APPENDIX H
DATA QUALITY ASSESSMENT REPORT

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APPENDIX H

Quality Control Summary Report

Phase II Remedial Investigation of Load Line 4

at the
Ravenna Army Ammunition Plant
Ravenna, Ohio

May 2004

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CONTENTS

TABLES

ACRONYMS

DQA	data quality assessment
DQCR	Daily Quality Control Reports
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
LCS	laboratory control sample
MPR	Monthly Progress Report
MS	matrix spike
MSD	matrix spike duplicate
PCB	polychlorinated biphenyl
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RI	Remedial Investigation
RPD	relative percent difference
RVAAP	Ravenna Army Ammunition Plant
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan
STL	Severn Trent laboratories, Inc.
SVOC	semivolatile organic compound
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound

1.0 PURPOSE OF THIS REPORT

Environmental data must always be interpreted relative to its known limitations and its intended use. As can be expected in environmental media of this type, there are areas and data points where the user needs to be cautioned relative to the quality of the project information presented. The data verification process and this data quality assessment (DQA) are intended to provide current and future data users assistance throughout the interpretation of this data.

The purpose of this Quality Control Summary Report is (1) to describe the quality control (QC) procedures followed to ensure data generated by Science Applications International Corporation (SAIC) during the Phase II Remedial Investigations (RIs) of Load Line 4 at the Ravenna Army Ammunition Plant (RVAAP) would meet project requirements; (2) to describe the quality of the data collected; and (3) to describe problems encountered during the course of the study and their solutions. A separate Chemical Quality Assessment Report will be completed by the U.S. Army Corps of Engineers (USACE), Louisville District quality assurance (QA) representative covering data generated from QA split samples remanded to their custody.

This report provides an assessment of the analytical information gathered during the course of the RVAAP Phase II RI for Load Line 4 performed during 2001. It documents that the quality of the data employed for the RI report and evaluation met their objectives. Evaluation of field and laboratory QC measures will constitute the majority of this assessment; however, references will also be directed toward those QA procedures that establish data credibility. The primary intent of this assessment is to illustrate that data generated for these studies can withstand scientific scrutiny; are appropriate for their intended purpose; are technically defensible; and are of known and acceptable sensitivity, precision, and accuracy.

Multiple activities must be performed to achieve the desired data quality in this project. As discussed in the report, decisions were made during the initial scoping of the RI to define the quality and quantity of data required. Project-specific data quality objectives (DQOs) were established in the Phase II RI Sampling and Analysis Plan (SAP) Addendum (USACE 2001a) in accordance with protocols specified in the RVAAP Facility-wide SAP (USACE 2001b) to guide the implementation of the field sampling and laboratory analysis. A QA Program was established as part of the Phase II RI SAP Addendum to standardize procedures and to document activities. This program provided a means to detect and correct any deficiencies in the process. Upon receipt by the project team, data were subjected to verification and review that identified and qualified problems related to the analysis. These review steps contribute to this final DQA, which defines that data used in the investigation met the criteria and are employed appropriately.

2.0 QUALITY ASSURANCE PROGRAM

A Facility-wide Quality Assurance Project Plan (QAPP) and a Phase II RI QAPP Addendum for Load Line 4 were developed and included in the respective Facility-wide SAP and Phase II RI SAP Addendum to guide the investigation. The purpose of these documents was to enumerate the quantity and type of samples to be taken to inspect the area of concern, and to define the quantity and type of QA/QC samples to be used to evaluate the quality of the data obtained.

The QAPP established requirements for both field and laboratory QC procedures. In general, field QC requirements were as follows:

- duplicates and QA split samples were required for each environmental sample matrix collected in the area being investigated;
- volatile organic compounds (VOC) trip blanks were to accompany each cooler containing water samples for VOC determinations; and
- analytical laboratory QC duplicates, matrix spikes (MSs), laboratory control samples (LCSs), and method blanks were required for every 20 samples or less of each matrix and analyte.

A primary goal of the RVAAP QA Program is to ensure that the quality of results for all environmental measurements are appropriate for their intended use. To this end, the QAPP and standardized field procedures were compiled to guide the investigation. Through the process of readiness review, training, equipment calibration, QC implementation, and detailed documentation, the project has successfully accomplished the goals set for the QA Program. Surveillances were conducted to determine the adequacy of field performance as evaluated against the QA plan and procedures.

2.1 MONTHLY PROGRESS REPORTS

Monthly Progress Reports (MPRs) were completed by the SAIC Project Manager during field operations and data verification and review. The MPRs contained the following information: work completed, problems encountered, corrective actions/solutions, summary of findings, and upcoming work. These reports were issued to the USACE, Louisville District Project Manager with copies forwarded to RVAAP and the Ohio Environmental Protection Agency. Access to these reports can be obtained through the USACE, Louisville District Project Manager.

2.2 DAILY QUALITY CONTROL REPORTS

The Field Team Leader produced all Daily Quality Control Reports (DQCRs). These include information such as, but not limited to; sub-tier contractors on-site, equipment on-site, work performed summaries, QC activities, Health and Safety activities, problems encountered, and corrective actions. The DQCRs were submitted to the USACE, Louisville District Project Manager and may be obtained through his office.

2.3 LABORATORY “DEFINITIVE” LEVEL DATA REPORTING

The QAPP for this project identified requirements for laboratory data reporting and identified Severn Trent Laboratories, Inc. (STL), North Canton, Ohio, as the laboratory for the project. During the execution of the project, the North Canton facility took the lead and performed the majority of the analyses, while STL, Knoxville, Tennessee, performed explosives by High Pressure Liquid Chromatography and STL, Sacramento, California, performed nitroguanidine and nitrocellulose determinations. U.S. Environmental Protection Agency (EPA) “definitive” data have been reported including the following basic information:

- laboratory case narratives,
- sample results (soils/sediments reported per dry weight),

- laboratory method blank results,
- LCS results,
- laboratory sample MS recoveries,
- laboratory duplicate results,
- surrogate recoveries [for VOCs, semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), and explosives],
- sample extraction dates, and
- sample analysis dates.

This information from the laboratory, along with field information, provides the basis for subsequent data evaluation relative to sensitivity, precision, accuracy, representativeness, and completeness. These have been presented in Section H4.0 of this appendix.

3.0 DATA VERIFICATION

The objective when evaluating the project data quality is to determine its usability. The evaluation is based on the interpretation of laboratory QC measures, field QC measures, and the project DQOs. This project implemented checklists to facilitate laboratory data review. These checklists were completed by the project-designated verification staff and were reviewed by the project laboratory coordinator. Data verification checklists for each laboratory sample delivery group (SDG) have been retained with laboratory data deliverables in the project files, with a copy of all checklists being forwarded to the USACE, Louisville District project chemist. Independent third-party validation of a percentage of the Phase II RI data will be conducted by the USACE, Louisville District data validation subcontractor.

3.1 FIELD DATA VERIFICATION

DQCRs were completed by the Field Team Leader. The DQCRs and other field-generated documents such as sampling logs, boring logs, daily health and safety summaries, daily safety inspections, equipment calibration and maintenance logs, and sample management logs were peer reviewed on-site. These logs and all associated field information have been delivered to the USACE, Louisville District Project Manager and copies are retained in the Architectural-Engineering contractor project file.

3.2 LABORATORY DATA VERIFICATION

Analytical data generated for this project have been subjected to a process of data verification and review. The following describes this systematic process and the evaluation activities performed. Several criteria have been established against which the data were compared and from which a judgment was rendered regarding the acceptance and qualification of the data. Because it is beyond the scope of this report to cite those criteria, the reader is directed to the following documents for specific detail:

- SAIC Technical Support Contractor QA Technical Procedure (TP-DM-300-7) Data Verification and Validation;

- EPA – National Functional Guidelines for Inorganic Data Review, EPA 540/R-94/013, February 1994;

- EPA – National Functional Guidelines for Organic Data Review, EPA-540/R-99/008, October 1999; and

- RVAAP Facility-wide SAP and Phase II RI SAP Addendum for Load Lines 2, 3, and 4 (USACE 2001a and 2001b).

