Proposed Preventive Action : SOPs will be revised at the next SOP review.

Corrective/Preventive Action Proposed By: Krupa Dubey Supervisor: Divyajit Mehta

QA/QC Director: Krupa Dubey Technical Director: Divyajit Mehta

Follow-Up completed on: Date: 06/15/2011 By: Krupa Dubey

Follow Up Review : CAR is followed until SOP is reviewed again

CAR Completion: Date: 06/15/2011 By: Krupa Dubey

CLOSE OUT

Was the proposed corrective action implemented? Yes M. Sunu 06/20/11 06/16/11

Was the proposed preventive action implemented? Yes Shah 6/20/11 6/16/11

If No, Why? 06/20/11

6/20/11

QA Control Code: A2040111

NITROAROMATICS AND NITRAMINES BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY (HPLC) METHOD 8330A and 8332

SOP NUMBER: SOP-327

REVISION NUMBER: 14

APPROVED BY:

SECTION MANAGER

QUALITY ASSURANCE MANAGER

EFFECTIVE DATE: 09/17/08

DATE OF LAST REVIEW: 09/17/08

METHOD 8330A and 8332

NITROAROMATICS AND NITRAMINES BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY (HPLC)

1.0 SCOPE AND APPLICATION

This SOP, based on SW-846 Method 8330A and 8332, is used for the trace analysis of explosives residues by high performance liquid chromatography (HPLC) using a UV-VIS detector in water, solid or sediment matrices. See SOP-431 for common environmental laboratory definitions.

2.0 SUMMARY OF METHOD

Samples are analyzed after appropriate sample preparation using HPLC with identification at 254nm on a C-18 reverse phase column and confirmation at 254nm on a Phenyl-hexyl column. The method can be extended to include PETN and nitroglycerin by analyzing the samples at a wavelength of 210 nm. The preparation is performed using a solid phase extraction method, SW846 method 3535 for low concentrations of explosives residues in water. Dilution and filtration prepare high concentration water samples for direct injection. Extraction with acetonitrile in an ultrasonic bath or shaker followed by filtration prepares soil and sediment samples.

3.0 INTERFERENCES AND POTENTIAL PROBLEMS

Solvents, reagents, glassware and other sample processing hardware may yield discrete artifacts and/or elevated baselines, causing misinterpretation of the chromatograms. All of these materials must be demonstrated to be free from interferences.

2-Am-DNT and 4-Am-DNT elute at similar retention times (retention time difference of 0.2 minutes). A large concentration of one isomer may mask the response of the other isomer. If it is not apparent that both isomers are present (or are not detected), an isomeric mixture should be reported.

Degradation products of tetryl appear as a shoulder on the 2,4,6-TNT peak on the synergi column. Peak heights rather than peak areas should be used when tetryl is present in concentrations that are significant relative to the concentration of 2,4,6-TNT.

4.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE

Samples are collected and handled as specified for semivolatile organics, (SW-846 Update IV, Chapter Four). Section 7.0 and table 6-1 and 6-2 of the Empirical Laboratories' Quality Assurance Manual include details concerning sample preservation, containers and handling of semi-volatile samples. Samples and sample extracts are stored in the dark at 4°C. Samples are stored in the sample storage walk-in cooler. Extracts are stored in the Hobart in the extraction laboratory. The holding time for samples is 7 days for waters and 14 days for soils. The holding time for extracts is 40 days.

5.0 INSTRUMENTATION, APPARATUS AND MATERIALS

5.1 Instrumentation

Agilent Series 1100 HPLC System

- Agilent G1311A Quaternary Pump
- Agilent G1379A Degasser
- Agilent 1313A 100 Position Autosampler
- Agilent G1316A Column Compartment
- Agilent G1314A Variable Wavelength Detector
- Agilent HPLC Chemstation

Hewlett Packard Series 1050 HPLC System

- Hewlett Packard Model 79852 1050 Quaternary HPLC Pump
- Hewlett Packard Model 79853 Variable Wavelength UV-VIS Detector
- Hewlett Packard 1050 79855A 21 Position Autosampler
- Hewlett Packard 1050 100 Position Autosampler Upgrade
- Hewlett Packard Model 79856A 1050 Solvent Module
- Hewlett Packard Model G1303A Vacuum Degassing Module
- Dell OptiPlex 933 GX150 Pentium III Computer
- Hewlett Packard PC Communication for HP Chemstation
- Hewlett Packard HPLC Chemstation
- SideWinder Temperature Control Module

5.2 Apparatus and Materials

- Solid-phase extraction system consisting of:
  - Manifold Station, *J.T. Baker spe-12G*, or equivalent
  - Tubing and connectors
  - SFE extraction cartridges, *Porapak®RDX Cartridges* or equivalent
  - Vacuum system capable of maintaining 18 inches of mercury
- Branson ultrasonic bath cooled by a chiller to 15-20°C
- Balance ± 0.01 g.
- Vortex mixer.
- Shaker
- Disposable cartridge filters - 0.45 mm PTFE filter.
- Scintillation Vials - 20 mL, glass.

- Vials - 15 mL, glass, Teflon-lined cap.
- Vials - 40 mL, glass, Teflon-lined cap.
- Disposable syringes - Plastipak, 3 mL and 10 mL or equivalent.
- Volumetric flask with ground glass stopper - 100 mL and 1000 mL.
- Vacuum desiccator - Glass.
- Mortar and pestle - Steel.
- Sieve - 30 mesh.
- Graduated cylinders - 10 mL, 25 mL, 250 mL, 1000 mL.
- Pasteur pipet - length 9 ".
- Manual Sample Mill.
- Wiley Sample Mill.
- Clippers for cutting vegetation

6.0 REAGENTS AND SOLUTIONS

6.1 Reagents

- Acetonitrile, CH_3CN - HPLC grade.
- Methanol, CH_3OH - HPLC grade.
- Calcium chloride, $CaCl_2$ - Reagent grade. Prepare an aqueous solution of 5g/L. This is for use with soil/sediment samples.
- Organic-free reagent water. Obtained from the Nano Pure Water System in the GC lab.
- 1% Acetic Acid, CH_3COOH, Solution – Prepare using 5.0mL CH_3COOH to 500mL of Organic free reagent water.
- Sodium Chloride solution - 325 g NaCl per 1000 mL reagent water.

6.2 Calibration/Method Standards

Stock standards are purchased in mixtures from reputable vendors. The date they are received is noted on the label and recorded in the Organic standards logbook. The date they are opened is noted on the label and recorded in the Organic standards logbook along with their lot number and vendor. Each standard that is prepared is recorded in the Organic standards logbook and given a sequential number. Each standards label is completed with the standard number, name, preparation date, expiration date, solvent and analyst initials. All standards are stored in the refrigerator in the dark at a temperature of 4°C $\pm$ 2°C or less from the date they are received/prepared. The refrigerator temperature is monitored daily with an annually calibrated thermometer and recorded with calibration correction in the GC refrigerator/freezer logbook or the Extraction temperature/calibration logbook. Makeup of some common standards is detailed below. The makeup of other standards can be found in the Organic standards logbook.

- Calibration Solutions - The 8330 calibration standards are prepared as follows using solutions purchased from Restek or an equivalent vendor.

Explosive (Mix#1,#2 and Surrogate) Calibration Stock Solutions: Using a 100µL syringe, 100µL of Mix # 1, Mix # 2, and Surrogate (Restek at 1000 µg/mL) are injected into a 10mL volumetric flask containing approximately 9.5mL 1:1 acetonitril and water and diluted to volume with same to make a 10 µg/mL standard. After capping and inverting several times, the solution is transferred into a labeled, 12ml, teflon-lined, screw-capped vial and stored in the refrigerator in the dark at 4°C or less for up to 30 days. These standards are used to make the calibration curve standards in 1:1 acetonitrile and water at concentrations of 10, 5.0, 1.0, 0.50, 0.10 and 0.025 µg/mL. The lowest calibration standard can be extended down to 0.010µg/ml, if required.

Mix # 3 Calibration Stock Solution: Using a 500µL syringe, 500µL of Mix # 3 (Restek PETN & Nitroglycerin, NG, at 1000 µg/mL) is injected into a 10mL volumetric flask containing approximately 9.0mL 1:1 acetonitrile and water and diluted to volume with same to make a 10 µg/mL standard. After capping and inverting several times, the solutions are transferred into a labeled, 12ml, teflon-lined, screw-capped vial and stored in the refrigerator in the dark at 4°C or less for up to 30 days. These standards are used to make the calibration curve standards in 1:1 acetonitrile and water at concentrations of 50, 25, 5, 2.5, 0.50 and 0.25 µg/mL. The working calibration standards must be prepared fresh the day of use.

- Matrix/LCS Spike Standard - The 8330 spiking solution is prepared by adding 0.5mL of a solution purchased from Ultra (Combined Stock Solution) in 50mL of acetonitrile for a final concentration of 10 µg/mL. Samples are spiked with 1 mL of this solution.

- Second Source Calibration Solution - The 8330 second source standard is prepared as follows using a solution purchased from Ultra(Combined Stock Solution) and Accustandard Inc.(Mix #3) or an equivalent vendor.

  Second Source Stock Solutions: Using a 100µL syringe, 100µL of Combined Stock Solution (Ultra at 1000 µg/mL) is injected into a 10mL volumetric flask containing approximately 9.5mL 1:1 acetonitrile and water and diluted to volume with same to make a 10 µg/mL standard. After capping and inverting several times, the solution is transferred into a labeled, 12ml, teflon-lined, screw-capped vial and stored in the refrigerator in the dark at 4°C or less for up to 30 days. This standard is used to make a second source check standard 1:1 acetonitrile and water at 1.0 µg/mL.
  Using a 500µL syringe, 500µL of Mix #3(Accustandard at 1000 µg/mL) is injected into a 10mL volumetric flask containing approximately 9.0mL 1:1 acetonitrile and water and diluted to volume with same to make a 10 µg/mL standard. After capping and inverting several times, the solution is transferred into a labeled, 12ml, teflon-lined, screw-capped vial and stored in the refrigerator in the dark at 4°C or

less for up to 30 days. This standard is used to make a second source check standard 1:1 acetonitrile and water at 5.0 µg/mL.

- Surrogate Spike Solution- The 1,2-dinitrobenzene solution (1-Chloro-3-Nitrobenzene may be used as an alternate) is prepared as follows using a standard purchased from Restek or an equivalent vendor.

  Surrogate Spiking Solution: Using a 250µL syringe, 200µL of 1,2-dinitrobenzene, (or 1-Chloro-3-Nitrobenzene), (Restek at 1000 µg/mL) is injected into a 100mL volumetric flask containing approximately 95mL acetonitrile and diluted to volume with same to make a 2.0 µg/mL standard. After capping and inverting several times, the solution is transferred into several labeled, 40ml, teflon-lined, screw-capped vial and stored in the refrigerator in the dark at 4°C or less for up to 30 days. Samples are spiked with 1 mL of this solution.

7.0 PROCEDURE

All waters have a seven-day holding time and soils have a 14-day holding time. Determine the samples necessary to extract as follows:

- Each day a backlog report will be provided indicating sample numbers with the respective analysis required. Line through all the extractions that have been completed and plan to do the remaining analysis within the required holding time.

- Samples requiring RUSH turn around time may be logged in throughout the day which will require your immediate attention. Log-in personnel will generally communicate this need.

- Check with log-in throughout the day and examine the COC (chain of custody) forms that arrive with each set of samples. If an analysis is ongoing, extra QC may be avoided by picking up those extractions on the same day.

- Wearing lab coat, gloves and safety glasses, get samples from cooler. Samples must be signed out of the walk-in refrigerator. Enter the sample numbers, your initials and the date and time removed on the log provided. Inspect as to whether they are in glass(soil)/glass amber jar(water) and have a Teflon lid. Find out if any special dilutions or screens need to be made for this client.

Before extraction, all glassware must be prepared as instructed in SOP-306 . Before weighing, the balance must be calibrated with ASTM Class I weights which bracket the amount to be weighed and recorded in the Extraction temperature/calibration logbook. If a heavy container is to be used for weighing, place a representative container on the balance, tare the balance and then calibrate the balance with the

chosen weights. During extraction, all pertinent information (glassware, amounts, reagent lots, standards, etc.) is recorded in the HPLC 8330 extraction logbook so as to allow reconstruction of the extraction in the future.

7.1 High Level Aqueous Extraction Method

- Before extraction begins get out enough scintillation vials for each sample, method blank, laboratory control sample, matrix spike and matrix spike duplicate. Place an Avery label on each vial containing the following information: Lab #, Client name, Type of Analysis, Initial Volume - Final Volume, and the Lab Prep Batch Code. The lab prep batch code is defined as MMDDYYEW# where #: 1 = 1st Method Blank for the day; 2 = 2nd Method Blank for the day; etc. The Method Blank and LCS label should include all lab #s in this set of samples.

- Place a 5 mL aliquot of each water sample in an appropriately labeled scintillation vial and add 4 mL of acetonitrile (3 mL for MS/MSD samples). Add 1.0 mL of the surrogate standard (2.0 µg/mL) using a 1.0 mL syringe to each sample, method blank and QC sample. Add 1.0 ml of 8330 standard spiking solution to each appropriate QC sample (LCS, MS&MSD). Shake samples thoroughly, and filter through a 0.45mm PTFE filter using a disposable syringe. Discard the first 3 mL of filtrate, and retain the remainder in a Teflon-capped vial for HPLC analysis. HMX quantitation can be improved with the use of methanol rather than acetonitrile for dilution before filtration. **For screening purposes, 1 ml of sample is placed in a 4 ml vial along with 0.5 ml of acetonitrile and 0.5 ml of water.**

7.2 Solid-Phase Extraction

This extraction method may not be appropriate for aqueous samples with greater than 1% suspended solids. Consult SW-846 Method 3535 for additional information.

- Mark the outside of the sample container at the sample meniscus with "white-out". This mark will be used to determine the initial sample volume after processing the contents. Add 1.0 mL of the surrogate standard (2.0 µg/mL) using a 1.0 mL syringe to each sample, method blank and QC sample. Add 1.0 ml of standard spiking solution to each appropriate QC sample (LCS, MS&MSD).

- Assemble the manifold for multiple extractions with SPE cartridges.

- Wash the cartridges with 6 mL acetonitrile 3 times and 6 mL reagent water 6 times with gravity flow, **do not let cartridge go dry**. **If it goes dry, you must start over.**

- Add sample to the cartridge and attach connectors and tubing.

- Turn on the vacuum pump and begin drawing sample through the cartridge, while adjusting the flow to 10mL/min.

- Empty the water trap as needed.

- After the sample extraction is complete draw air through the cartridge for 15 minutes to dry.

- Add 4 mL of acetonitrile to the cartridge and allow it to pass through with gravity flow collecting it in a 12 mL vial. Note: the volume of acetonitrile may be reduced to 3ml to lower detection limits. Place an Avery label on each tube containing the following information: Lab #, Client name, Type of Analysis, Initial Volume - Final Volume, and the Lab Prep Batch Code. The lab prep batch code is defined as MMDDYYEW# where #: 1 = 1st Method Blank for the day; 2 = 2nd Method Blank for the day; etc. The Method Blank and LCS label should include all lab #s in this set of samples. Bring extract up to 4 ml with acetonitrile and add DI water up to 8 ml. Record this volume in the HPLC extraction logbook. The extract is ready for analysis, proceed to Section 8.0.

