APPENDIX H

Quality Control Summary Report

Phase II Remedial Investigation of Load Line 2
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 2 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 2 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 2 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 Addendum 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, facilities 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 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 Louisville Corp Project Manager and can be obtained through his office.

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

- Phase II RI at Load Lines 2, 3, and 4 at the RVAAP, Ravenna, Ohio, SAP Addendum, SAIC, July 2001.

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 Reports 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, and 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 280 environmental soil, sediment, surface water, groundwater, and field QC samples were collected with approximately 20,600 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 220 soil and sediment samples to produce over 380 trinitrotoluene and hexahydro-1,3,5-trinitro-1,3,5-triazine screening measurements. Under the direction of the SAP and the USACE, Louisville District, the project produced acceptable results for over 99% of the sample analyses performed. Data that were rejected are relegated primarily to antimony non-detect levels in soils and SVOC compound determinations in water samples.

Table H-1 presents a summary of the collected investigation samples. It 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 25 field duplicates were analyzed for soil, sediment, groundwater, and surface water media. One equipment rinsate was collected and analyzed for this project. One site potable water source was sampled (sample ID LL21214). A total of seven trip blanks were 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, selenium, silver, 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 eight non-detect values were actually rejected, due to extremely low MS recoveries. Three mercury (LL21010, LL20945, LL20873) non-detect values were also rejected due to very 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, vanadium, and iron contributed to their estimation of J or UJ in a few soil samples. Occasional serial dilution variations caused beryllium, cobalt, iron, potassium, and vanadium 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 and mercury values exhibit an unknown negative bias and should not be used. Complete data results, with associated qualifiers, are provided in Appendix I of this Load Line 2 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. Minor method blank levels did result in the occasional qualification of aluminum, beryllium, cadmium, chromium, cobalt, manganese, potassium, silver, 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 aluminum, iron, and manganese results and low recoveries for thallium. Data were estimated as a consequence in those instances. All other MS data were acceptable. Post-digestion spike recoveries for thallium contributed to its estimation of J or UJ in a few samples. Occasional serial dilution variations caused calcium, potassium, and zinc levels to be estimated in various samples. LCS determinations were considered acceptable throughout the data set. Elevated relative percent differences (RPDs) for cobalt, iron, manganese, mercury, and nickel produced estimation of these elements in samples. 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 2 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. However, a few values were qualified as estimated due to low area counts for 1,1,2,2-tetrachloroethane. Initial calibration criteria and continuing calibration criteria were met for all compounds, with the exception of a few acetone RPDs that caused data to be estimated. Method blanks were clear of contamination; however, 2-butanone and toluene observed in some trip blanks caused the data to be estimated UJ. LCS and MS evaluations included all project-targeted analytes. Low LCS recoveries were observed for acetone and 2-butanone, while elevated recoveries were observed for dimethylbenzene. 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 acetone and 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; however, a few values were qualified as estimated due to low area counts for 1,1,2,2-tetrachloroethane, ethylbenzene, and dimethylbenzene. Initial calibration criteria and continuing calibration criteria were met for all compounds with the exception of a few elevated acetone and methylene chloride 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, benzene, 2-butanone, methylene chloride, and toluene. Sample data for most observed low concentrations of these compounds 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 acetone. Associated 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. Some SVOC extraction times exceeded the recommended time and associated values were estimated J or UJ as a result. Actual extraction times were within 2 times the recommend extraction time window. Surrogate recoveries and internal standard area counts were acceptable with the exception of low recoveries in sample LL20716 causing its concentrations to be estimated. Initial calibration criteria and continuing calibration criteria were met for all compounds. Bis-2-ethylhexylphthalate method blank levels resulted in a few data points being qualified as non-detect U; however, method blanks were clear of other contamination. LCS and MS/MSD evaluations included all project-targeted analytes. Chrysene, fluoranthene, phenanthrene, and benzoic acid were estimated J or UJ in a few samples due to elevated LCS or MS recoveries, while 2-methyl-4,6-dinitrophenol and 2,4-methylphenol were estimated UJ due to low LCS recovery. Extremely low MS recoveries for 3,3'-dichlorobenzidine, 3-nitrobenzenamine, 4-chlorobenzenamine, and hexachlorocyclopentadiene caused 13 analyses to be rejected R. While some of this data were qualified as estimated, only a few analyses 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 samples LL21149, LL21153, and LL21187 that had extremely poor phenolic surrogate recovery resulting in the rejection R of 48 values. All initial calibration criteria and continuing calibration criteria were met. 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) 27 hexachlorocyclopentadiene and demethylphthalate values in multiple samples. In addition, phthalates and phenols were estimated U" in several samples due to low LCS recovery. Other LCS and MS water matrix recoveries were within criteria. While some of this water data were qualified as estimated, a small number of data points did exhibited enough significant deviation 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 samples, with the exception of extraction times for samples LL20960, and LL20857; data for these samples were estimated. Surrogate recoveries were predominantly acceptable with the exception of a few elevated surrogates for pesticides, 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. 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 elevated LCS recoveries. Other LCS recoveries were within criteria. Poor MS recoveries caused some PCB and pesticide data to be estimated J. Very poor LCS recovery caused floor sweeping samples of delta-BHC non-detect levels to be rejected (R), while elevated MS recovery and RPD values resulted in estimation of results. Other LCS and MS recoveries were acceptable. Several positive PCB and 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 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.