Upon receipt of field and analytical data, verification staff performed a systematic examination of the reports, following standardized data package checklists to ensure the content, presentation, and administrative validity of the data. Discrepancies identified during this process were recorded and documented utilizing the checklists. As part of data verification, standardized laboratory electronic data deliverables were subjected to review. This technical evaluation ensured that all contract-specified requirements had been met, and that electronic information conformed to reported hardcopy data. QA Program Nonconformance Report and Corrective Action systems were implemented as required.

During the verification phase of the review and evaluation process, data were subjected to a systematic technical review by examining all field and analytical QC results and laboratory documentation, following EPA functional guidelines and SAIC internal procedures for laboratory data review. These data review guidelines define the technical review criteria, methods for evaluation of the criteria, and actions to be taken resulting from the review of these criteria. The primary objective of this phase was to assess and summarize the quality and reliability of the data for the intended use and to document factors that may affect the usability of the data. This process did not include in-depth review of raw data instrument out-put or recalculation of results from the primary instrument out-put. This data verification and analytical review process included, but was not necessarily limited to, the following parameters:

- Data completeness;
- Analytical holding times and sample preservation;
- Calibration (initial and continuing);
- Method blanks;
- Sample results verification;
- Surrogate recovery;
- LCS analysis;
- Internal standard performance;
- MS recovery;
- Duplicate analysis comparison;
- Reported detection limits;
- Compound, element, isotope quantification;
- Reported detection levels; and
- Secondary dilutions.

As an end result of this phase of the review, the data were qualified based on the technical assessment of the verification/validation criteria. Qualifiers were applied to each field and analytical result to indicate the usability of the data for its intended purpose.

3.3 DEFINITION OF DATA QUALIFIERS (FLAGS)

During the data verification process, all laboratory data were assigned appropriate data qualification flags and reason codes. Qualification flags are defined as follows:

"U"	Indicates the analyte was analyzed for, but not detected above, the level of the associated value.
"J"	Indicates the analyte was positively identified; however, the associated numerical value is an approximate concentration of the analyte in the sample.
"UJ"	Indicates the analyte was analyzed for, but not detected above, the associated value; however, the reported value is an estimate and demonstrates a decreased knowledge of its accuracy or precision.
"R"	Indicates the analyte value reported is unusable. The integrity of the analyte's identification, accuracy, precision, or sensitivity has raised significant questions as to the reality of the information presented.
"="	Indicates the analyte has been validated, the analyte has been positively identified, and the associated concentration value is accurate.

SAIC qualification reason codes have been provided as Attachment H-1, while copies of verification/validation checklists and qualified data forms are on-file with the analytical laboratory deliverable.

3.4 DATA ACCEPTABILITY

Over 200 environmental soil, sediment, surface water, groundwater, and field QC samples were collected with approximately 12,600 discrete analyses (i.e., analytes) being obtained, reviewed, and integrated into the assessment (these totals do not include field measurements and field descriptions). The on-site field laboratory processed over 130 soil and sediment samples to produce over 230 trinitrotoluene and hexahydro-1,3,5-trinitro-1,3,5-triazine screening measurements. The project produced acceptable results for 99% of the sample analyses performed. Data that were rejected are relegated primarily to antimony non-detect levels in soils and a few SVOC compound determinations in water and floor sweeping samples.

Table H-1 presents a summary of the collected investigation samples and tallies the successful collection of all targeted field QC and QA split samples, while Table H-2 identifies a cross reference for duplicate and QA split sample pair numbers. Table H-3 provides a summary of rejected analyses grouped by media and analyte category. The majority of estimated values were based on values observed between the laboratory method detection levels and the project reporting levels. Values determined in this region have an inherently higher variability and need to be considered estimated, at best.

For this RVAAP study, a total of 17 field duplicates was analyzed for soil, sediment, groundwater, and surface water media. Three equipment rinsate were collected and analyzed for this project. One site potable water source was sampled (sample ID LL41178). A total of six trip blanks was analyzed for VOCs relative to each shipment of VOC water samples.

4.0 DATA QUALITY EVALUATION

4.1 METALS

Soils, Sediments, and Floor Sweepings

Analytical holding times were met for all samples. Initial calibration and continuing calibration criteria were achieved for the majority of the data, although a few thallium values were qualified as estimated J or UJ due to continuing calibration verification results being slightly elevated. Minor method blank levels did result in qualification of beryllium, cadmium, mercury, and thallium values in a few samples as non-detect or estimated non-detect U or UJ. Antimony concentrations were consistently qualified as estimated J, UJ due to low MS results and 54 non-detect values were actually rejected (R), due to extremely low MS recoveries. Most of the other metals were occasionally estimated due to MS values being low or high relative to criteria. None of these deviations were considered significant enough to reject any of the data. Post-digestion spike recoveries for thallium contributed to their estimation as J or UJ in a few soil samples. Occasional serial dilution variations caused beryllium, cobalt, nickel, and potassium levels to be estimated in various samples. LCS determinations were considered acceptable throughout the data set. Reporting levels are considered to be consistent with the QAPP goals. Laboratory duplicate comparisons were elevated in several instances and caused various data to be estimated as J or UJ; however, none of the deviations were considered severe enough to reject any of the data. Although some analyses were qualified as estimated, the deviations observed should not have a primary influence on the results and the values are considered technically sound and defensible. Rejected antimony values exhibit an unknown negative bias and should not be used. Complete data results, with associated qualifiers, are provided in Appendix I of the Load Line 4 Phase II RI report, and are maintained in the SAIC Ravenna environmental database.

Groundwater, Surface Water, and Field Quality Control Samples

Analytical holding times were met for all samples. Initial calibration and continuing calibration criteria were achieved, with the exception of a few sodium and thallium continuing calibration verification results that caused data estimation (J or UJ). Minor method blank levels did result in the occasional qualification of antimony, aluminum, beryllium, cadmium, cobalt, manganese, potassium, thallium, vanadium, and zinc concentrations in samples as non-detect or estimated non-detect U or UJ. MS recoveries were satisfactory, with the exception of some elevated iron results. Iron was estimated as a consequence in those instances. All other MS data were acceptable. Occasional serial dilution variations caused potassium and zinc levels to be estimated in various samples. LCS determinations were considered acceptable throughout the data set. Reporting levels are considered to be consistent with the QAPP goals. Some of this data were qualified as estimated; however, none of the deviations were considered severe enough to reject any of the data. Although some analyses were qualified as estimated, the deviations observed should not have a primary influence on the results and the values are considered technically sound and defensible. Complete data results, with associated qualifiers, are provided in Appendix I of the Load Line 4 Phase II RI report, and are maintained in the SAIC Ravenna environmental database.

4.2 VOLATILE ORGANIC ANALYSES

Soils, Sediments, and Floor Sweepings

Analytical holding times were met for all samples. All surrogate recoveries were acceptable. Internal standard area counts were acceptable with the exception of sediment sample LL40951 results. Several values were qualified as estimated due to low area counts, while extremely low area counts for 1,1,2,2-tetrachloroethane caused its results to be rejected. Initial calibration criteria and continuing calibration criteria were met for all compounds, with the exception of a few acetone relative percent differences (RPDs) that caused data to be estimated. Method blanks were clear of contamination. LCS and MS evaluations included all project-targeted analytes. Low LCS recoveries were observed for acetone and 2-butanone. Associated compound values were qualified as estimated J or UJ. All other LCS recoveries were within criteria. MS recoveries and MS/matrix spike duplicate (MSD) RPD values were acceptable with the exception of few instances for 2-butanone. Associated values were estimated J, as required. Although some analyses were qualified as estimated, the deviations observed should not have a primary influence on the results and the values are considered technically sound and defensible.

Groundwater, Surface Water, and Field Quality Control Samples

Analytical holding times were met for all samples. All surrogate recoveries and internal standard areas were acceptable. Initial calibration criteria and continuing calibration criteria were met for all compounds with the exception of a few elevated acetone continuing calibration verification percent differences values that resulted in data being estimated J. Method blanks and trip blanks were clear of contamination with the exception of measurable levels of acetone and toluene. Sample data for most observed low acetone and toluene concentrations were therefore qualified as non-detect U based on a 5-times action level for these compounds. LCS and MS/MSD evaluations included all project-targeted analytes. Occasionally, low LCS recoveries were observed for carbon disulfide, chloroethane, chloromethane, 1,1,2,2-tetrachloroethene, bromomethane, and vinyl chloride. Associated compound values were qualified as estimated J or UJ. All other LCS recoveries were within criteria. MS recoveries and MS/MSD RPD values were acceptable for the water matrices. Although some analyses were qualified as estimated, the deviations observed should not have a primary influence on the results and the values are considered technically sound and defensible.