- Determine the original sample volume by refilling the sample bottle to the mark made with "white out". Transfer the liquid to a plastic 1000-mL graduated cylinder and record the sample volume in the HPLC extraction logbook to the nearest 10-mL. Transfer this information to the Avery label also.

7.3 Soil and Sediment Samples

Dry representative soil samples at room temperature, normally overnight, being careful not to expose the samples to direct sunlight. Grind and homogenize the dried sample thoroughly in an acetonitrile rinsed mortar so it will pass through a 30 mesh sieve. In other words, grind to a fine-dust like particle size. If one grinds the sample down to this small of a partical size, then the sieve would not be required.

NOTE : Soil samples may be screened by a commercially available test kit prior to grinding in a mortar and pestle. Visually observe the sample for lumps of material that have a chemical appearance. These lumps should be suspect and not ground. Explosives are generally a very finely ground grayish-white material. Soil samples as high as 2% 2,4,6-TNT have been safely ground. Samples containing higher concentrations should not be ground in the mortar and pestle. 2,4,6-TNT is the analyte most often detected in high concentration in soil samples.

Grinding of Vegetation Samples

Remove sample from shipping container and brush off dirt particles. Chop sample into about half inch pieces with clippers or other cutting tool. Place the sample in an aluminum pan and air-dry in an exhaust hood to the appropriate dryness for grinding. It should be dry enough where it won't stick to the inside of the mill. Grind the dried sample to fineness in either the manual sample mill or the Wiley mill or both if needed. Place the ground sample in a container and label immediately. Use 6g for extraction.

- Sample Extraction: Get out enough 40 mL vials for each sample, method blank and QC sample to be extracted. Place an Avery label on each vial containing the following information: Lab #, Client name, Type of Analysis, Initial Weight - Final Volume, and the Lab Prep Batch Code. The lab prep batch code is defined as MMDDYYES# where #: 1 = 1st Method Blank for the day; 2 = 2nd Method Blank for the day; etc. The Method Blank and LCS label should include all lab #s in this set of samples. Weigh-out a 2.0 – 2.3 g subsample of each soil (use a blank matrix soil for each method blank and LCS) into the appropriately labeled 40 mL vial. To each QC sample, (LCS, MS&MSD), add 8.0 mL of acetonitrile. Then add 1.0 mL of surrogate (2.0 µg/mL) standard and 1.0 ml of 8330 standard spiking solution. To each sample and method blank add 9.0 mL of acetonitrile and 1.0 mL of surrogate (2.0 µg/mL) standard using a 1.0 mL syringe. Cap each vial with a Teflon-lined cap and place in a shaker for 16-18 hours.
- After shaking, allow the sample to settle (10-15 minutes should be adequate). Add 10mL of calcium chloride and centrifuge samples for 10 minutes. (The calcium chloride solution is added to the samples to coagulate suspended particles and remove them from the supernatant.) Make sure the sample is labeled correctly.

8.0 HPLC ANALYSIS

8.1 Chromatographic Conditions

Agilent Series 1100 HPLC System

- Primary Column: C-18 reverse phase HPLC column, 25 cm x 4.6 mm, 5 µm.
- Mobile Phase: 56% methanol/44%water.
- Flow Rate: 1.0 ml/min.
- Injection Volume: 100 µL.
- UV Detector: 254 nm.(210 nm for PETN and nitroglycerin)
- Temperature: 28 degrees Celsius.

Hewlett Packard Series 1050 HPLC System

- Secondary Column: Phenyl-hexyl HPLC column, 25 cm x 4.6 mm, 5 µm.
- Mobile Phase: 37% acetonitrile/63%water.
- Flow Rate: 1.5 ml/min.
- Injection Volume: 100 µL.
- UV Detector: 254 nm.(210 nm for PETN and nitroglycerin)
- Temperature: 28 degrees Celsius.

8.2 Calibration of HPLC

- Upon initial startup of the pump, flow is increased to 5.0mL/min after opening the purge valve to bleed air from the solvent/water lines. When all air bubbles have been removed, the flow is reduced to normal run conditions and the purge valve is closed. The instrument is then pumped with 100% solvent for 45 minutes and then pumped with the appropriate solvent/water mixture for an additional 45 minutes.
- Initial Calibration: Injections of each calibration standard over the concentration range of interest are sequentially injected into the HPLC. Peak areas or heights are obtained for each analyte. (Peak height may be used instead of peak area for 2,4,6-TNT because degradation products of tetryl appear as a shoulder on the 2,4,6-TNT peak.) The calibration curve should be linear. However, some target analytes may be difficult to optimize without application of quadratic or higher order mathematical functions. Linearity may be determined using linear regression analysis for each target analyte by calculating the correlation coefficient r. Another term used to describe the goodness of fit of the line is coefficient of determination r^2 (the square correlation coefficient). The resulting line would normally not be forced through the origin or use the origin as a calibration point unless it is demonstrated that the intercept of the regression line is not statistically different from zero at 95% level of confidence. Linearity may be evaluated by calculating the percent relative standard deviation (*%RSD*). Alternatively the average response factor (*RF*) for each analyte may be used if the *%RSD* is less than 20%. Linearity is presumed if r is equal to or greater than 0.995, if r^2 is equal to or greater than 0.99 using six points. QC elements and acceptance limits are summarized in Table 1-8, pg. 22, taken from USACE *Appendix 1, Shell for Analytical Chemistry Requirements;* EM-200-1-3 2/01/01. Also found in Table B-2 of the *DoD Quality Systems Manual*, *Version 3*, January, 2006.
    - Due to the lack of resolution between 2-Am-DNT and 4-AM-DNT, calibration of these compounds can be based on “isomeric pairs”. Improved resolution may be obtained using a Supelco C-18 column with eluent of 57%/43% (v/v) methanol and water at 1.0 mL/min.

A visual inspection of the calibration curve should also be used as a diagnostic tool when nonlinear behavior is observed to verify if there is a large percentage error in any particular portion of the calibration curve. If the visual inspection indicates problems, or if one criteria is not met, then evaluate the following items for implementation based on an understanding of the detector response/contaminant concentration relationship.

- Check the instrument operating conditions or the initial calibration standards used and make adjustments to achieve a linear calibration curve.
- Narrow the calibration range using the same number of standards. Generally the highest standard is lowered first. The consequences of all actions taken must also be evaluated, i.e., reduction of the calibration range, raising of the Method Quantitation Limit, MQL, etc.
- Evaluate the use of a nonlinear curve, when applicable. When nonlinear calibration models are used, the resultant line should not be forced through the origin and the origin should not be used as a calibration point. No higher than a third-order (cubic) calibration model shall be used. When a nonlinear calibration model is employed, more data points are needed to maintain at least three degrees of freedom. For example, use of a quadratic function requires at least a six-point initial calibration curve. The resulting r^2 should be greater than or equal to 0.99 for this to be considered acceptable.
- Use of alternative techniques (e.g., relative standard error (RSE) outlined in the USEPA Memorandum, "Clarification Regarding Use of SW-846 Methods" (EPA/SW-846).

The standards used to make the calibration curve are verified to be accurate using a standard obtained from a second source, initial calibration verification (ICV). The percent recovery for the ICV target analytes determined from the initial calibration curve must agree within ± 15% (**80-**120% **DOD QSM Ver. 3**). If not, the source of the problem must be identified before analysis continues.

- Daily Calibration: Continuing calibration verification (CCV) standards must be analyzed, at a minimum, at the beginning of the day, after every 20 samples and at the end of the sequence(**at the beginning and end of sequence and after every 10 field samples, 20%D no average DOD QSM Ver.3**). The response factor for the CCV must agree within 15% of the response factor of the initial calibration. The same criteria is required for subsequent CCV responses compared to the response factor of the CCV beginning the day. If the CCV criteria are not met and a reanalysis does not meet, a new initial

calibration curve may be needed. The same analyte limitations, as mentioned above for initial calibration, for certain compounds that make the stated method acceptance criteria unattainable are evaluated for percent differences, *%D*, for CCVs. Evaluate the mean of the *%D* or percent drift values for all reported target analytes in the calibration verification standard to verify whether it is less than the method acceptance criteria. To avoid the inclusion of target analytes showing gross method failure, this approach may be utilized as long as the target analytes do not exceed the criteria for poor performers in Table 1-8 pg. 22 (same as above). **In addition the client must be notified of all target analytes exceeding method acceptance criteria, the individual *%D* values for those compounds, and the mean *%D* calculated. DOD QSM Ver. 3 does not allow averaging for the CCV.**

8.3 RT Windows

Retention time (RT) windows are determined for each compound through the analysis of 3 standards over a 72 hour period. The standard deviation of the standard retention times is calculated and the RT windows are determined to be ± 3x this standard deviation. New in-house retention time windows are established after every major change to the system (new column or flow) and after a new initial calibration using the mid-point standard. Retention times of each analyte in each CCV are compared to the established retention time window. Each analyte must fall within it's respective RT window. If this criterion is not met, the system must be adjusted to allow another CCV to meet criteria, or a new initial calibration performed and new retention time windows established.

8.4 Sample Analysis

- Samples will be prepared, analyzed and reported in batches and will be traceable to their respective batches. Quality control, QC, samples are required with each batch. A method blank, matrix spike/matrix spike duplicate and laboratory control sample is required for each sample matrix batch(normally sets of 20 samples). See section 9.0 for detail concerning the QC samples.
- Analyze the samples using the same conditions as the standards. Compounds identified on the C-18 column must be confirmed by injection on the Phenyl-hexyl column with an RPD limit of 40%. If the RPD exceeds 40%, results should be evaluated to determine if coelution or matrix is causing the exceedence and the reason noted. In cases of coelution or obvious matrix interference, the lower concentration may need to be reported. If no anomalies are noted, review the chromatographic conditions. If there is no evidence of chromatographic problems, report the higher result. Results should be flagged with a ***'P'*** on the report. (**"J" for DOD QSM projects)**

- Identification of a compound is made if a peak is found within the RT window on the C-18 column and then confirmed on the Phenyl-hexyl column. Column temperature control is employed so retention time shifts should not be a problem.

8.5 Data Reduction/Evaluation

- Each sample analysis sequence is documented in the HPLC run log. After the samples have been analyzed, the data is reduced using Target. All calculations are performed as covered in section 8.6 of this SOP. The following must be checked to determine if the sample will need any reanalysis or dilution:

  1. The initial CCV must be within ±15 % difference of the calibration curve. Each CCV that follows must be within ±15% difference of the calibration curve. Samples analyzed after a CCV which does not meet these criteria must be evaluated per section 8.2 and may require to be reanalyzed with a CCV which meets these criteria. See Table 1-8, pg. 22 (same as above). (**at the beginning and end of sequence and after every 10 field samples, 20%D no average DOD QSM Ver.3**)

  2. Analyte concentration must be within the range of the calibration curve. If an analyte exceeds the curve, a dilution must be performed.

  3. Surrogate recovery must be within the limits established by the laboratory or default values (USACE-Shell, Appendix 1; EM-200-1-3, 2/01/01.) of 60%-140% for water and 50-150% for solids/project sample matrix(**When analyzing samples for DOD QSM Ver. 3 projects, use DOD limits**). If the surrogate recovery falls outside the limits, the sample may need to be reextracted to verify matrix affect or the sample data must be qualified. See Table 1-8, pg. 22 (same as above).

     - After the data has been reduced and determined to be acceptable, it is placed on a sample report and reviewed. Formal data evaluation is detailed in SOP-216 and documented using the USACE Analyst Data Review Checklist for USACE projects (example on pages 20 and 21). Any manual integrations are documented by inclusion of the integrated signals(**before and after manual integration**)initialed, reason and dated with the quantitation report and chromatogram. **Refer to SOP-224 for guidance.**

8.6 Calculations

- Calculate the calibration factor for each analyte at each concentration as:

Peak Area (or Height) of the Compound in the Standard

CF = Mass of the Compound Injected (in nanograms)

- The mean CF is calculated as follows:

$$\overline{CF} = \frac{\sum_{i-1}^{n} CFi}{n}$$

- The standard deviation (SD) and the relative standard deviation (RSD) of the calibration factors for each analyte are calculated as follows:

$$SD = \sqrt{\frac{\sum_{i-1}^{n} (CFi - \overline{CF})^2}{n-1}}$$

$$RSD = \frac{SD}{CF} \times 100$$

- Calibration verification involves the calculation of the percent drift (linear or quadratic) or the percent difference (average) of the instrument response between the initial calibration and each subsequent analysis of the verification standard. Use the equations below to calculate % Drift or % Difference, depending on the calibration procedure used.

$$\% \text{ Drift} = \frac{(\text{Calculated concentration} - \text{Theoretical concentration}) * 100}{\text{Theoretical Concentration}}$$

where the calculated concentration is determined from the initial calibration and the theoretical concentration is the concentration at which the standard was prepared.

$$\% \text{ Difference} = \frac{(\text{CCV CF} - \text{Average CF}) * 100}{\text{Average CF}}$$

- External standard calibration - The concentration of each analyte in the sample may be determined by calculating the amount of standard injected, from the peak response, using the calibration curve. The concentration of a specific analyte is calculated as follows:

<u>Aqueous Samples</u>**:**

Concentration (µg/L) = $[(A_s)(V_t)(D)]/[(\overline{CF})(V_i)(D)]$

where:

A_s = Response for the analyte in the sample, units may be in area counts or peak height.

V_t = Total volume of the concentrated extract..

D = Dilution factor, if dilution was made on the sample prior to analysis. If no dilution was made, D = 1.

$\overline{CF}$ = Mean calibration factor from initial calibration (area/ng)

V_i = Volume of extract injected, µL.

V_s = Volume of aqueous sample extracted, mL.

Using the units specified here for these terms will result in concentration units of ng/mL, which is µg/L.

<u>Nonaqueous Samples</u>**:**

Concentration (µg/kg) = $[(A_s)(V_t)(D)]/[(\overline{CF})(V_i)(W_s)]$

where:

W_s = Weight of sample extracted, g. The wet weight or dry weight may be used, depending upon the specific applications of the data.

A_s, V_t, D, $\overline{CF}$ and V_i have the same definition as for aqueous samples.