Groundwater, Surface Water, and Field Quality Control Samples

Analytical holding times were met for all samples. All surrogate recoveries were acceptable with the exception of low recovery for sample LL21151 causing PCB results to be estimated J. 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, heptachlor, 4,4'-DDT, methoxychlor, 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, except for elevated recoveries for 4,4'-DDD. Some endosulfan sulfate and beta-BHC compound results were qualified as estimated J based on the percent difference between the primary column quantification and the secondary column quantification. 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 J or 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 analyses, with the exception of a few high recoveries causing data to be estimated J. LCS and MS/MSD evaluations included the project-targeted analytes, with the exception of nitroglycerine. LCS recoveries were within criteria. MS recoveries varied and results of several compounds were estimated U or UJ throughout the data set. 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 11 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 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 mostly satisfactory. However, 10 hexavalent chromium values were rejected (R) in solid and liquid samples (LL20977, LL21120, LL21131, LL21129, LL21133, LL20998, LL21127, LL21149, LL21187, and LL21156) due to very low MS recoveries. 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. The 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 391 RPD observations in surface soil duplicates, 365 (93%) were <50 or had acceptable absolute differences, while of the 46 RPD observations for subsurface soil duplicates, 41 (89%) were <50 or had acceptable absolute differences. Only 1% of the soil RPD comparisons were >100 and only 6% were >50. Approximately half of the >100 RPD comparisons were within the one duplicate set of samples LL20938 and LL21184. Field duplicate sediment comparisons were less satisfactory; however, they still exhibited acceptable results. Of 92 RPD observations in sediment duplicates, 76 (83%) were <50 or had acceptable absolute differences. Only 9% of the sediment RPD comparisons were >100 with all of these being observed in duplicate set LL21123 and LL21173. Surface water and groundwater field duplicate metal comparisons were all <30 RPD. Explosive, VOC, SVOC, pesticide, PCB, cyanide, and hexavalent chromium field duplicate comparisons were acceptable, with the exception of one trinitrotoluene comparison, three PCB comparisons, and one 4,4’-DDE comparison.

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, along 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. These high levels of individual contaminants 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 for 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 the 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 analyte were observed in the associated method blank.

- When the analyte sample concentration is above the 50 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 are then qualified as U with a reason code of "F01, F07."

- When the analyte sample concentration is determined below the 5- or 10-times the 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. These 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, benzene, 2-butanone, and toluene detected in project trip blanks. The concentrations observed were: acetone from 6.7 J to 21 J ug/L (reporting level at 10 ug/L); 2-butanone from 0.51 J to 0.62 J ug/L (reporting level at 10 ug/L); toluene from 0.25 J to 0.82J ug/L (reporting level at 1 ug/L); and one benzene value at 0.18 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 sample LL21214 exhibited similar levels for acetone, benzene, toluene, and 2-butanone. All rinsates were associated with groundwater sampling equipment and none of the contaminant levels impacted the sample values being reported.