4.3 SEMIVOLATILE ORGANIC ANALYSES

Soils, Sediments, and Floor Sweepings

Analytical holding times were not met for all samples. All SVOC extraction times exceeded the recommended time and all values were estimated J or UJ as a result. The laboratory experienced multiple difficulties with soxhlet extraction and sample matrices interferences. Due to theses difficulties, the laboratory worked with USACE and the A/E contractor chemists to overcome these issues. These re-extractions with extended holding times were necessary to overcome both extraction difficulties and analytical interferences, and the data are considered acceptable but estimated. Surrogate recoveries and internal standard area counts were acceptable with the exception of extremely low surrogate recoveries for phenolic compounds in floor sweep samples LL40835 and LL40845 causing 30 non-detect compound analyses to be rejected. Continuing calibration verification percent differences greater than 25 caused a few chrysene and benzoic acid concentrations to be estimated. All other initial calibration criteria and continuing calibration criteria were met for all compounds. Method blanks were clear of contamination. LCS and MS/MSD evaluations included all project-targeted analytes. Chrysene was estimated J or UJ in a few samples due to elevated LCS recoveries.

Other LCS recoveries were within criteria. MS recoveries were considered acceptable. While some of this data were qualified as estimated, only the phenols in floor sweeping samples exhibited enough significant deviations to be rejected. Although some analyses were qualified as estimated, the deviations observed should not have a primary influence on the results and the values are considered technically sound and defensible.

Groundwater, Surface Water, and Field Quality Control Samples

Analytical holding times were met for all samples. Surrogate recoveries and internal standard area counts were acceptable, with the exception of sediment sample LL41108 that had extremely poor phenolic surrogate recovery resulting in the rejection (R) of 16 values. All initial calibration criteria and continuing calibration criteria were met, except for one benzoic acid continuing calibration verification percent difference. Method blanks were clear of contamination. LCS and MS/MSD evaluations included all project-targeted analytes. Poor LCS or MS recovery information did create the need to reject (R) several hexachlorocyclopentadiene and demethylphthalate values in multiple samples, including the two surface waters LL40998 and LL41154. Other LCS and MS water matrix recoveries were within criteria. While some of this water data were qualified as estimated, only a few data points exhibited enough significant deviations to be rejected. Although some analyses were qualified as estimated, the deviations observed should not have a primary influence on the results and the values are considered technically sound and defensible.

4.4 PESTICIDE/PCB ANALYSES

Soils, Sediments, and Floor Sweepings

Analytical holding times were met for all samples. Surrogate recoveries were predominantly acceptable with the exception of a few elevated surrogates for PCBs, causing values to be estimated. Continuing calibration verification percent differences greater than 25 caused sporadic qualification of the pesticide compounds as estimated J or UJ in the data set. All other initial calibration criteria and continuing calibration criteria were met for compounds. Method blanks were clear of contamination. The LCS and MS/MSD evaluations included the project-targeted pesticides; however, PCB evaluations only included Aroclors-1016 and -1260. PCBs were estimated J or UJ in a few samples due to low LCS recoveries. Other LCS recoveries were within criteria. Poor MS recoveries caused some PCB data to be estimated J. Very poor LCS recovery caused two soil, three sediment, and three floor sweeping delta-BHC non-detect levels to be rejected R, while very low MS recovery resulted in rejection of six soil and six sediment non-detect PCB-1260 results. Other LCS and MS recoveries were acceptable. Several positive pesticide compound results were qualified as estimated J based on the percent difference between the primary column quantification and the secondary column quantification. While some of this data were qualified as estimated, only 20 data points exhibited enough significant deviations to be rejected. Although some analyses were qualified as estimated, the deviations observed should not have a primary influence on the results and the values are considered technically sound and defensible.

Groundwater, Surface Water, and Field Quality Control Samples

Analytical holding times were met for all samples, with the exception of samples LL40998, LL41154, and two equipment rinsates. All surrogate recoveries were acceptable. All initial calibration criteria and continuing calibration criteria were met for all compounds with the exception of elevated continuing calibration verification percent differences in a few instances. Toxaphene and endrin data were estimated UJ in these isolated cases. Method blanks were clear of contamination. LCS and MS/MSD evaluations included the project-targeted pesticides; however, PCB evaluations only included Aroclors-1016 and -1260. Water LCS and MS recoveries were within criteria. Although some analyses were qualified as estimated, the deviations observed should not have a primary influence on the results and the values are considered technically sound and defensible.

4.5 EXPLOSIVE ANALYSES

Soils, Sediments, and Floor Sweepings

Analytical holding times were met for all samples. Continuing calibration verification percent differences greater than 25 caused a few isolated qualifications of tetryl as estimated UJ in the data set. All other initial calibration criteria and continuing calibration criteria were met for all compounds. A few method blanks contained low concentrations of nitrocellulose. This resulted in some low concentrations being qualified as undetected U. All other method blanks were clear of contamination. Surrogate compound recoveries were acceptable for all analyses. LCS and MS/MSD evaluations included the project-targeted analytes, with the exception of nitroglycerine. LCS and MS/MSD recoveries were within criteria. Although some analyses were qualified as estimated, the deviations observed should not have a primary influence on the results and the values are considered technically sound and defensible.

Groundwater, Surface Water, and Field Quality Control Samples

Analytical holding times were met for samples, with the exception of extraction times for one SDG of six samples. Data for these analyses were qualified as estimated UJ. All initial calibration criteria and continuing calibration criteria were met for all compounds. Method blanks were clear of contamination. Surrogate compound recoveries were acceptable for all analyses. LCS and MS/MSD evaluations included the project-targeted analytes, with the exception of nitroglycerine. Water LCS and MS recoveries were within criteria. Although some analyses were qualified as estimated, the deviations observed should not have a primary influence on the results and the values are considered technically sound and defensible.

4.6 MISCELLANEOUS ANALYSES

Soils, Sediments, Groundwater, Surface Water, and Field Quality Control Samples

Analytical holding times were met for all total organic carbon and cyanide determinations. Hexavalent chromium analyses were predominantly run outside the holding time. Analyses performed outside holding times were qualified as estimated J or UJ. Initial calibration criteria and continuing calibration criteria were met for all analyses. All method blanks were clear of contamination for these analytes. MS data were satisfactory. One hexavalent chromium value was rejected R due to very low MS recoveries. Hexavalent chromium for sample LL40875 was rejected. LCS recoveries were consistently within criteria. While some of this data were qualified as estimated, only a few data points exhibited enough significant deviations to be rejected. Although some analyses were qualified as estimated, the deviations observed should not have a primary influence on the results and the values are considered technically sound and defensible.

4.7 PRECISION

Field duplicate samples were collected to ascertain the contribution to variability (i.e., precision) due to the combination of environmental media, sampling consistency, and analytical precision. Field duplicate samples were collected from the same spatial and temporal conditions as the primary environmental sample. Soil samples were collected from the same sampling device, after homogenization for all analytes except VOCs.

Field duplicate comparison information in Table H-4 presents the absolute difference or RPD for field duplicate measurements, by analyte. The RPD was calculated only when both samples were >5 times the reporting level. When one or both sample values were between the reporting level and 5 times the reporting level, the absolute difference was evaluated. If both samples were not detected for a given analyte, precision was considered acceptable. In order to review information, this DQA has implemented general criteria for comparison of absolute difference measurements and RPDs. RPD criteria were set at 50 and absolute difference criteria were set at 3 times the reporting level.

Field duplicate metal comparisons are considered good. Of 299 RPD observations in surface soil duplicates, 274 (92%) were <50 or had acceptable absolute differences, while all of the 26 RPD observations for subsurface soil duplicates were <50 or had acceptable absolute differences. Only 2% of the surface soil RPD comparisons were >100 and only 6% were >50. All of the >100 RPD comparisons were within the one duplicate set of samples LL40849 and LL41143. Surface water and groundwater field duplicate metal comparisons were all <30 RPD with the exception of manganese and sodium in duplicate pair L41118 and L41152. Explosive, VOC, SVOC, pesticide, PCB, cyanide, and hexavalent chromium field duplicate comparisons were all acceptable.