9.0 QUALITY ASSURANCE/QUALITY CONTROL/CORRECTIVE ACTIONS

9.1 Surrogate - All samples and QC are spiked with the surrogate. The surrogate recoveries from method blanks, LCS and samples are charted to generate control limits. Default limits (USACE-Shell Appendix 1; EM-200-1-3; 2/01/01) are set at 60-140% for water and 50-150% for

solids/project sample matrix. Surrogate recoveries must be within these limits for all samples and QC or reextraction/reanalysis may be performed to verify matrix affect. If matrix affect is confirmed or it is decided not to reextract/reanalyze, a corrective action report must be completed and forwarded within the same shift in which the problem was discovered. Also, the data must be flagged for QC problems on the final report. See Table 1-8, pg. 22 (same as above).**DOD limits will be used for DOD QSM Ver. 3 projects.**

9.2 LCS Sample - The LCS is analyzed at the frequency required by the regulatory agency or client (every batch or 20 samples, whichever comes first, for USACE projects). To prepare the LCS, a blank is spiked with the calibration standards. The recoveries are charted to generate control charts and limits. The default limits (USACE-Shell Appendix 1; EM-200-1-3; 2/01/01) are 60-120% recovery for waters and soils if the generated limits are wider or if limits have not yet been generated. If the LCS compound has a recovery above the upper limit, but the same compound is not detected in any of the batch samples, no corrective action is required. For all other situations, the LCS should be reanalyzed for the failed analytes only. If the second analysis fails, all associated samples should be reextracted/reanalyzed for the failed analytes only. All recovery problems need to be addressed and steps taken to locate their source. **DOD limits will be used for DOD QSM Ver. 3 projects.**

9.3 Method Blanks - The concentration of all method target analytes must be below ½ of the method reporting limit, MRL (USACE-Shell, Appendix 1; EM-200-1-3, 2/01/01; threshold value below which a result is reported as non-detected), for each method target analyte. The first step of corrective action is to assess the effect on the samples. If an analyte is found only in the method blank, but not in any batch samples, no further corrective action may be necessary. Steps should be taken to find/reduce/eliminate the source of this contamination in the method blank. If an analyte is found in the method blank and some, or all, of the other batch samples, then corrective action is required. The source of contamination must be investigated and appropriate action taken and documented to find/reduce/eliminate the source of this contamination. The method blank, and any samples containing the same contaminant, would likely be reextracted/reanalyzed. If a contaminant is found in the method blank and the samples, the compound concentration must be flagged with a 'B' on the final report unless the concentration is greater than 10x that found in the method blank. In any case, a corrective action report must be completed and forwarded within the same shift in which the contaminant is found.

9.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD) Sample - 1 in 20 samples are spiked for a MS/MSD. MS/MSD recovery limits are set at 50-140% recovery with a maximum RPD of 50% for normal analytes and 60% for poor performers (See Table 1-8 pg. 22; same as above). Generally, batch control is not based on MS/MSD results unless general

method failure is determined to be the problem. In that case, the samples and associated QC would be reanalyzed for the failed analytes only. MS data evaluation must include the consideration of the following factors. **DOD limits will be used for DOD QSM Ver. 3 projects.**

9.4.1 Sample matrix - If the sample is a soil, grab sample or sequentially collected water sample it may affect the %R and RPD of the MS/MSD. Corrective action must be taken in the form of reanalysis if a method problem is indicated.

9.4.2 Original sample concentration - If a spiked compound has a problem and the concentration of that compound in the original sample was two or more times the concentration of the spike, no further corrective action may be necessary other than the generation of a corrective action report to document the problem.

9.4.3 MS vs. MSD - If a spiked compound has a similar problem in the MS and the MSD which is not traceable to the execution of the method, no further corrective action may be necessary other than the generation of a corrective action report to document the problem as matrix effect.

9.4.4 Non-target Interference - The presence of significant non-target interference should be brought to the immediate attention of your supervisor who should discuss the problem with the client/project manager to determine the action to be taken.

9.4.5 Documentation of Capability (DOC) - Each analyst must perform a DOC to demonstrate proficiency with this method. See SOP-414 for guidance.

9.4.6 MDLs are performed annually or when there is a change in the method or MDL checks are analyzed quarterly per DOD QSM Ver.3. See SOP-414 for details.

10.0 HEALTH, SAFETY, WASTE MANAGEMENT AND POLLUTION PREVENTION

10.1 Standard precautionary measures used for handling other organic compounds should be sufficient for the safe handling of the analytes targeted by Method 8330A. The only extra caution that should be taken is when handling the analytical standard neat material for the explosives themselves and in rare cases where oil or waste samples are highly contaminated with the explosives. The HMX, RDX, Tetryl, and 2,4,6-TNT are explosives and the neat material should be handled carefully. Drying at ambient temperature requires several days. Do not dry at heated temperatures!

10.2 Care should be used in handling all samples. Safety glasses must be worn in the lab at all times. The use of blue nitrile gloves and lab coats is highly recommended.

10.3 Research into expected sample content and concentration should be done in order to be prepared for additional safety considerations. Generally, any samples which need special consideration have applicable notes on the sample logs.

10.4 MSDS sheets are available for all reagents and standards which have been purchased. These are located in the office next to the technical director.

10.5 Please see Waste Disposal SOP-405, for instruction of proper disposal of waste generated from this area. Quantity of chemicals purchased should be based on expected usage during its shelf-life and the disposal cost of unused material. Actual reagent preparation volumes should reflect anticipated usage and reagent stability.

REFERENCES

1. *40 CFR, Part 136*; Appendix A
2. *Test Methods for Evaluating Solid Waste*, SW-846, Third Edition
3. *National Environmental Laboratory Accreditation Conference*; Chap. 5, 2003
4. USACE, *EM 200-1-3; Appendix 1; Shell*, 2/2001
5. *DOD Quality Systems Manual for Environmental Laboratories*, Ver. 3, Jan. 2006.

ANALYST DATA REVIEW CHECKLIST

Sample Number(s):	
Batch Number(s):	
Method:	**8330**

QA/QC Item	Yes	No	NA	Second Level Review
A. Initial Calibration				
1. Does the curve consist of at least five Calibration Standards?				
2. Is the low RL standard in the calibration curve?				
3. Are the % RSDs within QC limits for all analytes?				
B. Second Source Verification				
1. Was the initial calibration curve verified by a second source calibration standard (ICV) and have QC criteria been met?				
C. Continuing Calibration				
1. Are the Continuing Calibration Verification (CCV) standards analyzed every 20 samples and at the end of the sequence?				
2. Are the % differences within QC limits for all analytes?				
D. Sample Analysis				
1. Are all sample holding times met?				
2. Was pH checked and recorded for all water samples?				
3. Are all samples with concentrations > the highest standard used for initial calibration diluted and reanalyzed?				
4. Are all compounds identified on the primary column confirmed on the secondary column?				
5. Are Surrogate recoveries within QC limits?				

ANALYST DATA REVIEW CHECKLIST
8330 (Explosives)

QA/QC Item	Yes	No	NA	Second Level Review
E. QC Samples				
1. Is the Method Blank extracted at the desired frequency and is its concentration for target analytes less than ½ the MRLs?				
2. Is the Laboratory Control Sample and its percent recovery within QC limits?				
3. Is the Matrix Spike/Matrix Spike Duplicate extracted at the desired frequency and is the percent recovery/RPD within QC limits?				
F. Others				
1. Are all nonconformances included and noted?				
2. Are all calculations checked at the minimum frequency?				
3. Did analyst initial/date the appropriate printouts and report sheets?				
4. Are all sample ID and units checked for transcription errors?				
5. Are all manual integrations checked by a second reviewer to verify why they were performed?				

Comments on any "No" response:

Analyst: _____ _____

Second Level Review: _____ _____

Table I-8

Summary of measurement quality objectives for Method 8330 Explosives (USACE – Shell 2/01)

QC Element	Target Analyte/Surrogate	Poor Performers/Sporadic Marginal Failures[1]
Initial Calibration (I.9.2.2.8)	Primary Evaluation: r ≥ 0.995, RSD ≤ 20%, r^2 ≥ 0.990 Alternative Evaluation: Mean %RSD for all target analytes ≤ 20% with maximum allowable restriction noted at right for individual analytes.	No allowance Alternative Evaluation: Maximum allowable %RSD for each individual target analyte ≤ 40%
ICV (I.9.3)	%Rec = 85% - 115%	No allowance
CCV (I.9.5/I.9.5.2)	Primary Evaluation: %Drift ± 15%, %D ± 15% Alternative Evaluation: Mean %Drift/%D for all target analytes ≤ 15%, with maximum allowable restriction noted at right for individual analytes.	**No allowance** Alternative Evaluation: Maximum allowable %Drift/%D for each individual target analyte is ± 30%
MB (I.10.2.1/I.11.4.1)	Target Analytes: Analytes < one-half MRL	Not applicable
LCS (I.10.2.2/I.11.4.2)	Water: %Rec = 60% - 120%[2] Solids: %Rec = 60% - 120%[2]	Sporadic Marginal Failures[1]: %Rec = 40% - 150%
MS (I.10.2.4/I.11.4.3/I.11.4.3.2)	%Rec = 50% - 140%[2]	Sporadic Marginal Failures[1]: %Rec = 40% - 150%
MSD/MD (I.10.2.2/I.11.4.4)	RPD ≤ 50%	RPD ≤ 60%
Surrogates (I.10.2.5/I.11.4.5)	Interference-Free Matrix: Water: %Rec = 60% - 140% Solids: %Rec = 50% - 150% Project Sample Matrix: %Rec = 50% - 150%	Not applicable
Target Analyte Confirmation (I.12.3)	RPD ≤ 40%	RPD ≤ 40%

[1] The number of sporadic marginal failure (SMF) allowances depends upon the number of target analytes reported from the analysis. For instance, if between 7 to 15 explosives are reported from the high-performance liquid chromatography analysis, 1 SMF is allowed to the expanded criteria presented for the LCS. If greater than 15 explosives are reported, 2 SMFs are allowed for the LCS. If the MS includes only a subset of compounds, allow only 1 SMF for this QC element.

[2] Due to the tendancy for Tetryl to decompose, an expanded criteria may be applied at 45% -140% for both the water and soil matrices.

QA Control Code: A2070102

SOP Name:	Trace Elemental Analysis by Inductively Coupled Plasma-Mass Spectrometric Method
SOP ID:	M6020/6020A-Metals ICPMS-13
Revision #:	13
Date Created:	January 22, 2004
Effective Date:	May 23, 2011
Reason for Revision:	SOP review
Supercedes:	M6020/6020A-Metals ICPMS-12

Approvals:

Analyst	05/18/11 Date
Supervisor	5/18/11 Date
QA/QC Director	5/18/11 Date
Technical Director	5/18/11 Date

"The technical information contained herein is to be considered confidential and proprietary and is not to be disclosed, copied, or otherwise made available to other parties without the express written consent of Chemtech."

TRACE ELEMENTAL ANALYSIS BY INDUCTIVELY COUPLED PLASMA – MASS SPECTROMETRIC METHOD

1. Test Method

1.1 Trace Elemental Analysis by Inductively Coupled Plasma-Mass Spectrometric Method using USEPA Test Methods SW 846 6020/6020A.

2. Applicable Matrices

2.1 Fresh (surface and ground) water and wastewater
2.2 Sediments, sludges, and soils
2.3 Industrial waste

3. Detection Limits

3.1 See Appendix A for Reporting limits.

4. Scope and Application

4.1 This method is utilized for the determination of ppb levels of a trace element.
4.2 No digestion is required for dissolved metals analysis. Samples must be filtered and acid preserved prior to analysis for dissolved elements.
4.3 The use of internal standard is required for each analyte determined by ICPMS

5. Summary of Method

5.1 Samples must be digested before analysis using methods SW 846 3005, 3010 or 3050.
5.2 The method measures ions produced by a radio-frequency inductively coupled plasma.
5.3 Analyte species originating in a liquid are nebulized and the resulting aerosol transported by argon gas into the plasma torch.
5.4 The ions produced are entrained in the plasma gas and introduced, by means of an interface, into a mass spectrometer. The ions produced in the plasma are sorted according to their mass to charge ratios and quantified with a channel electron multiplier.

6. Definitions

6.1 Aliquot - A measured portion of a field sample, standard, or solution taken for sample preparation and/or analysis.
6.2 Analysis Date/Time - The date and military time (24-hour clock) of the introduction of the sample, standard, or blank into the analysis system.
6.3 Analyte - The element, ion, or parameter an analysis seeks to determine; the element of interest.
6.4 Analytical Sample - Any solution or media introduced into an instrument on which an analysis is performed, excluding instrument calibration, initial calibration verification (ICV), initial calibration blank (ICB), continuing calibration verification (CCV), continuing calibration blank (CCB), and tunes. Note the following are all defined as analytical sample: undiluted and diluted

samples, matrix spike samples, duplicate samples, serial dilution samples, analytical spike samples, post-digestion spike samples, interference check samples (ICSs), Contract Required Quantitation Limit (CRQL) Check Standards (CRIs), Laboratory Fortified Blanks (LFBs) Laboratory control Samples (LCSs), performance Evaluation (PE) samples, Preparation Blanks (PBs), and Linear Range Samples (LRSs).

6.5 Analytical Sequence - The actual instrumental analysis of the samples from the time instrument calibration through the analysis of the final CCV or CCB.

6.6 Analytical Spike - A spike that is fortified just prior to analysis by adding a known quantity of the analyte to an aliquot of the prepared sample.

6.7 Background Correction - A technique to compensate for variable background contribution to the instrument signal in the determination of trace elements.

6.8 Batch - A group of sample designed to assess specific sources of contamination. See individual definitions for types of blanks.

6.9 Blank - An analytical sample designed to assess specific sources of using the same method.

6.10 Calibration - The establishment of an analytical curve based on the absorbance, emission intensity, or other measured characteristics of known standard. The calibration standards must be prepared using the same type of reagents or concentration of acids as used in the sample preparation.

6.11 Calibration Blank - A blank solution containing all of the reagents and in the same concentration as those used in the analytical sample preparation. This blank is not subjected to the preparation method.

6.12 Calibration Standards - A series of known standard solutions used by the analyst for calibration of the instrument (i.e., preparation of the analytical curve). The solutions may not be subjected to the preparation method but contain the same matrix (i.e., the same amount of reagents and/or preservatives) as the sample preparations to be analyzed.

6.13 Contamination - A component of a sample or an extract that is not representative of the environmental source of the sample. Contamination may stem from other sample, sampling equipment, while in transit, from laboratory reagents laboratory environment, or analytical instruments.

6.14 Continuing Calibration Verification (CCV) - A single parameter or multi-parameter standard solution prepared by the analyst and used to verify the stability of the instrument calibration with time, and the instrument performance during the analysis of samples. The CCV can be one of the calibration standards. However, all parameters being measured by the particular system must be represented in this standard and the standard must have the same matrix (i.e., the same amount of reagents and/or preservatives) as the samples.

6.15 Contract Required Quantitation Limit (CRQL) Check Standard (CRI) - A single parameter or multi-parameter standard solution prepared at the CRQL and used to verify the instrument calibration at low levels.

6.16 Control Limits - A range within which specified measurement results must fall to be compliant. Control limits may be mandatory, requiring corrective action if exceeded, or advisory, requiring that noncompliant data be flagged.

6.17 Digestion Log - An official record of the sample preparation (digestion).

6.18 Dissolved Metals - Analyte elements in a water/aqueous sample that will pass through a 0.45 micrometer (um) filter.

6.19 Dry Weight - The weight of a sample based on percent solids. The weight obtained after drying in an oven.

6.20 Duplicate - A second aliquot of a sample that is treated the same as the original sample in order to determine the precision of the method.

6.21 Field Blank - This is any sample that is submitted from the field is an identified as blank. This includes trip blank, rinsates, equipment blanks, etc.

6.22 Field QC - Any Quality Control sample submitted form the field to the laboratory. Examples include, but are not limited to: field blanks, field duplicates, and field spikes.

6.23 Field Sample - A portion of material received for analysis that is contained in single or multiple containers and identified by a unique sample number.

6.24 Holding Time - The elapsed time expressed in days from the date of receipt of the sample by the Contractor until the date of its analysis. Holding time = (sample analysis date- sample receipt date)

6.25 Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES) – A technique for the simulation or sequential multi-element determination of elements in solution. The basis of the method is the measurement of atomic emission by an optical spectroscopic technique. Characteristic atomic line emission spectra are produced by excitation of the sample in a radio frequency inductively coupled plasma.