Field source water blank sample LL21218 (collected 7/31/2001) exhibited few analyte levels above project reporting levels. Those detected included normal levels of calcium, magnesium, potassium, sodium, and zinc, with minor concentrations of iron, manganese, barium, aluminum, and the VOC compounds 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 2 Phase II RI data meets or exceeds the established project objectives. The project produced usable results for over 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 2 Phase II RI Sample Summary

Area	**Media**	**Environmental Samples**	**Field Duplicates**	**Trip Blanks**	**Equipment Rinsate Blanks**	**Source Water Blanks**	**USACE Split Samples**
Laboratory Analyses	Soils	184	19	-	-	-	19
	Sediment	38	4	-	-	-	4
	Surface Waters	14	1	4	-	-	1
	Groundwater	12	1	3	1	1	1
	Floor Sweepings	3	-	-	-	-	-
Totals		**251**	**25**	**7**	**1**	**1**	**25**
Field Analyses	Soil and Sediment (TNT/RDX)	217/164	4	-	-	-	-

RI = Remedial Investigation.
RDX = hexahydro-1,3,5-trinitro-1,3,5-triazine.
RVAAP = Ravenna Army Ammunition Plant.
TNT = trinitrotoluene.
USACE = U.S. Army Corps of Engineers.

Table H-2. RVAAP Load Line 2 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	LL2-067	LL20693 LL21182	A1G260125 A1G260125	None None	None None	LL21205
Surface Soil	LL2-078	LL20720 LL21171	A1G280115 A1G280115	A1G280115 A1G280115	None None	LL21196
Surface Soil	LL2-080	LL20726 LL21176	A1G280115 A1G280119	None None	None None	LL21201
Surface Soil	LL2-086	LL20740 LL21168	A1G280121 A1G310126	A1G280121 None	A1G280136 None	LL21193
Surface Soil	LL2-087	LL20743 LL21177	A1G260125 A1G260125	A1G280121 None	None None	LL21202
Surface Soil	LL2-096	LL20766 LL21169	A1G280115 A1G280115	A1G280115 A1G280115	None None	LL21194
Surface Soil	LL2-098	LL20772 LL21164	A1G280133 A1G280133	A1G280133 A1G280133	A1G280136 A1G280136	LL21189
Surface Soil	LL2-126	LL20850 LL21166	A1G280128 A1G280115	A1G310106 A1G280115	None None	LL21191
Surface Soil	LL2-129	LL20859 LL21165	A1G280128 A1G280121	A1G310106 A1G280121	A1G280136 A1G280136	LL21190
Surface Soil	LL2-141	LL20887 LL21172	A1G260125 A1G260125	A1G260125 A1G260125	None None	LL21197
Surface Soil	LL2-144	LL20896 LL21178	A1G310126 A1G310112	A1G310126 None	None None	LL21203
Surface Soil	LL2-147	LL20905 LL21179	A1G280133 A1G280133	None None	None None	LL21204
Surface Soil	LL2-158	LL20932 LL21180	A1G280128 A1G280128	A1H060145 None	None None	LL21205
Surface Soil	LL2-160	LL20938 LL21184	A1G310126 A1G310126	None None	None None	LL21209
Surface Soil	LL2-164	LL20950 LL21167	A1G310150 A1G310150	A1G310150 A1G310150	None None	LL21192
Surface Soil	LL2-201	LL21041 LL21181	A1H010109 A1H010109	None None	None None	LL21206
Surface Soil	LL2-214	LL21054 LL21183	A1G280133 A1G280133	None None	None None	LL21208

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

Media	Station #	Sample #/ Duplicate #	SDG # Metals, etc.	SDG # Explosives	SDG # Propellants	Split #
Subsurface Soil						
Subsurface Soil	LL2-086	LL20741 LL21186	A1G310126 A1G280121	A1G310126 A1G280121	None None	LL21211
Subsurface Soil	LL2-132	LL20869 LL21185	A1G310126 A1G310126	None None	None None	LL21210
Sediment						
Sediment	LL2-182	LL20998 LL21175	A1H010109 A1H010109	A1H020104 None	None None	LL21200
Sediment	LL2-249	LL21118 LL21170	A1G310150 A1G310150	A1H060145 A1G310150	A1G280136 None	LL21195
Sediment	LL2-250	LL21121 LL21174	A1G310150 A1G310150	A1G310150 None	None None	LL21199
Sediment	LL2sd/sw 049(d)	LL21123 LL21173	A1G280128 A1G280121	None None	A1G280136 None	LL21198
Surface Water						
Surface Water	LL2-226	LL21083 LL21188	A1G310126 A1G310126	A1G310126 A1G310112	A1G280136 A1G280136	LL21213
Groundwater						
Groundwater	LL2-265	LL21149 LL21187	A1I200103 A1I200103	A1I200103 A1I200103	A1I210102 A1I210102	LL21212