4.8 SENSITIVITY

Determination of minimum detectable values allows the investigation to assess the relative confidence that can be placed in a value relative to the magnitude or level of analyte concentration observed. The closer a measured value comes to the minimum detectable concentration, the less confidence and more variation the measurement will have. Project sensitivity goals were expressed as quantitation level goals in the QAPP. These levels were achieved or exceeded throughout the analytical process, with the exception of thallium in water. Actual laboratory method detection levels achieved during this investigation are presented in Table H-5 with original project quantitation level goals. Individual analyte reporting levels varied due to matrix differences and contaminant analyte concentrations. Reporting levels were elevated in soils and sediments due to inherent moisture content variability and results being reported in the standard dry weight format. However, there were larger elevations of reporting levels in several soil and sediment PCB, pesticide, and semivolatile results due to high levels of individual contaminants. This caused solid sample reporting levels for other analytes to be elevated by factors of 10 to 50 times, as a result of required dilutions. High levels of 2,4,6-trinitrotoluene in some solids also caused explosive and semivolatile analyses to be diluted and reporting levels to be elevated. Water determinations consistently met project reporting level goals. Reporting level variations have been considered during data interpretation and statistical applications.

Method blank determinations were performed with each analytical sample batch for each analyte under investigation. These blanks were evaluated during data review to determine their potential impact on individual data points, if any. Review action levels are set at 5 times the reporting level for all analytes, except those designated as common laboratory contaminants (methylene chloride, acetone, and phthalate compounds) with action levels set at 10 times reporting levels. During data review, reported sample concentrations are assessed against method blank action levels and the following qualifications are made when reportable quantities of analytes were observed in the associated method blank.

- When the analyte sample concentration is above the 5- or 10-times action level the data are not qualified and they are considered a positive value. They will receive a validation reason code of “F01, F08.”

- When the analyte sample concentration is determined below the 5- or 10-times action level but above the reporting level, the data are considered impacted by the method blank and the value reported is qualified as a non-detect at the analyte value reported. This data is then qualified as U with a reason code of "F01, F07."

- When the analyte sample concentration is determined below the 5- or 10-times action level and below the reporting level, the data are considered impacted by the method blank and the value reported is qualified as a non-detect at the reporting level. This data are then qualified as U with a reason code of "F01, F06."

No data were rejected as a result of method blank contamination; however, various analytes are qualified as non-detect U, according to the above validation reason codes.

Evaluation of overall project sensitivity can be gained through review of field blank information. These actual sample analyses may provide a comprehensive look at the combined sampling and analysis sensitivity attained by the project. Field QC blanks obtained during sampling activities at RVAAP included samples of VOC trip blank waters and a site potable water source.

There were only minor concentrations of the VOCs acetone, 2-butanone, and toluene detected in project trip blanks. The concentrations observed were: acetone from 2 to 28 J ug/L (reporting level at 10 ug/L); 2-butanone from 0.54 to 0.87 J ug/L (reporting level at 10 ug/L); and toluene from 0.21 to 0.55 J ug/L (reporting level at 1 ug/L). The impact of these values has been assessed during data review and values have been qualified where necessary. It is, therefore, determined that VOC analyses were not affected through the transportation and storage process, and that the procedures and precautions employed were effective in preserving the integrity of the sample analysis.

Equipment rinsate samples (LL41173, LL41174, and LL41175) exhibited similar levels for toluene and 2-butanone, while showing slightly higher values for acetone (43 ug/L, 63 ug/L, and 27 ug/L, respectively). Minor levels of carbon disulfide, 2,4-dinitrotoluene, aluminum, and zinc were also observed. All rinsates were associated with groundwater sampling equipment and none of the contaminant levels impacted the sample values being reported.

Field source water blank LL41178 (08/14/2001) exhibited few analyte levels above project reporting levels. Those detected included normal levels of calcium, magnesium, potassium, sodium, and zinc, with minor concentrations of acetone, bromodichloromethane, dibromochloromethane, and chloroform indicative of a chlorinated water source. There is no indication that the source water impacted associated sample levels.

4.9 REPRESENTATIVENESS AND COMPARABILITY

Representativeness expresses the degree to which data accurately reflect the analyte or parameter of interest for the environmental site and is the qualitative term most concerned with the proper design of the sampling program. Factors that affect the representativeness of analytical data include proper preservation, holding times, use of standard sampling and analytical methods, and determination of matrix or analyte interferences. Samples were delivered directly to the laboratory by courier, were received in good condition, and at appropriate temperature. Several organic analyses were conducted outside the holding time because samples were re-extracted and re-analyzed due to analytical difficulties or low surrogate recoveries. These data were qualified accordingly as outside of the holding time, per EPA protocols. These instances occurred when initial extraction results required the laboratory to repeat semivolatile extractions for a sample beyond the standard holding time, but within the direction and guidance of the analytical methodology. Sample preservation, analytical methodologies, and soil sampling methodologies were documented to be adequate and consistently applied. Estimated values qualified as being outside of the holding time were utilized with the requisite precautions in some of the report data interpretations. Use of these data might result in some additional uncertainty in specific interpretations where the values were incorporated, but are not believed to have detracted from achieving the overall project DQOs.

Comparability, like representativeness, is a qualitative term relative to an individual project data set. The Phase II RI employed appropriate sampling methodologies, site surveillance, use of standard sampling devices, uniform training, documentation of sampling, standard analytical protocols/procedures, QC checks with standard control limits, and universally accepted data reporting units to ensure comparability to other data sets. Through the proper implementation and documentation of these standard practices, the project has established the confidence that the data will be comparable to other project and programmatic information. Table H-6 presents the standardized parameter groups, analytical methods, sample containers, preservation techniques, and associated holding times.

4.10 COMPLETENESS

Usable data are defined as those data that pass individual scrutiny during the verification and validation process and are accepted for unrestricted application to the human health risk assessment evaluation or equivalent type applications. It has been determined that estimated data are acceptable for RVAAP project objectives.

5.0 DATA QUALITY ASSESSMENT SUMMARY

The overall quality of RVAAP Load Line 4 Phase II RI information meets or exceeds the established project objectives. The project produced usable results for 99% of the sample analyses performed. Through proper implementation of the project data verification, validation, and assessment process, project information has been determined to be acceptable for use.

Data, as presented, have been qualified as usable, estimated J or UJ, or rejected R. Data that have been estimated provide indications of either accuracy, precision, or sensitivity being less than desired, but adequate for interpretation. Data that are not acceptable for use have been rejected. Qualifiers have been applied to data when necessary.

Data produced for this project demonstrate that they can withstand scientific scrutiny; are appropriate for its intended purpose; are technically defensible; and are of known and acceptable sensitivity, precision, and accuracy. Data integrity has been documented through proper implementation of QA and QC measures. The environmental information presented has an established confidence that allows utilization for the project objectives and provides data for future needs.

6.0 REFERENCES

USACE (U.S. Army Corps of Engineers) 2001a. *Sampling and Analysis Plan Addendum No. 1 for the Load Lines 2, 3, and 4 Phase II Remedial Investigation, Ravenna Army Ammunition Plant, Ravenna, Ohio,* F44650-99-D-0007, ECAS 186, July.

USACE 2001b. *Facility-wide Sampling and Analysis Plan (SAP) for the Ravenna Army Ammunition Plant, Ravenna, Ohio,* DACA62-00-D-0001, DO CY 02, March.

Table H-1. RVAAP Load Line 4 Phase II RI Sample Summary

Area	Media	Environmental Samples	Field Duplicates	Trip Blanks	Equipment Rinsate Blanks	Site Source Water Blanks	USACE Split Samples
Laboratory Analyses	Soils	102	13	-	3	1	13
	Sediment	26	2	-	-	-	2
	Surface Waters	18	1	4	-	-	1
	Groundwater	8	1	2	-	-	1
	Floor Sweepings	3	-	-	-	-	-
Totals		**157**	**17**	**6**	**3**	**1**	**17**
Field Analyses	Soil and Sediment	127	5	-	-	-	-

RI = Remedial Investigation.
RVAAP = Ravenna Army Ammunition Plant.
USACE = U. S. Army Corps of Engineers.