6.26 Initial Calibration - Analysis of analytical standards for a series of different specified concentrations; used to define the quantitative response, linearity, and dynamic range of the instrument to target analytes.

6.27 Initial Calibration Verification (ICV) – Solution (s) prepared from stock standard solutions, metals or salts obtained form a source separate from that utilized to prepare the calibration standards. The ICV is used to verify the concentration of the calibration standards and the adequacy of the instrument calibration. The ICV should be traceable to NIST or other certified standard source.

6.28 Interference Check Sample – A solution containing both interfering and analyte elements of known concentration that can be used to verify background and interelement correction factors.

6.29 Interferents – Substances that affect the analysis for the element/parameter o interest.

6.30 Laboratory Control Sample (LCS) – A control sample of known composition. Laboratory control samples are analyzed using the same sample preparation, reagents, and analytical methods employed for the samples received.

6.31 Linear Range, Linear Dynamic Range – The concentration range over which the instrument response remains linear.

6.32 Matrix – The predominant material of which the sample to be analyzed is composed.

6.33 Matrix Effect – In general, the effect of particular matrix constituents.

6.34 Matrix Spike – Aliquot of sample (water/aqueous or soil) fortified (spiked) with known quantities of specific compounds and subjected to the entire analytical

procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery.

6.35 Method Detection Limit (MDL) – The concentration of a target parameter that, when a sample is processed through the complete method, produces a signal with 99 percent probability that it is different from the blank. For 7 replicates of the sample, the mean value must be 3.14s above the blank, where "s" is the standard deviation of the 7 replicates.

6.36 Narrative (SDG Narrative) – Portion of the data package which includes laboratory, contract, Case, sample number identification, and descriptive documentation of any problems encountered in processing the samples, along with corrective action taken and problem resolution.

6.37 Percent Difference (% D) – As used in this SOW and elsewhere to compare tow values. The difference between the two values divided by one of the values.

6.38 Percent Solids (% S) – The proportion of solid in a soil sample determined by drying an aliquot of the sample.

6.39 Preparation Blank – An analytical control that contains reagent water and reagents, which is carried through the entire preparation and analytical procedure.

6.40 Preparation Log – An official record of the sample preparation (digestion, distillation, and extraction).

6.41 Reagent Water – The purity of this water must be equivalent to ASTM Type II reagent water of Specification D1193-77, "Standard Specification for Reagent Water".

6.42 Relative Percent Difference (RPD) – The relative percent difference is based on the mean of the two values, and is reported as an absolute value, i.e., always expressed as a positive number or zero.

6.43 Run – A continuous analytical sequence consisting of prepared samples and all associated Quality Assurance (QA) measurements. A run begins with the instrument calibration and is to be completed within a 24-hour period.

6.44 Sample – A portion of material to be analyzed that is contained in single or multiple containers and identified by a unique sample number.

6.45 Sensitivity – The slope of the analytical curve (i.e., functional relationship between instrument response and concentration).

6.46 Serial Dilution – The dilution of a sample by a factor of five. When corrected by the dilution factor, the diluted sample must agree with the original undiluted sample within specified limits. Serial dilution may reflect the influence of interferents.

6.47 Standard Analysis – An analytical determination made with known quantities of target analytes.

6.48 Stock Solutions – A standard solution that can be diluted to derive other standards.

7. Interferences

7.1 Isobaric elemental interferences in ICP-MS are caused by isotopes of different elements forming atomic ions with the same nominal mass-to-charge

7.1.1 To correct this determine the signal of another isotope of the interfering element. Subtract the signal from the analyte isotope signal.

7.2 High ion currents at adjacent masses can also contribute to ion signals at the mass of interest.

7.3 Ions consisting of more than one atom or charge can cause Isobaric molecular and doubly–charged.

7.4 Physical interferences are generally considered to be effects associated with sample nebulization and transport processes such as change in viscosity, surface tension, high dissolved solids and acid concentration.

7.4.1 If such interferences are encountered, sample dilution may be performed. Additionally, when the presence of high dissolved solids is suspected, acidified Type II water is analyzed before and after each sample of the sample batch in order to reduce the potential for salt build up on the nebulizer tip.

7.5 Memory interferences can occur when there are large concentration differences between samples or standards, which are analyzed sequentially.

7.6 Sample deposition on the sampler, spray chamber design and the type of nebulizer affect the extent of the memory interferences that are observed.

7.6.1 Set the rinse period between samples long enough to eliminate significant memory interference.

7.7 Any kind of interference is noted in the case narrative.

8. Safety

8.1 The toxicity and carcinogenity of each reagent used in this method has not been fully established. Each chemical should be regarded as a potential health hazard and exposure to these compounds should be minimized.

8.2 Always wear safety glasses for eye protection when working with these reagents.

8.3 Use protective gloves when handling the chemicals.

8.4 Analytical Plasma sources emit radio frequency radiation in addition to intense UV radiation. Suitable precautions should be taken to protect personnel from such hazards. The inductively coupled plasma should only be viewed with proper eye protection from UV emissions.

9. Equipment and Supplies

9.1 X series ICP-MS with Dell Windows 2000- Computer System, IBM Proprinter III

9.2 pH paper (0-2.5)

9.3 Class A volumetric pipettes 10-100 mL

9.4 Eppendorf Pipettes 10-1000mL

9.5 Analytical Balance - VWR G400 - DO

9.6 Argon Gas (99.998% pure)

9.7 Nitrogen Gas (99.998% pure)

9.8 4-oz plastic bottles

10. Reagents and Standards

10.1 Concentrated Nitric Acid (Trace metals Analyzed)

10.2 1:1 Hydrochloric Acid (Trace metals Analyzed)*

10.3 1:1 Nitric Acid (Trace Metals Analyzed)*

10.4 Type II water (DI water)

10.5 See Table 1 for standards information.
10.6 MS tuning solution
10.7 Resolution check

11. Sample Handling and Preservation

Matrix	Container Type	Preservative
Water	Glass or Polyethylene	HNO_3 to pH <2
Sediment/Sludge/Soil	Glass or Polyethylene	Maintain at 4C ±2°C
Holding times	180 days	

12. Quality Control

12.1 Calibration
- 12.1.1 Calibrate the instrument prior to each analytical run.
- 12.1.2 Indicate the date and time of calibration on the raw data.
- 12.1.3 Perform standardization for all of the elements.

12.2 Tuning Solution
- 12.2.1 Analyze a tune standard before the calibration.

12.3 Spectral Interference Check Solutions (SIC)
- 12.3.1 Due to the unique configuration of each ICP, and the uniqueness of the methods, check all elements for their interfering properties.
- 12.3.2 Determine the linear ranges for all elements in the method quarterly.

12.4 Initial Calibration Verification (ICV)
- 12.4.1 Conduct an ICV on an independent quality control standard.
- 12.4.2 Run ICV at a concentration other than that used for instrument calibration but within the calibration range for Method 6020.
- 12.4.3 Run ICV at mid-level and low-level concentrations for Method 6020A.
- 12.4.4 Analyze the ICV in order to verify the instrument calibration.

12.5 Initial Calibration Blank (ICB)
- 12.5.1 Analyze an ICB immediately following the ICV at each element wavelength used for analysis.

12.6 Interference Check Sample (ICS)
- 12.6.1 Analyze an ICS solution (consisting of the interferents and analyte elements) in order to assess the interelement interferences.
- 12.6.2 Run this solution at all wavelengths used for each analyte for a given analytical run.
- 12.6.3 Analyze the ICS solution at the beginning of the analytical run.
- 12.6.4 See Table 1 and Table 4 for details pertaining to the preparation of this solution.

12.7 Continuing Calibration Verification (CCV)
- 12.7.1 Prepare the CCV by using the same standards used for calibration at a concentration near the mid-point of the calibration curve.
- 12.7.2 In addition, for Method 6020A, prepare a low-level continuing calibration verification (LLCCV) standard at the lower limit of quantitation (LLCCV standard = S1, See Table 1 and 2).
- 12.7.3 Analyze the CCV every 10 samples and after the last analytical sample.

12.7.4 For Method 6020A, analyze LLCCV standard at the end of the analytical run.

12.8 Continuing Calibration Blank (CCB)

12.8.1 Analyze the CCB immediately following the CCV.

12.9 Preparation Blank (PB)

12.9.1 Process one PB consisting of Type II water through the sample preparation and analysis procedure for each sample batch.

12.10 Laboratory Control Sample

12.10.1 Analyze aqueous and solid LCSs for each analyte using the same sample preparations, analytical methods and QA/QC procedures employed for the samples received except field blank.

12.10.2 Use the solutions used to prepare Spike 2 and 2A to prepare the LCSW for Method 6020.

12.10.3 Spike at approximately mid-point of the linear dynamic range for Method 6020A.

12.10.4 Prepare one LCS for each sample batch and/or matrix.

12.11 Spike Sample Analysis (S)

12.11.1 Perform at least one aqueous spike sample analysis on each group of samples of a similar liquid matrix.

12.11.2 In the case of sediment, sludge, and soil batch, perform a duplicate spike on a sample of a single ID.

12.11.3 Analyze these spiked samples at a frequency of 20 samples or per digestion batch or per matrix.

12.11.4 Add the spike to the sample prior to any reagent addition or digestion.

12.11.5 If the spike analysis is performed on the same sample that is chosen for the duplicate analysis, perform spike calculations using the result of the sample designated as the original sample.

12.11.6 Field blanks are not used for spiked sample analysis.

12.12 Duplicate Sample Analysis (D)

12.12.1 Analyze one duplicate sample from each group of samples of a similar matrix type in each sample batch.

12.12.2 Analyze duplicate samples at a minimum frequency of 20 samples or per digestion batch or per matrix. Do not average duplicate sample results.

12.12.3 Do not use field blanks for duplicate sample analysis is performed for each method employed.

12.13 ICP Serial Dilution Analysis (L)

12.13.1 Perform the ICP Serial Dilution Analysis on a sample from each group of samples of a similar matrix and for each sample batch.

12.14 Linear Range Analysis

12.14.1 Conduct the linear range studies every six months.

12.14.2 Run solutions of individual analytes at the existing high value of the linear curve.

12.16 Instrument Detection Limit

12.16.1 An IDL is determined for each analyte quarterly.

12.16.2 Determine the IDL by analysis of seven standard solutions at a concentration of three to five times the expected IDL.

12.16.3 Process the standard solution through the same analytical procedure that would be used for the samples.

12.16.4 Multiply the averages of the standard deviations obtained for each analyte by 3.14, and this mathematical product becomes the IDL.

12.16.5 Since it is only possible to determine annual IDLs for each analyte using reagent water as the matrix, the IDLs reported for real world samples are generally higher.

12.16.5.1 These levels represent the lowest concentrations that can be responsibly reported for a variety of samples, taking into consideration less than ideal matrices and conditions, which make reporting down to a theoretical IDL impractical.

12.17 Reporting Level Standard CRI

12.17.1 Run a reporting level standard or CRI at the beginning of every calibration. Run LLQC standard, prepared in the same manner as the CRI standard at the reporting level concentration and processed through all the preparation and analytical procedures, at the beginning of every calibration.

12.17.2 This standard, called lower limit of quantitation check (LLQC) sample, must be carried through the entire preparation and analytical procedure for analysis by Method 6020A.

12.17.4 For DoD work, set CRI at the required reporting level.

12.18 Limit of Detection (LOD)

12.18.1 Establish LOD by spiking a quality system matrix at approximately 2-3X the detection limit for single analyte tests and 1-4X detection limit for multiple analyte tests.

12.18.2 LOD is specific to each combination of analyte, matrix, method (including sample preparation) and instrument configuration.

12.18.3 LOD must be verified quarterly.

12.18.4 LOD must be verified on each instrument used, and every time the method is modified.

12.19 Limit of Quantitation (LOQ)

12.19.1 LOQ must be greater than the LOD.

12.19.2 LOQ must be verified quarterly for each quality system matrix, method and analyte, by analyzing QC sample containing the analytes of concern in each quality system matrix 1-2X the claimed LOQ.

12.19.3 LOQ must be performed if the method is modified.

13. Calibration and Standardization

13.1 Analyze the tune standard five times and calculate the %RSD.

13.1.1 The % RSD must meet $\leq$ 5%.

13.1.2 The peak width must be between 0.65-0.85 amu at 5% peak width.

13.2 Calibrate the instrument prior to each analytical run (for calibration standard levels refer to Table 1.

13.2 Blank (S0): Use reagent blank as a calibration blank standard.

13.3 Calibration Standards (S): Use the ICPMS calibration standards available form Inorganic Ventures, Inc.

13.4 Run an initial calibration verification standard from a second source immediately after the calibration (ICV).

13.5 Calculate the linear regression.

13.5.1 The linear regression must be r>0.998 or better.

13.5.2 If the linear regression is not met, recalibrate the instrument.

14. Sample Preparation

14.1 For digestion of soil samples, use Method SW846 3050B and for digestion of water samples, use Method SW846 3010A.

14.2 Analytical Procedure

14.2.1 ICP MS Startup

14.2.1.1 Start instrument for at least 30 min to stabilize.

14.2.1.2 Analyze the tuning solution five times

14.2.1.3 The relative standard deviation of these five readings must be ≤5% for all analytes.

14.2.1.4 Analyze a Mass Calibration and Resolution checks

14.2.1.4.1 Mass Calibration of interest must not vary for more than 0.1amu.

14.2.1.4.2 The resolution check must be less than 0.9amu.

14.2.2 Calibration

14.2.2.1 Calibrate the instrument using the analytical sequence listed on section 14.6.

14.2.2.2 Verify the calibration with the ICV before proceeding to the sample analysis.

14.2.2.3 Flush the instrument with a rinse blank after every standard sample or QC sample is analyzed.

14.2.3 Analyze the ICV and ICB immediately after the calibration.

14.2.4 Analyze the ICSA, ICSAB at the beginning of the analytical run, and CCV, CCB every 10 samples.

Note: Analysis is done in multiple mass of measurement. We reserve the right, in case of interference, to use a different mass to report the results than those listed in Appendix B.

14.3 Sample Analysis

Note: Once the instrument has been checked for performance (tune), it is ready for calibration and sample analysis.

14.3.1 Perform three injections for each run.

14.4 Analytical Run

A typical sequence in an analytical run for trace elements analysis is as follows:

Initial Analytical Run	Continuing Analytical Run
• Tuning Check	10 Samples
• STD-S0 (Blank)	CCV
• STD-S1	LLCCV (Method 6020A only)

- STD-S2 CCB
- STD-S3
- STD-S4
- STD-S5
- ICV (Initial Calibration Verification)
- Mid-level and low-level ICV (Method 6020A only)
- ICB (Initial Calibration Blank)
- CRI
- LLQC (Method 6020A only)
- ICSA
- ICSAB
- CCV
- CCB
- PBW or PBS (Preparation Blank W-Water or S-Soil)
- LCSS or LCSW(Laboratory Control Sample)
- 8 Samples
- CCV
- LLCCV (Method 6020A only, at the end of analytical run)
- CCB

15. Calculations

15.1 The ICPMS is a direct readout instrument in ppb. The result need only to be corrected for preparation and dilution factors, if any, and reported to three significant figures.