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

Table H-3. RVAAP Load Line 2 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	11/	4,646	0.2
	Volatile Organics	0/	1,470	0.0
	Semivolatile Organics	13/	2,838	0.5
	Pesticides/PCBs	0/	1,526	0.0
	Explosives	0/	1,109	0.0
	Miscellaneous	1/	41	2.4
	Subtotal	25/	11,630	0.2
Sediment	Metals	0/	966	0.0
	Volatile Organics	0/	630	0.0
	Semivolatile Organics	0/	1,188	0.0
	Pesticides/PCBs	0/	672	0.0
	Explosives	0/	292	0.0
	Miscellaneous	6/	28	21.4
	Subtotal	6/	3,776	0.2
Surface Water, Groundwater, and QC	Metals	0/	713	0.0
	Volatile Organics	0/	1,120	0.0
	Semivolatile Organics	75/	1,650	4.5
	Pesticides/PCBs	0/	721	0.0
	Explosives	0/	492	0.0
	Miscellaneous	3/	30	10.0
	Subtotal	78/	4,726	1.7
Floor Sweepings	Metals	0/	69	0.0
	Volatile Organics	0/	105	0.0
	Semivolatile Organics	0/	198	0.0
	Pesticides/PCBs	3/	84	3.6
	Explosives	0/	45	0.0
	Miscellaneous	0/	9	0.0
	Subtotal	3/	510	0.1
Project Total		**112/**	**20,642**	**0.5**

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

Table H-4. RVAAP Load Line 2 Phase II RI Field Duplicate Comparison

Analysis	**LL20693/LL21182 Surface Soil RPD**	**LL20720/LL21171 Surface Soil RPD**	**LL20726/LL21176 Surface Soil RPD**	**LL20740/LL21168 Surface Soil RPD**
Metals				
Aluminum	1	10	30	16
Antimony	*	*	*	*
Arsenic	100	0	39	8
Barium	6	6	45	21
Beryllium	*	*	*	*
Cadmium	*	*	*	*
Calcium	52	27	47	17
Chromium	12	8	36	31
Cobalt	38	14	76	9
Copper	32	20	70	8
Iron	20	26	33	3
Lead	28	17	79	84
Magnesium	23	7	29	37
Manganese	93	25	5	12
Mercury	*	*	*	*
Nickel	15	*	31	4
Potassium	*	*	*	*
Selenium	*	*	*	*
Silver	*	*	*	*
Sodium	*	*	*	*
Thallium	*	*	*	*
Vanadium	11	11	33	14
Zinc	6	6	70	39
Cyanide	NA	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	*
Except 2,4,6-TNT	NA	*	NA	96
2,4-DNT	NA	*	NA	35
1,3,5-TNB	NA	*	NA	22
Hexavalent	NA	NA	NA	NA
Pesticide/PCB Compounds				
All compounds	*	*	*	*
Except Aroclor-1254/-1260	*	15	12	*

Table H-4. RVAAP Load Line 2 Phase II RI Field Duplicate Comparison (continued)

Analysis	LL20741/LL21186 Subsurface Soil RPD	LL20743/LL21177 Surface Soil RPD	LL20766/LL21169 Surface Soil RPD	LL20772/LL21164 Surface Soil RPD
Metals				
Aluminum	2	9	12	1
Antimony	*	*	*	*
Arsenic	13	19	10	4
Barium	9	11	8	3
Beryllium	*	*	*	*
Cadmium	*	3	*	*
Calcium	*	50	*	11
Chromium	4	7	6	1
Cobalt	*	35	23	2
Copper	*	16	3	1
Iron	10	15	14	4
Lead	111	10	1	4
Magnesium	9	25	5	5
Manganese	61	12	15	3
Mercury	*	*	*	*
Nickel	11	4	6	1
Potassium	*	*	*	1
Selenium	*	*	*	*
Silver	*	*	*	*
Sodium	*	*	*	*
Thallium	*	*	*	*
Vanadium	8	8	8	3
Zinc	38	7	11	5
Cyanide	NA	NA	NA	*
Volatile Organic Compounds				
All compounds	NA	NA	*	*
Semivolatile Organic Compounds				
All compounds	NA	NA	*	*
Explosive Compounds				
All compounds	NA	NA	*	*
Hexavalent Chromium	NA	NA	NA	NA
Pesticide/PCB Compounds				
All compounds	NA	*	*	*
Except Aroclor-1254	NA	103	*	80