Table H-2. RVAAP Load Line 4 Phase II RI Primary, Duplicate, and Split Sample Correlation Table

Media	Station #	Sample #/ Duplicate #	SDG # Metals, etc.	SDG # Explosives	SDG # Propellants	Split #
Surface Soil						
Surface Soil	LL4-070	LL40687 LL41151	A1H240147 A1H240147	None None	NONE NONE	LL41169
Surface Soil	LL4-074	LL40698 LL41148	A1H220107 A1H220107	None None	None None	LL41166
Surface Soil	LL4-076	LL40704 LL41138	A1H220112 A1H220112	A1H240138 A1H220112	A1H240138 A1H220112	LL41156
Surface Soil	LL4-090	LL40744 LL41139	A1H240138 A1H240147	None A1H240147	None A1H240147	LL41157
Surface Soil	LL4-094	LL40756 LL41146	A1H230105 A1H230105	A1H240138 None	A1H240138 None	LL41164
Surface Soil	LL4-105	LL40788 LL41144	A1H240147 A1H240147	None None	None None	LL41162
Surface Soil	LL4-106	LL40790 LL41147	A1H150131 A1H150131	None None	None None	LL41165
Surface Soil	LL4-116	LL40816 LL41141	A1H150258 A1H150258	A1H150258 A1H150258	A1H150258 A1H150258	LL41159
Surface Soil	LL4-131	LL40849 LL41143	A1H150131 A1H150131	None None	None None	LL41161
Surface Soil	LL4-142	LL40878 LL41142	A1H250116 A1H250116	A1H250119 None	A1H250119 None	LL41160
Surface Soil	LL4-145	LL40887 LL41137	A1H140111 A1H140111	A1H150258 A1H140111	A1H150258 A1H140111	LL41155
Surface Soil	LL4-150	LL40902 LL41149	A1H250116 A1H240147	A1H250116 None	A1H250116 None	LL41167
Surface Soil	LL4-161	LL40913 LL41150	A1H250119 A1H250119	None None	None None	LL41168
Sediment						
Sediment	LL4-175	LL40951 LL41145	A1H150258 A1H150258	A1H230105 None	A1H230105 None	LL41163
Sediment	LL4-177	LL40979 LL41140	A1H140119 A1H140119	A1H150258 A1H140119	A1H150258 A1H140119	LL41158
Surface Water						
Surface Water	LL4-189	LL40998 LL41154	A1H140119 A1H140119	A1H140119 A1H140119	A1H140181 A1H140181	LL41172
Groundwater						
Groundwater	LL4-199	LL41118 LL41152	A1I060104 A1I060104	A1I060104 A1I060104	A1I060103 A1I060103	LL41170

RI = Remedial Investigation.
RVAAP = Ravenna Army Ammunition Plant.
SDG = sample delivery group.

Table H-3. RVAAP Load Line 4 Phase II RI Summary of Rejected Analytes (Laboratory) (grouped by medium and analysis group)

Media	Analysis Group	Rejected/	Total	(%) Rejected
Soil (surface and subsurface)	Metals	53/	2,645	2.0
	Volatile Organics	0/	875	0.0
	Semivolatile Organics	0/	1,586	0.0
	Pesticides/PCBs	8/	952	0.8
	Explosives	0/	541	0.0
	Miscellaneous	1/	21	4.0
	Subtotal	62/	6,620	0.9
Sediment	Metals	1/	644	0.2
	Volatile Organics	1/	315	0.3
	Semivolatile Organics	0/	593	0.0
	Pesticides/PCBs	9/	385	2.3
	Explosives	0/	212	0.0
	Miscellaneous	0/	10	0.0
	Subtotal	11/	2,159	0.5
Surface Water, Groundwater, and QC	Metals	0/	644	0.0
	Volatile Organics	0/	560	0.0
	Semivolatile Organics	33/	1,056	3.1
	Pesticides/PCBs	0/	525	0.0
	Explosives	0/	448	0.0
	Miscellaneous	0/	15	0.0
	Subtotal	33/	3,248	1.0
Floor Sweepings	Metals	0/	93	0.0
	Volatile Organics	0/	135	0.0
	Semivolatile Organics	30/	234	12.8
	Pesticides/PCBs	3/	112	2.7
	Explosives	0/	45	0.0
	Miscellaneous	0/	9	0.0
	Subtotal	33/	628	0.9
Project Total		**139/**	**12,655**	**1.1**

PCB = polychlorinated biphenyl.
QC = quality control.
RI = Remedial Investigation.
RVAAP = Ravenna Army Ammunition Plant.

Table H-4. RVAAP Load Line 4 Phase II RI Field Duplicate Comparison

Analysis	LL40687/LL41151 Surface Soil RPD	LL40698/LL41148 Surface Soil RPD	LL40704/LL41138 Surface Soil RPD	LL40744/LL41139 Surface Soil RPD
Metals				
Aluminum	13	4	6	0
Antimony	*	*	*	*
Arsenic	23	33	18	8
Barium	15	11	14	54
Beryllium	16	*	23	*
Cadmium	*	*	*	UNAC
Calcium	17	20	48	19
Chromium	14	*	12	7
Cobalt	5	22	26	22
Copper	24	23	29	41
Iron	21	13	25	23
Lead	4	27	12	15
Magnesium	15	11	28	28
Manganese	12	7	9	8
Mercury	*	*	*	*
Nickel	18	19	23	67
Potassium	8	6	7	8
Selenium	*	*	*	*
Silver	*	*	*	*
Sodium	*	*	*	*
Thallium	*	*	*	*
Vanadium	15	7	16	16
Zinc	15	14	15	53
Cyanide	NA	NA	*	*
Volatile Organic Compounds				
All compounds	NA	NA	*	*
Semivolatile Organic Compounds				
All compounds	NA	NA	*	*
Explosive Compounds				
All compounds	NA	NA	*	NA
Except 2,4,6-TNT	NA	NA	*	NA
Hexavalent Chromium	NA	NA	NA	NA
Pesticide/PCB Compounds				
All compounds	NA	NA	NA	*

Table H-4. RVAAP Load Line 4 Phase II RI Field Duplicate Comparison (continued)

Analysis	LL40756/LL41146 Surface Soil RPD	LL40788/LL41144 Surface Soil RPD	LL40790/LL41147 Surface Soil RPD	LL40816/LL41141 Surface Soil RPD
Metals				
Aluminum	6	1	1	1
Antimony	*	*	*	*
Arsenic	69	33	3	25
Barium	34	14	0	4
Beryllium	*	*	3	*
Cadmium	*	*	*	*
Calcium	UNAC	22	6	68
Chromium	13	3	1	2
Cobalt	70	10	18	4
Copper	60	9	4	6
Iron	70	8	3	30
Lead	14	26	8	7
Magnesium	77	3	4	21
Manganese	16	15	25	18
Mercury	*	*	*	*
Nickel	52	7	3	9
Potassium	*	1	3	*
Selenium	*	*	*	*
Silver	*	*	*	*
Sodium	*	*	*	*
Thallium	7	*	12	67
Vanadium	7	5	0	24
Zinc	13	8	5	36
Cyanide	NA	NA	NA	NA
Volatile Organic Compounds				
All compounds	NA	NA	NA	NA
Semivolatile Organic Compounds				
All compounds	NA	NA	NA	NA
Explosive Compounds				
All compounds	NA	NA	NA	*
Except 2,4,6-TNT	NA	NA	NA	*
Hexavalent Chromium	NA	NA	NA	NA
Pesticide/PCB Compounds				
All compounds	*	*	*	*

Table H-4. RVAAP Load Line 4 Phase II RI Field Duplicate Comparison (continued)