15.1.1 For soil samples: The concentrations in the digestates are to be reported on the basis of the dry weight of the sample with the following equation:

$$\text{Concentration dry weight (mg/Kg)} = \frac{C \times V}{W \times S}$$

Where:	C	=	Concentration in mg/L
	V	=	Final volume in liters
	W	=	Weight in kg of wet sample
	S	=	Percent solids ÷ 100

15.2 Calculations applied to the quality control samples are outlined in the Quality Control Section (see Section 18).

16. Method Performance

16.1 Precision and accuracy data are obtained for Trace Elements using laboratory fortified blank with trace elements concentrations.

16.2 Method detection limits are obtained using the spiking concentration that is 1-10X the expected MDL.

17. Pollution Prevention

17.1 Use only the amounts of chemicals required.

17.2 Do not make large quantities of solutions.

17.3 Use hood when working with acids.

17.4 Keep the area clean and clutter free in the digestion lab and around the instruments in order to avoid any mishaps.

17.5 Keep chemicals away from drains.

17.6 Properly collect and dispose of waste according to Chemtech Waste Disposal SOP.

17.7 Laboratory is properly equipped with spill cleanup equipment and laboratory personnel are trained. Depending upon the size and type of spill, it may be handled by the individual or department creating the spill or by specially trained personnel.

17.8 Small spills may occur routinely and shall be handled by the individual person or department creating the spill. Spill kits are stored in a blue basket or blue cover bin located in each laboratory and chemical storage area. The spill kits can handle water based, solvent and mercury spills. Specially trained personnel handle larger spills, which may pose a threat to health or environment involves a large volume not easily contained.

17.9 A detailed description of the procedure for handling a spill or accident is covered in the CHEMTECH Emergency and Contingency Plan.

17.10 The Safety Coordinator is responsible for implementing the Chemical Hygiene and the CHEMTECH Emergency and Contingency Plans. It is the responsibility of various company personnel to assist in implementing the different aspects of the Plan. These include: Laboratory Coordinator, Technical Director, Operations Manager, Department Managers and Supervisors.

18. Data Assessment and QC Criteria

18.1 Initial Calibration

18.1.1 Verify that the calibration meets r=0.998 or better.

18.2 Initial Calibration Verification (ICV)

18.2.1 Ensure that agreement between the true value and the actual value is ±10% for Method 6020.

18.2.2 Ensure that the agreement between the true value and the actual value is ±10% for the mid-level standard and ±30% for the low-level standard for Method 6020A.

18.3 Initial Calibration Blank (ICB)

18.3.1 The magnitude (absolute value) of the calibration blank should not exceed CRQL.

18.4 Interference Check Sample (ICS)

18.4.1 Verify the interelement and background correction factors at the beginning of each analytical run. Do this by analyzing the ICS. Confirm that the results are within ±20% of the true value.

18.4.2 For analytes not present in the Interference check solution, the concentration found must be within a range equal to ± the analyte CRQL.

18.4.3 For DoD work, the concentration of the analytes not present in the ICSA solution must be <2 X MDL, unless they are verified trace impurity from one of the spiked analysis.

18.5 Continuing Calibration Verification (CCV)

18.5.1 Ensure that agreement between true value and the actual value for the CCV is ±10%.

18.5.2 Ensure that agreement between true value and the actual value for the LLCCV standard is ±30% for Method 6020A.

18.6 Continuing Calibration Blank (CCB)

18.6.1 The acceptance criteria are the same for the CCB as the ICB (See Section 18.3).

18.7 Preparation Blank (PB)

18.7.1 If the absolute value of the concentration of the blank is less than the CRQL for each target analyte, don not take any corrective action.

18.7.2 If any target analyte concentration in the blank is above the CRQL it is out-of-control.

18.7.3 Redigest any samples associated with that blank along with a new preparation blank.

18.7.4 If, however, the target analyte concentration is at least 10 times the blank concentration, report the results.

18.7.5 Do not correct the sample concentration for the blank value.

18.7.6 If the concentration is below the negative MDL, redigest any sample not at least 10 times the MDL for that target analyte along with a reanalysis of new preparation blank.

18.7.7 For DoD work, the acceptance criteria is no analytes can be detected at 2 X MDL.

18.8 Laboratory Control Sample

18.8.1 Confirm that the agreement between true values and actual values for each analyte is ±20%.

18.8.2 If agreement is not ±20%, do not report the results for any associated sample with the out-of-control LCS.

18.8.3 For DoD work, Refer to the control limits in the DoD QSM Appendix D unless project specific limits are provided.

18.9 Spike Sample Analysis (S)

18.9.1 Spike recovery for both aqueous and sediment, sludge and soil batches must be within the limits of 75-125%.

18.9.2 For sediment, sludge and soil batches both spike and spike duplicate results are governed by the above criteria.

18.9.3 Additionally, ensure that agreement between the spike and duplicate spike results is within 10% of each other.

18.9.4 Calculate spike Recoveries as follows:

$$\% \text{ Recovery} = \frac{SSR - SR}{SA} \times 100$$

Where: SSR = Spiked Sample Result
SR = Sample Result
SA = Spike Added

Note: When sample concentration is less than the MDL, the sample result value is understood to equal zero and is reported as undetected.

18.9.5 The Relative Percent Difference between spike and duplicate results is

$$RPD = \frac{SS - SSD}{(SS + SSD)/2} \times 100$$

Where: RPD = Relative Percent Difference
SS = Sample Spike Value
SSD = Sample Spike Duplicate Value

18.10 Duplicate Sample Analysis (D)

18.10.1 Calculate the Relative Percent Difference (RPD) for each analyte as follows:

$$RPD = \frac{S - D}{(S = D)/2} \times 100$$

Where: RPD = Relative Percent Difference
S = Original Sample Value
D = Duplicate Sample Value

18.10.2 Use the control limit of 20% for RPD when the original result > 10X MDL.

18.10.3 When the average between the original and duplicate results is less than 10X MDL, calculate the control limit as follows:

$$\text{Control Limit} = \frac{\text{Method Detection Limit}}{\text{Average of original and duplicate result}} \times 100$$

18.11 ICP Serial Dilution Analysis (L)

18.11.1 If the analyte concentration is at a minimum of 10X RL, ensure that the five fold serial dilution agrees within 10%, if not, suspect a chemical or physical interference effect. Note the non-conformance in case narrative.

18.11.2 Calculate the Percent Difference for each analyte as follows:

$$\% \text{ Difference} = \frac{I - S}{I} \times 100$$

Where: I = Initial Sample Result
S = Instrument Serial Dilution Result x 5

18.12 Linear Range Analysis

18.12.1 If the true value and the actual value agree with in 5%, the existing high value remains unchanged.

18.12.2 If the results do not agree within 5%, run the lower concentrations of the analyte.

18.12.3 The highest concentration which agrees within 5% becomes the new high value of the range.

18.13 Reporting Level Standard (CRI) and LLQC standard

18.13.1 The acceptance range for the reporting level standard CRI is 70-130% except for Co, Mn, Zn, Al, Fe, Mg, K, Na and Ca at 50-150%. The acceptance range for the LLQC standard is 70-130% recovery.

18.13.2 For **USACE/DoD work** -The acceptance range for the reporting level standard is ± 20%. The lowest standard will be set at the RDL.

18.14 Sample Analysis

18.14.1 Diluted all samples that exceed the highest standard in the calibration curve.

18.14.2 Flag the first results as estimated when a dilution is needed.

18.15 Internal Standards (ISTD)

18.15.1 No ISTD must deviate from 60-125% limit for Method 6020 and 70-130% for Method 6020A.

18.15.2 If criteria are not met, run 2X dilution.

18.16 Post digestion Spike

18.16.1 The post digestion spike must meet 75-125%

18.17 Limit of Detection

18.17.1 All analytes spiked should be positively identified.

18.17.2 The apparent signal to noise ratio at the LOD must be at least three and the results must meet all method requirements for analyte identification.

18.18 Limit of Quantitation

18.18.1 Analysis must meet the acceptance criteria for the laboratory control sample.

19. Corrective Actions for Out-of-Control Data

19.1 Method Blank

19.1.1 If concentrations exceed reporting limit, re-digest and re-analyze the samples. If the method blank continues to contain target constituents after the batch is reprocessed, tell your supervisor and document it in your laboratory notebook.

19.2 Laboratory Control Sample (LCS)

19.2.1 Reanalyze the LCS if it does not meet criteria. If the limits are still not met after two consecutive analyses, re-prepare and re-analyze all samples in that batch.

19.2.2 For DoD work, reprep and reanalyze the LCS and all associated samples if it exceeds the QC criteria

19.3 Spike sample

19.3.1 If the matrix spikes are not within recovery limits, perform a post-spike analysis for that element.

19.3.2 If upon re-analysis the matrix spike recoveries are still outside acceptable criteria, and the LCS is within acceptable criteria, note this in the laboratory notebook and tell your supervisor. Place a note in the case narrative section of the final data package.

19.3.3 For DoD work, perform MSA on a failing matrix spike if the failure is due to matrix interference.

19.4 Initial Calibration Verification (ICV)

19.4.1 If the ICV fails to meet criteria reanalyze.

19.4.2 If the ICV fails twice then recalibrate the instrument.

19.5 Initial Calibration Blank (ICB)

19.5.1 If the absolute value of the calibration blank exceeds the CRQL for any target analyte, do not report those associated target analyte sample results.

19.5.2 Instead, reanalyze these samples following instrument recalibration with an in-control ICB.

19.6 Interference Check Sample (ICS)

19.6.1 If the criteria are not met, rerun the interferent check solutions.

19.6.2 If ICS still fails, recalibrate the instrument.

19.7 Continuing Calibration Verification (CCV)

19.7.1 If the CCV fails to meet criteria reanalyze.

19.7.2 If the CCV fails to meet criteria for the second time, all samples analyzed after the last acceptable CCV must be reanalyzed.

19.7.3 If the LLCCV standard fails to meet criteria, then all samples associated with the LLCCV are reanalyzed.

19.8 Initial Calibration Curve(ICC)

19.8.1 If the ICC does not meet calibration requirements recalibrate.

19.8.2 If the ICC does not meet the calibration requirements have instrument serviced. Notify the Supervisor and the Department Manager

19.9 Internal Standard

19.9.1 If the internal standard fails to meet the requirements for the blank verify the cause of the problem and reanalyze all samples.

19.9.2 If the internal standard fails to meet the requirements for samples dilute the samples 2X and reanalyze

19.10 Limit of Detection

19.10.1 If LOD verification fails, then repeat the detection limit determination and LOD verification at a higher concentration and set the LOD at the higher concentration.

19.11 Limit of Quantitation

19.11.1 Reevaluate the LOD and the LOQ.

19.12 Reporting Level Standard (CRI) and LLQC standard

19.12.1 Reanalyze. If it still fails, note in the case narrative.

20. Contingencies for Handling Out-of-Control or Unacceptable Data

20.1 When all above corrective measures have been taken and the data remains outside the quality assurance criteria set forth above, immediately contact your supervisor and inform the individual of the situation.

20.2 Document the situation clearly in your laboratory notebook and place a copy of the information in the case narrative of the final data report.

20.3 The supervisor must then contact the Quality Assurance Officer, Laboratory Manager, and Technical Director and notify them of the situation. A corrective action plan will be developed amongst these individuals and implemented.

21. Waste Management

21.1 Keep samples for 180 days and dispose them off according to the procedures explained in the SOP for waste disposal.

22. References

22.1 USEPA Test Methods for Evaluating Solid Waste, Laboratory Manual Physical/Chemical Methods, SW-846, Third Edition, Method 6020, Revision 0, September 1994 – Inductively Coupled Plasma – Mass Spectrometry.

22.2 Method 6020A, Revision 1, February 07 – Inductively Coupled Plasma – Mass Spectrometry.

22.3 Department of Defense Quality Systems Manual for Environmental Laboratories Version 4.2, 10/25/10.

23. Appendices

23.1	Table 1	Metals Standards Preparation
23.2	Table 2	Metals Standard and Spike Concentration
23.3	Table 3	ICV
23.4	Table 4	"True Value" Concentrations for the elements in Interference Check Sample Part A and Part B
23.5	Appendix A	Detection Limits
23.6	Appendix B	Mass of measurement

Table 1 Metals Standards (Final volume made with calibration blank)

Standard Name	Inorganic Ventures catalog number	Volume used mL	Conc. of Standard mg/L	Final Volume mL
SO/ICB/CCB Calibration Blank	Conc. HNO3 Conc. HCl	20.0 10.0	- -	2000
S1*	SOL S1	1.0	-	100
S2	S5	1.0	See Table 2	10
S3	S5	2.0	See Table 2	10
S4	S5	5.0	See Table 2	10
S5	6020 Cal 1	2.5	See Table 2	100
	SOL. A	0.9	See Table 2	
	SOL. C	0.5	See Table 2	
ICV	ICV-1	2.0	See Table 3	100
	CHEM-QC-4**	0.05mL	1000ug/mL to 500ug/L	100
	Th, U	0.05mL	1000ug/mL to 500ug/L	100
CCV	6020 Cal 1	1.25	See Table 2	100
	SOL. A	0.45	See Table 2	
	SOL. C	0.25	See Table 2	
Tune std	Validation Soln	1.0	See Table 2	100
ISS	6020ISS	5.0	See Table 2	500
ICSAB	ICS-A	1.0	See Table 4	10
	ICS-B	1.0	See Table 4	
ICSA	ICS-A	1.0	See Table 4	10

*S1 = CRI solution

**CHEM-QC-4 = Second source standard for B, Mo, Si, Ti, Sn

- *Prepare LLICV standard using second source standard, as the reporting limit level, in the same manner as S1 standard.*
- *Prepare LLCCV standard in the same manner as S1 standard.*
- *Prepare LLQC standard in the same manner as S1 standard, and process this standard through all the sample preparation and analytical procedures.*

Stock Standard Catalog #	Analyte	Initial Concentration (ppm)	Intermediate standard (ppm)	Final concentration S1 (ppb)
SOL S1	Ca, Mg, Na, K	10000	20	200
	Al	10000	2	20
	Fe	10000	20	200
	Sb, Cr, Cu, Zn	1000	0.2	2
	As, Be, Cd, Co, Pb, Mn, Ni, Ag, Tl	1000	0.1	1
	B, Ti, Sn, V, Se, U	1000	0.5	5
	Mo, Si	1000	1.0	10
	Th	1000	2.5	25
	Ba	1000	1.0	10

Table 2 Metals Spiking Stock Standards

Stock Standard Catalog Number	Analytes Present	Initial Concentration (µg/mL)	Final Concentration (µg/mL)
Standard Mix 6020 Cal 1	Ba, Co, Mn, Ni, V, Zn, Cu, Cr, Be, Ag, Sb, As, Se, Tl, Pb, Cd, Na, K, Ca, Mg, Al, Fe	20	S2 = 0.05
			S3 = 0.10
			S4 = 0.25
			S5 = 0.5
SOL. A	Na, K, Ca, Mg, Al, Fe	500	S2 = 0.5
			S3 = 1.0
			S4 = 2.5
			S5 = 5.0
SOL. C	Mo, B, Sn, Ti, Si, Th, U	100	S2 = 0.05
			S3 = 0.1
			S4 = 0.25
			S5 =0.5
ISS	Bi, In, Li, Rh, Y, Sc, Ho, Tb	10	0.1
Tune Solution	Be, Mg, Co, In, Pb	10	0.10

Solution A: Na, K, Ca, Mg, Al, Fe (10000ppm) – Use 2.5mL in 50mL Final Volume with DI water. Final Concentration is 500ppm

Solution C: Mo, B, Sn, Ti, Si (1000ppm) – Use 5mL in 50mL Final Volume with DI water. Final Concentration is 100ppm.