Table H-4. RVAAP Load Line 2 Phase II RI Field Duplicate Comparison (continued)

Analysis	LL20850/LL21166 Surface Soil RPD	LL220859/LL21165 Surface Soil RPD	LL20869/LL21185 Subsurface Soil RPD	LL20887/LL21172 Surface Soil RPD
Metals				
Aluminum	2	2	3	4
Antimony	*	*	*	*
Arsenic	7	17	3	2
Barium	1	9	30	5
Beryllium	*	*	*	*
Cadmium	*	*	*	*
Calcium	20	4	130	1
Chromium	1	13	15	5
Cobalt	7	8	33	4
Copper	5	17	14	1
Iron	5	2	7	1
Lead	5	4	97	2
Magnesium	1	2	15	9
Manganese	11	9	2	21
Mercury	*	*	*	*
Nickel	1	2	2	9
Potassium	*	1	*	*
Selenium	*	*	*	*
Silver	*	*	*	*
Sodium	*	*	*	*
Thallium	*	*	*	*
Vanadium	8	3	19	5
Zinc	1	1	148	9
Cyanide	*	*	NA	NA
Volatile Organic Compounds				
All compounds	*	*	NA	NA
Semivolatile Organic Compounds				
All compounds	*	*	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 2 Phase II RI Field Duplicate Comparison (continued)

Analysis	LL20896/LL21178 Surface Soil RPD	LL20905/LL21179 Surface Soil RPD	LL20932/LL21180 Surface Soil RPD	LL20938/LL21184 Surface Soil RPD
Metals				
Aluminum	8	5	1	74
Antimony	*	*	*	UNAC
Arsenic	2	11	9	72
Barium	6	21	5	80
Beryllium	*	*	*	*
Cadmium	*	*	9	*
Calcium	16	17	36	81
Chromium	10	26	1	59
Cobalt	9	6	45	75
Copper	9	5	1	75
Iron	5	5	1	72
Lead	5	112	25	63
Magnesium	6	3	2	80
Manganese	22	13	13	56
Mercury	*	*	*	*
Nickel	12	8	1	82
Potassium	*	*	*	*
Selenium	*	*	*	*
Silver	*	*	*	*
Sodium	*	*	*	*
Thallium	*	*	*	*
Vanadium	4	9	4	63
Zinc	7	42	4	31
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	NA
Hexavalent Chromium	NA	NA	NA	NA
Pesticide/PCB Compounds				
All compounds	*	*	*	NA
Except Aroclor-1254/ -1260	*	31	59	NA

Table H-4. RVAAP Load Line 2 Phase II RI Field Duplicate Comparison (continued)

Analysis	LL20905/LL21167 Surface Soil RPD	LL21041/LL21181 Surface Soil RPD	LL21054/LL21183 Surface Soil RPD	
	Metals			
Aluminum	10	15	15	
Antimony	*	*	*	
Arsenic	3	2	1	
Barium	9	15	29	
Beryllium	*	*	*	
Cadmium	*	*	*	
Calcium	46	*	33	
Chromium	6	19	19	
Cobalt	3	22	8	
Copper	1	*	1	
Iron	5	2	1	
Lead	121	54	11	
Magnesium	4	18	9	
Manganese	13	26	40	
Mercury	*	*	*	
Nickel	2	26	1	
Potassium	*	*	*	
Selenium	*	*	*	
Silver	*	*	*	
Sodium	*	*	*	
Thallium	*	*	*	
Vanadium	4	13	5	
Zinc	99	31	1	
Cyanide	*	NA	NA	
	Volatile Organic Compounds			
All compounds	*	NA	NA	
	Semivolatile Organic Compounds			
All compounds	*	NA	NA	
	Explosive Compounds			
All compounds	*	NA	NA	
Hexavalent Chromium	NA	NA	*	
	Pesticide/PCB Compounds			
All compounds	*	*	NA	
Except 4,4’-DDE	18	*	NA	

Table H-4. RVAAP Load Line 2 Phase II RI Field Duplicate Comparison (continued)