Analysis	LL40849/LL41143 Surface Soil RPD	LL40878/LL41142 Surface Soil RPD	LL40887/LL41137 Surface Soil RPD	LL40902/LL41149 Surface Soil RPD
Metals				
Aluminum	43	3	27	3
Antimony	*	*	*	*
Arsenic	61	1	10	3
Barium	73	5	31	3
Beryllium	*	*	*	*
Cadmium	89	*	*	*
Calcium	122	9	9	4
Chromium	147	24	31	6
Cobalt	63	1	88	19
Copper	47	4	18	5
Iron	122	4	17	1
Lead	130	32	10	2
Magnesium	115	4	3	1
Manganese	84	13	28	31
Mercury	28	*	*	*
Nickel	53	1	20	8
Potassium	40	7	17	1
Selenium	*	*	*	*
Silver	*	*	*	*
Sodium	*	*	*	*
Thallium	*	*	*	*
Vanadium	61	4	32	4
Zinc	73	3	2	2
Cyanide	NA	NA	*	NA
Volatile Organic Compounds				
All compounds	NA	NA	*	NA
Semivolatile Organic Compounds				
All compounds	NA	NA	*	NA
Explosive Compounds				
All compounds	NA	NA	*	NA
Hexavalent Chromium	NA	*	NA	NA
Pesticide/PCB Compounds				
Arochlor-1254	5	*	*	NA
All other compounds	*	*	*	NA

Table H-4. RVAAP Load Line 4 Phase II RI Field Duplicate Comparison (continued)

Analysis	LL40913/LL41150 Surface Soil RPD	LL40951/LL41145 Sediment RPD	LL40979/LL41140 Sediment RPD	LL40998/LL41154 Surface Water RPD
Metals				
Aluminum	2	13	7	*
Antimony	*	89	*	*
Arsenic	1	9	4	*
Barium	2	17	5	0
Beryllium	*	*	*	*
Cadmium	*	7	*	*
Calcium	15	53	9	1
Chromium	2	7	13	*
Cobalt	10	1	2	*
Copper	1	4	3	*
Iron	12	2	16	4
Lead	13	49	7	*
Magnesium	7	8	5	2
Manganese	7	0	9	0
Mercury	*	*	*	*
Nickel	3	20	10	*
Potassium	4	9	9	0
Selenium	*	*	*	*
Silver	*	*	*	*
Sodium	*	1	*	4
Thallium	*	6	*	*
Vanadium	0	1	4	*
Zinc	2	16	7	0
Cyanide	NA	NA	NA	*
Volatile Organic Compounds				
All compounds	NA	NA	NA	*
Semivolatile Organic Compounds				
All compounds	NA	NA	NA	*
Explosive Compounds				
All compounds	NA	NA	*	*
Hexavalent Chromium	NA	NA	NA	NA
Pesticide/PCB Compounds				
All compounds	NA	NA	*	*

Table H-4. RVAAP Load Line 4 Phase II RI Field Duplicate Comparison (continued)

Analysis		LL41118/LL41152 Groundwater RPD
Metals		
Aluminum		*
Antimony		*
Arsenic		*
Barium		*
Beryllium		*
Cadmium		*
Calcium		*
Chromium		*
Cobalt		*
Copper		*
Iron		*
Lead		*
Magnesium		17
Manganese		54
Mercury		*
Nickel		*
Potassium		26
Selenium		*
Silver		*
Sodium		69
Thallium		*
Vanadium		*
Zinc		*
Cyanide		*
Volatile Organic Compounds		
All compounds		*
Semivolatile Organic Compounds		
All compounds		*
Explosive Compounds		
All compounds		*
Hexavalent Chromium		NA
Pesticide/PCB Compounds		
All compounds		*

* = At least one value is <5 times the reporting level, and duplicate comparison is within 3 times the reporting level.
NA = not applicable.
PCB = polychlorinated biphenyl.
RI = Remedial Investigation.
RPD = relative percent difference.
RVAAP = Ravenna Army Ammunition Plant.
UNAC = At least one value is <5 times the reporting level, and duplicate comparison is NOT within 3 times the reporting level.

Table H-5. Project Quantitation Limit Goals and Achieved Method Detection Levels for the RVAAP Load Line 4 Phase II RI

Parameters/Methods	Water		Sediment	
	Project Quantitation Goal	Achieved Method Detection Level	Project Quantitation Goal	Achieved Method Detection Level
Volatile Organic Compounds SW 846-8260B	(µg/L)	(µg/L)	(µg/kg)	(µg/kg)
Chloromethane	10	1.1	10	0.73
Bromomethane	10	0.92	10	1.2
Vinyl Chloride	10	0.58	10	0.66
Chloroethane	10	0.67	10	0.92
Methylene Chloride	5	0.4	5	1.4
Acetone	10	5.9	10	1.8
Carbon Disulfide	5	0.4	5	1.1
1,1-Dichloroethene	5	0.53	5	067
1,1-Dichloroethane	5	0.62	5	063
1,2-Dichloroethene (total)	5	0.87	5	9.61
Chloroform	5	0.51	5	0.71
1,2-Dichloroethane	5	0.43	5	0.57
2-Butanone	10	9.7	10	4.8
1,1,1-Trichloroethane	5	0.63	5	0.71
Carbon tetrachloride	5	0.41	5	0.62
Bromodichloromethane	5	0.39	5	0.65
1,2-Dichloropropane	5	0.32	5	0.65
cis-1,3-Dichloropropene	5	0.35	5	0.61
Trichloroethene	5	0.54	5	0.7
Dibromochloromethane	5	0.36	5	0.57
1,1,2-Trichloroethane	5	0.41	5	0.54
Benzene	5	0.45	5	0.63
trans-1,3-Dichloropropene	5	0.64	5	0.59
Tribromomethane	5	0.35	5	0.50
4-Methyl-2-pentanone	10	5.5	10	3.3

Table H-5. Project Quantitation Limit Goals and Achieved Method Detection Levels for the RVAAP Load Line 4 Phase II RI (continued)

Parameters/Methods	Water		Soil/Sediment	
	Project Quantitation Goal	Achieved Method Detection Level	Project Quantitation Goal	Achieved Method Detection Level
2-Hexanone	10	8.6	10	1.2
Tetrachloroethene	5	1.3	5	074
Toluene	5	0.45	5	0.75
1,1,2,2-Tetrachloroethane	5	0.57	5	0.7
Chlorobenzene	5	0.43	5	0.72
Ethylbenzene	5	0.41	5	0.84
Styrene	5	0.43	5	0.65
Xylenes (total)	5	1.4	5	0.2
Semivolatile Organic Compounds SW 846-8270C	(µg/L)	(µg/L)	(µg/kg)	(µg/kg)
Phenol	10	1.3	330	35
bis(2-Chloroethyl) ether	10	2.1	330	33
2-Chlorophenol	10	1.6	330	28
1,3-Dichlorobenzene	10	1	330	32
1,4-Dichlorobenzene	10	0.9	330	36
1,2-Dichlorobenzene	10	0.9	330	29
2-Methylphenol	10	1.1	330	37
2,2'- oxybis(1-Chloropropane)	10	1.3	330	93
4-Methylphenol	10	1.7	330	27
N-nitroso-di-n-dipropylamine	10	1	330	31
Hexachloroethane	10	2.3	330	40
Nitrobenzene	10	2.6	330	32
Isophorone	10	2.7	330	32
2-Nitrophenol	10	1	330	44
2,4-Dimethylphenol	10	1.1	330	57
bis(2-chloroethoxy) methane	10	2.6	330	21
2,4-Dichlorophenol	10	1	330	45

Table H-5. Project Quantitation Limit Goals and Achieved Method Detection Levels for the RVAAP Load Line 4 Phase II RI (continued)

Parameters/Methods	Water		Soil/Sediment	
	Project Quantitation Goal	Achieved Method Detection Level	Project Quantitation Goal	Achieved Method Detection Level
1,2,4-Trichlorobenzene	10	2.5	330	38
Naphthalene	10	0.7	330	35
4-Chloroaniline	10	2.8	330	33
Hexachlorobutadiene	10	1.2	330	31
4-chloro-3-methylphenol	10	1.2	330	31
2-Methylnaphthalene	10	0.9	330	33
Hexachlorocyclopentadiene	10	3.4	330	150
2,4,6-Trichlorophenol	10	1.3	330	57
2,4,5-Trichlorophenol	25	1.1	800	69
2-Chloronaphthalene	10	2.5	330	32
2-Nitroaniline	25	1.4	800	33
Dimethylphthalate	10	3.7	330	36
Acenaphthylene	10	2.7	330	35
2,6-Dinitrotoluene	10	2.8	330	30
3-Nitroaniline	25	2	800	33
Acenaphthene	10	2.7	330	35
2,4-Dinitrophenol	25	13	800	150
4-Nitrophenol	25	4.8	800	350
Dibenzofuran	10	2.8	330	36
2,4-Dinitrotoluene	10	0.8	330	41
Diethylphthalate	10	3.2	330	38
4-Chlorophenyl-phenyl ether	10	1.3	330	36
Fluorene	10	2.9	330	29
4-Nitroaniline	25	1.2	800	47
4,6-Dinitro-2-methylphenol	25	7.5	800	180
N-nitrosodiphenylamine	10	0.9	330	37
4-bromophenyl-phenylether	10	1	300	35
Hexachlorobenzene	10	1.8	330	41