Table 3 ICV (Concentrations subject to change)

Element	Concentration (µg/L)
Aluminum	504
Antimony	199
Arsenic	200
Barium	99
Beryllium	99
Cadmium	99
Calcium	2005
Chromium	98
Cobalt	100
Copper	98
Iron	1016
Lead	200
Magnesium	1215
Manganese	100
Nickel	101
Potassium	2004
Selenium	206
Silver	100
Sodium	2019
Thallium	206
Vanadium	100
Zinc	205
Boron	500
Molybdenum	500
Silicon	500
Tin	500
Titanium	500
Thorium	500
Uranium	500

Table 4 "True Value" Concentrations for the Elements in Interference Check Sample Part A and Part B (Concentrations Subject to Change)

Element	Concentration (µg/L)	
	Part A	Part B
Al	[100000]	[100000]
Sb	(1.5)	22
As	(0.1)	19
Ba	(1.2)	22
Be	(0)	19
Cd	(0.7)	20
Ca	[100000]	[100000]
Cl	[1000000]	[1000000]
Cr	21	40
Co	1	20
Cu	8	25
Fe	[100000]	[100000]
Pb	4	25
Mg	[100000]	[100000]
Mn	7	27
Ni	6	24
Se	(0.3)	19
Ag	(0)	18
Na	[100000]	[100000]
Tl	(0)	21
V	(0.5)	19
Zn	11	29
B	--	--
Mo	[2000]	[2000]
Si	--	--
Sn	--	--
Ti	[2000]	[2000]
Th	--	--
U	--	--

[ ] Indicates analytes that do not require ICP-MS determination in the ICS
( ) Indicates analyte values that are less than the CRQL and the value is to be used as a set point for the ±3 times CRQL acceptance criteria calculations

Appendix A

Reporting Limits

Analyte	RL mg/Kg Soil	RL µg/L Water
Aluminum	2.0	20.0
Antimony	0.2	2.0
Arsenic	0.1	1.0
Barium	1.0	10.0
Beryllium	0.1	1.0
Cadmium	0.1	1.0
Calcium	50.0	500.0
Chromium	0.2	2.0
Cobalt	0.1	1.0
Copper	0.2	2.0
Iron	20.0	200.0
Lead	0.1	1.0
Magnesium	50.0	500.0
Manganese	0.1	1.0
Nickel	0.1	1.0
Potassium	50.0	500.0
Selenium	0.5	5.0
Silver	0.1	1.0
Sodium	50.0	500.0
Thallium	0.1	1.0
Vanadium	0.5	5.0
Zinc	0.2	2.0
Boron	0.5	5.0
Molybdenum	1.0	10.0
Silicon	1.0	10.0
Tin	0.5	5.0
Titanium	0.5	5.0
Thorium	2.5	25.0
Uranium	0.5	5.0

Appendix B

Mass of Measurement

Analyte	Mass
Aluminum	27
Antimony	121
Arsenic	75
Barium	137
Beryllium	9
Cadmium	111
Calcium	44
Chromium	52
Cobalt	59
Copper	63
Iron	57
Lead	208
Magnesium	24
Manganese	55
Molybdenum	98
Nickel	60
Potassium	39
Selenium	82
Silver	107
Sodium	23
Thallium	205
Vanadium	51
Zinc	66
Boron	10
Molybdenum	98
Silicon	28
Tin	118
Titanium	47
Thorium	232
Uranium	238

CHEMTECH 284 Sheffield Street, Mountainside, NJ 07092 (908) 789-8900

READ RECEIPT

Employee Name: _____

Department: _____

_____**M6020/6020A-Metals ICPMS-13**_____
Method or Document Read (Include Title, Number, Revision, as applicable)

Employee Statement: I have read and understood the information in the above mentioned method or document.

_____ _____
Employee Signature Date

Supervisory Statement: I have reviewed this document or method with the employee.

_____ _____
Supervisor Signature Date

Note: This receipt is to be returned to the Quality Assurance/Quality Control Department for incorporation into employee training record files. If you have questions or would like to review your train record files, please see QA/QC Director.

CHEMTECH

APPENDIX A

CAR TRACKING #: CAR0711-031

CORRECTIVE ACTION/PREVENTIVE ACTION REPORT

Created By : Krupa Dubey

Client: Chemtech Consulting Group Order ID: Date Initiated: 07/19/2011

Project ID : SOP correction Initiated By: Client No Client notification: No

Approved By: Divyajit Mehta Department: QA/QC Due Date : 07/26/2011 Given To: Krupa Dubey

Description : Revise 200.8 and 6020/A SOP. Add IS prep to section 10-Internal standard: Add 25mL 6020ISS - 10ug/mL Bi, Ho, Li, Rh, Sc, Tb, Y + 25mL conc. HNO3. Make final volume 2500mL. Remove Table 1 and add Table 1 per attached. Add calibration standard concentrations as per attached. Remove final concentrations from Table 2. Remove SOL. A prep. from Table 2 and from the note at bottom. Revise Appendix A RL for Bo, Mo, Si, Sn, Ti to 5ug/L and for Th and U to 1ug/L.

Root Cause Analysis : Revise SOPs to reflect current practices.

Analysis submitted By: Krupa Dubey Review By: Divyajit Mehta

Proposed Corrective Action : CAR will be followed

Proposed Preventive Action : SOP will be revised at next review.

Corrective/Preventive Action Proposed By: Krupa Dubey Supervisor: Divyajit Mehta

QA/QC Director: Krupa Dubey Technical Director: Divyajit Mehta

Follow-Up completed on: Date: 07/19/2011 By: Krupa Dubey

Follow Up Review : CAR is attached to SOP. SOP will be revised at next review.

CAR Completion: Date: 07/19/2011 By: Krupa Dubey

CLOSE OUT

Was the proposed corrective action implemented? Yes

Was the proposed preventive action implemented? Yes

If No, Why?

QA Control Code: A2040111

CAR0711-031

Add Table for Calibration standard concentrations:

Element	Standard concentration (ug/L)				
	Std. S1	Std. S2	Std. S3	Std. S4	Std. S5
Be	1	125	250	500	1000
B	5	125	250	500	1000
Na	500	12500	25000	50000	100000
Mg	500	12500	25000	50000	100000
Al	20	2500	5000	10000	20000
Si	5	125	250	500	1000
P	0	2500	5000	10000	20000
K	500	6250	12500	25000	50000
Ca	500	12500	25000	50000	100000
Ti	5	125	250	500	1000
V	5	125	250	500	1000
Cr	2	125	250	500	1000
Mn	1	250	500	1000	2000
Fe	200	6250	12500	25000	50000
Co	1	125	250	500	1000
Ni	1	125	250	500	1000
Cu	2	250	500	1000	2000
Zn	2	250	500	1000	2000
As	1	125	250	500	1000
Se	5	125	250	500	1000
Mo	5	125	250	500	1000
Ag	1	125	250	500	1000
Cd	1	125	250	500	1000
Sn	5	125	250	500	1000
Sb	2	125	250	500	1000
Ba	10	625	1250	2500	5000
Tl	1	125	250	500	1000
Pb	1	125	250	500	1000
Th	1	125	250	500	1000
U	1	125	250	500	1000

CHEMTECH CAR 0711-031

Table 1. Metals Standards Preparation

Blank/ICB/CCB solution – Prepare by adding 10mL HCl + 20mL Nitric acid, and make final volume to 2L with DI water

Standard S5 – Prepare by adding 0.1mL 1000ug/mL Copper, Manganese and Zinc each + 0.19mL 10000ug/mL Aluminum + 0.4mL 1000ug/mL Barium + 0.49mL 10000ug/mL Iron and Potassium each + 0.99mL 10000ug/mL Calcium, Magnesium and Sodium each + 5mL Calibration Standard Method 6020 + 1mL 100ppm Sol. C and make final volume 100mL with Blank solution. + 0.1 mL 1000 ug/mL Th + U each

CCV – Prepare by adding 0.25mL 1000ug/mL Copper, Manganese and Zinc each + 0.475mL 10000ug/mL Aluminum + 1mL 1000ug/mL Barium + 1.225mL 10000ug/mL Iron and Potassium each + 2.475mL 10000ug/mL Calcium, Magnesium and Sodium each + 12.5mL Calibration Standard Method 6020 + 2.5mL 100ppm Sol. C and make final volume 500mL with Blank solution. + 0.25 mL 1000 ug/mL Th + U each

Standard S4 – Prepare by adding 25mL Standard S5 to 25mL Blank solution.

Standard S3 – Prepare by adding 12.5mL Standard S5 to 37.5mL Blank solution.

Standard S2 – Prepare by adding 6.25mL Standard S5 to 43.75mL Blank solution.

Standard S1 (concentrated solution) – Prepare by adding 0.05mL Th + U 1000ug/mL Arsenic, Beryllium, Cadmium, Cobalt, Lead, Manganese, Nickel, Silver and Thallium each + 0.1mL 10000ug/mL Aluminum + 0.1mL 1000ug/mL Antimony, Chromium, Copper and Zinc each + 0.25mL CHEM-CLP-4 + 0.25mL 1000ug/mL Selenium and Vanadium each + 0.5mL 1000ug/mL Barium + 1mL 10000ug/mL Iron + 2.5mL 10000ug/mL Calcium, Magnesium, Potassium and Sodium each and make final volume 250mL with Blank solution.

Note: The final concentration of Standard S1 (concentrated solution in ug/L) = 200X CRQL concentration for water matrix.

Standard S1 (working solution) – Prepare by adding 0.25mL Standard S1 (concentrated solution) to 49.75mL Blank solution.

LCS/MS/MSD – Digest by adding 0.1 mL spiking soln. 2 + 2A into 100 mL final volume, before any reagents are added.

APPENDIX G

CROSSWALK TO UFP-QAPP GUIDANCE AND SUPPLEMENTAL WORKSHEETS

UFP-SAP CROSSWALK FOR INFORMATION CONTAINED IN TIER II SAP FOR MRP REMEDIAL INVESTIGATION OF FORMER MACHINE GUN RANGE COMPLEX AT NAS JACKSONVILLE

UFP-SAP Worksheet #	Required Information per UFP-SAP Guidance and USEPA Checklist	Crosswalk to Related Information in Tier II SAP
A. Project Management		
Documentation		
1	Title and Approval Page	Title and Approval Page (pg. 1)
2	Table of Contents SAP Identifying Information	SAP Worksheets, List of Figures, List of Tables, List of Appendices (pp. 4-6) Appendix G
3	Distribution List	Appendix G
4	Project Personnel Sign-Off Sheet	Appendix G
Project Organization		
5	Project Organizational Chart	Section 1.0 (pp. 12)
6	Communication Pathways	Section 2.0 (pp. 13-17)
7	Personnel Responsibilities and Qualifications Table	Appendix G
8	Special Personnel Training Requirements Table	Appendix G
Project Planning/Problem Definition		
9	Project Planning Session Documentation (including Data Needs tables) Project Scoping Session Participants Sheet	Section 3.0 (pp. 18-23)
10	Problem Definition, Site History, and Background. Site Maps (historical and current)	Section 4.0 (pp. 24-46)
11	Site-Specific Project Quality Objectives	Section 5.0 (pp. 47-56)
12	Measurement Performance Criteria Table	Section 6.0 (pg. 57)
13	Sources of Secondary Data and Information, Secondary Data Criteria and Limitations Table	Appendix G
14	Summary of Project Tasks	Sections 8.1-8.3 (pp. 64-75)
15	Reference Limits and Evaluation Table	Section 9.0 (pp.94-101)
16	Project Schedule/Timeline Table	Appendix G
B. Measurement Data Acquisition		
Sampling Tasks		
17	Sampling Design and Rationale	Section 7.0 (pp. 58-63)
18	Sampling Locations and Methods/Standard Operating Procedure (SOP) Requirements Table Sample Location Map(s)	Section 8.5 (pp. 78-91)
19	Analytical Methods/SOP Requirements Table	Section 8.6 (pg. 92)
20	Field Quality Control Sample Summary Table	Section 8.7 (pg. 93)
21	Project Sampling SOP References Table Sampling SOPs	Section 8.4 (pp. 76-77)
22	Field Equipment Calibration, Maintenance, Testing, and Inspection Table	Appendix G
Analytical Tasks		
23	Analytical SOPs Analytical SOP References Table	Section 10.0 (pg. 102)
24	Analytical Instrument Calibration Table	Appendix G
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	Appendix G

UFP-SAP Worksheet #	Required Information per UFP-SAP Guidance and USEPA Checklist	Crosswalk to Related Information in Tier II SAP
Sample Collection		
26	Sample Handling System, Documentation Collection, Tracking, Archiving, and Disposal Sample Handling Flow Diagram	Appendix G
27	Sample Custody Requirements, Procedures/SOPs Sample Container Identification Example Chain-of-Custody Form and Seal	Appendix G
Quality Control (QC) Samples		
28	QC Samples Table Screening/Confirmatory Analysis Decision Tree	Section 11.0 (pp. 103-107)
Data Management Tasks		
29	Project Documents and Records Table	Appendix G
30	Analytical Services Table Analytical and Data Management SOPs	Section 8.6 (pg. 92)
C. Assessment Oversight		
31	Planned Project Assessments Table	Appendix G
32	Assessment Findings and Corrective Action Responses Table	Appendix G
33	QA Management Reports Table	Appendix G
D. Data Review		
34	Verification (Step I) Process Table	Section 12.0 (pp. 108-110)
35	Validation (Steps IIa and IIb) Process Table	Section 12.0 (pg. 108-110)
36	Validation (Steps IIa and IIb) Summary Table	Section 12.1 (pg. 111)
37	Usability Assessment	Section 8.3.3 (pg. 73-74)

SAP Worksheet #2 -- SAP Identifying Information
(UFP-QAPP Manual Section 2.2.4)

Site Name/Number:	Unexploded Ordnance (UXO) Sites 1-6
Contractor Name:	Tetra Tech, Inc. (Tetra Tech)
Contract Number:	N62470-08-D-1001
Contract Title:	Comprehensive Long-term Environmental Action Navy (CLEAN)
Work Assignment Number:	Contract Task Order (CTO) JM55

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)* (IDQTF, 2005) and the United States Environmental Protection Agency (USEPA) *Guidance for Quality Assurance Project Plans, EPA QA/G-5, QAMS* (USEPA, 2002).

2. Identify regulatory program: Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as reauthorized by Superfund Amendments and Reauthorization Act (SARA).

3. This SAP is a project-specific SAP.

4. List dates of scoping sessions that were held:

Scoping Session	Date
Data Quality Objective (DQO) Scoping Meetings (Jacksonville Partnering Team)	June 13, 2011 July 20, 2011

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

Title	Date
None	None

6. List organizational partners (stakeholders) and connection with lead organization:

Florida Department of Environmental Protection (FDEP) (regulatory stakeholder)
USEPA Region 4 (regulatory stakeholder)
Naval Air Station (NAS) Jacksonville (property owner)

7. Lead organization:

Naval Facilities Engineering Command Southeast (NAVFAC SE)

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:

Not Applicable (NA), as there are no exclusions.