Analysis	LL20998/LL21175 Sediment RPD	LL1118/LL21170 Sediment RPD	LL21121/LL21174 Sediment RPD	LL21123/LL21173 Sediment RPD
Metals				
Aluminum	27	42	18	16
Antimony	*	*	22	*
Arsenic	3	*	22	108
Barium	14	38	1	28
Beryllium	*	*	*	*
Cadmium	*	*	4	*
Calcium	62	45	6	101
Chromium	26	42	44	141
Cobalt	0	49	45	55
Copper	16	42	67	174
Iron	32	42	13	159
Lead	24	542	47	106
Magnesium	40	41	8	29
Manganese	5	53	4	70
Mercury	*	*	72	*
Nickel	6	*	45	163
Potassium	*	*	*	*
Selenium	*	*	*	*
Silver	*	*	*	*
Sodium	*	*	*	*
Thallium	*	*	*	*
Vanadium	13	42	53	46
Zinc	9	46	64	157
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
Hexavalent Chromium	NA	NA	NA	NA
Pesticide/PCB Compounds				
All compounds	*	*	*	*
Except Aroclor-1254/-1260	*	*	28	*

Table H-4. RVAAP Load Line 2 Phase II RI Field Duplicate Comparison (continued)

Analysis	**LL21083/LL21188 Surface Water RPD**		**LL21149/LL21187 Groundwater RPD**	
Metals				
Aluminum	*		*	
Antimony	*		*	
Arsenic	*		6	
Barium	10		*	
Beryllium	*		*	
Cadmium	*		*	
Calcium	2		1	
Chromium	*		*	
Cobalt	*		4	
Copper	*		*	
Iron	7		12	
Lead	11		*	
Magnesium	*		1	
Manganese	0		0	
Mercury	*		*	
Nickel	*		3	
Potassium	3		*	
Selenium	*		*	
Silver	*		*	
Sodium	3		1	
Thallium	*		*	
Vanadium	*		*	
Zinc	*		*	
Cyanide	*		*	
Volatile Organic Compounds				
All compounds	*		*	
Semivolatile Organic Compounds				
All compounds	*		*	
Explosive Compounds				
All compounds	*		*	
Except RDX	11		*	
Hexavalent	NA		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 2 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
2-Hexanone	10	8.6	10	1.2
Tetrachloroethene	5	1.3	5	074

Table H-5. Project Quantitation Limit Goals and Achieved Method Detection Levels for the RVAAP Load Line 2 Phase II RI (continued)

Parameters/Methods	Water		Soil/Sediment	
	Project Quantitation Goal	Achieved Method Detection Level	Project Quantitation Goal	Achieved Method Detection Level
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
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

Table H-5. Project Quantitation Limit Goals and Achieved Method Detection Levels for the RVAAP Load Line 2 Phase II RI (continued)

Parameters/Methods	Water		Soil/Sediment	
	Project Quantitation Goal	Achieved Method Detection Level	Project Quantitation Goal	Achieved Method Detection Level
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
Pentachlorophenol	25	0.6	800	34
Phenanthrene	10	2.4	330	43
Anthracene	10	0.9	330	37
Carbazole	10	1.1	330	42

Table H-5. Project Quantitation Limit Goals and Achieved Method Detection Levels for the RVAAP Load Line 2 Phase II RI (continued)

Parameters/Methods	Water		Soil/Sediment	
	Project Quantitation Goal	Achieved Method Detection Level	Project Quantitation Goal	Achieved Method Detection Level
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
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

Table H-5. Project Quantitation Limit Goals and Achieved Method Detection Levels

for the RVAAP Load Line 2 Phase II RI (continued)

Parameters/Methods	Water		Soil/Sediment	
	Project Quantitation Goal	Achieved Method Detection Level	Project Quantitation Goal	Achieved Method Detection Level
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
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

Table H-5. Project Quantitation Limit Goals and Achieved Method Detection Levels for the RVAAP Load Line 2 Phase II RI (continued)

Parameters/Methods	Water		Soil/Sediment	
	Project Quantitation Goal	Achieved Method Detection Level	Project Quantitation Goal	Achieved Method Detection Level
Copper	25	4.2	2.5	0.27
Iron	100	88	10	6.6
Lead	3	2.5	0.3	0249
Magnesium	5000	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				
VOCs 5030/8260B	One 2-oz glass jar with Teflon®-lined cap (no headspace)	20 g	Cool, 4 ºC	14 d
SVOCs 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)
PCBs 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		
VOCs 5030/8260B	Three40-mL glass vials with Teflon®-lined septum (no headspace)	80 mL	HCl to pH <2 Cool, 4 ºC	14 d
SVOCs 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 @ 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 ea.	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.
VOC = volatile organic compound.

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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 the 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 were 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 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.