Table H-5. Project Quantitation Limit Goals and Achieved Method Detection Levels for the RVAAP Load Line 4 Phase II RI (continued)

Parameters/Methods	Water		Soil/Sediment	
	Project Quantitation Goal	Achieved Method Detection Level	Project Quantitation Goal	Achieved Method Detection Level
Pentachlorophenol	25	0.6	800	34
Phenanthrene	10	2.4	330	43
Anthracene	10	0.9	330	37
Carbazole	10	1.1	330	42
Di-n-butylphthalate	10	1.1	330	59
Fluoranthene	10	0.9	330	38
Pyrene	10	1.4	330	57
Butylbenzylphthalate	10	1.9	330	44
3,3'-Dichlorobenzidine	10	1.1	330	140
Benzo(a)anthracene	10	2.8	330	35
Chrysene	10	0.9	330	50
bis(2-Ethylhexyl)phthalate	10	2.1	330	65
Di-n-octylphthalate	10	2	330	50
Benzo(b)fluoranthene	10	2.6	330	35
Benzo(k)fluoranthene	10	1.2	330	41
Benzo(a)pyrene	10	3	330	33
Indeno(1,2,3-cd)pyrene	10	1.2	330	42
Dibenzo(a,h)anthracene	10	1.2	330	38
Benzo(g,h,i)perylene	10	3.3	330	45
Polychlorinated Biphenyls **SW 846-8082**	(µg/L)	(µg/L)	(µg/kg)	(µg/kg)
Arochlor-1016	1.0	0.02	33	5.3
Arochlor-1221	2.0	0.09	67	19
Arochlor-1232	1.0	0.16	33	11
Arochlor-1242	1.0	0.3	33	18
Arochlor-1248	1.0	0.22	33	4.6
Arochlor-1254	1.0	0.10	33	20
Arochlor-1260	1.0	0.07	33	7.4

Table H-5. Project Quantitation Limit Goals and Achieved Method Detection Levels for the RVAAP Load Line 4 Phase II RI (continued)

Parameters/Methods	Water		Soil/Sediment	
	Project Quantitation Goal	Achieved Method Detection Level	Project Quantitation Goal	Achieved Method Detection Level
Explosive Compounds **SW 846-8330**	(µg/L)	(µg/L)	(mg/kg)	(mg/kg)
HMX Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	20	0.09	2	0.18
RDX (cyclonite) Hexahydro-1,3,5-trinitro-1,3,5-triazine	20	0.09	2	0.17
1,3,5-Trinitrobenzene	2	0.09	1	0.09
1,3-Dinitrobenzene	3	0.04	1	0.03
Tetryl	50	0.06	5	0.38
Nitrobenzene	10	0.06	1	0.05
2,4,6-Trinitrotoluene	3	0.05	1	0.05
2,4-Dinitrotoluene	0.1	0.05	1	0.05
2,6-Dinitrotoluene	0.1	0.09	1	0.09
4-Amino-2,6-dinitrotoluene	0.1	0.09	1	0.09
4-Amino-2,6-dinitrotoluene	0.1	0.09	1	0.09
o-Nitrotoluene	10	0.14	1	0.14
m-Nitrotoluene	10	0.14	1	0.14
p-Nitrotoluene	10	0.10	1	0.09
Additional Explosive Compounds	(µg/L)	(µg/L)	(mg/kg)	(mg/kg)
Nitroglycerin	10	0.3	1	0.12
Nitroquanidine	10	0.96	1	0.023
Nitrocellulose	10	0.36	1	0.28
Metals **(Target Analyte List)** **SW 846-6010B/6020 or 7000**	(µg/L)	(µg/L)	(mg/kg)	(mg/kg)
Aluminum	200	28	20	1.1
Antimony	5	2.2	0.5	0.49
Arsenic	5	4.1	0.5	0.3
Barium	200	3	20	0.13

Table H-5. Project Quantitation Limit Goals and Achieved Method Detection Levels for the RVAAP Load Line 4 Phase II RI (continued)

Parameters/Methods	Water		Soil/Sediment	
	Project Quantitation Goal	Achieved Method Detection Level	Project Quantitation Goal	Achieved Method Detection Level
Beryllium	4	0.54	0.5	0.046
Cadmium	5	0.28	0.5	0.04
Calcium	5,000	250	500	37
Chromium	10	1.4	1	0.38
Cobalt	50	1.3	15	0.15
Copper	25	4.2	2.5	0.27
Iron	100	88	10	6.6
Lead	3	2.5	0.3	0249
Magnesium	5,000	30	500	12
Manganese	15	0.9	1.5	0.15
Mercury (CVAA) SW 846-7470A/7471A	0.2	0.13	0.1	0.008
Nickel	40	2.2	4	0.27
Potassium	5,000	41	500	5.1
Selenium	5	4.5	0.5	0319
Silver	10	1.5	1	0152
Sodium	5,000	630	500	50
Thallium	2	5	0.5	0.5
Vanadium	50	0.82	5	0.13
Zinc	20	12	2	1.2

RI = Remedial Investigation.
RVAAP = Ravenna Army Ammunition Plant.

Table H-6. Container Requirements for Environmental Investigations at RVAAP

Analyte Group	Container	Minimum Sample Size	Preservative	Holding Time
Soil and Sediment				
Volatile Organic Compounds 5030/8260B	One 2-oz glass jar with Teflon®-lined cap (no headspace)	20 g	Cool, 4 ºC	14 d
SVOC 3540/8270C	One 8-oz glass jar with Teflon®-lined cap	60 g	Cool, 4 ºC	14 d (extraction) 40 d (analysis)
Pesticide Compounds 3540/8081A	Include in SVOC container	60 g	Cool, 4 ºC	14 d (extraction) 40 d (analysis)
Polychlorinated biphenyls 3540/8082	Include in SVOC container	60 g	Cool, 4 ºC	14 d (extraction) 40 d (analysis)
Explosive Compounds 8330	One 4-oz glass jar with Teflon®-lined cap	60 g	Cool, 4 ºC	14 d (extraction) 40 d (analysis)
Propellant Compounds 8330, 353.2, and UV-HPLC	One 4-oz glass jar with Teflon®-lined cap	60 g	Cool, 4 ºC	14 d (extraction) 40 d (analysis)
Metals 6010B and 7471	One 4-oz glass jar with Teflon®-lined cap	50 g	Cool, 4 ºC	180 d; Hg at 28 d
Cyanide 9012A	Include in metals container	25 g	Cool, 4 ºC	14 d
Hexavalent Chromium 7196A	Include in metals container	25 g	Cool, 4 ºC	24 hr

Table H-6. Container Requirements for Environmental Investigations at RVAAP (continued)

Analyte Group	Container	Minimum Sample Size	Preservative	Holding Time
Water Matrix				
Volatile Organic Compounds 5030/8260B	Three 40-mL glass vials with Teflon®-lined septum (no headspace)	80 mL	HCl to pH <2 Cool, 4 ºC	14 d
SVOC 3520/8270C	Two 1-L amber glass bottle with Teflon®-lined lid	1,000 mL	Cool, 4 ºC	7 d (extraction) 40 d (analysis)
Pesticide Compounds 3520/8081A	One 1-L amber glass bottle with Teflon®-lined lid	1,000 mL	Cool, 4 ºC	7 d (extraction) 40 d (analysis)
PCBs 3520/8082	One 1-L amber glass bottle with Teflon®-lined lid	1,000 mL	Cool, 4 ºC	7 d (extraction) 40 d (analysis)
Explosive Compounds 8330	One 1-L amber glass bottle with Teflon®-lined lid	1,000 mL	Cool, 4 ºC	7 d (extraction) 40 d (analysis)
Propellant Compounds 8330, 353.2, and UV-HPLC	One 1-L amber glass bottle with Teflon®-lined lid	1,000 mL	Cool, 4 ºC	7 d (extraction) 40 d (analysis)
Metals 6010A and 7470	One 1-L polybottle	500 mL	HNO_3 to pH <2 Cool, 4 ºC	180 d; Hg at 28 d
Cyanide 9012A	500-mL polybottle	500 mL	NaOH to pH >12 Cool, 4 ºC	14 d
Anions (Br, Cl, F, SO4) 300.0	250-mL polybottle	250 mL	Cool, 4 ºC	28 d
Nitrate-Nitrite 353.2	250-mL polybottle	100 mL	H_2SO_4 to pH <2 Cool, 4 ºC	28 d
TSS/TDS 160.2 and 160.1	500-mL polybottle	100 mL each	Cool, 4 ºC	28 d

PCB = polychlorinated biphenyl.
RVAAP = Ravenna Army Ammunition Plant.
SVOC = semivolatile organic compound.
TDS = total dissolved solids.
TSS = total suspended solids.