SAP Worksheet #3 – Distribution List
(UFP-QAPP Manual Section 2.3.1)

Name of SAP Recipients	Title/Role	Organization	Telephone Number	E-Mail Address or Mailing Address
Adrienne Wilson	Navy Remedial Project Manager (RPM)/ Manages Project Activities for the Navy	Department of the Navy Naval Facilities Southeast Code OPDE3/AW Attn: Ajax Street, Bldg 135N P.O. Box 30A Jacksonville, FL 32212-0030	(904) 542-6160	adrienne.wilson@navy.mil
Tim Curtin	Installation Restoration Program (IRP) Manager/ NAS Jacksonville Point of Contact (POC)	NAS Jacksonville Building 1, Code 064TC NASJAX /Yorktown/Langley Jacksonville, FL 32212	(904) 542-4228	tim.l.curtin@navy.mil
Jonathan Tucker	NAVFAC Quality Assurance Officer (QAO)/ Government Chemist	NAVFAC Atlantic EV32 6506 Hampton Blvd Bldg A Norfolk VA 23508 757-322-8288, 757-322-8288	(757) 322-8288	jonathan.tucker@navy.mil
David Grabka	FDEP RPM/ Provides Regulator Input	FDEP 2600 Blair Stone Road, MS 4535 Tallahassee, FL 32399-2400	(850) 245-8997	david.grabka@dep.state.fl.us
Peter Dao	USEPA RPM/ Provides Regulator Input	USEPA Region 4 Atlanta Federal Center 61 Forsyth Street, SW Atlanta, GA 30303-8960	(404) 562-8508	dao.peter@epa.gov
Bonnie Capito	Librarian and Records Manager	Naval Facilities Engineering Command Code 1832 5 I 0 Gilbert Street. Norfolk, VA 23511-2699	757-322-4785	bonnie.capito@navy.mil
Mark Peterson	Activity Coordinator/ Oversees Project Activities	Tetra Tech 8640 Philips Hwy, Suite 16 Jacksonville, FL 32256	(904) 730-4669 Extension (Ext.) 213	mark.peterson@tetratech.com

Name of SAP Recipients	Title/Role	Organization	Telephone Number	E-Mail Address or Mailing Address
Barb Becker	Project Manager (PM)/ Manages Project Activities	Tetra Tech 234 Mall Blvd, Suite 260 King of Prussia, PA 19406	(610) 382-3770	barb.becker@tetratech.com
Alan Pate	Field Operations Leader (FOL) / Site Safety Officer (SSO)/ Manages Field Operation and Site Safety Issues	Tetra Tech 8640 Philips Hwy, Suite 16 Jacksonville, FL 32256	(904) 730-4669 Ext. 214	alan.pate@tetratech.com
Tom Johnston, PhD (electronic copy only)	Quality Assurance Manager (QAM)/ Manages Corporate Quality Assurance (QA) Program and Implementation	Tetra Tech 661 Andersen Drive Foster Plaza 7 Pittsburgh, PA 15220	(412) 921-8615	tom.johnston@tetratech.com
Mark Traxler (electronic copy only)	Project Chemist/ Provides Coordination with Laboratory	Tetra Tech 234 Mall Blvd, Suite 260 King of Prussia, PA 19406	(610) 382-1171	mark.traxler@tetratech.com
Kurt Hummler (electronic copy only)	Laboratory PM/ Representative for Laboratory and Analytical Issues	Chemtech Consulting Group, Inc. (Chemtech) 283 Sheffield Street Mountainside, NJ 07092	(908) 728-3143	khummler@chemtech.net
Brian Richard (electronic copy only)	Laboratory PM/ Representative for Laboratory and Analytical Issues	Empirical Laboratories, LLC (Empirical) 621 Mainstream Drive, Suite 270 Nashville, TN 37228	(615) 345-1113 Ext. 249	brichard@empirlabs.com

SAP Worksheet #4 – Project Personnel Sign-Off Sheet
(UFP-QAPP Manual Section 2.3.2)

Certification that project personnel have read the text will be obtained by one of the following methods as applicable:

1. In the case of regulatory agency personnel with oversight authority, approval letters or e-mails will constitute verification that applicable sections of the SAP have been reviewed. Copies of regulatory agency approval letters / 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 the Navy, Tetra Tech, and subcontractor project personnel who will be requested to verify by e-mail that they have read the applicable SAP / sections and the date on which they were reviewed. Copies of the verification e-mail will be included in the project files and is identified in Worksheet #29.

   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	Organization/Title/Role	Telephone Number	Signature/E-Mail Receipt	SAP Section Reviewed	Date SAP Read
Navy and Regulator Partnering Team Personnel					
Adrienne Wilson	Navy/ RPM/ Manages Project Activities for the Navy	(904) 542-6160	See Worksheet #1 for signature	All	
Tim Curtin	Navy/ IRP Manager/ NAS Jacksonville POC	(904) 542-4228		All	
David Grabka	FDEP/ RPM/ Provides Regulator Input	(850) 245-8997	See Worksheet #1 for signature	All	
Peter Dao	USEPA Region 4/ RPM/ Provides Regulator Input	(404) 562-8508	See Worksheet #1 for signature	All	

Name	Organization/Title/Role	Telephone Number	Signature/E-Mail Receipt	SAP Section Reviewed	Date SAP Read
Tetra Tech Partnering Team Personnel					
Barb Becker	Tetra Tech/ PM/ Manages Project Activities	(610) 382-3770	See Worksheet #1 for signature	All	
Alan Pate	Tetra Tech/ FOL/SSO/ Manages Field Operation and Site Safety Issues	(904) 730-4669 Ext. 214		All	
Tom Johnston	Tetra Tech/ QAM/ Manages NAVFAC SE Contract QA Program and Implementation	(412) 921-7273	See Worksheet #1 for signature	All	
Mark Traxler	Tetra Tech/ Project Chemist/ Provides Coordination with Laboratory	(610) 382-1171		All	
Subcontractor Personnel					
Kurt Hummler	Chemtech/ Laboratory PM/ Representative for Laboratory and Analytical Issues	(908) 728-3143		Worksheets #6, #12, #14, #15, #19, #23-28, #30, and #34-36	
Brian Richard	Empirical/ Laboratory PM/ Representative for Laboratory and Analytical Issues	(615) 345-1113 Ext. 249		Worksheets #6, #12, #14, #15, #19, #23-28, #30, and #34-36	

SAP Worksheet #7 – Personnel Responsibilities and Qualifications Table
(UFP-QAPP Manual Section 2.4.3)

Name	Title/Role	Organizational Affiliation	Responsibilities
Adrienne Wilson	Navy RPM/ Manages project activities for the Navy	NAVFAC SE	Oversees project implementation including scoping, data review, and evaluation.
Tim Curtin	IRP Manager/ Manages daily site activities related to this project	NAS Jacksonville	Oversees site activities and participates in scoping, data review, evaluation, and reviews the SAP.
David Grabka	RPM/ Provides regulator input	FDEP	Participates in scoping, data review, evaluation, and approves the SAP.
Peter Dao	RPM/ Provides regulator input	USEPA Region 4	Participates in scoping, data review, evaluation, and approves the SAP.
Mark Peterson	Activity Coordinator/ Oversees project activities	Tetra Tech	Oversees project implementation, including scoping, data review, and evaluation.
Barb Becker	PM/ Manages project on a daily basis	Tetra Tech	Oversees project and manages financial, schedule, and technical day-to-day activities of the project.
Alan Pate	FOL/SSO Manages field operations and oversees site activities to ensure safety requirements are met	Tetra Tech	As FOL, supervises, coordinates, and performs field sampling activities. As the SSO, is responsible for on-site project-specific health and safety training and monitoring site conditions. Details of these responsibilities are presented in the HASP.
Tom Johnston	QAM/ Oversees program and project QA activities	Tetra Tech	Reviews the SAP and ensures quality aspects of the CLEAN program are implemented, documented, and maintained.
Matt Soltis	HSM/ Oversees health and safety activities	Tetra Tech	Oversees CLEAN Program Health and Safety Program.
Mark Traxler	Project Chemist/ Conducts data validation and reporting	Tetra Tech	Participates in project scoping, prepares laboratory scopes of work, and coordinates laboratory-related functions with laboratory. Oversees data quality reviews and QA of data validation deliverables.
Joseph Samchuck	DVM/ Oversees data validation activities	Tetra Tech	Manages data validation activities within Tetra Tech, including ensuring QA of data validation deliverables, providing technical advice on data usability, and coordinating and maintaining the data validation review schedule.

Name	Title/Role	Organizational Affiliation	Responsibilities
Kurt Hummler Brian Richard	Laboratory PM/ Representative for Laboratory and Analytical Issues	Chemtech Empirical	Coordinates analyses with laboratory chemists, ensures that scope of work is followed, provides QA of data packages, and communicates with Tetra Tech project staff.

SAP Worksheet #8 – Special Personnel Training Requirements Table
(UFP-QAPP Manual Section 2.4.4)

Each site worker will be required to have completed appropriate Hazardous Waste Operations and Emergency Response (HAZWOPER) training specified in Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.120 (e). Project-specific safety requirements are addressed in greater detail in the site-specific HASP.

SAP Worksheet #13 – Secondary Data Criteria and Limitations Table
(UFP-QAPP Manual Section 2.7)

Secondary Data	Data Source	Data Generator(s)	How Data Will Be Used	Limitations on Data Use
Site Inspection Report for Munitions Response Program Site Inspections at the Former Machine Gun Range Complex	Tetra Tech NUS, Inc. / Site Inspection Report for Munitions Response Program Site Inspections at the Former Machine Gun Range Complex, NAS Jacksonville, September 2010	Tetra Tech	Data will be used to calculate environmental risks.	None, the data were validated as planned.

SAP Worksheet #16 – Project Schedule / Timeline Table
(UFP-QAPP Manual Section 2.8.2)

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Prepare/Submit Second Draft SAP	**Tetra Tech**	**01/25/12**	**02/17/12**	**Second Draft SAP**	**02/17/12**
Navy Review of SAP Complete	Navy	02/20/12	03/28/12	NA	NA
Prepare/Submit Draft Final SAP	**Tetra Tech**	**03/29/12**	**04/12/12**	**Draft Final SAP**	**04/12/12**
Regulatory Review of SAP Complete	USEPA, FDEP	04/13/12	05/14/12	NA	NA
Prepare/Submit Final SAP	**Tetra Tech**	**05/15/12**	**06/15/12**	**Final SAP**	**06/15/12**
Prepare/Submit Draft ESSDR	**Tetra Tech**	**05/15/12**	**05/25/12**	**Draft ESSDR**	**05/25/12**
Navy Review of ESSDR Complete	Navy	05/29/12	06/08/12	NA	NA
Prepare/Submit Final ESSDR	**Tetra Tech**	**06/11/12**	**06/15/12**	**Final ESSDR**	**06/15/12**
Receive approval of ESSDR	NOSSA	06/18/12	07/02/12	NA	NA
Field Work	**Tetra Tech**	**07/16/12**	**08/31/12**	**NA**	**NA**
Laboratory Results	Chemtech, Empirical	07/23/12	09/28/12	Laboratory EDDs	NA
Data Validation Reports	Tetra Tech	08/24/12	10/29/12	Data Validation Technical Memoranda	NA
Prepare/Submit Draft RI Report	**Tetra Tech**	**10/30/12**	**01/30/13**	**Draft RI Report**	**01/30/13**
Navy Review of RI Complete	Navy	01/31/13	03/01/13	NA	NA
Prepare/Submit Draft Final RI Report	**Tetra Tech**	**03/04/13**	**03/29/13**	**Draft Final RI Report**	**03/29/13**
Regulatory Review of RI Complete	USEPA, FDEP	04/01/13	05/01/13	NA	NA
Prepare/Submit Final RI Report	**Tetra Tech**	**05/02/13**	**05/31/13**	**Final RI Report**	**05/31/13**

SAP Worksheet #22 -- Field Equipment Calibration, Maintenance, Testing, and Inspection Table
(UFP-QAPP Manual Section 3.1.2.4)

Field Equipment	Activity	Frequency	Acceptance Criterion	Corrective Action	Responsible Person	SOP Reference[1]	Comments
YSI 600 Series Water Quality Meter	Visual Inspection Calibration/ Verification	Daily Beginning and end of day	Manufacturer's guidance	Operator correction or replacement	Tetra Tech FOL or designee	SOP-07, Manufacturer's Guidance Manual, FDEP FT 1100, FT 1200, FT 1400, FT 1500	To be used to determine purge completion.
Turbidity Meter (LaMotte 2020 or equivalent)	Visual Inspection Calibration/ Verification	Daily Beginning and end of day	Manufacturer's guidance Calibrations must bracket expected values. Initial Calibration Verification (ICV) must be <5 Nephelometric Turbidity Unit (NTU).	Operator correction or replacement	Tetra Tech FOL or designee	SOP-07, Manufacturer's Guidance Manual, FDEP FT 1600	To be used to determine purge completion.
Water Level Indicator and Oil/Water Interface Probe	Visual Inspection Field checks as per manufacturer	Daily Once upon receiving from vendor	0.01 foot accuracy	Operator correction or replacement	Tetra Tech FOL or designee	SOP-08, Manufacturer's Guidance Manual	None.
GPS	Positioning	Beginning and end of each day used	Accuracy: sub-meter horizontal dilution of precision < 3, number of satellites must be at least six	Wait for better signal, replace unit, or choose alternate location technique	Tetra Tech FOL or designee	SOP-09	None.