ATTACHMENT H-1

SAIC Data Validation Flagging Codes

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DATA VALIDATION REASON CODES

Organic, Inorganic, and Radiological Analytical Data

Holding Times

A01	Extraction holding times were exceeded.
A02	Extraction holding times were grossly exceeded.
A03	Analysis holding times were exceeded.
A04	Analysis holding times were grossly exceeded.
A05	Samples were not preserved properly.
A06	Professional judgment was used to qualify the data.

GC/MS Tuning

B01	Mass calibration was in error, even after applying expanded criteria.
B02	Mass calibration was not performed every 12 hrs.
B03	Mass calibration did not meet ion abundance criteria.
B04	Professional judgment was used to qualify the data.

Initial/Continuing Calibration – Organics

C01	Initial calibration RRF was < 0.05.
C02	Initial calibration RDS was > 30%.
C03	Initial calibration sequence was not followed as required.
C04	Continuing calibration RRF was < 0.05.
C05	Continuing calibration %D was > 25%.
C06	Continuing calibration was not performed at the required frequency.
C07	Resolution criteria were not met.
C08	RPD criteria were not met.
C09	RDS criteria were not met.
C10	Retention time of compounds was outside windows.
C11	Compounds were not adequately resolved.
C12	Breakdown of endrin or DDT was > 30%.
C13	Combined breakdown of endrin/DDT was > 30%.
C14	Professional judgment was used to qualify the data.

Initial/Continuing Calibration – Inorganics

D01	ICV or CCV were not performed for every analyte.
D02	ICV recovery was above the upper control limit.
D03	ICV recovery was below the lower control limit.
D04	CCV recovery was above the upper control limit.
D05	CCV recovery was below the lower control limit.
D06	Standard curve was not established with the minimum number of standards.
D07	Instrument was not calibrated daily or each time the instrument was set up.
D08	Correlation coefficient was <0.995.
D09	Mid-range cyanide standard was not distilled.
D10	Professional judgment was used to qualify the data.

ICP and Furnace Requirements

E01	Interference check sample recovery was outside the control limit.
E02	Duplicate injections were outside the control limit.
E03	Post digestion spike recovery was outside the control limit.
E04	MSA was required but not performed.
E05	MSA correlation coefficient was <0.995.
E06	MSA spikes were not at the correct concentration.
E07	Serial dilution criteria were not met.
E08	Professional judgment was used to qualify the data.

Blanks

F01	Sample data were qualified as a result of the method blank.
F02	Sample data were qualified as a result of the field blank.
F03	Sample data were qualified as a result of the equipment rinsate.
F04	Sample data were qualified as a result of the trip blank.
F05	Gross contamination exists.
F06	Concentration of the contaminant was detected at a level below the CRQL.
F07	Concentration of the contaminant was detected at a level less than the action limit, but greater than the CRQL.
F08	Concentration of the contaminant was detected at a level that exceeds the action level.
F09	No laboratory blanks were analyzed.
F10	Blank had a negative value >2 times the IDL.
F11	Blanks were not analyzed at required frequency.
F12	Professional judgment was used to qualify the data.

Surrogate/Radiological Chemical Recovery

G01	Surrogate/radiological chemical recovery was above the upper control limit.
G02	Surrogate/radiological chemical recovery was below the lower control limit.
G03	Surrogate recovery was <10%.
G04	Surrogate recovery was zero.
G05	Surrogate/radiological chemical recovery data was not present.
G06	Professional judgment was used to qualify the data.
G07	Radiological chemical recovery was <20%.
G08	Radiological chemical recovery was >150%.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

H01	MS/MSD recovery was above the upper control limit.
H02	MS/MSD recovery was below the lower control limit.
H03	MD/MSD recovery was <10%.
H04	MS/MSD pairs exceed the RPD limit.
H05	No action was taken on MS/MSD limit.
H06	Professional judgment was used to qualify the data.
H07	Radiological MS/MSD recovery was <20%.
H08	Radiological MS/MSD recovery was >160%.
H09	Radiological MS/MSD samples were not analyzed at the required frequency.

Matrix Spike

I01 MS recovery was above the upper control limit.
I02 MS recovery was below the lower control limit.
I03 MS recovery was <30%.
I04 No action was taken on MS data.
I05 Professional judgment was used to qualify the data.

Laboratory Duplicate

J01 Duplicate RPD/radiological duplicate error ratio (DER) was outside the control limit.
J02 Duplicate sample results were >5 times the CRDL.
J03 Duplicate sample results were <5 times the CRDL.
J04 Professional judgment was used to qualify the data.
J05 Duplicate was not analyzed at the required frequency.

Internal Area Summary

K01 Area counts were outside the control limits.
K02 Extremely low area counts or performance was exhibited by a major drop off.
K03 IS retention time varied by more than 30 sec.
K04 Professional judgment was used to qualify the data.

Pesticide Cleanup Checks

L01 10% recovery was obtained during either check.
L02 Recoveries during either check were >120%.
L03 GPC cleanup recoveries were outside the control limits.
L04 Florisil cartridge cleanup recoveries were outside the control limits.
L05 Professional judgment was used to qualify the data.

Target Compound Identification

M01 Incorrect identifications were made.
M02 Qualitative criteria were not met.
M03 Cross contamination occurred.
M04 Confirmatory analysis was not performed.
M05 No results were provided.
M06 Analysis occurred outside the 12-hr GC/MS window.
M07 Professional judgment was used to qualify the data.
M08 The %D between the two pesticide/PCB column checks was >25%.

Compound Quantitation and Reported CRQLs

N01 Quantitation limits were affected by large off-scale peaks.
N02 MDLs reported by the laboratory exceeded corresponding CRQLs.
N03 Professional judgment used to qualify the data.

Tentatively Identified Compounds (TICs)

O01	Compound was suspected laboratory contaminant and was not detected in the blank.
O02	TIC result was not above 10 times the level found in the blank.
O03	Professional judgment was used to qualify analytical data.

Laboratory Control Samples (LCSs)

P01	LCS recovery was above upper control limit.
P02	LCS recovery was below lower control limit.
P03	LCS recovery was <50%.
P04	No action was taken on the LCS data.
P05	LCS was not analyzed at required frequency.
P06	Radiological LCS recovery was <50% for aqueous samples; <40% for solid samples.
P07	Radiological LCS recovery was >150% for aqueous samples; >160% for solid samples.
P08	Professional judgment was used to qualify the data.

Field Duplicate

Q01	Field duplicate RPDs were >30% for waters and/or >50% for soils.
Q02	Radiological field DER was outside the control limit.
Q03	Duplicate sample results were >5 times the CRDL.
Q04	Duplicate sample results were <5 times the CRDL.

Radiological Calibration

R01	Efficiency calibration criteria were not met.
R02	Energy calibration criteria were not met.
R03	Resolution calibration criteria were not met.
R04	Background determination criteria were not met.
R05	Quench curve criteria were not met.
R06	Absorption curve criteria were not met.
R07	Plateau curve criteria were not met.
R08	Professional judgment was used to qualify the data.

Radiological Calibration Verification

S01	Efficiency verification criteria were not met.
S02	Energy verification criteria were not met.
S03	Resolution verification criteria were not met.
S04	Background verification criteria were not met.
S05	Cross-talk verification criteria were not met.
S06	Professional judgment was used to qualify the data.