1 Specify the appropriate reference letter or number from the Project Sampling SOP References Table (Worksheet #21).

SAP Worksheet #24 – Analytical Instrument Calibration Table
(UFP-QAPP Manual Section 3.2.2)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS Low Level PAHs	Tune Verification – decafluoro-triphenyl-phosphine (DFTPP)	Prior to each ICAL and at the beginning of each 12-hour analytical sequence.	Must meet the ion abundance criteria required by the method (SW-846 8270C).	Retune and/or clean or replace source. No samples may be accepted without a valid tune.	Analyst/ Supervisor	Chemtech M8270C/D-BNA-16
	Breakdown Check (DDT only)	At the beginning of each 12-hour analytical sequence.	The degradation must be ≤ 20% for DDT to verify inertness of the injection port.	Correct the problem then repeat breakdown check. No samples shall be run until degradation is ≤20% for DDT.	Analyst/ Supervisor	
	Initial Calibration (ICAL) – A minimum of a 5-point calibration is prepared for all target analytes	Upon instrument receipt, instrument change (new column, source cleaning, etc.), when CCV is out of criteria.	The average response factor (RF) for System Performance Check Compound s (SPCCs) must be ≥ 0.050. The percent relative standard deviation (%RSD) for RFs for calibration check compounds (CCCs) must be ≤ 30%; and %RSD for each target analyte must be ≤ 15%, or the linear least squares regression correlation coefficient (r) must be ≥ 0.995; or the coefficient of determination (r^2) must be ≥ 0.99 (minimum of 6 points required for second order).	Correct problem then repeat ICAL. No samples may be run until ICAL has passed.	Analyst/ Supervisor	
	ICV – Second Source	Perform after each ICAL, prior to beginning a sample run.	The percent recovery (%R) of all target analytes must be within 80-120% of the true value. SPCC RFs must be ≥ 0.050; CCCs must be ≤ 20 percent difference or percent drift (%D.)	Correct problem and verify ICV. If that fails, correct problem and repeat ICAL. No samples may be run until ICV has been verified.	Analyst/ Supervisor	
	Retention Time (RT) Window Position Establishment	Once per ICAL for each analyte and surrogate.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA.	Analyst / Supervisor	
	Evaluation of RTs	With each sample.	RT of each target analyte must be within ± 0.06 RRT units.	Correct problem, then rerun ICAL.	Analyst / Supervisor	

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
	Continuing Calibration Verification (CCV)	Analyze a standard at the beginning of each 12-hour shift after tune and before sample analysis.	SPCC RFs must be ≥ 0.050; all target analytes and surrogates must be ≤ 20%D.	If %D is high and sample result is ND, qualify/narrate with project approval. If %D is low or project approval not received, reanalyze all samples since the last successful CCV.	Analyst/ Supervisor	
High Pressure Liquid Chromato-graphy (HPLC)/ Ultraviolet (UV) Nitroglycerin (NG)	ICAL - A minimum of a 5-point calibration is prepared for all target analytes	Annually or more often as needed due to changes in response or retention times or following major instrument maintenance.	The RSD for RFs for each target analyte must be ≤ 20%; or r must be ≥ 0.995, or r^2 must be ≥ 0.99.	Correct problem then repeat ICAL. No samples may be run until ICAL has passed.	Analyst/ Supervisor	Empirical SOP-327
	ICV – Second Source	Once after each ICAL, prior to the analysis of samples.	All target analytes must be within established retention time (RT) windows. The %R of all target analytes must be within 85-115% of true value.	Correct problem and verify ICV. If that fails, correct problem and repeat ICAL. No samples may be run until ICV has been verified.	Analyst / Supervisor	
	CCV	Daily prior to the analysis of samples, every 10 sample injections, and at the end of the run.	The %R of all target analytes must be within 85-115% of true value.	Correct problem and rerun CCV. If that fails, repeat ICAL and reanalyze all samples analyzed since the last successful CCV.	Analyst / Supervisor	
Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS) Metals	Tune	Prior to ICAL.	Mass calibration must be ≤ 0.1 atomic mass units (amu) from the true value. Resolution must be within 0.65-0.85 amu peak width at 5% peak height. For stability, RSD must be ≤ 5% for five replicate analyses.	Retune and/or clean or replace source, then reanalyze tuning solutions. No samples may be accepted without a valid tune.	Analyst, Supervisor	Chemtech M6020/ 6020A-Metals ICPMS-13
	ICAL - a minimum of a 1-point calibration per manufacturer's guidelines is prepared for all target analytes	At the beginning of each day, prior to the analysis of samples.	None; only one high standard and a calibration blank must be analyzed. If more than one calibration point is used, r must be ≥ 0.998.	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards.	Analyst, Supervisor	

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
	ICV – Second Source	Following ICAL, prior to the analysis of samples.	The %R for all target analytes must be within 90-110% of true value.	Do not use results for failing elements unless the ICV >110%R and the sample < LOQ or Reporting Limit (RL). Investigate and correct problem.	Analyst, Supervisor	
	Calibration Blank	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence.	No target analytes detected > LOD.	Correct the problem, then re-prepare and reanalyze.	Analyst, Supervisor	
	CCV	Analyze a standard at the beginning and end of the sequence and after every 10 samples.	The %R for all target analytes must be within 90-110% of true value.	Check problem, recalibrate, and reanalyze any samples not bracketed by passing CCVs.	Analyst, Supervisor	
	Low-Level Calibration Check Standard (if using 1-point ICAL)	Daily after 1-point ICAL and before samples.	The %R for all target analytes must be within 80-120% of true value.	Correct problem, then reanalyze. No samples may be analyzed without a valid low-level calibration check standard (should be ≤ LOQ).	Analyst, Supervisor	
	Interference Check Standards (ICS – ICS A and ICS B)	At the beginning of an analytical run.	The absolute value of ICS A recoveries for non-spiked analytes must be < LOD; and ICS B recoveries must be within 80-120 %R of true value.	Terminate analysis; locate and correct problem; reanalyze ICS.	Analyst, Supervisor	

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	CA	Responsible Person	SOP Reference
GC/MS	Check pressure and gas supply daily. Change septa as needed, change liner as needed, cut column as needed.	Low Level PAHs	Ion source, injector liner, column, column flow.	Prior to ICAL and/or as necessary.	Acceptable ICAL and CCV.	Correct the problem and repeat ICAL or CCV.	Analyst/ Supervisor	Chemtech M8270C/D-BNA-16
HPLC/UV	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.	NG	Check pump pressure, check for leaks, check for adequate mobile phase.	Prior to ICAL and as necessary.	Acceptable ICAL and CCV.	Correct the problem and repeat ICAL or CCV.	Analyst, Supervisor	Empirical SOP-327
ICP-MS	Clean plasma torch; clean filters; clean spray and nebulizer chambers; replace pump tubing.	Metals	Torch, nebulizer chamber, pump, pump tubing.	Prior to ICAL and as necessary.	Acceptable ICAL and CCV.	Correct the problem and repeat ICAL or CCV.	Analyst, Supervisor	Chemtech M6020/ 6020A-Metals ICPMS-13

SAP Worksheet #26 – Sample Handling System
(UFP-QAPP Manual Appendix A)

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Tetra Tech FOL or designee / Tetra Tech
Sample Packaging (Personnel/Organization): Tetra Tech FOL or designee / Tetra Tech
Coordination of Shipment (Personnel/Organization): Tetra Tech FOL or designee / Tetra Tech
Type of Shipment/Carrier: Federal Express
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Sample Custodians / Chemtech, Empirical
Sample Custody and Storage (Personnel/Organization): Sample Custodians/ Chemtech, Empirical
Sample Preparation (Personnel/Organization): Extraction Laboratory, Metals Preparation Laboratory / Chemtech, Empirical
Sample Determinative Analysis (Personnel/Organization): Gas Chromatography Laboratory, GC/MS Laboratory, Metals Laboratory / Chemtech, Empirical
SAMPLE ARCHIVING
Field Sample Storage (Number of days from sample collection): 60 days from receipt
Sample Extract/Digestate Storage (No. of days from extraction/digestion): 3 months from sample digestion/extraction
Biological Sample Storage (Number of days from sample collection): N/A
SAMPLE DISPOSAL
Personnel/Organization: Sample Custodians / Chemtech, Empirical

SAP Worksheet #27 – Sample Custody Requirements Table
(UFP-QAPP Manual Section 3.3.3)

27.1 SAMPLE NOMENCLATURE, SAMPLE COLLECTION DOCUMENTATION, HANDLING, AND TRACKING PROCEDURES

The following sections outline the procedures that will be used to document project activities and sample collection, handling, tracking, and custody procedures during the investigation. All forms must be filled in as completely as possible.

27.1.1 Sample Nomenclature

Refer to Section 8.5 for how the samples will be labeled.

Sample nomenclature will be conducted in general accordance with the procedures outlined in Tetra Tech SOP-02. Sample nomenclature put forth for this field event has been selected based on historical usage. The sample nomenclature for each tracking number includes the site being investigated, sample media identifier, and sample location number. The standard sample matrix and type codes used for this field event are as follows: Duplicate samples will be submitted to the laboratory as blind duplicates. The quality assurance/ quality control (QA/QC) type codes used for this field event are as follows: RB for equipment rinsate blanks. Field QC blanks will be labeled sequentially followed by the date (i.e., TB-20101213, FB-20101214, etc.). Samples to be used for matrix spikes (MSs) and matrix spike duplicates (MSDs) will be labeled MS/MSD on the container label and noted on the chain-of-custody, as required in the laboratory QA Plan; however, “MS/MSD” will not be part of the unique sample identifier in order to maintain consistency with the project database. Additional information regarding protocol for sample labeling is contained in Tetra Tech SOP-01 (see Appendix F).

27.1.2 Sample Collection Documentation

Documentation of field observations will be recorded in a field logbook and/or field log sheets including sample collection logs, boring logs, VOC screening logs, and monitoring well construction logs. Field logbooks utilized on this project will consist of a bound, water-resistant logbook. All pages of the logbook will be numbered sequentially and observations will be recorded with indelible ink.

Field sample log sheets will be used to document sample collection details and other observations and activities will be recorded in the field logbook. Instrument calibration logs will be used to record the daily instrument calibration. Example field forms are included in Appendix F.

For sampling and field activities, the following types of information will be recorded in the field logbook as appropriate:

- Site name and location
- Date and time of logbook entries
- Personnel and their affiliations
- Weather conditions
- Activities involved with the sampling
- Subcontractor activity summary
- Site observations including site entry and exit times
- Site sketches made on site
- Visitor names, affiliations, arrival and departure times
- Health and safety issues, including personal protective equipment (PPE)

27.1.3 Sample Handling and Tracking System

Following sample collection into the appropriate bottleware, all samples will be immediately placed on ice in a cooler. The glass sample containers will be enclosed in bubble-wrap in order to protect the bottle ware during shipment. The cooler will be secured using strapping tape along with a signed custody seal. Sample coolers will be delivered to a local courier location for priority overnight delivery to the selected laboratory for analysis. Samples will be preserved as appropriate based on the analytical method. The laboratories will provide pre-preserved sample containers for sample collection. Samples will be maintained at 0 to 6 degrees Celcius (°C) until delivery to the laboratory. Proper custody procedures will be followed throughout all phases of sample collection and handling.

After collection, each sample will be maintained in the sampler's custody until formally transferred to another party (e.g., FedEx). For all samples collected, chain-of-custody forms will document the date and time of sample collection, the sampler's name, and the names of all others who subsequently held custody of the sample. Specifications for chemical analyses will also be documented on the chain-of-custody form. Tetra Tech SOP-03 provides further details on the chain-of-custody procedure, which is provided in Appendix F.

These subsections outline the procedures that will be used by field and laboratory personnel to document project activities and sample collection procedures. All forms must be filled in as completely as possible.

Tetra Tech personnel will collect the samples. The samplers will take care not to contaminate samples through improper handling. Samples will be sealed in appropriate containers, packaged by Tetra Tech

personnel and placed into sealed coolers under chain-of-custody in accordance with the applicable SOP. All coolers will contain a temperature blank. Samples will be transferred under chain-of-custody to a courier as described below. Once received by the laboratory, receipt will be documented on the chain-of-custody form and the samples will be checked in. The samples will remain under chain-of-custody throughout the analysis period to ensure their integrity is preserved. Details are provided below.

Samples to be delivered to the laboratory(s) will be made by a public courier (i.e., FedEx). After samples have been collected, they will be sent to the laboratory(s) within 24 hours. Under no circumstances will sample holding times be exceeded.

27.2 FIELD SAMPLE CUSTODY PROCEDURES

Chain-of-custody protocols will be used throughout sample handling to establish the evidentiary integrity of sample containers. These protocols will be used to demonstrate that the samples were handled and transferred in a manner that would eliminate possible tampering. Samples for the laboratory will be packaged and shipped in accordance with Tetra Tech SOP-04 (see Appendix F).

A sample is under custody if:

- The sample is in the physical possession of an authorized person.
- The sample is in view of an authorized person after being in his/her possession.
- The sample is placed in a secure area by an authorized person after being in his/her possession.
- The sample is in a secure area, restricted to authorized personnel only.

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

Integrity of the samples collected 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.

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 record documents the sample custody transfer from the sampler to the laboratory, often through another

person or agency (common carrier). Upon arrival at the laboratory, internal sample custody procedures will be followed as defined in the Laboratory SOPs included in Appendix G.

27.3 LABORATORY CHAIN OF CUSTODY – CHEMTECH AND EMPIRICAL

Laboratory sample custody procedures (receipt of samples, archiving, and disposal) will be used according to Chemtech and Empirical SOPs. 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 form will be checked against the sample containers for accuracy. Samples will be logged into the Laboratory Information Management System (LIMS) and given a unique log number which can be tracked through processing. The Laboratory PM will notify the Tetra Tech FOL verbally or via e-mail of any problems on the same day that an issue is identified.

SAP Worksheet #29 – Project Documents and Records Table
(UFP-QAPP Manual Section 3.5.1)

Document	Where Maintained
Field Documents Field Logbook Field Sample Forms Chain of Custody Records Air Bills Sampling Instrument Calibration Logs Sampling Notes Photographs FTMR Forms This SAP HASP	Field documents will be maintained in the project file located in the Tetra Tech King of Prussia, Pennsylvania office.
Laboratory Documents Sample receipt, custody, and tracking record Equipment calibration logs Sample preparation logs Analysis Run logs Corrective Action forms Reported field sample results Reported results for standards, QC checks, and QC samples Extraction/clean-up records Raw data	Laboratory documents will be included in the hardcopy and portable documents format deliverables from the laboratory. Laboratory data deliverables will be maintained in the Tetra Tech Pittsburgh project file and in long-term data package storage at a third-party professional document storage firm. Electronic data results will be maintained in a database on a password protected Structured Query Language (SQL) server.

Document	Where Maintained
Assessment Findings Field Sampling Audit Checklist (if conducted) Analytical Audit Checklist (if conducted) Data Validation Memoranda (includes tabulated data summary forms)	All assessment documents will be maintained in the Tetra Tech King of Prussia, Pennsylvania office.
Reports Remedial Investigation/Feasibility Study Report	All reports will be stored in hardcopy in the Tetra Tech King of Prussia, Pennsylvania project file and electronically in the server library.

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 Corrective Action** (title and organizational affiliation)	**Person(s) Responsible for Monitoring Effectiveness of Corrective Action** (title and organizational affiliation)
Laboratory System Audit[1]	Every two years	External	DoD ELAP Accrediting Body	DoD ELAP Accrediting Body Auditor	Laboratory QAM or Laboratory Manager, Chemtech and Empirical	Laboratory QAM or Laboratory Manager, Chemtech and Empirical	Laboratory QAM or Laboratory Manager, Chemtech and Empirical

1 Chemtech and Empirical are DoD ELAP accredited by a recognized Accrediting Body. The DoD ELAP accreditation letters are included in Appendix G.

SAP Worksheet #32 – Assessment Findings and Corrective Action Responses Table
(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 Corrective Action Response Documentation**	**Individual(s) Receiving Corrective Action Response** (name, title, organization)	**Timeframe for Response**
Laboratory System Audit	Written audit report	Laboratory QAM, Chemtech and Empirical	Specified by DoD ELAP Accrediting Body	Letter	DoD ELAP Accrediting Body	Specified by DoD ELAP Accrediting Body

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 sample delivery group (SDG)	Within 3 weeks after receiving the data from the laboratory	Project Chemist or Data Validator, Tetra Tech	PM, Tetra Tech; project file
Project Monthly Progress Report	Monthly for duration of the project	Monthly	PM, Tetra Tech	PM, Tetra Tech; QAM, Tetra Tech; Program Manager, Tetra Tech; Navy RPM; project file
Laboratory QA Report	When significant plan deviations result from unanticipated circumstances	Immediately upon detection of problem (on the same day)	Laboratory PM, Chemtech and Empirical	PM and project file, Tetra Tech

Additional Information

Several other worksheets within the Tier 2 SAP format are provided in other locations and/or formats than provided in a UFP-SAP. The following summarizes where specific UFP-SAP Worksheet information can be found:

- Worksheet #18 is provided as Section 8.5.
- Worksheet #19 is provided in Section 8.6.
- Worksheet #20 is provided as Section 8.7.
- Worksheet #21 is provided as Section 8.4.
- The information in Worksheet #30 of the UFP-SAP is provided in Section 8.6.
- The information in Worksheet #37 of the UFP-SAP is provided as part of Section 8.3.3 (Data Review).